Hopper Dredge Recapitalization Analysis

Examination of the Corps and Industry Hopper Dredge Capacity: the Need, Composition, Location and Recapitalization of the Corps Hopper Dredge Fleet

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Contents

Executive Summary 4
Purpose 4
Findings 4
Recommendations 6
Path Forward 7
1. Introduction 8
2. The Minimum Fleet Capital Investment Report 2012-2061 9
2.1. Background 9
2.2. Status of the MFCIP Recommendations 10
3. Hopper Dredge Recapitalization Analysis 12
3.1. The Minimum Fleet Law Parameters for the Composition and Use of the Hopper Dredge Fleet. . 12
4. Determining the Government's Hopper Dredging Needs – The Current and Projected Hopper Dredging Mission 18
4.1. Dredging Data 18
4.2. Historical Hopper Dredging 19
4.3. Future Needs 20
5. Dredge Utilization and Dredge Fleet Capacity 26
5.1. Historical Utilization 26
5.2. Industry Capacity Based on Historical Utilization 27
5.3. Optimizing Fleet Capacity 33
6. The Ready Reserve Fleet 36
6.1. Call-Out History for the Ready Reserve Fleet 36
6.2. Could the Ready Reserve be Privately Owned? 37
7. Keep or Alter the Corps Hopper Fleet Composition or Location 39
7.1. Alternatives Considered 39
7.2. Factors Considered in Assessing the Alternatives 39
7.3. Geographical Location 43
8. The Physical Condition of the US Fleet 45
8.1. Condition and Upgrades to the Corps Dredges 45
8.2. Recent Capital Improvements to Corps Hopper Dredges: 45
8.3. The Condition of the Industry Fleet 46
9. Dredge Operations and Maintenance of Corps Dredges 49

9.1. Current Corps Hopper Dredge Operations 49
9.2. Current Corps Hopper Dredge Maintenance 50
9.3. Optimizing Operations and Maintenance 51
9.4. Lifecycle Analysis of the Corps Hopper Dredges 52
9.5. Analysis of the Maintenance Trends 55
9.6. Summary Findings and Recommendations based on the Maintenance Trends of the Hopper Dredges 58
9.7. Optimizing Operations & Maintenance of Future Dredge Fleet Life Cycle Management 58
10. Considerations for Replacement Dredges 60
11. Financial Details, Analyses and Review Findings 62
11.1. Recapitalization Financial Overview 62
11.2. Corps Dredge Rental Rate - Ownership and Operating Costs 62
11.3. Hopper Dredge Operating Accounts 63
11.4. Current Hopper Dredge Financial Asset Data: 64
11.5. PRIP Account Financial Data 66
11.6. Hopper Dredge Replacement Financial Plan – PRIP Financing 70
11.7. Daily Rental Rates of the Recapitalized Dredges 71
11.8. Summary Findings and Recommendations of the Financial Analysis 72
12. Findings, Recommendations and Path Forward 73
12.1. Findings 73
12.2. Recommendations 74
12.3. Path Forward 75
References 76
Appendix A – Summary Findings from the Minimum Fleet Capital Investment Report 2012-2061 77
Appendix B – Optimizing Fleet Capacity 78
5.3. Optimizing Fleet Capacity, continued. 78
Practical Scheduling Constraints Captured by the Model 80
Model Runs 83
Interpretation of Model Output 83
Appendix C – List of Acronyms 89
Appendix D – List of Prior Corps Studies and Memo to POTUS (1983) 90
Prior Corps Studies 90

2016 Hopper Dredge Recapitalization Analysis

Executive Summary

Purpose

In 2011 the Corps completed a report titled *Minimum Fleet Capital Investment Report 2012-2061* (MFCIR). The proposed schedule for implementing the Recommendations of the report was based on assumptions regarding the future workload of the Corps, program funding and the composition of the Corps and Industry dredge fleet inventory. In the period since the report, the fleet composition, the workload and forecasts of work have changed, particularly for the hopper dredge component of the national fleet. A series of events have generated spikes and sustained increases in the hopper dredge requirements. One such spike was a significant workload increase following the April 20, 2010 Deepwater Horizon oil spill, when sands were pumped to create berms to protect Louisiana wetlands from the oil spill. Additional funds were appropriated in 2012 in response to damages caused by Hurricane Sandy, which were focused on the North Atlantic and North Carolina coastal areas. In 2011, 2015 and 2016 flooding on the Mississippi created a surge in need that the hopper dredging industry was unable to respond to, resulting in extended call outs of the Corps Ready Reserve vessels. Congress has appropriated additional funds in recent years for navigation dredging and hurricane and storm damage reduction projects related to the impacted coastlines of Alabama and Louisiana.

Because of this recent experience, a re-examination of the hopper dredge segment of the dredging mission and floating plant has been assigned by Corps Headquarters to a Product Delivery Team (PDT). The focus for this report is only on the four hopper dredges in the minimum fleet-- the Yaquina, Essayons, Wheeler and McFarland – and the need and options for recapitalizing them, given the requirements of the minimum fleet authorization language, the current and projected dredging mission and the current and projected industry hopper fleet capability. As a part of the process in developing the findings and recommendations, a separate document, titled “Assumptions and Analysis,” (A&A) was produced for review by interested stakeholders. The A&A document contained information about the historical volume of hopper dredging, dredging costs, industry utilization and the projected future hopper dredging needs, utilization, capacity and capability of the industry dredging fleet, historic use of the ready reserve hopper fleet, and assumptions about maintenance life cycles for dredging equipment. This information is key to the PDTs work and deliberations. Comments on the A& A document were taken between March 31, 2017 and April 21, 2017. The comments were considered by the PDT during final analysis and in developing findings and recommendations.

Findings

1. Most of the Summary Findings of the 2011 MFCIR, which covered the topics relevant to making decisions regarding the recapitalization of hopper dredges were affirmed.

However, this new analysis and the recommendations are influenced by changes since the MFCIR. Changes include the financial health of the Corps navigation program, the Plant Replacement and Improvement Program (PRIP) balance and the individual operating accounts of the dredges, our evolving understanding of how asset management principles apply to Corps hopper dredges and the apparent changes in the industry hopper dredge fleet. Databases and modeling tools that were new or in development during the analysis for the MFCIR, can now help define the present state of dredging and placement options and estimate the future state.

2. Taking advantage of industry capability to perform dredging and related work, as required in the language of Public Law (PL) 95-269 and as implemented by the Corps, has been generally effective in meeting the routine navigation needs of the nation, but the frequent activation of the Ready Reserve dredges over the past five years demonstrates that there is a need for the Ready Reserve dredges.
3. The Corps of Engineers Reserve Fleet (CERF) program cannot be used as originally envisioned. The intent of the CERF program was to sign Basic Ordering Agreements (BOA) with hopper dredge owning companies that could be used to direct industry dredges in response to emergency conditions. The BOAs that formed the basis of the CERF agreements did not contain the necessary pricing data with which to award a contract under Federal Acquisition Regulations. Therefore, if or when an event would occur, the Corps would still be required to process a Justification and Approval (J&A) for an Unusual and Compelling procurement action. It would be difficult to pre-price an unknown event with a BOA or any other contractual vehicle, and a contractor would likely include significant contingencies in their proposed prices that would be difficult for the Government to support.
4. The number of Corps Ready Reserve call-outs over the past several years demonstrated that the current industry fleet cannot meet the current surge needs of the Corps dredging program. The analysis showed that with two new hopper dredges industry can meet the present surge need, but it would require the fleet mix to be stable. Given the age of the industry fleet, there is no reason to believe that the industry fleet, will remain in the present configuration.
5. The hopper dredging needs of the nation have increased over the past decade and are likely to continue to increase in the foreseeable future.
6. Without the Ready Reserve Fleet, the Corp has limited options for addressing urgent dredging when industry cannot respond. There is not a substitute acquisition vehicle for CERF contracting and Jones Act prohibitions restricts the Corps from accessing the international hopper fleet. [1]

[1] The Merchant Marine Act of 1920, known as "The Jones Act," was enacted to promote and maintain maritime workers and commerce in the territorial waters of the United States. Vessels engaged in US domestic commerce, including dredges, must be owned by U.S. citizens, operated by U.S. nationals (75% of the crew), registered in a U.S. port, and built in an American shipyard. The effect of this legislation on the dredging industry is that neither foreign owned companies nor foreign made

7. The Corps hopper dredges provide strategic economic and risk reduction benefits to the nation's navigation program, national defense, emergency response, resiliency and recovery, and an alternative when there are no bids or bids that exceed a reasonable Government estimate for solicited work. The finding is based on the history of the use of the minimum fleet, which controverts conclusions of some previous studies the minimum fleet was not needed.
8. The PRIP Account in the Revolving Fund will support the planned replacement of the four Government hopper dredges considered in this analysis.
9. The current Corps hopper dredges are experiencing increasing age-related maintenance and repair costs. Since the 2011 MFCIR was prepared, the Corps approach to operation and maintenance of assets integrated the principles of life cycle asset management. These principles dictate that the floating plant assets should be replaced at some point in their life cycle, rather than continue to repair and maintain them indefinitely at ever increasing cost. This asset recapitalization approach was intended and financially supported through PRI payments to the PRIP. The existing financial obligations of individual dredges to the PRIP revolving fund would impact the replacement schedule without changes to the depreciation schedules and increment escalators.
10. There may be opportunities to optimize the operation and maintenance of the hopper dredges by consolidating and managing some aspects of the dredges as a national fleet, but in depth focus on this issue is beyond the scope of this analysis.

Recommendations

1. The Government's minimum hopper dredge fleet should remain at the same strength and positioned in the same geographic locations.
2. No significant change in Minimum Fleet dredge capabilities is recommended other than the foreseeable requirements to meet environmental standards and whatever efficiencies would be gained by having newer, contemporary features, such as electrical, hydraulic and mechanical systems. While the Minimum Fleet hopper dredges do some routine maintenance work, their emergency or urgent work is focused relieving channel obstructions and enhancing the national navigation resiliency, rather than constructing beach or other restoration type projects.
3. The current four hopper dredges should be replaced on a schedule consistent with both the financial obligations of the dredge fleet and demonstrated need informed by physical inspections of these dredges. This includes returning the ESSAYONS to a replacement schedule ending in 2033, rather than 2059. The costs to construct and maintain new dredges represents a savings to the Corps Civil Works Program over continuing to repair and maintain the current fleet of hopper dredges. Recapitalization

dredges can work in the United States. This does not prevent US flagged ships from working abroad, however. Waivers may be granted but historically have only been given in cases of National Emergency or by request of the Secretary of Defense. Cabotage Laws similar to the Jones Act that regulate U.S. coastal trade have existed since the late 18th century.

scheduling will be developed with consideration to maintain sufficient funding levels in the PRIP account.

4. Future Corps dredges must be maintained with adherence to industry standard life cycle asset management principles. The financial implications of this include shorter depreciation schedules that match current understanding of ship hull life, the planned periodic investment for the replacement of electronics, mid-life engine replacement, and a systematic evaluation of a hull and major system components before any major investment decisions. The resulting impacts to the daily rate from these changes are likely to be offsetting. Higher life time depreciation costs would be offset by lower Plant Replacement Increment (PRI) costs and a more realistic life cycle should decrease maintenance costs over the life of the vessel. The PRIP accounting regulations (ER 37-1-29, Financial Management of Capital Investments) for floating plant should be updated to reflect these expectations.
5. The assumptions for plant replacement value and need that are used for PRI calculations for each dredge should be adjusted as necessary given economic and material cost changes, but not less often than at ten year intervals.
6. A study should be undertaken to determine if or how efficiencies can be gained by consolidating the hopper dredge management to One Fleet, with national manning, training, maintenance and operating policies.

Path Forward

1. Complete in-depth physical inspections of critical components of the hopper dredges in the coming 18 months. The inspections will result in an assessment of the remaining life of key components of the dredges. The data from the inspections will be analyzed together with the costs to replace or repair at-risk components, ownership and operating costs to arrive at maintenance program that will enable the dredges to reach their replacement dates as cost efficiently as possible.
2. Continue planning for the recapitalization of the dredges as planned and as depreciation schedules and physical condition require. The principles of cost effective asset management should be considered at each decision point.
3. The Philadelphia District (NAP) and North Atlantic Division (NAD) will prepare a white paper detailing the cost savings in operations and ownership costs for the McFarland. This will help inform the future direction of the dredge design and economic operations.
4. Continue to incorporate the efficiencies that have been gained by utilizing national manning, training, maintenance and operating policies of the Corps dredges.

2016 Hopper Dredge Recapitalization Analysis

1. Introduction

The U.S Army Corps of Engineers (Corps) is responsible for maintaining and improving the nation's Federal navigable channels, harbors, and waterways. A significant part of that effort is accomplished through dredging of the federal channels, both on a regular basis for maintenance and as necessary for channel improvements. Support of the national dredging mission is accomplished using primarily private industry and to a lesser degree Government-owned dredging equipment. In 1978 PL 95-269 directed the Corps to employ industry dredges as much as possible to accomplish this mission and also, as industry demonstrated sufficient capability, to reduce the Government dredge fleet to the minimum necessary to respond for national defense, emergency, and industry supplemental needs. The Corps is also responsible for constructing and re-nourishing hurricane and storm damage risk reduction projects along the nation's coasts through the use of industry dredges. This report focuses on hopper dredges in the Corps Minimum Dredge Fleet, which have been the subject of scrutiny since the passage of the law and are the only Corps dredges to have been restricted in operating days to increase dredging for private industry.

As a part of the process in developing the findings and recommendations of this report, a separate document, titled "Assumptions and Analysis," (A&A) was produced for review by interested stakeholders. The A&A document contained information about the historical volume of hopper dredging, dredging costs, industry utilization and the projected future hopper dredging needs, utilization, capacity and capability of the industry dredging fleet, historic use of the ready reserve hopper fleet, and assumptions about maintenance life cycles for dredging equipment. This information is key to the PDTs work and deliberations. Comments on the A& A document were taken between March 31, 2017 and April 21, 2017. The comments were considered by the PDT during final analysis and in developing findings and recommendations.

2. The Minimum Fleet Capital Investment Report 2012-2061

2.1. Background

In 2011, the Corps undertook a study for management, titled Minimum Fleet Capital Investment Report 2012-2061 (MFCIR). These Findings are still generally valid today, though some of the findings and recommendations were influenced by factors that have changed since 2011. The summary of the findings of the MFCIR is included in Appendix A, with the current study team's assessment of their validity.

Factors that have changed in ways that impact this analysis include:

1. The composition of the industry dredge fleet is changing, with the introduction of new dredges.
2. It is clear that the need for hopper dredges is not just for the navigation mission. Use of hopper dredges for hurricane and coastal storm damage risk reduction has increased in recent years.
3. Both Private and non-Federal dredging has been following an upward trajectory.
4. The passage of the Water Resources Reform and Development Act of 2014 (WRRDA), directed release of Harbor Maintenance Trust Fund (HMTF) revenues, which fund all of the hopper maintenance dredging work on coastal navigation channels and harbors.

5. The available funding in the PRIP account in the Corps Revolving Fund has increased due a revision of the Corps Resource Management Policies with regard to PRIP repayments. A large portion of the increase has come from the PRI payments from Corps hopper dredges.
6. The individual operating accounts for the hopper dredges have greatly improved and as a whole, now have a positive operating balance.
7. Since 2005 there have been multiple climatic events which highlight the need for surge capacity in the hopper fleet.
8. Databases and analytical tools that were just coming on line during the analysis for the MFCIR, are now available that help define the present state of dredging and dredged material placement options and estimate the future state.

2.2. Status of the MFCIP Recommendations

The MFCIP laid out 3 planning scenarios and recommended one that seemed most likely. The MFCIP recommended that the Corps pursue "*Funding Scenario 2*, *Scenario 2 Status Quo Funding (0-5% decrease)".*

There are specific actions associated with each of the scenarios and the Corps has undertaken some of the recommendations. The analyses completed for this report fulfill several of the recommended actions. The Status of the Corps actions with regard to the MFCIP report are shown in Table 2.1.

Table 2.1 Status of Recommendations from the Minimum Fleet Capital Investment Report

"Funding Scenario 2, Scenario 2 Status Quo Funding (0-5% decrease) "	
Specific Recommendations	Status
FUNDING SCENARIO 2 (0-5% Decrease)	Funding has not declined and has improved more than anticipated. The coastal navigation dredging budget has benefitted from the passage of WRRDA 2014. Funding for hurricane and storm damage reduction projects has also increased.
Consider deferring vessel sustainment and improvements; evaluate Currituck replacement/mothball options; evaluate affordability of Yaquina and Wheeler; schedule evaluations for replacement/retirement options for remaining vessels; evaluate minimum fleet consolidation; evaluate minimum fleet program for operational efficiency improvement	A financial analysis of the Wheeler and Yaquina was done, which supported their operations. The disposition of the Special Purpose Dredge Currituck is not investigated in this report.
Examine the future need for ten minimum fleet dredges, especially four hopper dredges and three dustpan dredges, as necessary for consolidation opportunities	Evaluation for the replacement/retirement options for the Hopper Dredges is the subject of this analysis.

	Analysis of the other Floating Plant in the Minimum Fleet has not been done.
Develop an underlying policy to either 1) build to repair and sustain, or 2) build to consume and replace	The underlying policy is considered in this analysis and an articulation of the benefits and risks involved in the two approaches. A recommendation is provided.
Comprehensively review minimum fleet financial and management policies and overall impacts upon the minimum fleet to improve their interactions and effectiveness	A review of the financial and management policies and their impacts is in this report
Consider obtaining direct funding for the continued improvement and replacement of the minimum dredge fleet as required.	Considered politically untenable and financially unnecessary

3. Hopper Dredge Recapitalization Analysis

In addition to updating the MFCIP information for the hopper dredges Essayons, Yaquina, McFarland and Wheeler, this report examines the industry fleet as it exists today and with the addition of the two newest dredges that are anticipated to begin operations in 2017 and 2018 as well as other potential changes in the market or fleet and their impact on the recommendations for the Corps Minimum fleet hopper dredges.

3.1. The Minimum Fleet Law Parameters for the Composition and Use of the Hopper Dredge Fleet.

In making decisions regarding the minimum fleet, it is worthwhile to review the language of the statutes, and the history of compliance. The U.S. dredging history is closely tied to Corps navigation work. Until the 1960s, the nation's development of Federal navigation waterways and port access channels was primarily accomplished by Corps-owned dredging plant. At its peak, the Corps owned 38 dredges. Then, in the mid-1960s, the Corps was faced with replacing aging dredges. The Administration and Congress deliberated funding the replacements or encouraging private industry to take over the construction and maintenance dredging work.

Congress enacted Public Law 95-269 on April 26, 1978, referred to as *The Industry Capability Program*. There has been subsequent direction for limiting the use of the Corps Minimum Fleet since the original law, including the directions in the Water Resources Development Acts (WRDA) of 1996 and 2007, which placed the Corps hopper dredges Wheeler and McFarland, respectively in a Ready Reserve Status. The specific language in the original law is important in determining the minimum fleet composition and recapitalization and is as follows:

a. *The Secretary shall have dredging and related work done by contract if he determines private industry has the capability to do such work and it can be done at reasonable prices and in a timely manner.*

b. *To carry out emergency and national defense work the Secretary shall retain only the minimum federally owned fleet capable of performing such work and he may exempt from the provisions of this section such amount of work as he determines to be reasonably necessary to keep such fleet fully operational.*

c. *The minimum federally owned fleet shall be maintained to technologically modern and efficient standards, including replacement as necessary. The Secretary is authorized and directed to undertake a study to determine the minimum federally owned fleet required to perform emergency and national defense work.*

3.1.1. Dredging and Related Work Shall be given to Industry

The first provision of the Industry Capability Program has been translated into a policy of "Use Industry First" in consideration of apportioning the Corps hopper work. The placement of the

East Coast and Gulf Coast hopper dredges, the McFarland and the Wheeler, into a Ready Reserve status has effectively increased the portion of the Atlantic and Gulf Coast dredging being offered to private industry. There is a cost associated with maintaining these dredges in Ready Reserve since they are idle much of the year and because they remain minimally crewed, but trained to respond quickly and effectively in emergencies. In the past 10 years, the Wheeler has been called out in emergencies 17 times for 573 days of dredging and the McFarland, only in Reserve status since 2010, has been called out 7 times for 249 days of operation. Having studied the issue in 2003 and 2012, the Government Accountability Office (GAO) concluded that keeping Corps Dredges in the Ready Reserve has increased costs to the Corps, but GAO did not conclude that putting Corps dredges into Ready Reserve has served to either increase competition for Government contracts by the dredging industry or drive down costs.

WRDA 2007, which placed the McFarland in ready reserve status, released the West Coast Dredges, the Yaquina and the Essayons from any operating limits. The Essayons and Yaquina are part of a West Coast regional program that uses both industry and Corps-owned hoppers to manage the requirements at Federal projects along the West Coast, Alaska and Hawaii. Because the mobilization of private dredges to the West Coast through the Panama Canal is both costly and time consuming (typically greater than 21 days), efforts are made to manage the Corps hopper work in the west regionally utilizing a single contract, with the participation of the six Pacific Corps districts. The planning takes into account the budgets, the short, intense weather window, the environmental windows and the efficient utilization of industry equipment. The districts take pains to ensure that the successful bidder of the regional contract has sequential work with relatively low risk of under runs in dredging volumes or extended standby time. Response time is the single biggest factor in the location of Minimum Fleet Dredges on the west coast, as it affects both cost and timeliness.

3.1.2. Reasonable Prices and in a Timely Manner

The Corps compares industry dredging bids to the Independent Government Estimate (IGE). 33 USC 624 directs the Corps to use the Minimum Fleet dredges if the bid prices for private dredges is over 125% of the IGE. Federal Acquisition Regulations for Civil Works contracts also specify that when costs exceed 125% of the IGE, the contract is not awardable. At that point, the Corps will examine the scope and the IGE for the contract and make adjustments, if warranted, or convert to a negotiated procurement; or if these alternatives fail to result in an awardable bid, begin the "Raise the Flag"[2] procedures for calling on a Ready Reserve dredge.

[2] The Raise the Flag procedure was developed from provisions in WRDA 1996, as it pertains to hopper dredge work. Raise the Flag procedure provides a systematic method to identify and respond to the Nation's urgent or emergency dredging needs. It is used when a district, through its normal procurement procedures, receives no bids, or bids that are deemed unawardable, for hopper dredging needs, or when industry cannot complete or satisfactorily perform work on a contract. Raising the yellow flag is a signal to inform Division and Headquarters that there is the possibility that an urgent or emergency maintenance dredging requirement is in jeopardy of not being performed without assistance and to advise contractors of the need and follow-on solicitation. If the District/Division is unsuccessful in obtaining an awardable bid, then the red flag is raised and the request for activating a Ready Reserve dredge is made.

If there are no bids for a hopper contract, then the Corps will begin the "Raise the Flag" procedures for calling on a Ready Reserve dredge. During the "Raise the Flag" procedure, industry representatives are invited to confirm their availability and prices for doing the solicited work.

3.1.3. Emergency and National Defense Work

The second provision above indicates that the Secretary of the Army shall keep sufficient capability to address national defense needs and emergencies. There is no further definition of "national defense" in the bill. Some historical perspective is needed in developing a conclusion regarding both national defense and emergency needs. In the late 1970s when the Corps was debating the correct size of the minimum fleet, "national defense needs" was assumed to mean overseas contingency needs. Corps dredges had historically been used in war theaters in both World Wars, and the Korean and Vietnam Wars. As a result, the current Corps dredges that were designed then were built with specific features to accommodate operations in support of war time needs (helicopter pads, heavy gage hulls, extra-large fuel and water tanks, compartmentalized hoppers with retracting doors, etc.). This makes them slightly less efficient than a standard design hopper dredge of their era. Then, in 1991, a study by the Engineering Study Center concluded that the international dredge fleet could meet the US need for overseas contingencies and that the Corps fleet was no longer needed for that purpose, but they concluded, domestic emergency and cost control were still likely reasons to keep a minimum fleet.

While the 1991 study catalogues the deepest Military Sealift Command (MSC) vessels leaving the US as having drafts over 44 feet, the report failed to include dredging to maintain these depths in support of domestic military logistics. The National Port Readiness Network (NPRN) is a federal inter-departmental program established to promote the readiness of U.S. strategic military and commercial seaports and related intermodal systems to support deployment of military personnel and cargo in the event of mobilization, national defense contingency, national emergencies, or disasters through enhanced coordination and cooperation among NPRN members. Strategic ports are a U.S. commercial or military seaport designated by Surface Deployment and Distribution Command (SDDC) to support the deployment of U.S. Armed Forces assets in the event of war, contingency, or other national emergency or disaster. The NPRN is administered and chaired by the Maritime Administration (MARAD) within the Department of Transportation. According to a report by the GAO, "sealift is the primary means of deploying and sustaining the combat power required in major ground operations, typically accounting for upwards of 90 percent of all military cargo, and U.S. strategic seaports play an important role in ensuring that the U.S. military is able to quickly and efficiently deploy to address the country's overseas interests. (GAO-13-511R: Defense Logistics: The Department of Defense's Report on Strategic Seaports Addressed All Congressionally Directed Elements Published: May 13, 2013) There are seventeen (17) strategic ports on the Gulf, East and West Coasts, Alaska and Guam. (GAO-13-511R: Defense Logistics: The Department of Defense's Report on Strategic Seaports Addressed All Congressionally Directed Elements Published: May 13, 2013) Of these identified ports, nearly all have access channels that receive routine hopper dredging. In addition to these ports, the

Corps regularly maintains the US Navy bases in Florida, Virginia, California, and Hawaii, having been called on in several instances for "just in time dredging" to support specific operations. Figure 1 shows the location of the current inventory of Strategic Ports.

Figure 3.1

Based on U.S. Navy dredging and the Strategic Ports needs, it is clear that even if the Corps dredges were not required for OCONUS military operations, their availability to maintain the domestic military bases and Strategic Ports is relevant and in fact, represents a national defense need for the dredges. This is true regardless of whether the Corps normally contracts that work to industry dredges, rather than assigning Government hoppers to the projects. In summary, the Corps team believes that the conclusions of the 1991 study are not valid based on more current assessment of the use of the minimum fleet in the years since the report.

3.1.4. Emergency Needs

Historically, all four hopper dredges have been called on as resources for emergency response services not associated with navigation channel dredging. In 1989, the Essayons and Yaquina went to Alaska to assist in the oil recovery after the grounding of the EXXON VALDEZ. In 2005 after a series of hurricanes devastated multiple areas on the gulf coastline between Florida and Texas, the McFarland and Wheeler were used for communications and hoteling of Corps officials and responders. The use of the Wheeler for these functions as well as channel

clearing is identified in the MVD and SAD Hurricane Emergency Operations Plans.

Currently, Ready Reserve call-outs happen after the Corps implements the “Raise the Flag” procedure and the Director of Civil Works approves the call out of the Minimum Fleet Dredge. Based on the number of Ready Reserve Call Outs since 2005, it is evident that the Corps Ready Reserve dredges do provide necessary surge capacity to the nation during unusual and extreme events.

3.1.5. Emergency Dredging Contracts

In working documents between Corps leadership, the Assistant Secretary of the Army for Civil Work (ASA-(CW)) and Office of Management and Budget (OMB) during the lead up to a determination of the minimum fleet size, a key factor in deciding on a fewer, rather than a greater number of Corps owned dredges was the development of the CERF (see Appendix D) In simplest terms, the intent of the CERF was to rely on industry to mobilize when directed. The dredging contractors signed a non-binding agreement with the Corps, which, theoretically, would enable the Corps to quickly utilize private dredges from the CERF during times of emergency. The contracting vehicle for the CERF agreements was a BOA with some pre-negotiated costs.

However the CERF cannot be used as originally envisioned. The BOAs that formed the basis of the CERF agreements did not contain the necessary pricing data with which to award a contract under Federal Acquisition Regulations. It is simply an agreement with the "method of pricing, issuing, and delivering future orders" stated in the document. Further, it does not relieve the Corps from the requirement of preparing justification documents to limit competition to the companies with which we have BOAs. Therefore, if or when an event would occur, the Corps would still be required to process a Justification and Approval (J&A) for an Unusual and Compelling procurement action. It would be difficult to pre-price an unknown event with a BOA or any other contractual vehicle, and a contractor would likely include significant contingencies in their proposed prices that would be difficult for the Government to support.

During emergency situations, the Corps utilizes all acquisition authorities; however, that does not change the fact that dredging needs have repeatedly exceeded the capacity of the dredging fleet (both Government and private). In 2015 and 2016, conditions were such that all available US hopper dredges were utilized (either on Corps work, or private work) or unavailable (in repair status). New Orleans district, requested that Corps Headquarters (Corps HQ) pursue redirection of industry dredges under CERF rules. The Raise the Flag process had been executed, Reserve Dredges were utilized and additional hopper efforts were still required. The Corps can exercise no unilateral authority for moving dredges, save the minimum fleet hopper dredges.

Another recent example that demonstrates the need for flexibility to move dredges occurred as a result of a need on the west coast. In spring of 2011, the successful bidder for the Portland District’s North Coast contract suffered a several month delay in leaving the shipyard

and could not report to the dredge site on the Mouth of the Columbia River on time. Dredging the ocean entrances on the west coast has a fairly tight weather window and the high priority need was more than the Dredge Essayons could accomplish during the weather window. When it became apparent that the contractor would be unable to mobilize on time, there was really no time left to re-advertise. Moreover, because 2011 was a historic flood year in the Mississippi River as well, the remainder of the industry dredges were already under contract. The Corps had no way to address the looming emergency unilaterally. Eventually, a subcontracting agreement with a second company was engineered, but it took the concerted effort of divisions, districts and contracting officers to allow the two contractors to negotiate with each other. This arrangement for the benefit of one project likely caused a loss to the original bidder and caused early curtailment of another project in order to free up capacity. Dredging projects that are started late, modified and / or ended prior to completion of requirements also suffer increased costs from double mobilizations, inefficient equipment or deferred maintenance.

3.1.6. The Secretary of the Army's Discretion

"The minimum federally owned fleet shall be maintained to technologically modern and efficient standards, including replacement as necessary. The Secretary is authorized and directed to undertake a study to determine the minimum federally owned fleet required to perform emergency and national defense work." (PL 95-269)

This portion of the Minimum Fleet Law affirms the Secretary of the Army's discretion in determining the composition, location and replacement of the dredges in order to have a Minimum Fleet of Dredges that meets the Mission of the Corps under the requirements of the law. Including the study just prior to the passage of the original law in 1978 and subsequent language for the restrictions on the use of the fleet, the Corps has studied the minimum fleet hopper dredges mission eight times (see Appendix D)and other agencies and organizations (US Army Audit Agency, GAO, Pacific Northwest Waterways Association) several more times. This analysis marks the ninth time that the agency has examined the right makeup of the fleet to address the needs of the navigation mission. The number of studies are an indicator of the Corps diligence in fulfilling the requirements of the law and also the high degree of interest by Congress in both the industry and Government hopper fleet.

There is also an important benefit derived by the Corps dredging program by virtue of owning and operating dredges. Dredging and dredge equipment is a specialty among marine construction industries. As with other technical specialties, the Corps personnel maintain expertise at developing program budgets and plans, realistic consultations with resource agencies, independent Government estimates, contract scopes of works and innovating around the needs of the industry precisely because the Corps also owns hopper dredges and maintains cost, pricing and production data. Corps research on its own vessels has led to many innovations, for example: better drag head designs, crab and turtle deflectors and excluders, automatic ullage sensors, and the initial work done to develop what is now known as the Dredging Quality Management Program.

4. Determining the Government's Hopper Dredging Needs – The Current and Projected Hopper Dredging Mission

4.1. Dredging Data

For this report, district data records and Corps data bases have been used to assess the historical hopper dredging quantities, hopper dredge utilization, and placement history. The period of record examined varies a little from source to source, but when possible the period 2005-2015 was used. This period captures some low funding years, some high funding years, years with abnormal weather events, the period after the McFarland was placed into ready reserve, and is a period with a fairly stable industry dredge fleet.

Three Corps databases, Dredging Information System (DIS), records from the Dredging Quality Management Program (DQM) and the Continuing Cost Analysis (CCA) of dredging data were utilized. Early DIS data (pre-2005) is less reliable than current data. Past work completed using Construction authority and funds, especially when not on a navigation project (beach building and restoration projects), was sometimes missed in the records. More recent DIS data has better captured Navigation work done under Operations and Maintenance, as well as a good portion of work done under Construction and other authorities. There are still some weaknesses identified with DIS data entry and DIS was not designed or intended to track private dredging authorized under Department of the Army (DA) permits unless performed by or under contract to the Corps. In the DQM, the available records only go back as far as 2007 (earlier records are not yet converted to a new data storage system). DQM does provide information about permitted private work and historical work, but cannot be used for volume measurements. The DQM records many types of data about the dredging operation while the dredges are onsite working. Data queries of total dredging days have proven to be very useful in making an assessment of overall dredge utilization at the asset level and the number of days that industry hopper dredges are engaged in private work. The CCA is set of records maintained by the Institute of Water Resources which is useful in tracking dredging volumes and costs regionally, dredging funded by supplement appropriations and routine O&M dredging. Like the DIS, the data is limited to work performed by or under contract to the Corps and is normally entered by Operations personnel. The CCA includes all costs associated with a project, including environmental coordination costs and contract administration costs. The array of costs included in the CCA has changed somewhat over the years. The CCA could be used to compare years, and/or types of dredges (hopper and non-hopper), however, the data does not support the direct comparison of costs between years and individual dredge equipment. It is useful however, for looking at overall trend lines.

Future needs are estimated using trend lines, Corps planning studies for harbor improvements, information about upcoming work from Federal and non-Federal sources and sand and gravel mining permits.

4.2. Historical Hopper Dredging

Hopper Dredges are the primary plant used for maintenance of coastal entrance channels and are well suited to dredging sands and sandy material. They can maintain operations in relatively high currents and rough seas. Because they are mobile, they are used in high ship traffic channels at coastal entrances, in harbors and in rivers because they do not require anchors, floating line and attendant plant which cause disruptions. Hopper dredges are often used to create near shore berms to enhance natural beach building processes. Direct beach nourishment is called for to quickly rebuild after large storm events and it is a growing requirement that dredges have pump ashore capability. Off shore mining with upland or beach placement of materials is almost solely done by industry dredges. The Corps hopper dredges McFarland and Essayons have pump ashore capability, although only the McFarland presently does pump-off activities in the Delaware River. The Essayons pump ashore system has been partially dismantled. The Corps does not own mooring buoys or shore pipe to support beach nourishment activities.

An examination of records from the CCA shows that between FY 2005 and FY 2015, the total volume of material dredged by Government and industry hopper dredges on Federal projects was 681million cubic yards. Of that total, 78% was dredged by contractors and 22% by Corps dredges.

The annual analysis further breaks out volumes by O&M, New Work, Federally administered Work for Others and Work funded by special supplemental appropriations, such as funding received after Hurricane Katrina and Super Storm Sandy. Table 4.1 below shows what dredged volume is attributed to Government hopper dredges and to contractor hopper dredges for FY 2005 through FY 2015.

	O&M (MCY)		New Work (MCY)		Work for OTH (MCY)		Surge (MCY)	
Industry	360,626	72%	65,362	98%	10,283	87%	92,354	92%
Corps	141,788	28%	1,104	2%	1,570	13%	8,155	8%
Total	502,414	100%	66,466	100%	11,853	100%	100,509	100%

Table 4.1 Hopper Dredge Volumes 2005-2015 (MCY), Summarized from Annual Continuing Analysis of Dredging Costs (http://www.navigationdatacenter.us/dredge/ddcosts.htm)

O&M work can conservatively be called the Base Workload. This dredging is completely navigation O&M funded. The other categories are not funded by the Navigation O&M funding, but through Construction appropriation, Flood Control and Coastal Emergencies Program, and/or Federal/Non-Federal cost shared projects, or Supplemental Appropriations for Disaster Relief and Emergency activities – noted as "surge" work. Table 4.2 below shows the regional distribution of Corps hopper dredge work from 2010 through 2015[3].

[3] The record period for this comparison was shortened to 2010 through 2015 to focus on the distribution after the McFarland was placed into Ready Reserve Status, which effects the East and Gulf Coast distribution of work and after the Columbia River Channel Deepening work was completed and the Essayons was repowered, which affected the West Coast distribution of work.

Region	Total Vol, MCY	% of Total	Contr Vol MCY	Contr %	Govt Vol MCY	Govt %	Ready Resv Call Out Days	Ready Resv Readiness Days
National	357,930	100%	274,737	77%	83,193	23%	632	737
East/Gulf	278,231	78%	241,996	87%	36,234	13%	632	737
West/Pacific	79,699	22%	32,740	41%	46,959	59%	0	

Table 4.2 Hopper dredging by Region. FY 2010 – 2015 (McFarland began Ready Reserve in FY 2010)

The regional distribution of the Corps work shown in Table 4.2 illustrates important information for assessing the utilization of industry hopper dredges and the need for Corps Minimum Fleet hoppers. The Corps requirement for hopper work is heavily concentrated in the East and Gulf regions. In this region, industry hopper dredges performed 87% of the work, while the Corps Minimum Fleet dredges – call out days included – performed 13%. Had the industry had adequate capacity to meet surge needs, the percentage of Corps work would have been less over this period.

The remaining portion of the Corps hopper dredging is on the West Coast, where the operating days of the Corps dredges were unrestricted in language included in the WRDA 2007, but where weather and environmental windows have condensed the dredging season for all but the Columbia River. The hopper dredging portion is higher for Corps dredges, handling 59% of the work, compared, to the 41% done by Industry dredges. Since 2013, the largest hopper dredging contract on the West Coast has been advertised as a regional contract to maximize the efficiency of the industry and Government dredge schedules, minimize mobilization charges and maximize the amount of work. The regional contract has allowed the Corps to deal with fluctuations in funding, periodic Pacific Ocean Division requirements for the Corps dredges and the long mobilization times through the Panama Canal for industry dredges.

The base workload funding has been growing with larger allocations in the President's Budget and from additional work plan amounts executed with appropriation "funding pots." Funding pots have been effectively used by Congressional appropriators to make additional Harbor Maintenance Trust Fund distributions to address highest priority dredging needs, deferred maintenance dredging, new work, and increases in maintenance after completion of new work, and otherwise increasing the amount above the President's budget.

4.3. Future Needs

The MFCIP states that the total volume of annual Corps dredging with all types of dredges hadn't changed much since the 1960s. That conclusion and the budget outlook during the MFCIP report development, which was constrained and declining at the time the MFCIP was developed, resulted in an overall assessment that a steady program volume was a reasonable assumption, despite a few indicators that might argue for an increased dredging program,. For this review, a shorter study period with better data and a focus on one dredge type has been used to assess trends and make projections.

The biggest advantage of using the shorter window and focusing on hoppers is better quality

data.

There are several indicators of a strong and modestly growing hopper dredge work load. With the passage of WRRDA 2014, which directs larger outlays from the HMTF, and the Water Infrastructure Improvements for the Nation Act of 2016 (WIIN), which emphasizes continued use and minimum increases in the distribution of the HMTF, the financial health of the program seems more secure, so long as appropriators continue to respond to this authorization language as they have been. The national focus on infrastructure and international trade by top leaders is a positive sign for increased appropriations, as well as a trend for increased non-federal funding for federal and non-federal work.

The optimistic outlook is echoed in industry analyses, such as IBISWorld, who project strong growth in the Dredging Services Industry, which in a June 2016 report projected strong growth through 2021, based on the factors described below. (Digging deep: Demand for dredging services will rise to accommodate larger oceanic vessels; IBIS*World*; June 2016)

4.3.1. Funding Scenarios

With the passage of WRRDA 2014 and WIIN 2016, which directed a schedule of increases from the HMTF until outlays match prior year HMTF revenues, the financial health of the national navigation program should stabilize and should increase over the next 20 years. A portion of this will be directed towards hopper dredging. To meet the requirements of the scheduled expenditures, Congress has dedicated funding to navigation needs through the use of "funding pots" intended to address the Corps needs in new work construction, O&M, and Investigation studies. A continued focus on the national infrastructure by both the Administration and the Congress may translate into more funding for the navigation program.

The funding scenarios that seem most likely given recent history and the legislation are as follows:

1. HMTF receipts through Work Plan. The navigation coastal programs have benefitted more than other Corps in Work Plans, largely because the HMTF are a source for the increases in programmed amounts.
2. Increases based on actual funding history between – Actual funding from all sources 2005- 2016, including Supplemental Appropriations for federal work.
3. Budget ceilings – 0-5% decrease (MFCIP Scenario #2)

Given the new work currently planned and the capability funding included in Corps dredging documents, contracted dredging quantities will still be capped by funds available, but the trend for funding is increasing for industry hopper dredges. New work navigation dredging and coastal nourishment and re-nourishment are normally conducted by industry dredges and with the constraints to working the Government hopper dredges on the east coast, this growth would fall entirely to industry dredgers.

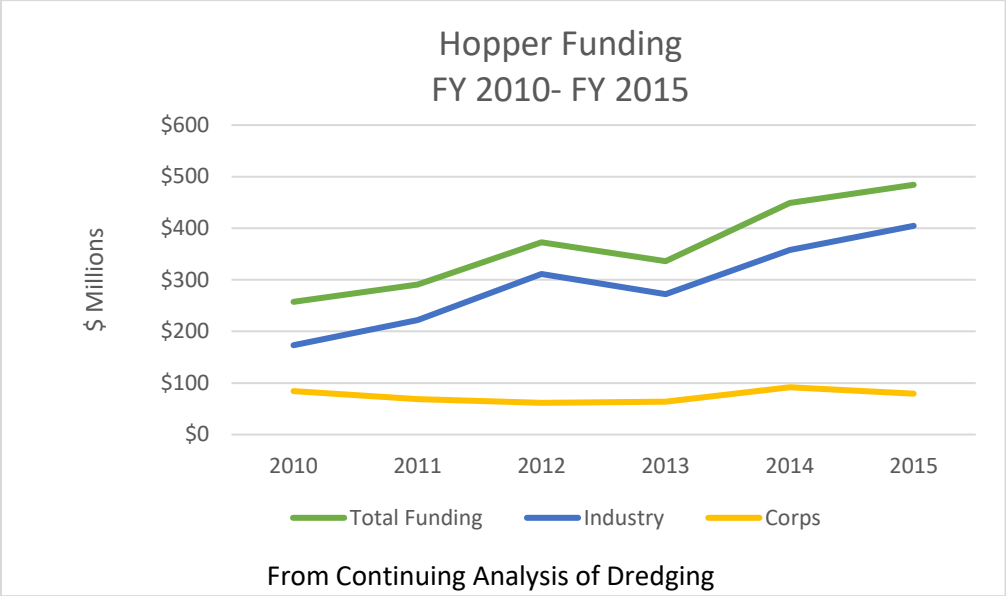


Figure 4.1 shows the actual funding for Federal hopper dredging projects for the period FY 2010 – FY 2015 from the CCA. This includes cost-shared work for New Work dredging, hurricane and storm damage reduction, and environmental restoration projects that were completed by hopper dredges.

4.3.2. Effect of Completing Key Improvements

For the purposes of describing the Corps hopper dredge work load, New Work could be considered surge work, but once the project construction is completed, the O&M of the deepened channel would get added to the base work. A number of navigation harbor deepening projects/studies on the East, West and Gulf coasts are underway, which if fully constructed would able to accommodate many of the larger vessels being employed in world trade and moving through the Suez Canal and newly deepened and widened Panama Canal. As of December 2016, there were fifteen Federal improvement projects that are authorized but awaiting construction funds, or being evaluated for deepening. Another two were under construction. Figure 4.2 shows the Corps projects in evaluation for deepening, being constructed, or authorized and awaiting construction. The majority of these are being built by the Federal Government with federal and non-federal funds, but there are some projects that non-federal sponsors propose financing the construction costs and then turning the project over to the Corps for maintenance. Non-Federal sponsors for most authorized but unconstructed projects are targeting construction starts in the next 5 years, funding permitting. Additionally, the focus on our nation's infrastructure has continued to grow. With the recognition of the importance of having suitably deep and reliable ports and harbors as a catalyst to economic growth, it is likely that more interest in port development or channel deepening may spur increased needs and funding for dredging in the future.

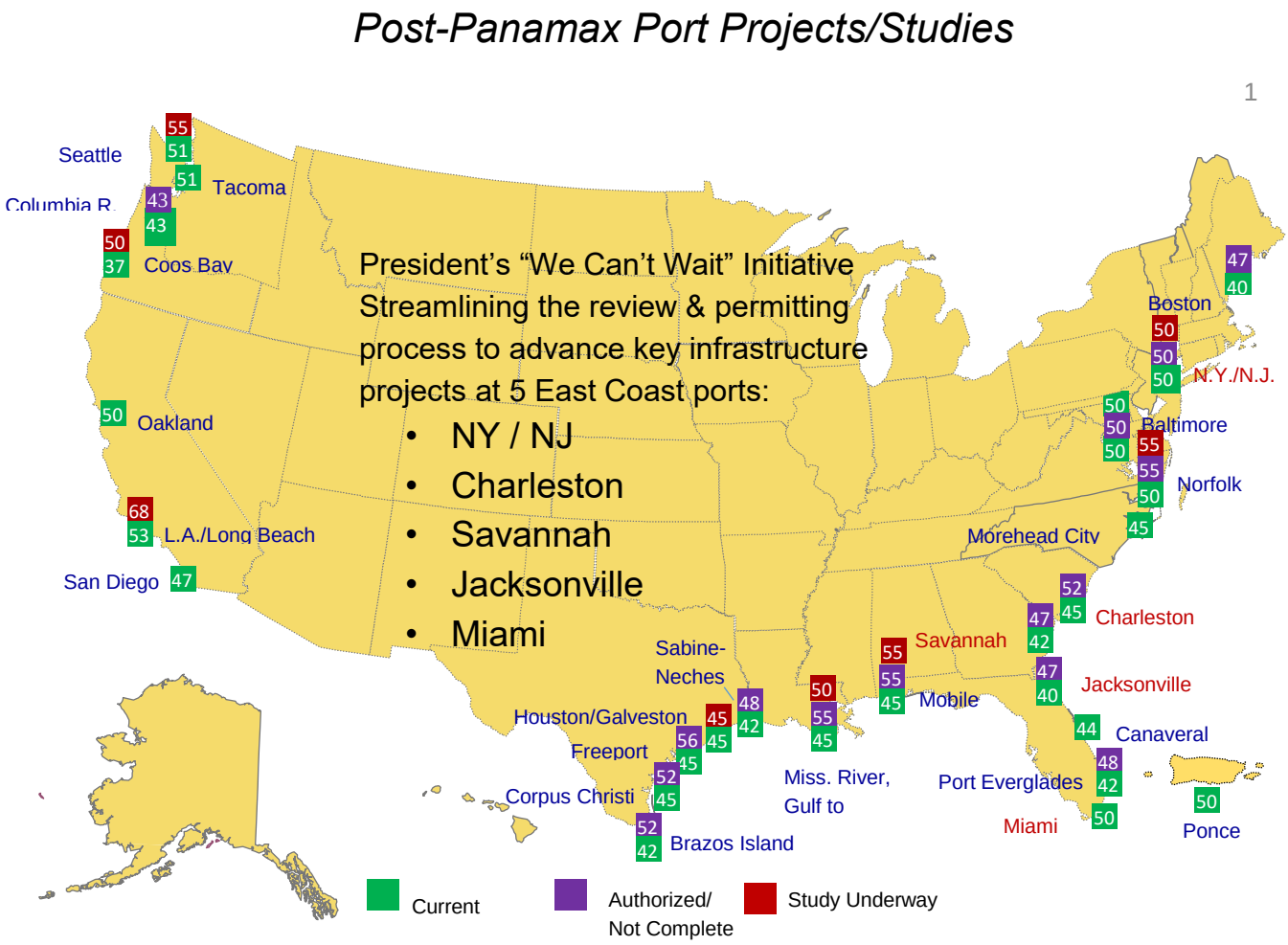


Figure 4.2: Corps Projects in Evaluation for Deepening

4.3.3. Private Work

Using data since 2008 from the DQM and the weekly dredge location reports, DA permitted and privately funded hopper work has averaged around 300 days per year (not including mobilization or demobilization time). In this context "private" refers to work that may be funded by sponsors or other governmental entities. There has not been significant non-civil works hopper dredging on the West Coast, so the 300 days of work done by permit can be considered East and Gulf Coast work. Since the work done by DA permit typically must fall within the same environmental windows as Federal channel maintenance and hurricane and shore damage risk reduction, these projects directly impact the availability of industry dredges for Corps work.

Given the growth of population on the coast, the importance of tourism and the need for coastal resiliency, privately funded work can be expected to increase, although the demand may fluctuate from year to year. The Corps weekly hopper dredge status report, which is

information collected from the industry and Government dredge managers on projected schedules for each plant, contains a Project category designation "Private." As of the date of this writing, the industry is anticipating 705 days of dredging that are either labeled "Private" or other non-O&M navigation work.

4.3.4 Beach Nourishment

The volume of Corps navigation O&M dredging by hopper dredge with beach placement for beneficial uses has been about 3 million cubic yards (mcy) a year. Substantially more material has gone to beaches as part of the Flood Risk Management and Flood Control and Coastal Emergencies programs, much of it cost-shared between the Construction Account and non-Federal sponsor. While this is not funded from the navigation O&M program, it represents a significant and growing demand on hopper dredges. The Corps Regional Sediment Management Center of Expertise, in Jacksonville District, estimates on average, nearly 9 million cubic yards of sand was placed by direct hopper pump out to beaches over the past decade.

The quantity of the material associated with Federal cost shared projects are captured in the "surge" quantities on the summary dredging table.

Beaches are key to resiliency for much of the Atlantic and Gulf Coastlines. They provide protection to both the coastal residents and the investment in coastal infrastructure, as well as generating substantial income for state tourism. Much of the sand comes from offshore sites, which require a lease for off-shore minerals, issued from the Bureau of Ocean Energy Management (BOEM). Applications for sand mining have grown steadily since the mid-1990s. BOEM leases are all for material at least 3 miles offshore, which makes this sand source particularly suited for mining by hopper dredges. Since 1995, BOEM has issued permits for over 139 million cubic yards (mcy) of sand to local and state agencies on the Atlantic and Gulf coasts, including the Texas coastline. BOEM managers report that the leased quantity and the dredged quantity are generally close in volume. For 2016, the volume of sand leased by BOEM was 15 mcy. The majority of the 15 mcy is associated with Federal projects and that it is accounted for in the CCA data, but BOEM permit managers report a trend of smaller communities combining efforts to acquire leases and initiate beach building through DA permitted activities.

4.3.5. Climate Change, Coastal Storms and Resiliency

Since 2005, there have been numerous weather events that resulted in a spike in hopper dredging needs and special Supplemental Appropriations from Congress. (Hurricanes Ike, Rita, Katrina, Super Storm Sandy and Matthew). Extensive flooding in 2011 and the most recent two years (2015 and 2016) of flooding on the Mississippi River did not result in a supplemental appropriation, but the conditions were severe enough to result in multiple Ready Reserve call out events to address shoaling in the Mississippi River's Southwest Pass.

The pattern of flooding and coastal storms is consistent with the prediction of increased storm

severity due to climate change (Melillo and Richmond and Yohe 2014, 841). It is likely that weather events that cause coastal damages and river flooding will continue at the same or increased rate so that surge events will become the "routine non-routine". For the purposes of this evaluation the Corps team has assumed dredging surge events will continue to occur at about the same rate and dredging requirement as they have occurred during the period 2005 to 2016. The 2016 late fall Hurricane Matthew event bears out the assumptions as preliminary estimates indicate a need of nearly 14 mcy of sand for beach restoration in Florida, South Carolina and North Carolina. Supplemental Funding for Hurricane Matthew recovery has been appropriated and funding packages are being developed as of this report date.

4.3.6. Other Temporary Workload Increases

Between 2009 and 2012, the American Recovery and Reinvestment Act (ARRA) funds added substantially to the hopper dredging workload. Coming at the end of a number of years of shrinking budgets and a constrained dredging program, the ARRA funds helped the Corps to address part of the deferred dredging. After the Deepwater Horizon oil spill off the coast of Louisiana in 2010, a short term effort to build barrier islands to protect the shoreline, was rapidly developed and paid for with private funds, and taxed the dredging fleet capacity for a short while. As a result of the Deepwater Horizon event, there are at least five programs that are not funded through the navigation O&M budget but that have the potential to impact the hopper dredging needs in the near future, including the Louisiana Coastal Area Program, The Restore Act, The Natural Resource Damage Assessment (NRDA) mitigation for damages associated with the Deepwater Horizon clean up, The Environmental Benefit Fund and the Criminal settlement funding, one half of which goes to the State of Louisiana. Also, there is a joint Federal effort to rebuild barrier islands in Mobile District under the Mississippi Coastal Improvement Program (MsCIP), which will add to the hopper dredging load in the short term. Not all of the dredging from any of these projects would utilize hopper dredging, but where the site development and unit price favor hopper dredges, if they are available, hopper dredges will be used.

5. Dredge Utilization and Dredge Fleet Capacity

5.1. Historical Utilization

Table 5.1 is the data extracted from the DQM program for dredge utilization. The DQM utilization is measured by full dredging days registering in the DQM. While partial work days are counted as whole days, DQM does not include transit time to or from the job sites. The data therefore under-represents the utilization, therefore unused plant capacity cannot be derived solely from this chart.

PLANT	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	AVG
ATCHAFALAYA	71	38	0	0	27	4	33	24	5	30	23.2
BAYPORT	39	85	80	86	90	63	93	72	64	62	73.4
B.E. LINDHOLM	33	81	55	78	3	6	67	64	70	76	53.3
COLUMBIA	76	66	37	76	83	46	41	88	23	65	60.1
DODGE ISLAND	36	72	88	62	70	78	83	91	68	82	73
GLENN EDWARDS	81	93	87	87	95	53	83	84	61	74	79.8
LIBERTY ISLAND	44	85	80	56	79	67	61	49	54	79	65.4
NEWPORT	43	41	95	78	54	76	87	87	73	72	70.6
PADRE ISLAND	18	57	69	50	72	72	88	80	69	70	64.5
R.N. WEEKS	17	65	83	68	48	45	73	74	47	66	58.6
STUYVESANT	18	0	0	9	0	58	51	88	64	76	67.4
TERRAPIN ISLAND	72	93	67	68	72	85	62	57	82	64	72.2
WESTPORT	30	7	28	22	33	45	52	50	46	47	36
WHEELER	27	24	29	45	40	35	7	31	42	35	31.5
MCFARLAND	32	32	47	47	19	27	26	19	36	35	32
ESSAYONS	57	10	50	48	53	54	55	52	25	50	45.4
YAQUINA	53	52	53	51	51	54	51	59	49	63	53.6

Table 5.1 Percent Utilization of Hopper Dredge FY 2007-2016

Despite its limitations, the data collected in the DQM program offers some insights into the utilization of the Corps and Industry hopper dredges.

- *Industry large and medium size dredges are being used more than the smaller dredges.* There are several reasons for this. One is a consequence of performance based budgeting that prioritizes the high tonnage channels for maintenance and has resulted in uneven funding for low commercial tonnage ports, which are also often shallower depth. Generally, the medium and high tonnage projects are deep draft ports that are least efficient for small dredges to maintain. In the case of the Columbia, the dredge does not have a load line certificate and is limited to working in protected waters. Small dredges typically have physical constraints for working in rough sea conditions. The small dredge that is an exception to this observation of low utilization is the Corps

Dredge Yaquina. The Yaquina services two niche dredging situations. Her dimensions (length and width) and rugged construction were specifically designed to make her effective on small coastal entrance bars. After funding for these ports was severely curtailed by the 2012 reduction in funding for low commercial use projects, the State of Oregon entered into a contributed funds agreement with the Corps to address appropriation shortfalls for their ports. Because the funding of small ports is often Work Plan dependent (rather than in the President's Budget), this generally does not allow for an efficient contracting schedule. A second reason for the increase in the Yaquina's utilization comes from the results of a third party Value Engineering Study of the Portland District Dredging program. The analysts suggested using the Yaquina on isolated sand wave shoals in the Columbia River, having the dredge move cross-wise to the channel and stay on the crest of the shoal. This has proved to be a very effective for the Yaquina and allows the district to focus the work of the larger hoppers (Industry and Corps) on the larger multiple sandwave areas and using deeper, more distant placement sites.

- *Traveling from the Gulf to the West Coast affects utilization.* In the years that an industry dredge travels from the East or Gulf Coast to the West Coast to dredge, the utilization of the dredge is reduced compared to the years when the dredge is not making long transits, which is at a minimum, a 42 day round-trip.

- *Dredge utilization on the West Coast is constrained by work windows.* The two West Coast minimum fleet dredges are not working under statutory work restrictions, but their utilization is constrained by weather and environmental windows. Their utilization rates are lower than industry dredges, which have longer dredging seasons on the East and Gulf Coast projects.

- *Dredges, like all working assets, are occasionally out of service.* Over the period of record covered in the table, nearly every dredge has had a year or more of reduced utilization—sometimes dramatically so. These years represent various events, some planned and some not. Dredges are generally, but not always performing reliably, and occasionally require extensive repairs. Removal of one dredge from the fleet can have a demonstrable negative impact on the ability of the Corps to meet its obligations.

5.2. Industry Capacity Based on Historical Utilization

The dredging industry is currently in the process of building two new hopper dredges to add to the existing U.S. industry fleet of 13 hopper dredges. The Ellis Island is a 15,000 cy articulated tug barge being built by Great Lakes Dredge and Dock Company, which will be the largest hopper dredge in the U.S., and the Magdalen is a 8,550 cy hopper dredge being built by Weeks Marine, Inc. Once the two new dredges are added to the fleet, the industry hoppers will be comprised of 8 low production capacity hoppers, 4 moderate production capacity hoppers, and 3 high production capacity hoppers (Table 5.2). The term "production capacity hoppers" is based on production records and is being used to generally compare the production of hopper

industry dredges and does not necessarily correlate to the traditional hopper size classification used in literature. For purposes of evaluating production, the industry dredge fleet was divided up into 3 general categories based on similarities in production and size as experienced at our most frequently dredged channels. These production categories are relative to each other and don't imply that a specific group has a low production. The dredges in the small category are estimated to have a 17,634 CY/day and range in bin size from 3,600 CY to 4,100CY. The dredges in the medium category are estimated to have a 27,235 CY/day and range in bin size from 5,000 CY to 8,500CY. The dredges in the large category are estimated to have a 38,876 CY/day and range in bin size from 10,000 CY to 15,000CY. However, based on bin size alone, industry capacity would increase by 34.6% once these two dredges enter the market in 2017 (Figure 5.1). This represents the highest bin capacity that has been held by the dredge industry. Note that for this analysis, while the Atchafalaya, Columbia and Westport all do important work for the Corps, they were excluded due to limitations in size, capability and geographic distance from the areas of highest need. Because of the limitations, including these dredges would have skewed the calculations and show the fleet as having a lower overall utilization and therefore less productive capacity. However, the dredged material volume typically dug by these vessels was also removed to more accurately represent the overall quantity needing to be dredged by the moderate and high production capacity hoppers.

Table 5.2 Industry Hopper Production Capacity Composition

*Low Production Capacity Hoppers***	*Moderate Production Capacity Hoppers*	*High Production Capacity Hoppers*
Dodge Is.	Terrapin Is.	Stuyvesant
Padre Is.	Liberty Is.	Glenn Edwards
Newport	Bayport	Ellis Is. (when available)
RN Weeks	Magdalen (when available)	
B.E. Lindholm		

***Atchafalaya, Columbia, and Westport were excluded due to limitations in size, capability, and geographic location.*

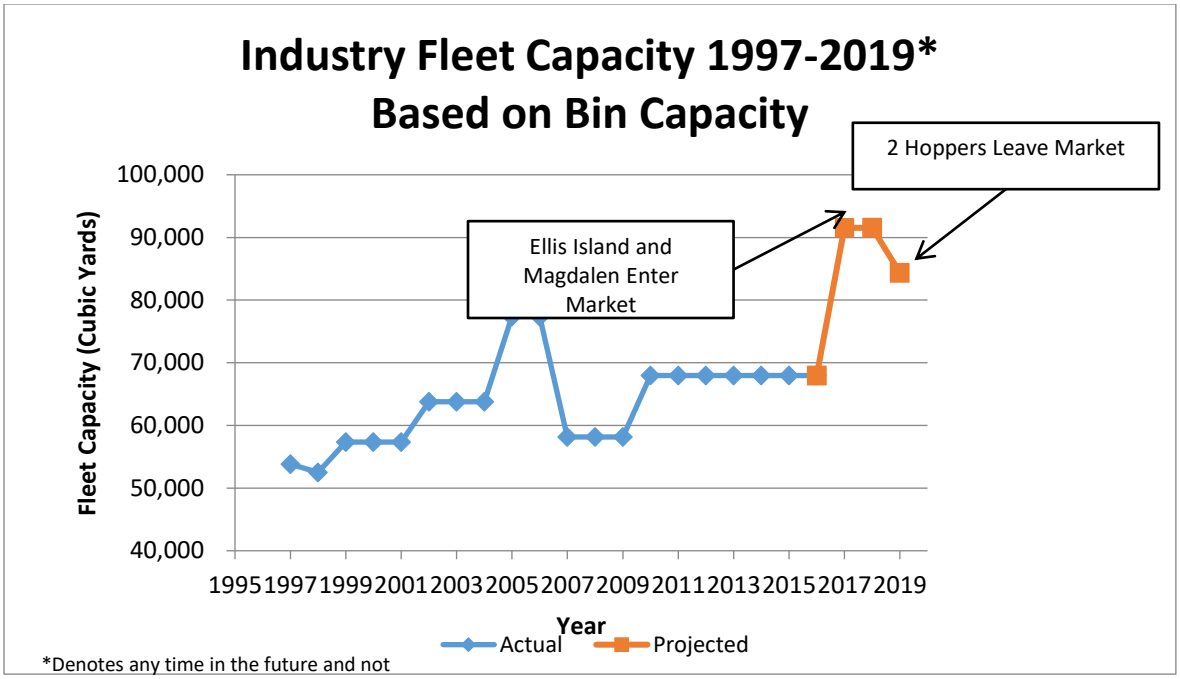


Figure 5.1 Industry Hopper Bin Capacity

A 34.6% increase hopper bin capacity does not translate into the same increase in production. In order to evaluate the potential increase in production capacity, dredging Project Managers around the country submitted contract information regarding the average production rates experienced on their hopper contracts. DQM was used to estimate the utilization of the dredges (Table 5.1). The average utilization for hoppers was 64.7% (Table 5.3) over the last 10 years. It should be noted that this production analysis excluded 3 small production capacity hoppers (Atchafalaya, Columbia, and Westport) from the calculation due to their limited use, limited capabilities, small size, and geographic location.

Table 5.3 Percent Utilization of Hopper Dredge FY 2007-2016 (in days)

PLANT	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	AVG
BAYPORT	39	85	80	86	90	63	93	72	64	62	73.4
B.E. LINDHOLM	33	81	55	78	3	6	67	64	70	76	53.3
DODGE ISLAND	36	72	88	62	70	78	83	91	68	82	73
GLENN EDWARDS	81	93	87	87	95	53	83	84	61	74	79.8
LIBERTY ISLAND	44	85	80	56	79	67	61	49	54	79	65.4
NEWPORT	43	41	95	78	54	76	87	87	73	72	70.6
PADRE ISLAND	18	57	69	50	72	72	88	80	69	70	64.5
R.N. WEEKS	17	65	83	68	48	45	73	74	47	66	58.6
STUYVESANT	18	0	0	9	0	58	51	88	64	76	67.4
TERRAPIN ISLAND	72	93	67	68	72	85	62	57	82	64	72.2
TOTAL											**64.7**

Based on average production rates provided by Corps project managers and the data obtained from DQM, the addition of the Ellis Island and Magdalen is estimated to result in a 25% to 35% increase in production capacity. This additional production capacity should allow industry to meet peak capacity needs for the current market (Table 5.4), except when the peak demand is spread over several separate areas and a tight dredging window where the number of projected available dredges is insufficient to concurrently dredge in several locations. This situation is typical during peak dredging demand periods in SW Pass.

The addition of the two new dredges would appear to create excess capacity for normal dredging demands; However, the excess capacity tails off as demand for dredging increases from the expanding private market, new Civil Works projects, the projected increases in the HMTF to address more than just minimum dredging needs, beach rebuilding projects and the unquantifiable effect of other types of surges and climatic events. It is expected that any overcapacity situation will not last. The excess will be lost as demand increases or if dredges are removed from the inventory, which is expected based on the age of the industry fleet and the related need for the equipment to remain profitable.

Age alone is not the only reason for anticipating fleet loss, but it is an indicator for where the potential exists for loss of fleet to occur. Any vessel can be made to work indefinitely, but the costs associated with the maintenance of older hulls and equipment and the lower production of 80's vintage dredges when compared to new dredges, makes them less profitable to operate. When the margin of profitability compared to other dredges (hopper or not) decreases enough, it will make removal, retirement or recapitalization an attractive financial alternative. It is worth noting that the biggest four European companies (DEME, Royal Boskalis, Jan de Nul and Van Oord) own around 95 trailing arm hopper dredges. Their inventory has an average age of 15 years, compared to the private US fleet's 26 years (including the two new dredges) and they have only 17 hopper dredges over 30 years old and only 5 over 35 years old. It seems to indicate that in a more competitive open market, dredges are not kept in inventory past their mid-30s without substantial reinvestment. Like the US fleet, the oldest dredges are smaller capacity dredges.

In the early 2000s four dredges left the US market because, according to industry representatives, there was insufficient work to remain profitable. Presumably, there was enough world demand for dredging to make leaving the US market an attractive alternative. All are early 1980s vintage, two are no longer owned by US companies have been sold to smaller international firms, and only one – the 9870 cubic yard Stuyvesant, returned to the US Market when the need for domestic dredging increased. Although now owned by a US company, the Stuyvesant ownership history includes conglomerates and partnerships with foreign companies. Special legislation was enacted to allow the dredge to be used in the US through a "grandfathering" clause attached to the ship in the 1992 Amendment to 46 USC 55109, Dredging. Also, if a US owned vessel has repairs done in a non-US shipyard, there are special requirements in order for and payments required of the vessel owners for the vessel to retain its eligibility to work in US waters when it returns.

Given these factors, it is probable that the private dredge inventory will change in the coming years. If the inventory is over capacity at some point, the industry will right size. When they become under capacity again, and if the demand appears stable, industry will build to meet increased demands. In this present situation it can be seen however, that demand cannot be met instantaneously. There is a time lag. It has taken as short as 3 years to bring a new dredge into service, but as long as 7 years. The variability in bringing a new hopper dredge to market is a result of many circumstances, from the time needed to secure funding internally or from investors, design time and construction issues in the US Shipbuilding Industry. The shipyards in the US have had an uneven history of capacity and availability in the last two decades. Given the high cost of investment in a private dredge, it is likely that a stable base need will be necessary prior to building a new dredge. So in addition to the missions described in PL-95-269, the Corps dredges operate as a shock absorber to the private market when there is mismatch in capacity versus need, as during fiscal years 2015 and 2016.

It is noteworthy that in the Southwest Pass and in some other places, when hopper dredge capacity was unavailable, some traditional hopper dredge work has been done by sea-going pipeline dredges. The use of pipelines is generally not interchangeable with hopper dredges, but situationally they can be used to alleviate emergency situations for a period of time until hopper capacity is available. Whether or not tradition hopper work will go to pipeline dredges is mainly a matter of project requirements and whether other dredge combinations could safely meet the contracts requirements with competitive pricing.

Table 5.4 Industry Production Capacity Estimates								
		Est. Production – Low Production Capacity (CY/Day)	**Est. Production - Moderate Production Capacity (CY/Day)**	**Est. Production - High Production Capacity (CY/Day)**	**Approx. Peak Yardage Removed (CY)**	**% of Peak Capacity Met**	**Approx. Average Yardage Removed (CY)**	**% of Ave Capacity Met**
		15,117	**26,814**	**38,876**	**71,150,000**		**49,810,000**	
Current Fleet	# of Dredges in Category	5	3	2				
	Annual Total QTY Capability	**17,860,000**	**19,010,000**	**18,370,000**	**55,240,000**	93%	**55,240,000**	133%
	Capacity Excess/(Need)				**(15,910,000)**		**5,430,000**	
Additional Fleet	# of Dredges in Category	5	4	3				
	Annual Total QTY Capability	**17,860,000**	**25,340,000**	**27,550,000**	**70,750,000**	118%	**70,750,000**	168%
	Capacity Excess/(Need)				**(400,000)**		**20,940,000**	
Loss Fleet	# of Dredges in Category	3	4	3				
	Annual Total QTY Capability	**10,710,000**	**25,340,000**	**27,550,000**	**63,600,000**	104%	**63,600,000**	149%
	Capacity Excess/(Need)				**(7,550,000)**		**13,790,000**	

Table 5.5 Industry Capacity Summary					
	Low Production Capacity Hoppers	Moderate Production Capacity Hoppers	High Production Capacity Hoppers	% of Peak Capacity Met	% of Average Capacity Met
Current Fleet	5	3	2	93%	133%
Additional Fleet	5	4	3	118%	168%
Loss of Fleet*	3	4	3	104%	149%
** Assumes 2 small production capacity hoppers*					

5.3. Optimizing Fleet Capacity

For this analysis, the Corps' dredge fleet assignment and scheduling optimization model under development at the Engineering Research and Development Center (ERDC) was applied to the problem of determining the effectiveness of various hypothetical fleet configurations against future anticipated dredging requirements. The application of such a model to dredging is relatively new, but it is based on models used by other industries seeking to optimize delivery of goods or services, like trucking, freight carriers, airlines, etc. Until now, the ERDC model has been used to inform decisions for smaller, regional subsets of dredging projects, but this is the first application to encompass the full national hopper dredging program. What follows is a generalized summary of the model and results. A more complete description of the model objectives, constraints and results is in Appendix B.

The model algorithms seek to maximize total cubic yardage (cy) subject to a breakeven unit cost threshold (here assumed to be $10/cy), with as many constraining factors, such as budgetary constraints, required travel times between jobs, environmental work windows, weather windows, channel dimensions, and required maintenance days, etc., as could be realistically captured in the logic. Project and plant specific information was added from historical dredging records if available, and when records were not available for a specific dredge-project combination, they were assumed based on similarly sized dredges in the existing fleet. The annual requirements for the U.S. hopper fleet were aggregated from the individual project dredging requirements and considered as a relative handful of large, regional jobs. The model then assigned multiple dredges to each job (region), working either consecutively or simultaneously, as is the case with the real-world execution of the Corps O&M dredging work plan. This was accomplished using a subtask feature for each region, with the number of subtasks matching the number of possible hopper dredges needed to fully execute the respective regional dredging requirements within the allowable work window. This subtask approach allowed the model to iteratively search for the optimal number of hoppers per region to satisfy minimum dredging requirements within the allowable work window while also maximizing the availability of the rest of the U.S. fleet to perform work in other parts of the country.

Five different fleet configurations were considered for evaluation by the model:

1. Existing baseline U.S. hopper dredge fleet plus two additional plants (the Ellis Island and the Magdalen) expected to come online in the 2017/2018 timeframe; this configuration is referred to as the "new fleet" when describing the other scenarios below
2. The new fleet, but without the Essayons or McFarland Government plants; these two dredges were removed completely from the model.
3. The new fleet, but with all four of the Government hopper dredges placed in Ready Reserve status. The real-world complexity governing the use of the Ready Reserve fleet precluded a true simulation within the model. As a proxy, each of the four Government hopper dredges was capped at 165 days of utilization. This represents a reduction of 100 dredging days for each Government dredge relative to the 265-day

limit placed on the rest of the fleet. This 100-day reduction is intended to reflect the Raise the Flag process required before Ready Reserve dredges can actually be used.

4. The new fleet, but without the Yaquina or the Wheeler Government plants; these two dredges were removed completely from the model.
5. The existing baseline U.S. hopper dredge fleet without inclusion of the Ellis Island and the Magdalen. This scenario also assumes that the four Corps dredges can be fully utilized throughout the year (no forced Ready Reserve status).

Once sample runs were verified as producing realistic real-world solutions (i.e., no dredges making multiple east coast to west coast runs within a single season), each model run was allowed to iteratively search for solutions for 17 hours. Each model run produced copious amounts of output for the researchers to organize and analyze, but the most gains in optimization were achieved in the first hour or two of searching.

Given the level of input generalization required in this effort for time constrained application of the model, the results are most valuable in that they provide insight concerning how each optimized work plan for each scenario compares to the others, rather than in the absolute values generated for unit costs or dredged quantities under each scenario. Since the model generates an idealized work plan of maximum efficiency that is unencumbered by the real world constraints of contracting requirements, free market bidding, funding availability, etc., all alternatives, including the existing fleet configurations, returned solutions that showed a theoretical total dredged volume of roughly 100 million cubic yards. However, there are nonetheless important insights that can be gleaned from comparing the respective work plans returned by the model for each scenario.

One output quantity returned by the model was the total number of unused available dredge-days available within the fleet for each fleet configuration alternative. As noted, all five fleet configurations showed an optimized solution that theoretically would meet the Corps annual hopper dredging needs, but the model also indicated a theoretical number of days wherein dredges were available to be used but simply were not needed to fully execute dredging requirements. Assuming that this measure of excess capacity (unused dredge-days) can be taken as a measure of the surge capacity of the fleet, it can be inversely interpreted as an indirect measure of the risk of not meeting the annual hopper dredging requirements. This seemed to correlate with what is known from recent experience; the present configuration of the fleet had smaller excess capacity (one would argue close to none, based on recent experience) than the fleet configuration with the two new dredges, which had the greatest excess capacity. However, the lowest excess capacity was experienced in the scenario that included the two newest dredges while simultaneously placing all 4 Corps hopper dredges into Ready Reserve status. Stated differently, the gains provided by the two additional dredges towards overall fleet capacity, at least as captured by this unused dredge-days metric, are negated by then placing the four Corps dredges in Ready Reserve status.

TABLE 5.6 – Summary of Unused Dredging Days across Five Scenarios Evaluated			
	Avg. Unused Dredge-Days	Total Possible Dredge Days	% Unused Dredge-Days
New Fleet (existing +2 new)	2,345	5,300	44.2%
New Fleet, no Essayons, no McFarland	1,587	4,770	33.3%
New Fleet, GOV'T Fleet in Ready Reserve	1,181	4,900	24.1%
New Fleet, no Yaquina, no Wheeler	1,709	4,770	35.8%
Baseline existing fleet (no new dredges)	1,369	4,770	28.7%

6. The Ready Reserve Fleet

6.1. Call-Out History for the Ready Reserve Fleet

The Wheeler was placed in the Ready Reserve Status in 1997 and the McFarland in 2010. The philosophy of the Ready Reserve fleet has supported the Use Industry First concept, while maintaining a Government owned capacity to serve as a "fire truck," ready to be used as needed, but to otherwise be at the dock and conducting sufficient readiness days to keep the crew ready and effectively trained. The Ready Reserve dredges are a public investment providing an additional emergency capacity available to respond to emergencies and support national economic interests and national defense needs.

Since being placed in Ready Reserve in 1997, the Wheeler has been called out 33 times for emergencies, for 865 days. The McFarland, placed in reserve in 2010, has been called out 7 times, for a total of 249 days. In the last seven years on three occasions both dredges were required to work simultaneously in the Mississippi River under Urgent Dredging Call Outs (FY2010, FY2015 and FY2016).

Based on the history of use, the Minimum Fleet reserve dredge capability is clearly needed. The dredges have been sent to projects when there is not an awardable contract, but more often when there are no bids for a contract. While most often a flooding emergency in the Mississippi River triggers call-outs, the McFarland and Wheeler have both been called to dredge other ports, including those with the Strategic Ports designation.

Fiscal Year 2016 was perhaps the most critical year for use of the McFarland and Wheeler. Even with the use of the Ready Reserve fleet, dredging requirements in the Mississippi River were not met and extended channel restrictions resulted. In FY 2016, the New Orleans District had seven bid openings to procure a hopper dredge for the Mississippi River between mid-December 2015 and early April 2016. Five of these resulted in no bids being received and one resulted in an unawardable bid. The Wheeler was also unavailable during part of this time due to scheduled shipyard repairs. The Wheeler and McFarland worked a total of 100 days (Wheeler 55, McFarland 45) under three Red Flag Emergency Call Outs. A great deal of effort by the Corps locally, regionally and nationally was required to free up industry capacity to help address the emergency. CERF activation was not possible and so alternate contracting methods were used to procure those hopper dredges. Eventually, a total of four contracts for private hopper dredges were successfully awarded for the Mississippi River during the fiscal year, but the effort fell short of an adequate response. Channel restrictions were implemented in the Mississippi River for nearly 6 months, from 14 Jan 2016 to 13 Jul 2016 for a total of 182 days. The minimum first order economic loss is estimated at $96,410,932 to impacted shippers and ports (based on calculations using 2008 Waterborne Commerce Statistics Center (WCSC) vessel transit data and considering only light loading, and not including any loss of cargo.) The actual losses were likely much higher as many shippers reported diverting cargos to other ports or cancelling shipments altogether.

In FY 2015, a similar situation occurred. Eight bid openings were held and six of those resulted in no bids being received. Only two industry hopper dredges were successfully contracted to work in the Mississippi River during the fiscal year and the Wheeler and McFarland worked a total of 148 (Wheeler 86, McFarland 62) days under five Red Flag Emergency Call Outs. As a result of limited hopper dredge availability during the fiscal year, channel restrictions were implemented in the Mississippi River from 22 March 2015 to 30 August 2015 for a total of 121 days or 33% of the year.

6.2. Could the Ready Reserve be Privately Owned?

In the comments to the 2014 GAO study, Actions Needed to Further Improve Management of Hopper Dredging (GAO-14-290), the Dredging Contractors of America suggested using industry dredges as an alternative to Corps owned Ready Reserve dredges. They cited the example of the Military Sealift Command (MSC) as the successful utilization of industry in a "ready reserve" capacity. While an interesting concept, the comparison of mission requirements is not valid. Experienced crews for this mission harder to locate. The MSC ships are manned with traditional merchant marines when activated. The qualifications and experience of a crew necessary to man the MSC roll on/roll off (RO/RO) industry is more widespread and generally available than that of dredge crew qualifications, experience and familiarity with specific equipment that is required in the dredging industry.

The difference in the MSC use of reserve vessels and the prescribed call out time for their use (4-20 days) notwithstanding, the use of a private reserve fleet does not meet the Congressional direction that the Secretary give work to industry when it can be done at a reasonable price, but maintain a federally owned Minimum Dredge Fleet for emergency and national defense work. As a Reserve Fleet with the same capability of the Corps dredges, the contract would likely be a leased plant contract needing a dredging rate and a standby rate. Presently, the payment of Government directed standby is allowed in the Corps dredging contracts as an hourly rate. For example, Government directed standby for the West Coast Regional Contract has had an average of $3100/hour over the past 5 years (from bid abstracts). Using that as basis for vessels that are fully manned, but not dredging, yields an annual cost of around $27 million when not underway. This is conservatively high, as private dredgers would likely change the crew composition as the Corps dredges do for cost savings. Transit to work sites and actual dredging days would generally be higher to account for fuel consumption, engine wear, etc.

Finally, it is not clear how a private reserve fleet would benefit the Government for call outs when there is not an awardable bid. The provisions in 33 U.S.C §624 are clear that the Secretary of the Army, acting through the Chief of Engineers shall assign work to the Government dredges if the contract cost is greater than 25 percent of the Independent Government Estimate (IGE). This provision is echoed in the language of PL 95-269. If there is no Government capability to maintain the Ready Reserve mission, then the Corps lacks a no non-Industry alternative if bids cannot be reconciled with the IGE. The private ownership of medium and large hopper dredging is already concentrated in only four companies (Great

Lakes Dredge and Dock, Dutra, Manson and Weeks Marine), which makes competitive bidding difficult under the best of circumstances. It is extremely unlikely that a fifth company could invest the needed financial resources to keep dredges and crews at the ready for the opportunity to work on 72-hour standby. More likely one of the four existing companies would own the contract, which would amount to a conflict of interest where high bids result in a paid activation.

7. Keep or Alter the Corps Hopper Fleet Composition or Location

7.1. Alternatives Considered

Alternatives considered to the present composition of the Corps fleet and the decision to recapitalize or retire dredges was made in consideration of the information gathered and developed by the team members. There is no perfect solution, and all solutions rely on a mix of information about the financial and physical condition of the dredges, the best projections of workload and funding, the modeled results of optimal contracting versus actual experience in contracting, recent experiences in Ready Reserve Call outs and professional judgement by subject matter experts.

The alternatives considered for changing the composition of the hopper dredge fleet were:

1. No change in Fleet composition or Ready Reserve status
2. Reduce the Fleet by one Ready Reserve Dredge (the McFarland)
3. Three dredges in Ready Reserve – Add the Essayons to Reserve Status
4. Three dredges in Ready Reserve – Add the Yaquina to Reserve Status
5. Four dredges in Ready Reserve Status
6. No Dredges in Ready Reserve
7. Retire and dispose of all dredges
8. Reduce the Fleet to two dredges, dispose of the McFarland and the Essayons
9. Reduce the Fleet to two dredges, dispose of the McFarland and the Yaquina
10. Reduce the Fleet to two dredges, dispose of the Wheeler and the Yaquina
11. Reduce the Fleet to two dredges, dispose of the Wheeler and the Essayons

7.2. Factors Considered in Assessing the Alternatives

The first assumption in the discussion and evaluation is that the current configuration of the hopper fleet meets the Corps needs. It was the opinion of the study team that the two Ready Reserve dredges have had enough call-outs since being placed in reserve status to demonstrate that they fulfill their intended need and that the scheduling of the dredges and contracted hopper on the West Coast optimizes the Corps hopper dredge workload. From this perspective, other configurations were measured as either being better, the same or worse than the factors considered relevant to the decision.

This configuration of four dredges arranged on the three coasts is viable in the future, as well. Two new industry dredges will add to the industry capability and for some period of time call-out frequency may be less. However, it is anticipated that the industry inventory will change. Old dredges will be retired, vessels may leave the inventory and remaining capacity will be used to meet the growing demand for navigation and mining dredging, or the fleet will otherwise adjust to the world dredging market. Because there is a financial disincentive to overbuild the private fleet, because the Jones Act prohibits the Corps from looking outside the domestic hopper fleet, and because it takes a lag of several years to bring a new dredge on line, the Reserve Dredges will always be the shock absorber for surge events and when

capacity and need become unbalanced.

The value factors against which alternatives were judged are described below. The alternatives were evaluated against the factors individually, as well as jointly discussing the benefits and costs of changing the current configuration of the hopper dredges. These are roughly in descending order of their weight of importance in the professional judgment of the majority of the study team. However, there was not complete agreement on the order of importance.

Despite the difference in weighting of the factors, the team was unanimous in its conclusion that maintaining the current fleet composition and geographic distribution of the dredges met the nation's navigation needs, offered resiliency for emergencies and did not substantively impact the work provided to the industry, even when considering the two new hoppers entering the fleet in the next couple of years.

7.2.1 Economic Loss Avoidance from Draft Restrictions

The economic loss to the ports and stakeholders is significant if the combination of industry and Corps dredges cannot keep channels clear, either because the capacity is inadequate – even temporarily – or surge needs overwhelm the capacity. The Channel Portfolio Tool (CPT) developed at the ERDC allows the Corps to quickly gage the significance of various depth restrictions on navigation channels in the country, based on the Waterborne Commerce Statistics of reported draft of the vessels using the project and cargo value. Because the Southwest Pass of the Mississippi River has the most cargo tonnage of any maritime gateway in the country and because it is also easily impacted by sudden fluctuations in the stage of the Mississippi River, disruptions in traffic here are of particular interest. In FY 2016, there were channel restrictions on Mississippi River for a total of 182 days with a minimum estimated economic loss of $96,410,932. This economic loss was based on 2008 Waterborne Commerce Statics Center vessel transit data, but does not include other losses in cargo degradation/expiration, income, earnings or opportunity losses experienced by the stakeholders and public.

Table 7.1 shows outputs from the CPT from a 5-foot draft restriction for 20 selected projects based on the average Waterborne Commerce Statistics reported transits (FY 2011-2015). Note that these results are for comparison purposes only, because they are show the full value of the cargo, and do not take into consideration light loading or losses that would be experienced by ports and shippers, such as employment losses, contract penalties for reduced bulk exports, and loss of export business to other unencumbered ports internationally. Losses can be significant and some are highly localized, but for many exported grains and other bulk commodities where there is international competition, a few cents per ton of additional cost makes US products less attractive.

Table 7.1 Average Annualized Totals Disrupted by a 5 –ft. Draft Restriction at each Respective Project*					
	District	Project	Tons (M)	$-Value ($B)	Trips Impacted
1	Galveston	Houston Ship Channel	84.6	63.1	1980
2	Galveston	Galveston Harbor and Channel	57.7	33.2	1069
3	New Orleans	Lower Mississippi River - MVN	54.5	17.1	855
4	Galveston	Sabine-Neches Waterway	51.8	26.9	928
5	Philadelphia	Delaware River, Philadelphia to the Sea	39.4	25.0	892
6	Norfolk	Norfolk Harbor	33.3	8.4	563
7	New York	New York Harbor	33.2	69.4	1480.8
8	New Orleans	Calcasieu River and Pass	32.2	16.0	749
9	Portland	Columbia and Lower Willamette Rivers	27.8	11.0	686
10	Norfolk	Thimble Shoal Channel	27.7	4.5	340
11	Mobile	Mobile	26.2	7.8	604
12	Mobile	Pascagoula Harbor	22.6	11.3	431
13	Galveston	Texas City Channel	22.2	13.3	383
14	Jacksonville	Tampa	18.0	10.4	819
15	San Francisco	Richmond Harbor	17.4	8.3	342
16	Galveston	Port Arthur, TX	15.8	7.8	306
17	Norfolk	Newport News	15.2	2.0	173
18	Baltimore	Baltimore Harbor	13.4	2.4	221
19	Savannah	Savannah Harbor	13.0	32.5	1529
20	Galveston	Freeport Harbor	11.3	5.7	185

**Data averaged from 2011-2015 Waterborne Commerce Reports*

7.2.2. The Corps Ability to Respond to Urgency and Emergencies in a Direct and Unilateral Manner

Without the ability to move dredges unilaterally as envisioned in the CERF fleet (see paragraph 3.1.5). Corps does not have the ability to unilaterally shift dredges to its highest priority needs, even if they are working on other Corps projects and certainly not if they are engaged in dredging for a private entity. This situation was demonstrated during the 2011, 2015 and 2016 dredging seasons.

7.2.3. The Statutory Requirement for the Secretary of the Army

Public Law 95-269 states that the Secretary, "Secretary shall have dredging and related work done by contract if he determines private industry has the capability to do such work and it can be done at reasonable prices and in a timely manner," but maintain a minimum fleet of dredges for defense needs, emergencies, and unawardable contracting situations. Alternatives were weighed against the directions of Congress to maximize the use (and protect the investment profit) of the industry dredge fleet. In 33 USC 624, the Corps is directed to use the Minimum Fleet dredges if the bid prices for private dredges is over 125% of the

Independent Government Estimate.

7.2.4. Cost to the Corps Civil Works Budget to Maintain Projects and to Recapitalize Dredges

While there is not a requirement that the ownership of Government hopper dredges be on par with the industry cost to own a dredge other than explainable short term cost increases, a wide disparity in costs would deserve serious examination. Because of restrictions or weather windows which decrease the utilization days of the Government dredges, a direct comparison of unit dredging cost is not a valid. The subsidy to keep the Ready Reserve dredges is significant, but it allows industry to invest in new dredges to meet the countries needs up to what they believe is a reasonable work load and foreseeable increases without risking return on investment deficits by over building the fleet. The subsidized Ready Reserve Fleet likewise protects the Government from the impacts of surge needs, of US dredges leaving the country to work or becoming otherwise unavailable should there be a downturn in needs or civil works funding. The minimum fleet dredges do not compete with the private industry and their use is in line with the statutory requirements of the original language of PL 95-269 and subsequent modifications. There is nothing to indicate that the volume of Corps maintenance dredging needs is a limiting factor in contracting hopper dredge work (or any other dredging plant), therefore efficiency gained by recapitalizing the Corps fleet, like a more efficient industry fleet, serves to benefit the overall civil works program.

7.2.5. The Cost to Shut Down the Dredges and Dredge Support Facilities

There is a cost to shutting down the dredges, the support yards and the disposal of the infrastructure presently supporting the moorage of the dredges. These are one-time costs, but they are significant and include paying back the Revolving fund for any undepreciated value of the plant, supporting equipment (cranes, etc.) and buildings, as well as the costs of severance, relocations or other human resources considerations.

7.2.6. The Intangible Benefits of Control, Security and Maintaining In-House Dredging Expertise

The Corps benefits from the ability to unilaterally respond to even normal dredging needs without the lead time required to execute a contract. In many areas, the time it takes to coordinate and receive environmental clearances becomes the critical path for civil works maintenance projects, the requirements for which can change annually. The acquisition process for contracting and the environmental process are not seamlessly aligned. Misalignments can mean a missed dredging window and cause economic loss for shippers from draft restrictions. Government hoppers provide a flexible alternative when the environmental coordination for critical dredging is delayed. It is a national issue and has happened in several West Coast and Pacific projects in the recent past. Additionally, a concern that has been elevated by stakeholders and contractors alike is the loss of Corps expertise in dredging, which impacts our ability to manage the program and produce sound, realistic contracts and contract estimates. The operation of our own minimum fleet equipment helps to maintain that expertise and spread it throughout the Corps.

7.2.7. The Value of the Dredges to the Corps for Other Uses Other than Dredging

As noted in other parts of the report, the Wheeler is part of the Hurricane Response Plan for the Mississippi River Valley Division and all four of the hoppers have been utilized during emergencies. The dredges add to the Corps ability to respond to and recover from disasters. All four dredges have also been used by ERDC researchers for research and development purposes. Examples include the development of the DQM system, as maritime control centers during emergencies, entrainment and excluder studies of multiple species, environmental lubricants trials, development of automatic ullage sensors, and the practicality of and impact to crabs from thin layer bottom dump placement, to name a few. Because the dredges are budgeted for based on their annual costs, most other opportunity uses that occur during the normal use of the dredge do not require additional funding over the appropriated project funding and require only the coordination with the owning district for logistical support.

7.3. Geographical Location

West Coast: Since only one small hopper, the Westport, is permanently located on the West Coast, usually in Alaska, and the majority of the dredging is along the Gulf and East Coasts, the Corps West Coast dredges are really the only hopper resources that can respond faster than the three weeks it takes to transit through the Panama Canal to ports in California, Oregon, and Washington during an emergency. The situation is the same for Hawaii and Alaska. If available, the Westport could have utility for some projects, but the barge and tow boat configuration of the Westport limits its transits and work during rough sea conditions for the same reason makes it an inadequate resource for the ocean entrances of the large projects.

East and Gulf Coasts: Ready Reserve call-outs have been used to address needs in Freeport, Mobile, Galveston, Wilmington Harbor, and Morehead City – most of which are designated as Strategic Ports. But the majority of the Ready Reserve call outs have been to the Mississippi River Southwest Pass during extreme flooding conditions. The Wheeler was designed for work in the Mississippi River and is primarily dedicated to the Mississippi River for Ready Reserve exercises and for emergencies.

The importance of the Mississippi River waterborne commerce and the historical timing of Mississippi River call-outs is one of the most compelling strategic reasons for keeping a second Ready Reserve dredge on the East Coast. The port system on the Lower Mississippi River (LMR) – from below Baton Rouge and extending below New Orleans – is the third largest port system in tonnage in the world with 4 of the top 15 ports in the United States. An estimated 11,000 vessels transit this area annually with 500 million tons of cargo. Approximately 60 percent of the nation's grain and 20 percent of the nation's coal and petrochemicals are shipped through the LMR.

The nature of the Mississippi River with its dynamic water elevations and high sedimentation rates has created emergency conditions in the deep draft navigation channel during 15 of the past 19 years. Dredging emergencies on the Mississippi River frequently occur during the

timeframe which is also the in-water work window for protection of turtles on the East and Gulf coasts and when there is the highest demand for industry dredges. Between ship readiness days in the Southwest Pass and call-outs to meet this frequent urgent need, the Wheeler is rarely available to respond to emergencies on other channels along the Gulf and East coasts. During high water, it is common to require multiple dredges working simultaneously from Mississippi River mile 10 Above the Head of Passes to 22 Below the Head of Passes due to the continuous sedimentation on over this 30 miles of the river. The McFarland has traveled to the Gulf to assist the Wheeler in Southwest Pass emergencies when industry is engaged and cannot respond and also when the Wheeler was not available. In addition to being regionally placed for emergency work and for the Strategic Ports on the East Coast, the McFarland provides a valuable role as back-up to the Wheeler when there are extreme conditions on the Mississippi River. The Mississippi River is one of the projects under study for deepening in the next decade, which will make maintaining depth during rapid shoaling events even more challenging.

Responsiveness to emergencies and recovery efforts benefit by having assets positioned regionally. As an agency the Corps plans for its response to catastrophic emergencies around the country. In all the coastal districts, the Corps dredges are inventoried as response assets. Historically, all the hopper dredges have been used as resources in the response to non-navigation emergencies. Both Ready Reserve dredges (McFarland and Wheeler) have played support roles during hurricane response and maintain a 72-hour readiness posture. As often as hurricanes make landfall on Gulf and East Coasts, having Ready Reserve dredges in two separate locations, New Orleans and Philadelphia, provides greater mission flexibility and resiliency if one is damaged or already in use. Depending on the magnitude of the response necessary, the two vessels provide capability to conduct emergency response missions in different locations. Because of the distance involved, it is unlikely that the West Coast dredges could easily fulfil a backup mission within the response time needed to meet urgent needs.

8. The Physical Condition of the US Fleet

8.1. Condition and Upgrades to the Corps Dredges

In general, the Corps hopper dredges are relatively old. Three of the four hopper dredges – the Essayons, Yaquina and Wheeler, were constructed and put into service in the early 1980s, which makes them over 30 years old. The McFarland was put into service in the mid-1960s. Each of the four dredges has had significant upgrades to equipment within the last 10 years to keep them operational and within regulatory standards, as detailed below. As an overview, Essayons, Wheeler, and Yaquina were repowered with current model engines that satisfied EPA Tier emission requirements at that time. This was necessary given the service life of the engines and the requirements of working on the West Coast. Work on the McFarland in the past ten years has been limited to major electrical upgrades to overcome electrical reliability issues.

The upgrades of the engines and dredge pumps improved the reliability of the dredge systems, but the hulls and overall condition reflect the age of those dredges. Recent shipyard periods show a significant increase in the cost to overcome emerging issues that are indicative of deterioration associated with their continuing use and age. The dredges will remain serviceable for as long as the Corps chooses to maintain them, but the cost to do so will continue to increase. This is detailed in the Operations and Maintenance section of the report.

8.2. Recent Capital Improvements to Corps Hopper Dredges:

ESSAYONS: Last Major Improvement: 2/2007 – 2/2009	
Propulsion Engines:	(2) CAT C280-12, 4640 HP each, 900 RPM
600V Generator Sets:	(2) CAT C280-12/Kato, 3250 kW each, 900 RPM
Propulsion Reduction Gears:	(2) Haley Marine Gears – Ratio 5.792:1
Ship Service Generators:	(3) CAT 3512C, 1030 kW each, 480V output
Emergency Generator:	(1) CAT C18, 425 kW, 480V output
Bow Thruster:	HRP USA, Inc. 1000 HP
Replaced the Integrated Control & Monitoring System, Propulsion Control System, 480V Switchboard and Overside Dredge Pump Drives. Modified the 600V Switchboard and installed a new Power Management System.	
Previous electrical configuration maintained separate ship service and dredging switchboards requiring respective generators to be online in order to supply that switchboard (ex. SSDG's online to supply 480V). With the Repowered configuration, a bus-tie transformer was installed to allow any generator to feed either switchboard which expanded the various electrical operating scenarios and therefore increased system flexibility, redundancy, and efficiency.	

WHEELER: Last Major Improvement: 7/2012 – 8/2013	
Propulsion Engines:	(2) CAT C280-16, 6169 HP each, 900 RPM
Generator Sets:	(2) CAT C280-12, 3700 kW each, 1000RPM
Propulsion Reduction Gears:	(2) Reintjes LAF5666 – Ratio 4.762:1
Propellers:	Michigan Wheel Marine, 162" diameter MRA162
Ship Service Generator Alternators:	(3) Kato Engineering, 1000 kW each
Ship Service Generator Engines were replaced in the late 1990's, early 2000's. Replaced the Integrated Control & Monitoring System and Propulsion Control System.	

YAQUINA: Last Major Improvement: 11/2008 – 3/2012 *(Work occurred during the dredge's offseason, which allowed the dredge to continue to work during this time period)*	
Propulsion Engines:	(2) MTU 8V4000 M60, 1140 HP each, 1800 RPM
Propulsion Reduction Gears and CPP:	(2) Hundested type CPG size 120 gears, model MP/HP size 1200 propellers
Ship Service Generator Sets:	(2) MTU 12V2000 P82, 440 kW each, 1800 RPM
Dredge Pump Engines:	(2) MTU 12V2000 P12, 805 HP each, 1800 RPM
Dredge Pump Reduction Gears:	(2) ZF Marine ZFW3350 – Ratio 4:1
Dredge Pumps:	(2) GIW 20 x 20 LHD-42 Single Walled, Centrifugal Dredge Pumps
Bow Thruster Engine:	(1) MTU Detroit Diesel Series 60, 425 HP, 1800 RPM (Existing bow thruster unit remained in use)
Bow Thruster Reduction Gear:	(1) ZF Marine ZF360 – Ration 1.237:1
Replaced the Propulsion Control System, Integrated Control & Monitoring System, Engine Control Systems and Ship Service and Emergency Switchboards.	

MCFARLAND: (3/2010 – 3/2011)
Replacement of the Auxiliary and Dredge Switchgears, Jetting Pump Controller, Local Engine Panel, Dragarm Winch Motor, Drives and Consoles.

8.3. The Condition of the Industry Fleet

It must be stated that the authors of this report are not familiar with the specific condition or repair history of the hopper dredges in the industry fleet. This is in part due to the competitive nature of the business and the reluctance of the industry owners to provide information that may in some way compromise their competitive position or divulge proprietary information. Corps plant assessments during contract start-ups are generally only safety related inspections and no additional effort is made to document the physical condition of industry dredges. However, like Corps dredges, they are production assets working in a coastal marine environment and as a result, it is reasonable to assume that their general overall condition reflects their age and their usage. Similar to the Corps hopper dredges, they

represent large capital investments and some of the older vessels, on a case-by-case basis, have had significant upgrades to the pumps, engines and electronics to keep them serviceable and competitive.

For the purpose of this report and reflected in Table 8.0, potential replacement is shown at the 40-50-year life. This is for general perspective only and does not reflect specific plans of any of the industry contractors. It is worth noting that examining the world wide dredging equipment database, the biggest four European companies, who between them own around 84 trailing arm hopper dredges, have only 15 over 30 years old and of those only 4 over 35 years old. There are none over 40 years old as of this writing. Industry dredges are operated with a different set of financial management rules than Corps dredges regarding depreciation length and salvage value which impacts their investment strategy. Some dredges in the same age bracket as those in the present fleet have left the U.S. market.

Table 8.0 U.S. Industry Hopper Dredge Fleet

Owner	*Vessel*	*Capacity (cu yd)*	*Year Built*	*Potential Retirement*[c]
Cashman Dredging	*Atchafalaya*	1300	1980	2020-2025
Dutra Group	*Stuyvesant*	9870	1981	2021-2026
	Columbia	4350	1986[a]	2026-2031
Great Lakes Dredge & Dock	*Ellis Island*	15000	2017[b]	2057-2061
	Liberty Island	6540	2002	2042-2047
	Terrapin Island	6400	1981	2021-2026
	Dodge Island	3600	1980	2020-2025
	Padre Island	3600	1981	2021-2026
Manson Construction	*Glenn Edwards*	13500	2006	2046-2051
	Bayport	4855	1999	2039-2044
	Newport	4000	1983	2023-2028
	Westport	1800	1978	2018-2023
Weeks Marine	*Magdalen*	8500	2017[b]	2057-2061
	R.N. Weeks	4000	1987	2027-2032
	B.E. Lindholm	4000	1985	2025-2030

Notes:
[a] The Columbia was originally built in 1944 to transport military equipment in WWII, was later converted to a hopper dredge and began its service as a hopper dredge in 1986 under the name of the Columbus. The ship is limited by the Oceans Act of 1992 to transporting merchandise (except valueless material, Including dredged material between places within navigable waters in the United States
[b]Expected completion
[c]Assuming 40-50-year life
Sources:
GAO-14-290 Army Corps Hopper Dredging

Our conclusion is that the industry inventory will not remain static. Even considering the two new dredges soon to be brought into service, eight of the fifteen industry vessels are as old as the Corps vessels and are likely experiencing an increase in investments to maintain. These eight dredges represent over 43 percent of the new fleet hopper volume. The industry

dredges' high utilization rate is a two-edged sword. They have many more days over which to spread maintenance costs than the Corps fleet, but the high utilization of vessels causes more wear. The ships as a group will also experience some degradation and maintenance cost directly related to age and operating environment regardless of usage. While vessel life can be extended almost indefinitely by continuing to invest in the asset, at the point that these investments versus the return become unprofitable, older, more expensive, less productive dredges will be removed from service.

It is also understood that any future acquisition of industry assets would not necessarily reflect in-kind replacements, but would be based on the work projected and funding environment at the time of the decision and based on business profitability. This is reflected in the design of the two new dredges currently being built; the Magdalen and the Ellis Island. The Ellis Island, when operational, will have greater capacity than any of the other dredges in the US fleet and offers a great advantage to off shore mining and beach rebuilding projects. The Magdalen is being built with a single drag arm.

It is also important to note that, based on recent construction history with both the Magdalen and the Ellis Island, once the decision is made to invest in a new dredge, the process to bring one on line has significant lead time, under the best of circumstances. This means that there will always be a lag in providing a new hopper dredge in response to changes in mission requirements.

9. Dredge Operations and Maintenance of Corps Dredges

The Corps operates the four hopper dredges for the common purpose of maintaining navigation in the ports and waterways around the United States. The difference in geographic project requirements and the statutory limitations on working days result in management decisions that currently lead to differing operations and maintenance plans for each of the four hopper dredges. Most notably, the hopper dredges McFarland and Wheeler both operate in Ready Reserve status, and are not assigned any scheduled dredging other than 70 days of maintenance dredging that is completed as Readiness Exercises to maintain the skills of the crew. These exercises maintain the skill of the crew and readiness of machinery and equipment, as well as assure that both the McFarland and the Wheeler remain ready to respond to any emergency dredging requirements. When not on dredging assignments, both dredges remain at their respective docks, with sufficient crew to respond within 72 hours when directed by higher authority. The hopper dredges Essayons and Yaquina do not operate in Ready Reserve status, but instead each work approximately 190 days each year to offset ownership and operating costs.

9.1. Current Corps Hopper Dredge Operations

Due to the Ready Reserve status of the McFarland and the Wheeler, the ships are crewed differently than most working hopper dredges. Both dredges have two distinct crews, commonly referred to as tours, which work on a rotating two-week basis. On the Wheeler, the larger 1st tour, known as the “Starboard” operating tour, is made up of 24 to 28 crewmembers and is fully capable of operating all features of the dredge 24 hours per day. This crew’s primary purpose is to execute the Readiness Exercises as part of the Ready Reserve program as well as any emergency dredging assignments that arise. This crew also gets heavily involved in major maintenance activities required each winter to prepare the dredge for the next dredging season. The second tour, known as the “Port” maintenance tour, is made up of 10-14 crewmembers and is intended to maintain the 72-hour readiness posture of the dredge while at the dock. This crew is capable of quickly preparing the dredge upon notice of a dredging assignment, but is not capable of mobilizing to a dredging site or performing full scale dredging operations without being supplemented by other crew. The Wheeler’s Port tour manning concept helps to reduce labor expenses by over 50% while the dredge is at the dock. While the specific positions are different due to the different make-up of the equipment aboard the dredge, the McFarland is crewed with a similar sized crew, however split equally between the two tours. This level of manning needs only approximately 75% of the positions that would be required if the dredge was not in the Ready Reserve status. Regardless of when the Readiness exercises are completed or when deployed by Corps, either tour is augmented by a few crew members from the opposite tour to allow for continuous operations.

Although the reduced crews are the most effective way to meet each dredge’s mission requirements while in Ready Reserve status, these crewing concepts can strain crew resources during extended emergency call outs. During extended emergency call outs on either dredge, in addition to supplementing crew from the opposite tour of duty, both Ready Reserve vessels can pull crewmembers from the other ship’s crew. Multiple McFarland and Wheeler

crewmembers have been cross trained so that they can stand an independent watch aboard the other dredge. Both Districts have made a commitment to train a sufficient number of officers from all of the four minimum fleet hopper dredges in order to be in a position to help the other dredges in time of need. Additionally, the Rehired Annuitant program has provided the Ready Reserve vessels increased flexibility in filling short-term crew shortages during extended emergency call outs.

Both the Essayons and the Yaquina carry two complete crews, both of which meet the U.S. Coast Guard (USCG) manning requirements for ocean voyages. When on duty, the crews work rotating shifts to accommodate a 24-hour dredging cycle. While the crews are working in Oregon and Washington, the first and second crews rotate weekly, 8 days on and 6 days off, with overlap on crew change days. When the vessels are working farther away in other states, they shift to a two week schedule to reduce travel costs and logistics concerns. When vacancies, illness or leave requires a crewmember to be absent, either the watch standing schedules change, or a member from the off-duty crew stays over. The Essayons and Yaquina do some cross training with each other and some with the McFarland and Wheeler and have a history of being extra resources for the Ready Reserve dredges during extended call outs. During extended down time of winter overhauls, most of the crewmembers stay overnight on the vessel, but switch from a 24-hour schedule to a day-work schedule and their duties shift to vessel maintenance or quality assurance for the maintenance contract if they are in drydock. The winter layup time is also when personal leave or mandatory training is scheduled.

For all dredges, the actual dredging operations vary due to the specific capabilities of the vessels and the requirements of the dredging location. Each vessel and each dredge site has a unique set of variables. The dredge control officers use their knowledge of the ship, the dredge site and the aid of the onboard computer programs to operate within the envelope of highest efficiency to maximize the amount of material moved while working at the project. Most of the time the most efficient operation (the economic loading) results in filling the hopper until the vessel reaches the load line of the ship and then the vessel proceeds to the in-water placement site to empty the hopper. In some cases, based on consideration of length of cut and traffic, the settling speed of the material in the hopper, or environmental restrictions that limit overflows from the hopper, the most effective operation can be to load lighter before going to the placement site. When conditions allow, the dredge can perform agitation dredging. This is more common in the Gulf region where the dredged material is immediately placed back into the current and carried downstream in the channel. On the West Coast this practice is usually prohibited.

9.2. Current Corps Hopper Dredge Maintenance

USCG and American Bureau of Shipping Load Line certifications require Corps hopper dredge fleet to go to drydock inspection at least twice every five years. The McFarland and the Wheeler both currently drydock every two years on an alternating schedule so that one of the two is always available for dredging while the other undergoes major maintenance. In between the major shipyard years on the McFarland and the Wheeler, maintenance is done

on items that do not require dry-docking, mostly during a wet-docking period. Both the dry-docking and wet-docking periods are scheduled outside of the normal dredging period on the East and Gulf Coasts – October to January. As much preventive maintenance as possible is done during the wet-docking years. This approach helps to use the major maintenance periods effectively to minimize or eliminate unscheduled maintenance, which is nearly always more expensive and disrupts the urgent work that the Ready Reserve has been called to address.

The Essayons and Yaquina both dry-dock on an annual basis during the non-dredging season on the West Coast, which is typically between the months of December and March. The need to dry dock on an annual basis is due to the need for reliability. During the dredging season, the vessels work continuous 24-hour/7-day/week schedule and incur extensive maintenance due to the nature of the work and abrasive material dredged. Dry-dock work on the ships' hulls, hoppers, propulsion shafts and propellers is done by contract shipyard crews, while dredging systems and routine maintenance of the vessel is done by the ships engineering department or a team of dredge support craft workers (welders, machinists, electricians and electronics specialists). The ship support personnel are land based employees of the Portland District that travel to the ships to take care of maintenance needs while the ships are working. The weather and environmental windows on the West Coast and Pacific projects constrain the dredges working season and in order to meet the needs of the projects within those windows, neither the Essayons nor the Yaquina can afford much unscheduled downtime between April and October.

The Corps hopper dredges have entered the period of their life cycle where they need longer and more expensive maintenance during the dry-dockings to deal with steel replacement and other maintenance indicative of aging vessels. The McFarland, the Essayons, and the Wheeler have all needed extensive replacement of hopper and hull steel, as well as interior frames and bulk heads.

Due to the age of the minimum fleet hopper dredges, it is expected that these trends will continue in order to extend the operational lives of these ships. Steel will continue to need to be replaced due to degradation over time and use. Electrical replacements will continue to be necessary to update to more current hardware and software and to take advantage of advancements that enhance dredging efficiency. Many of the other ships major components will wear out or replacement parts will become unavailable.

9.3. Optimizing Operations and Maintenance

Despite the differences in the day-to-day requirements of the missions, Corps dredge managers deal with many of the same issues in staffing, maintenance planning, contracting and meeting the training requirements of the Corps and US Coast Guard. Dredge operations managers meet and share information to solve common problems in crewing, licensing, best practices etc. It may be worthwhile to take the cooperation step further and consider managing the dredges as "One Corps Fleet." With advancements in communications, remote monitoring, and maintenance management software, there may be further opportunities to

optimize operations and maintenance across the fleet. The primary benefit may only be applying consistency in best management practices across the hopper dredge fleet, but there may be other benefits to consolidating management, crews, and support service to address some of the challenges the Corps hopper dredge fleet faces. To fully explore the potential benefits of this "One Corps Fleet" concept is beyond the scope of this analysis, but a follow-on study is recommended to determine if some level of centralized management would provide value the Corps hopper fleet.

9.4. Lifecycle Analysis of the Corps Hopper Dredges

The four minimum fleet hopper dredges that were evaluated for this analysis are all showing symptoms attributable to their age. Maintenance and repair costs associated with each of the dredges have been steadily increasing throughout their service lives and have jumped significantly in recent years. Trends in these costs coupled with consideration of other maritime data on life expectancies of similar seagoing vessels point to the possibility that these hopper dredges are either at or past the point where the service life can only be extended with accelerating investments in maintenance (ER 37-1-29 Appendix B).

Figure 9.1 shows the lifetime biennial maintenance costs for the McFarland. The McFarland has been able to last through the original 50-year depreciation schedule, likely due to the original stout construction. However, the McFarland has had a major uptick in annual maintenance and repair costs in the last 10 years, resulting in an over 50% increase in average annual maintenance and repair costs from the 10 prior years. This increase is well above the generally accepted inflation rate over the same time period of approximately 20%, indicating that the McFarland is likely in the steep maintenance and repair costs portion of her lifecycle curve. The McFarland has also had some large spikes in maintenance and repair costs over the last 10 years which shows some level of unpredictability in maintenance and repair costs from year to year due to the age of the vessel. It is notable that even though the McFarland moved into Ready Reserve status in 2010, there has not been an appreciable decline in maintenance and repair requirements, which is another indicator that maintenance and repair requirements are now being dictated by the age of the vessel and are not currently a function of workload.

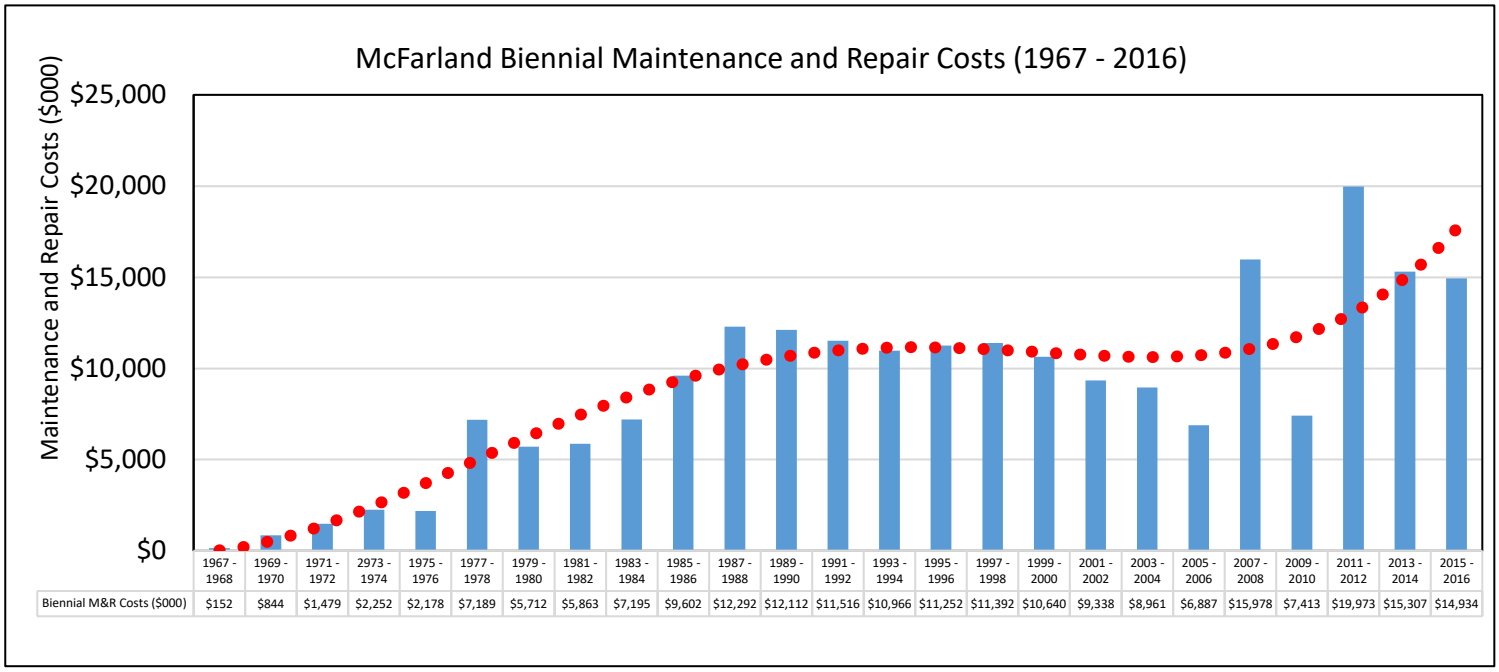


Figure 9.1 McFarland Biennial Maintenance and Repair Costs

Figures 9.2 and 9.3 show the lifetime maintenance costs for the Essayons and Wheeler. Like the McFarland, the Essayons and the Wheeler have both experienced large increases in average annual maintenance costs over the last 10 years – 60% for the Essayons and greater than a 70% increase for the Wheeler, both again well above the generally accepted inflation rate of approximately 20% over the same time period. That increasing trend actually appears much worse over the last 3 years for the Essayons, and shows a significant jump on the Wheeler in FY16, largely attributable to major steel replacement on both vessels. This maintenance investment may help flatten the curves for a few years or could be the first indicator of these vessels moving into the somewhat unpredictable high maintenance and repair investment requirements like those seen on the back end of the McFarland's life. Note that the Wheeler's cost data is combined into biennial increments, but the Essayons' cost data is shown on an annual basis, reflecting their respective dry-docking schedules. For the Essayons, prior to 1992 the maintenance costs were budget allowances, not actual costs for needed maintenance. This management approach did not reflect accurate maintenance and repair needs, forced over-prioritization and resulted in deferred maintenance.

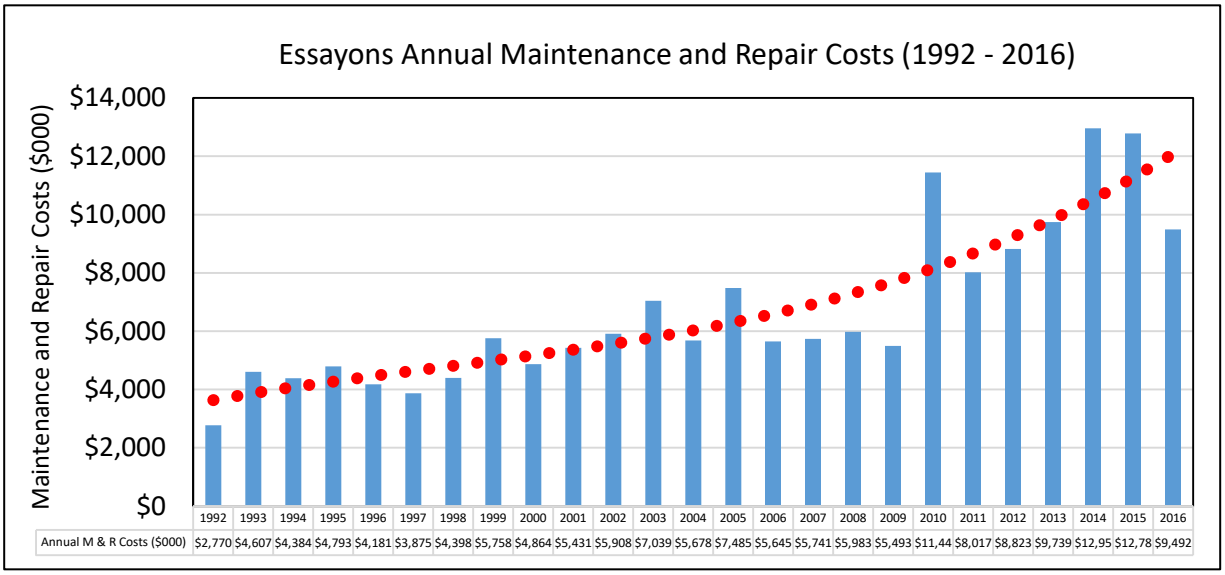


Figure 9.2 Essayons Annual Maintenance and Repair Cost

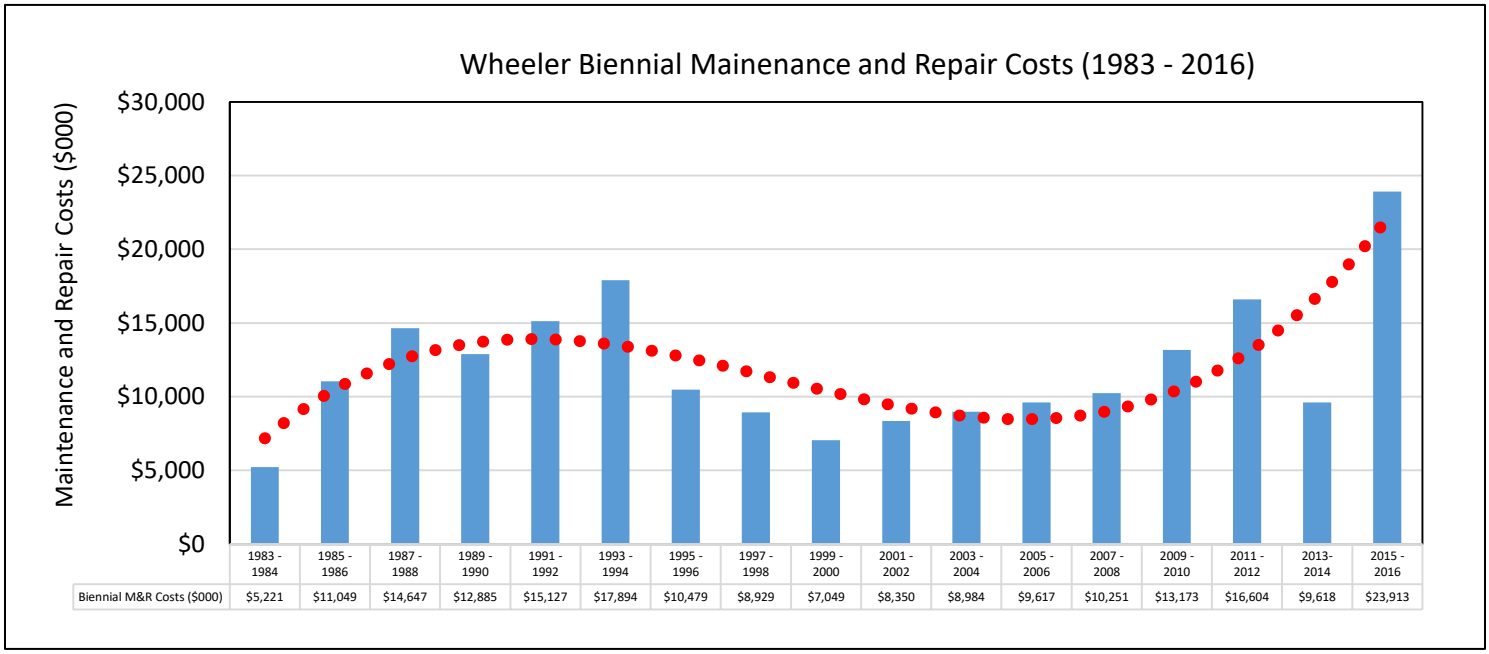
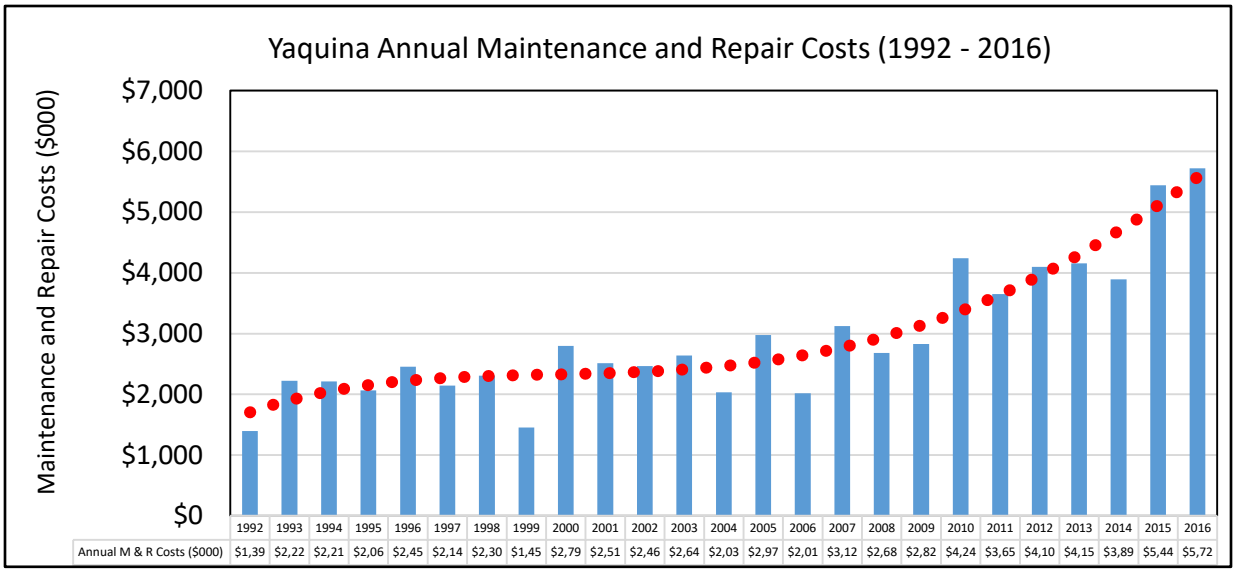


Figure 9.3 Biennial Wheeler Maintenance and Repair Costs

Figure 9.4 shows the Annual Maintenance and repair costs for the Yaquina. Although lower in relative total annual maintenance expenditures than the others, the Yaquina has also experienced increasing maintenance and repair costs over the last 10 years, showing a greater than 70% increase in maintenance and repair costs when compared to the 10 years prior, again much higher than the expected approximately 20% inflation over the same time period.

Note that like the Essayons, reliable maintenance and repair cost data is not available prior to 1992 as repairs were based on budget amounts as opposed to needs. This financial management of the dredges, likely resulted in deferred maintenance.



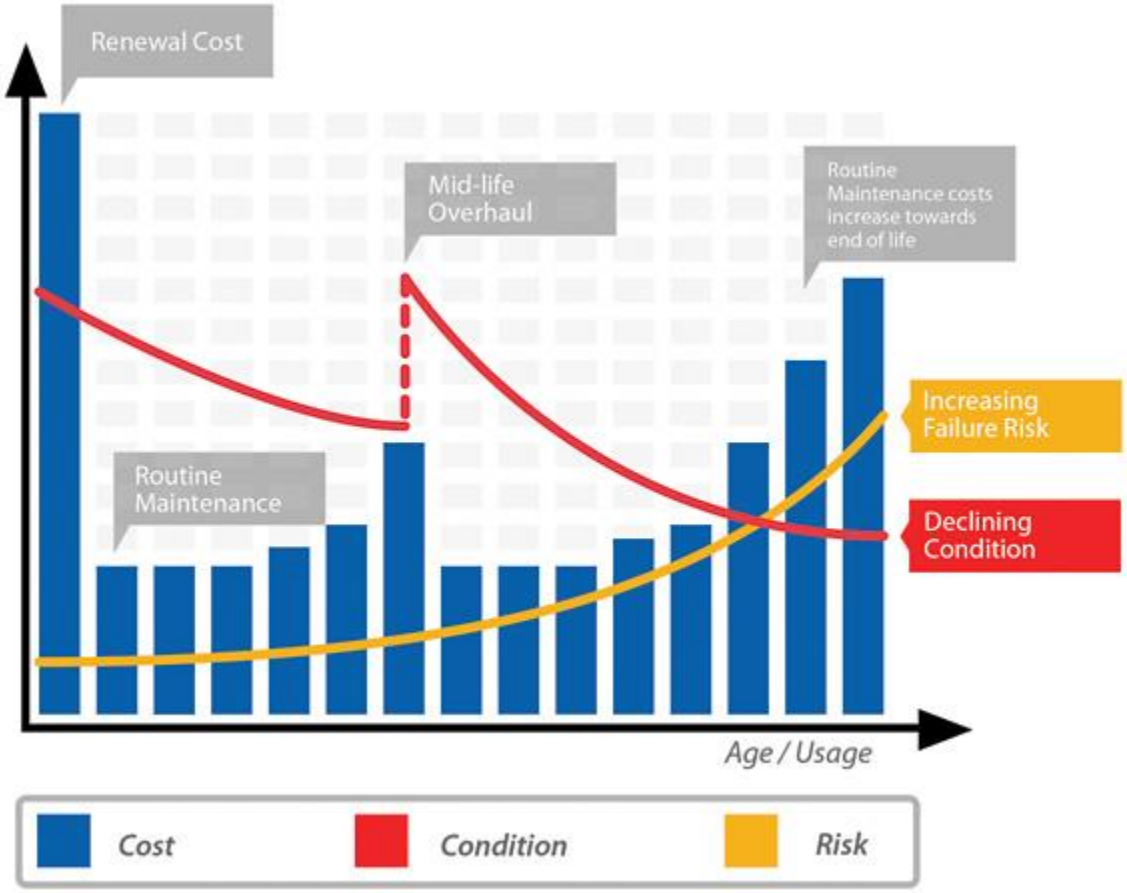
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Annual M & R Costs ($000)	$1,39	$2,22	$2,21	$2,06	$2,45	$2,14	$2,30	$1,45	$2,79	$2,51	$2,46	$2,64	$2,03	$2,97	$2,01	$3,12	$2,68	$2,82	$4,24	$3,65	$4,10	$4,15	$3,89	$5,44	$5,72

Figure 9.4 Yaquina Annual Maintenance and Repair Cost

9.5. Analysis of the Maintenance Trends

All of the Corps hopper dredges are following typical lifecycle maintenance trends. Figure 9.5 shows a generally expected routine maintenance life cycle curve for an asset of this type. Hopper dredges and other large mechanical plant assets have a high initial investment with expected increasing routine maintenance requirements throughout the life cycle of the asset in order to reduce risk of failure. Overhauls within the life span help reset routine maintenance costs at a lower level, but it can be expected that maintenance costs will begin to grow considerably as the asset approaches the end of its service life. Optimally, these assets should

be renewed (replaced) when the cost to maintain reliability becomes so high that replacing the vessel is more cost effective.



Source: An Anatomy of Asset Management, The Institute of Asset Management (IAM)

Figure 9.5: Expected Routine Maintenance Lifecycle Curve

The original ownership and maintenance plans for these four hopper dredges are not consistent with the Corps more recent Risk Informed Asset Management strategy, which began in 2009 (see paragraph 9.7), so the hopper dredges have been operated and maintained as if their service life would be the same as their depreciation schedule[4].

The observed trends associated with the Corps hopper dredges is not unique to our vessel type nor the demands associated with our dredging mission. In recent years, the U.S. Navy has experienced similar trends on maintenance and repair costs of their fleet of vessels and has

[4] Unlike privately owned marine equipment which can be depreciated by a variety of legal methods, with a remaining salvage value, the Corps dredges are depreciated on a straight-line schedule with no salvage value. The Corps dredges were originally depreciated on a 40-year schedule and extended to 50 years or beyond during their service life. The Essayons depreciation schedule currently sits at 75 years, ending in 2059. The USACE Financial Management (PRIP policy) dictates this.

undertaken in-depth studies to understand the impacts of age on maintenance costs for various surface vessels. One result shows that the implication of an aging fleet is that one can expect the rate of maintenance costs to climb at a rate similar to the rates seen on Corps hopper dredges as shown in the Figure 9.6 (Button and Martin and Sollinger and Tidwell 2015, 8).

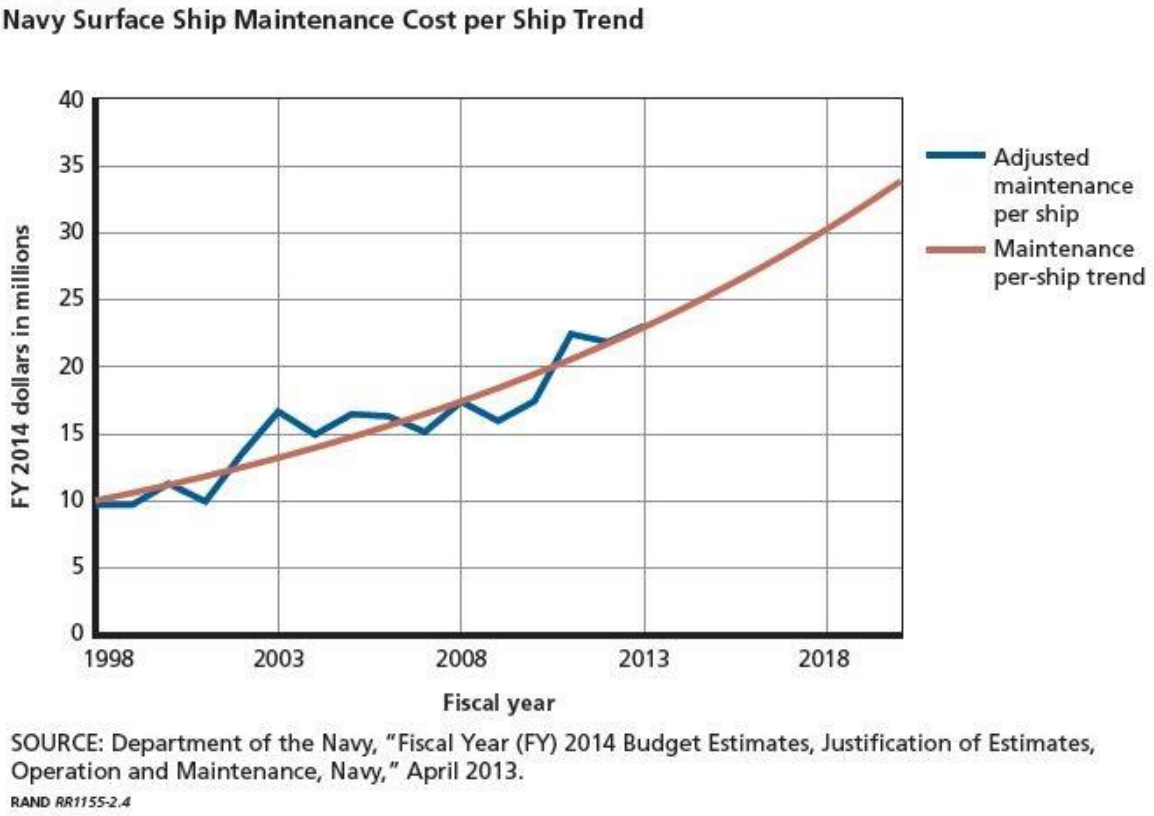


Figure 9.6 Navy Surface Ship Maintenance Cost Projections

The Wheeler's maintenance curve in the mid 1990's shows that when the vessel was moved into Ready Reserve status, the maintenance and repair requirements decreased. That benefit may now have been overcome by the vessel age.

Using the data from the McFarland, the repair and maintenance costs for the Essayons and the Wheeler are expected to continue to rise over their remaining lives. There may be some unpredictable spikes in maintenance and repair costs to increase reliability or buy down risk on different portions of each vessel.

The depreciation schedules for hopper dredges is so long that the maintenance costs of the dredges will likely be far into the escalating costs portion of the lifecycle curve. Data from these maintenance and repair cost show a noticeable inflection at the 30-35-year range.

9.6. Summary Findings and Recommendations based on the Maintenance Trends of the Hopper Dredges

The Corps hopper dredges are experiencing the maintenance trends that can be expected for aging large mechanical assets. There is an expectation that the maintenance costs to keep them viable will continue to escalate or that the reliability of the dredges will be at risk. This will impact the daily rate of the dredges to projects. These present four minimum fleet hopper dredges have financial depreciation lives that now may be greater than their optimum service lives. Adherence to Asset Management principles would suggest planning replacements for the dredges and developing a risk based maintenance plan to make the best maintenance investment decisions for the remainder of their service lives.

At approximately 35 years, the maintenance costs for steel hulled vessels operating in marine environments (Navy vessels and Corps or industry dredges) can be expected to reach an inflection point that begins a significant escalation of maintenance and repair costs, future dredges should be depreciated on a 35-year schedule to more closely match the this length of service life. As the vessels approach the end of the depreciation schedule, choices can be made regarding further repair or replacement independent of the PRIP fund financing obligations.

The McFarland is at the 50-year depreciation threshold now and recapitalization through replacement is recommended. The recapitalization plan for the dredges should also address revising the depreciation schedule for the Essayons, since the projection of maintenance costs to stay reliable until the current depreciation of 2059 and the associated PRI with that schedule will result in an intolerable rental rate.

In order to extend the service lives of the existing dredges to match their economic lives will require support from the civil works budget and strategic decisions for maintenance and repairs. Presently the Corps does not have a risk based maintenance plan for the dredges. An in-depth inspection of the Wheeler, the Essayons and the Yaquina is needed to define the condition of each critical component on the dredges, including the estimated remaining life span of the components. Then a defensible, individualized maintenance plan to help target maintenance funds to buy down risk and improve reliability while balancing risk against cost-effectiveness can be developed. The Essayons currently has a detailed assessment planned. Similar assessments and plan development should be completed within 18 months on both the Wheeler and the Yaquina.

9.7. Optimizing Operations & Maintenance of Future Dredge Fleet Life Cycle Management

Since 2009 the Corps has formally adopted Asset Management (AM) as a Business Practice and has been developing asset management tools for the analysis and prioritization of investments for its widely diverse portfolio of assets. The hopper dredges are unique in the Corps inventory of assets and represent the largest investments in floating plant as well as some the most expensive maintenance items. Prior to the adoption of AM principles, many of

the decisions regarding the ownership, operations and crewing costs were made based on the pressures of the day, rather than sound management of the asset with an assumed end state of eventual replacement.

Some decisions were based solely on keeping the daily rate low to maximize the amount of dredging that could be funded in the civil works budget. Some were based on outdated ideas about recapitalization opportunities. Examples include the decision to depreciate the dredges using a 50% discounted cost for defense purposes (until 1991), not including PRI to the ownership costs (until 1994), reducing crew sizes to barebones, and increase the economic life well past the reasonable physical life of the dredges. Most of these decisions, however necessary or well intentioned, were short sighted. Until the MFCIP report, there was not much thought or a plan for recapitalizing the dredges. At that point the hopper dredges all had major engine upgrades either completed or about to start.

It was not an error to replace and upgrade the engines and pumps on the dredges as this could be considered a normal cost in owning a dredge, but it demonstrates the traditional asset maintenance approach that the Corps has practiced, “Repair and Sustain.” Many European companies practice the opposite approach, one of “Consume and Replace” and depreciate the dredge in only 15-18 years, make upgrades more judiciously, and plan for a maximum service life of around 30 years.

Given the statutory restrictions on the Government’s hopper dredges, neither approach is a good fit. When the engines were replaced when the vessels were about 25 years old, it would have been advisable then to take an inventory of the condition of the hull and other parts not being replaced at the same time. It would likely have shown that to increase the service life of the ship very far to the future, with straight-line depreciation of the asset and the associated PRI, is not the least expensive plan for owning the asset.

For the Corps dredges, the proposed vessel life of 35 years matches the expected hull life for marine vessels and is a long enough period of time to amortize the initial cost and a midlife repowering, without incurring unreasonable escalation in the maintenance costs and PRI payments.

10. Considerations for Replacement Dredges

A primary conclusion of this report is that the Corps dredges fulfill a necessary mission that will continue and that they will be needed for the foreseeable future. Their geographic distribution is warranted, based on both logistical considerations (time and expense associated with East/West Coast transit via Panama Canal) and based upon the existing infrastructure in place to support the Corps hopper dredges. New dredges would be procured in the approximate time frame identified in the Financial Section of this report, subject to future evaluation of their ongoing condition.

The size of the existing fleet, including 1 large class, 2 medium class, and 1 small class hopper dredge as Corps hopper fleet, has been effective in meeting the national hopper dredge minimum fleet's missions and that the same mix of dredge sizes should be maintained as they are recapitalized. Except for efficiency features now available to new dredges, no significant increase in capability over the current fleet is envisioned. Through the management of these four hopper dredges, Corps has gained a substantial understanding of the life cycle operations and maintenance requirements of these assets that can be used to inform both design and operations and maintenance decisions of any future replacement hopper dredges.

The current four hopper dredges have additional features that would be considered above the minimum required features for the base navigation mission of these assets (helo pads, gun mounts, and large living quarters). These extra features have added some value and likely some longevity to the current dredges, but they add to the size and weight of each dredge that negatively impacts the efficiency of the dredges. When combined with the added maintenance costs for these features, the costs outweigh the benefits in most cases. In general, in order to maximize cost efficiency in construction, new Corps dredges should take advantage of design advances in the dredging industry and seek to build something as close to a standard dredge design on the open market. This should drive down construction costs and future maintenance costs if replacement parts are more generally available. For example, Corps dredges all have the older technology of separate engines for dredging and propulsion, now considered inefficient. Newer dredges have dual purpose engines with gear reduction takeoffs for propulsion and dredging. Hull and hopper designs are also more efficient than Corps existing hopper dredges and a new dredge should take advantage of that as well.

The vast majority of new maintenance hopper dredges worldwide are production designed in Europe by suppliers such as IHC, Vosta, and Damen. The designs and equipment packages for these dredges meet all current regulatory standards and are very efficient. In some cases, complete vessels are built by these suppliers, while in others, the hulls are built in other countries, with the design and equipment package supplied by the European companies.

Where there are specific customized design features on the Corps dredges that have proven to be valuable to the projects in which they work, those features should be considered for part of the new design. For example, the McFarland maintains the capability to place material via the direct pump-out method for upland placement, in addition to placement through opening

the bottom hopper doors. This capability (upgraded to modern technology) is necessary for operations in the Delaware River, and should be maintained on any replacement to the McFarland.

For each of the vessels, a thorough design review and comparison of the features that can or should be maintained will be considered. Maintaining flexibility for mission needs or special work areas must be balanced against development of the most economical design.

Based on DOD and Jones Act requirements, Corps would be required to build the vessels (hull and integration of machinery and equipment) in a US shipyard. The most likely approach would be to purchase the design and equipment package from an internationally based hopper dredge designer/supplier and furnish it as Government Furnished Equipment to a US Shipyard for vessel construction. This way, Corps can take full advantage of the design efficiencies developed by those suppliers over many years of experience in this market.

For future vessels, a planned service life of 35 years, with mid-life equipment upgrades and two upgrades to controls/automation/monitoring should be planned during the life of the vessel. With limited production hours as a Ready Reserve dredge, it is anticipated that age would have more of an impact on service life than production wear. Specific strategies to mitigate natural hull deterioration will be explored.

Since the Wheeler and the Essayons were originally built within a five-year window in the early 1980s and are approximately the same age and appear to be in similar condition, it may be possible to purchase more than one dredge in a single procurement action to gain economies of scale in the original purchase process and to deliver vessels that have common components. Vessels with common components would allow reduction of spare parts, improved maintenance planning, reduction of training requirements, and ease staff cross training issues between vessels for backup crews.

11. Financial Details, Analyses and Review Findings

11.1. Recapitalization Financial Overview

In 2010, the both the PRIP account and the Dredge Operating Accounts revolving fund balance were diminished for a variety of reasons. In 2011, HQ Resource Management Division implemented policy guidance and enforcement of the paybacks from the users of the PRIP account. Those efforts to replenish the PRIP revolving fund were successful and the balance of the PRIP account is once again growing. During the same period, HQ Operations Division and the dredge owning districts implementing a "Back to Black" plan for the dredge operating revolving fund. That effort has also been effective at bringing the hopper dredge operating accounts from a deficit condition to an overall surplus. The only exception is the individual balance of the Dredge Essayons, which incurred an operating deficit in excess of $20M as a result of being idled for the majority of the 2015 dredging season because of a shipyard bid protest.[5] The Corps has responded to that misfortune by increasing project funding to recover the revenue shortage. The Essayons should be operating in the black again in FY 2018.

For this effort, a new analysis was completed of the present and projected balance of the dredge operating accounts, the PRIP account, the current and projected costs of the current fleet and the projected costs to own and operate new dredges. A financial plan and schedule for replacements was developed and is proposed, that supports the conclusions of the alternatives analysis to keep the present configuration of the hopper fleet. The plan is caveated by the acknowledgement that the detailed life cycle costs for the maintenance of the existing dredges won't be complete for a few months. However, it is assumed that the cost for maintenance of the dredges can be managed to meet the required financial depreciation life within the financial regulations.

11.2. Corps Dredge Rental Rate - Ownership and Operating Costs

The daily rental rate for the Corps dredges covers ownership and operating costs. Under present statutory authorizations, the Ready Reserve Dredges are restricted in operating days and their costs are supplemented by funding from Remaining Items portion of the Corps Civil Works Budget. The Essayons and Yaquina work unrestricted schedules, and cover all costs with the daily rental rate charged to projects.

The ownership costs for each of the dredges include Insurance, Plant Depreciation and Plant Replacement Increment (PRI). The PRI is charged to ensure that the PRIP account grows sufficiently with inflation in order to finance the inflated asset replacement cost. All capital

[5] In the fall of 2014, the losing bidder on the Essayons shipyard repair contract protested directly to GAO. The dredge could not return to work without critical USCG required repairs and remained idled until after the ruling on the protest, awaiting a delayed shipyard. The Corps original decision was upheld, but the delay cost approximately 154 days of schedule and $20M of lost rental revenue for the dredge. There were impacts to the navigation mission but as much of the highest priority dredging work as possible was given to the industry dredge working on the West Coast Regional Hopper Dredge contract. Recovery of the deficit in the Essayons revolving fund has required the infusion of millions of dollars of unplanned civil works funding to get back to a positive balance by 2019.

costs and improvements to the Corps floating plant are funded from the PRIP revolving fund. Depreciation is a straight line for the financial life of the dredge to $0 (no salvage value) and PRI is a calculation essentially akin to the “time value of money” from the original expenditure and changes with the consumer price index and a separate shipyard building index.

Operating costs include all the other expenses associated with operating and maintaining the dredges: District overhead, routine and non-routine maintenance repairs, warehousing, tools, fuel and lubricating oils, crew labor, support labor, training, food and supplies. Costs to maintain and replace the parts of the dredge exposed to the constant erosion of the dredged sands can be significant.

All of the Corps dredges have experienced some escalation in costs in the past 5 years. Based on life cycle cost curves for large pieces of mechanical plant (Chapter 9), it is anticipated that the operating costs for each dredge will continue to increase to maintain and repair their aging hulls and internal structures and to repair and replace equipment as it wears out. The challenge of maintaining aging vessels is one that is shared with industry dredge owners. This is supported by an observable increase in the industry dredge contract costs during the same period. Some of the operating increases are attributable to factors other than the dredge age and maintenance. Fuel prices, insurance and crew labor costs are all big factors in the operating costs of dredges, as are the costs of materials and shipyard labor costs. Another challenge that is shared with all US flagged vessels is that the number of US shipyards available that can meet our major maintenance needs has been steadily declining. This has led to higher, less competitive pricing on our large shipyard contracts, which drives maintenance and repair costs up.

11.3. Hopper Dredge Operating Accounts

The health of the Dredge Operating Accounts is an indication of how well the Corps and managing districts are estimating operating needs and executing their plans during a given fiscal year. The operating accounts for the four hopper dredges have improved substantially since the pessimistic projections of the 2011 MFCIP. At the end of FY 2016, the total operating account balance of the hopper dredge fleet was a $20M surplus. Three of the four hopper dredges are in surplus conditions and Essayons will be positive by the FY 2017/2018 timeframe. Table 11.1 shows this improving Fiscal Year End Balances for the hopper fleet FY 2013 – 2016.

Table 11.1	OPERATING BALANCE HOPPER DREDGE			
	BACK TO BLACK ACTION RESULTS			
	FY 2013	**FY 2014**	**FY 2015**	**FY 2016**
WHEELER	$ (14,157,975.91)	$ (3,082,500.67)	$ 11,493,049.79	$ 9,807,160.03
McFARLAND	$ 4,747,618.97	$ 5,774,573.67	$ 17,639,579.80	$ 15,386,307.92
YAQUINA	$ 7,626,455.84	$ 7,060,508.55	$ 4,744,738.58	$ 4,722,444.14
ESSAYONS	$ (4,379,177.34)	$ (9,562,796.61)	$ (23,502,877.23)	$ (9,763,022.06)
TOTAL	$ (6,163,078.44)	$ 189,784.94	$ 10,374,490.94	$ 20,152,890.03
Source: CEFMS 66m Report				

11.4. Current Hopper Dredge Financial Asset Data:

The current total book cost for the hopper dredge fleet is $391M, which includes the original acquisition cost plus additions and betterments (A & Bs) funded through the PRIP account. The remaining book value on the hopper dredge fleet was $207M, through FY 2016. This means that the four hopper dredges have re-paid $184M to the PRIP account through depreciation for PRIP financing of acquisition cost. It should be noted that the remaining balance for each dredge has to be paid back to the PRIP whether the hopper dredge was replaced or retired. In the event of retirement, additional significant costs would be incurred for personnel costs, disposal clean-up costs, associated plant retirement, indirect plant support functions, etc. Table 11.2 details these totals for each hopper dredge.

TABLE 11.2			PRESENT HOPPER DREDGE FLEET FINANCIAL DATA (END OF FY 2016)					
VESSEL	**DISTRICT**	**TYPE**	**BOOK COST**	**BOOK COST (A&B)**	**TOTAL BOOK COST**	**REMAINING BOOK VALUE**	**REMAINING BOOK VALUE (A&B)**	**TOTAL REMAINING BOOK VALUE**
WHEELER	NEW ORLEANS	LARGE HOPPER	$102,295,363.82	$ 40,170,662.16	$142,466,025.98	$ 39,503,749.44	$ 33,610,738.31	$ 73,114,487.75
McFARLAND	PHILADELPHIA	MEDIUM HOPPER	$ 23,423,562.02	$ 15,285,915.73	$38,709,477.75	$ 261,656.82	$ 12,290,384.42	$ 12,552,041.24
ESSAYONS	PORTLAND	MEDIUM HOPPER	$146,767,819.73*	$ 0.00*	$146,767,819.73	$ 87,004,831.45	$ 0.00	$ 87,004,831.45
YAQUINA	PORTLAND	SMALL HOPPER	$ 37,597,481.73	$ 25,555,851.52	$63,153,333.25	$ 13,827,681.86	$ 20,574,439.68	$ 34,402,121.54
		TOTAL	$310,084,227.30	$ 81,012,429.41	$391,096,656.71			$ 207,073,481.98

Source: CEFMS sdipr – Revolving Fund Depreciation Schedule
** Because the ESSAYONS was repowered prior to the 2011 RM PRIP policy changes, the A&Bs going into service in 2009 were added to the depreciation schedule, not separately depreciated. Plant Increment is based on the total asset value, based on a service life beginning in 1981.*

As noted, like all PRIP financed assets, the hopper dredge fleet repays the PRIP investment over the asset life span on a straight-line basis. Currently, the hopper dredge fleet total annual depreciation is $9.8M and as noted before, the hopper dredge fleet has paid a total accumulated depreciation of $184M through FY 2016. Additionally, the four vessels in the hopper dredge fleet pay the PRIP account $10.9M in PRI annually (see Table 11.3). Since FY 2012, the hopper dredge fleet has paid $54.5M in PRI to the PRIP account. Prior to FY 2012, hopper dredge fleet PRI payments to the PRIP account total at least $30M, despite that until 1994, the dredges were not charged PRI. Between depreciation and PRI, the hopper dredge fleet has paid back a total of $268.5M into the PRIP account. This amount plus future dredge depreciation and PRI payments is available to finance future hopper dredge replacements.

TABLE 11.3 ANNUAL DEPRECIATION, INCREMENT, AND INSURANCE CHARGED FISCAL YEAR 2016

FY 2016	YEARLY DEPRECIATION	YEARLY INCREMENT	YEARLY INSURANCE
WHEELER	$ 4,569,888.72	$ 4,259,683.08	$ 102,360.24
McFARLAND	$ 1,239,945.84	$ 1,410,514.80	$ 17,572.92
YAQUINA	$ 1,947,137.64	$ 1,803,577.08	$ 48,163.08
ESSAYONS	$ 2,043,166.32	$ 3,398,152.44	$ 121,806.72
TOTAL	$ 9,800,138.52	$ 10,871,927.40	$ 289,902.96

Source: CEFMS sdipr - Revolving Fund Depreciation Schedule

11.5. PRIP Account Financial Data

It is important to understand the recapitalization of the hopper dredges, and the significance and contribution of the dredges, is to the PRIP account balance. The PRIP account balance has recovered since FY 2011 and is once again postured to fund replacement of existing asset including hopper dredges. Table 11.5 shows the growth from a balance of $132M in FY 2011 to the present $374M. The $374M balance available for distribution/future investments validates that the PRIP account has the $268.5M that the hopper dredge fleet has repaid.

TABLE 11.5	PRIP FINANCIAL STATUS FY16-FY11					
	FY 2016	**FY15**	**FY14**	**FY13**	**FY12**	**FY11**
PRIP Beginning Balance	$343,053,006.00	$286,053,306.00	$252,503,958.28	$196,411,133.56	$170,153,538.83	$147,658,450.11
Less:						
Funds distributed to MSCs/FOAs	$ 52,561,386.00	$49,701,104.00	$71,077,997.19	$45,484,551.11	$66,730,543.84	$60,503,136.71
-Reserved Insurance Liability Coverage	$ 38,000,000.00	$38,000,000.00	$38,000,000.00	$38,000,000.00	$38,000,000.00	$38,000,000.00
Estimated Carryover/ Re-issue	$0.00	$9,485,144.00	$0.00	$0.00	$0.00	$0.00
Net Available for Distribution	$252,491,620.00	$188,867,058.00	$143,425,961.09	$112,926,582.45	$65,422,994.99	$49,155,313.40
Plus:						
Recovery of PY Funds	$17,443,353.00	$2,541,813.00	$624,425.61	$2,504,151.16	$663,402.86	$2,051,203.85
Plus:						
Depreciation	$57,732,904.00	$57,571,689.00	$63,806,219.03	$52,737,515.49	$49,861,332.99	$50,462,000.64
Plant Increment	$46,228,324.00	$46,587,303.00	$40,196,700.31	$46,335,709.18	$42,463,402.72	$30,485,020.94
Subtotal Income	$103,961,228.00	$104,158,992.00	$104,002,919.34	$99,073,224.67	$92,324,735.71	$80,947,021.58
Total Ending Balance Available for Distribution	$373,896,201.00	$295,567,863.00	$248,053,306.04	$214,503,958.28	$158,411,133.56	$132,153,538.83
Source: PRIP DCG Approved SPBAC						

Through FY 2016, the PRIP has financed 2,504 capital assets totaling $1.9 B. Table 11.6 details these assets by Property Type. Property Type 30 is for the entire minimum fleet, which consists of eleven assets. For this report, Property Types 30 and 30A is further separated by hopper dredge and non- hopper dredge. The accounting shown in the table indicates that the while four hopper dredges comprise only 0.16% of the number of capital assets, they are valued at 20% of the total capital asset inventory. These are very large value assets whereby their repaid depreciation and PRI contributions have replenished the account in order to continue financing all asset investments while at the same time growing the account balance of the PRIP in order to build sufficient reserves for their replacement.

TABLE 11.6 **Book Cost of PRIP Assets by Property Type**

Property Type	Number of Assets	Total Book Cost
05 – Buildings	366	$ 303,995,385.56
10 - Other Structures	374	$ 98,504,868.64
20 – Aircraft	2	$ 16,266,965.18
30 - Hopper Dredge	4	$ 391,096,656.71
40 - Other Floating Plant	750	$ 608,862,817.81
50 - Mobile Floating Plant	63	$ 5,281,585.53
5V - Passenger Vehicle	13	$ 672,521.20
5X - Other Mobile Land Plant	337	$ 78,175,390.08
60 - Fixed Land Plant	32	$ 2,932,379.64
6C - Comm Equipment	30	$ 7,639,663.34
6X - Other Fixed Lant PLT	149	$ 22,492,036.06
70 - Tools, Office Furniture & Equipment	206	$ 51,668,668.40
80 - ADP Software	30	$ 119,458,639.46
90 - ADP Equipment	2	$ 91,933.00
9A - Computers/Peripheral	62	$ 15,302,790.98
9D - CADD Equipment	4	$ 157,141.58
9W - WCDS Equipment	4	$ 183,824.12
LH - Leasehold Improvements	69	$ 59,010,810.98
30A - Other Dredges (MF)	7	$ 140,165,301.74
Grand Total	2,504	$ 1,921,959,380.01

Source: EDW All PRIP Assets Report / CEFMS sdipr Report

Four Hopper Dredges Equal 20% of Total PRIP Assets

Another way to show the significant asset value of the hopper dredge fleet is to list the top 20 PRIP capital assets by book value. Table 11.8 shows that the hopper dredges are all within the top six assets (with two other non-hopper minimum fleet dredges). Table 11.8, when compared to the PRIP account balance of $374M, clearly shows the current high balance in the PRIP account is necessary to sustain the revolving financing mechanism for the near-term and mid-term hopper dredge replacement cycle.

TABLE 11.8 Top 20 PRIP Assets by Book Cost

PROPERTY TYPE	ASSET	SUM OF BOOK COST
30 - Hopper Dredge	Essayons – Hopper Dredge	$ 146,767,819.73
30 - Hopper Dredge	Boat – Dredge Wheeler	$ 142,466,025.98
30A - Other Dredges (MF)	Boat, "Hurley" Dustpan Dredge	$ 64,372,070.80
30 - Hopper Dredge	Yaquina – Hopper Dredge	$ 63,153,333.25
30A - Other Dredges (MF)	Dredge Potter Bar Tag 17238	$ 38,752,046.62
30 - Hopper Dredge	Dredge McFarland	$ 38,709,477.75
80 - ADP Software	CEFMS – Corps of Engineers Financial Management System	$ 38,435,056.34
05 - Buildings	Bldg 8000 ERDC	$ 32,859,043.64
80 - ADP Software	P2 Software	$ 31,743,547.25
40 - Other Floating Plant	Barge, Crane Barge, Crane 8501	$ 29,238,483.38
05 - Buildings	Real Property Improvement Item #000001 on site Nodeos	$ 25,577,396.25
LH - Leasehold Improvements	Real Property Improvement item # GAO-L1 on Site GAOBDG	$ 24,194,170.39
40 - Other Floating Plant	Barge QT	$ 23,194,562.08
LH - Leasehold Improvements	Real Property Improvement item # on Project ORH	$ 20,683,895.66
30A - Other Dredges (MF)	Dredge Murden	$ 20,519,632.92
30A - Other Dredges (MF)	Boat Dredge PLT. NO. Jadwin	$ 19,957,521.39
05 - Buildings	WW Dist HQ Building	$ 18,799,927.22
05 - Buildings	New EL Bldg – Real Property Improvement Item #B-3270 on site Wes	$ 18,147,261.96
10 - Other Structures	Real Property Improvement item # on Project SB4902	$ 17,156,476.55
05 - Buildings	District Office HQ – Bldg 2204	$ 17,001,111.43

Source: EDW All PRIP Assets Report

11.6. Hopper Dredge Replacement Financial Plan – PRIP Financing

The financial plan for replacing the dredges is shown graphically in Figure 11.1. The graph shows that with a beginning PRIP financed balance of $260M, which is the hopper dredges' repaid total plus future income into the PRIP account from hopper dredge depreciation and increment, the PRIP account can finance the replacement of the four hopper dredges. Further the hopper replacements can be accomplished without negative impact to the other uses of the PRIP account, which could be funded from the remaining balance and collections from the other non-hopper dredge assets. The cumulative HD Recapitalization Plan balance never falls below $0, so the PRIP account balance as a whole also will not adversely affected as a result of hopper dredge replacement distributions. Additionally, post-recapitalization, the PRIP balance will again replenish in time for major component replacements, mid-life repowering, etc. and/or a future round of hopper dredge recapitalizations.

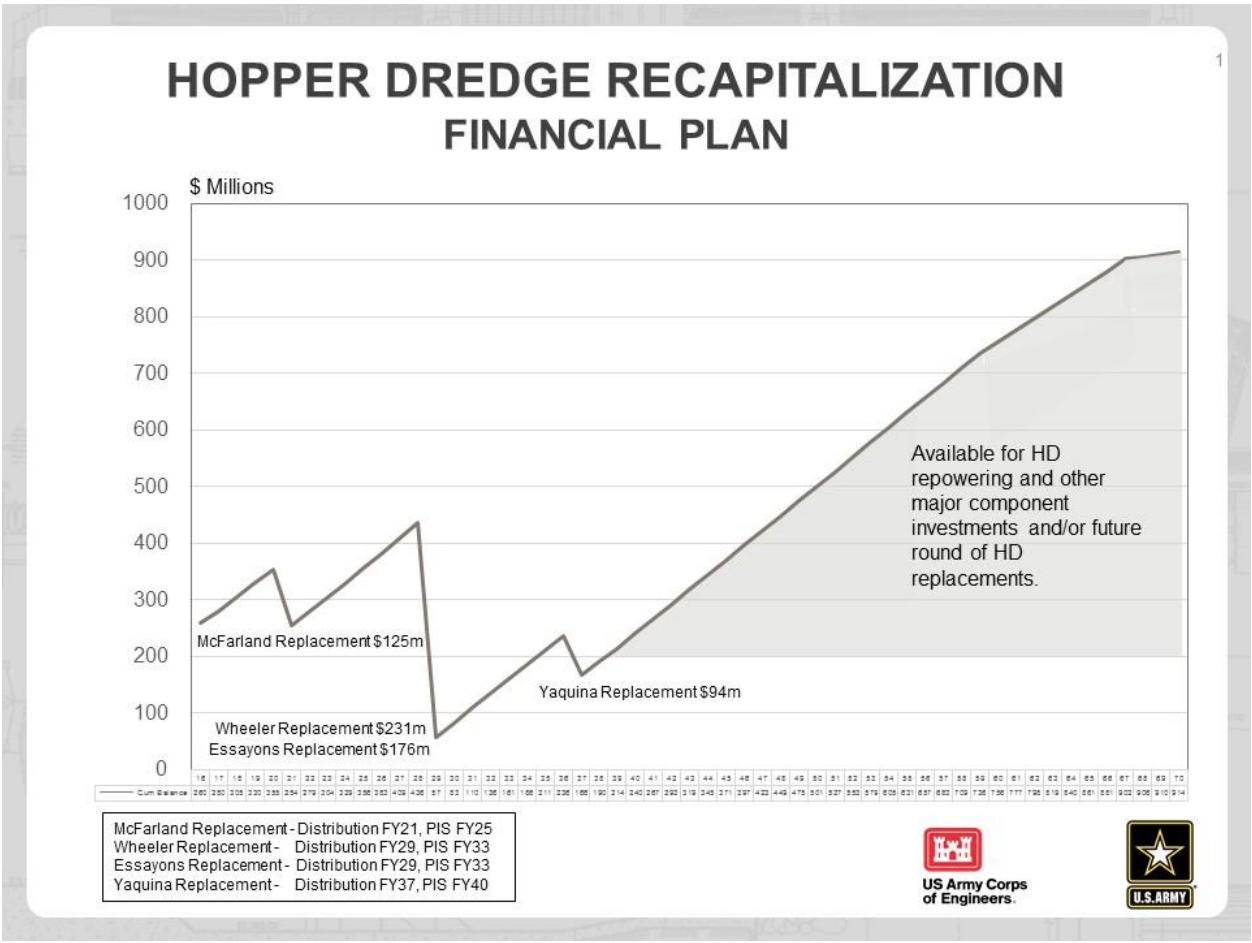


Figure 11.1: Financial Plan for Dredge Replacement

Important aspects to this plan are as follows:

1. Hopper dredge replacement cost is based on the Marine Design Center provided industry benchmark for new hopper dredges inflated 1% per year to the FY of construction.

2. PRIP financed construction year is based on allowing 3 full years of construction prior to being "placed in service" (PIS).
3. The new hopper dredges' PIS FY was based on original acquisition year plus 50 years for the existing dredges.
4. Remaining depreciation for McFarland and Essayons are accelerated (to pay back in full before projected PIS) due to service life degradation.
5. PRI payment amounts for current hopper dredge are frozen at FY 2016 levels. (It is the opinion of the MDC that the current replacement values used for the Plant Increment are inflated.)
6. Increment amounts on new hopper dredge are calculated more realistically to actual replacement values.
7. The new recapitalized hopper dredge will be depreciated on a 35-year service life (2011 MF report recommended 40 years vice current 50 years. See Life Cycle Analysis in this report for more current life cycle assessments).
8. $260M of the current $374M will be isolated by CERM for hopper dredge replacement. This still allows $114M for non-hopper dredge investments, which will be sufficient to satisfy future scheduled requirements. Additionally, all future income from hopper dredge will be isolated.

11.7. Daily Rental Rates of the Recapitalized Dredges

The daily rental rate for the recapitalized hopper dredge will be less than the current hopper dredge breakeven rental rates. This is shown in Table 11.9. These rates are lower because of the efficiencies of new dredges (See Operation and Maintenance of Existing hopper dredges). Maintenance & Repair costs are lower than current aged fleet, Operating costs are lower than current due to a slight decrease in personnel staffing and fuel costs for more efficient engines/power and pump configuration and remote monitoring capability. Ownership costs will be less because the PRI is lower than current reflecting a more realistic and shorter interval for replacement.

Table 11.9 HOPPER DREDGE RECAPITALIZATION DAILY RATE COMPARISON

	FY 2017 DAILY RATE*	FY 2018 (ESS FY 2033) DAILY RATE*	RE-CAP DAILY RATE*
McFARLAND	$ 130,578	$ 137,618	$ 87,251
WHEELER	$ 151,984	$ 151,928	$ 95,992
ESSAYONS	$ 164,353	$ 183,091	$ 151,520
YAQUINA	$ 97,195	$ 97,186	$ 88,912

**** Break Even Rate does not account for keeping a RF balance for unexpected events***

11.8. Summary Findings and Recommendations of the Financial Analysis

11.8.1. It is Possible, and Makes Financial Sense, for the Corps to Recapitalize its Fleet of Four Hoppers Dredges.

By replacing the dredges, the Corps can achieve the same or greater level of reliable risk reduction to the navigation mission with a smaller outlay of civil works funds than by keeping the aging dredges. The next cycle of investments will ensure the hopper dredges will be available until at least FY 2070. There is no additional financial burden to the civil works O&M program to recapitalize all four hopper dredges, than is currently experienced. In fact, the daily rental rate for the new hopper dredges should be less than current rental rates due to savings in both operating and ownership costs. The PRIP account can finance the recapitalization of all four hoppers and no supplemental appropriations would be necessary in the given schedule of replacements

11.8.2. Acceleration of Depreciation is Advisable

There is an incongruity in the financial depreciation schedules and the service life of the dredges, a fact that was noted in the MFCIP. The PRIP Revolving Fund depreciation life of vessels is set by current policy at 40 years since 2011, but the existing dredges have a financial life of 50 years and the ESSAYONS had been extended beyond 50 years to 75 years. It is normal Government financial practice to require a straight-line depreciation of assets to $0. Concurrently, the PRI for the vessel moves upward with inflation. By the end of the asset life, both the PRI and the maintenance costs of large mechanical assets are likely at their peaks, making replacement a financial advantage.

Given the above, compression of depreciation schedules is recommended for the McFarland and Essayons based on service life degradation. This compression will be more affordable than the rising maintenance costs - and PRI. The McFarland's revolving fund balance is sufficient to cover the remaining undepreciated cost of Additions and Betterments, so no increase in daily rate is anticipated to cover the acceleration. For the Essayons, the compression of depreciation back to the original 50 years avoids an unsustainable situation, where, theoretically, the cost to run the vessel in 2059 would be in excess of $130M per year, of which $20M would be PRI.

Considering the current balance in the PRIP, the financial planning recommended would enable PRIP investment for construction of a replacement for the McFarland in FY 2021; the Wheeler in FY 2029; the Essayons in FY 2029 and the Yaquina in FY 2037. As noted in Chapter 9, when planning for new hopper dredges, they should be depreciated for a period not greater than 35 years, rather than the current 50. New dredge rates should be set with anticipation of a mid-life repowering, electronics upgrades, etc. as life cycle maintenance and usage mandates. New hopper dredge PRI should be based on more realistic replacement values (i.e. lower than current) and reviewed frequently to gage what actual dredge replacement costs will be at the end of the service life of the replacement vessel.

12. Findings, Recommendations and Path Forward

Based on the various analyses done for this report and the collective professional experience and judgement of the study team, the following are the summarized Findings and Recommendations from the work, followed by a short term path forward for the Corps.

12.1. Findings

1. Most of the Summary Findings of the 2011 MFCIR, which covered the topics relevant to making decisions regarding the recapitalization of hopper dredges were affirmed. However, this new analysis and the recommendations are influenced by changes since the MFCIR. Changes include the financial health of the Corps navigation program, the Plant Replacement and Improvement Program (PRIP) balance and the individual operating accounts of the dredges, our evolving understanding of how asset management principles apply to Corps hopper dredges and the apparent changes in the industry hopper dredge fleet. Databases and modeling tools that were new or in development during the analysis for the MFCIR, can now help define the present state of dredging and placement options and estimate the future state.
2. Taking advantage of industry capability to perform dredging and related work, as required in the language of Public Law (PL) 95-269 and as implemented by the Corps, has been generally effective in meeting the routine navigation needs of the nation, but the frequent activation of the Ready Reserve dredges over the past five years demonstrates that there is a need for the Ready Reserve dredges.
3. The Corps of Engineers Reserve Fleet (CERF) program cannot be used as originally envisioned. The intent of the CERF program was to sign Basic Ordering Agreements (BOA) with hopper dredge owning companies that could be used to direct industry dredges in response to emergency conditions. The BOAs that formed the basis of the CERF agreements did not contain the necessary pricing data with which to award a contract under Federal Acquisition Regulations. Therefore, if or when an event would occur, the Corps would still be required to process a Justification and Approval (J&A) for an Unusual and Compelling procurement action. It would be difficult to pre-price an unknown event with a BOA or any other contractual vehicle, and a contractor would likely include significant contingencies in their proposed prices that would be difficult for the Government to support.
4. The number of Corps Ready Reserve call-outs over the past several years demonstrated that the current industry fleet cannot meet the current surge needs of the Corps dredging program. The analysis showed that with two new hopper dredges they may be able to meet them, but it would require the fleet mix to be stable. Given the age of the industry fleet, there is no reason to believe that the industry fleet, will remain in the present configuration.
5. Without the Ready Reserve Fleet, the Corp has limited options for addressing urgent dredging when industry cannot respond. There is not a substitute acquisition vehicle for CERF contracting and Jones Act prohibitions restricts the Corps from accessing the

international hopper fleet. [6]

6. The Corps hopper dredges provide strategic economic and risk reduction benefits to the nation's navigation program, national defense, emergency response, resiliency and recovery, and an alternative when there are no bids or bids that exceed a reasonable Government estimate for solicited work. The finding is based on the history of the use of the minimum fleet, which controverts conclusions of some previous studies that the minimum fleet was not needed.
7. The PRIP Fund will support the planned replacement of the four Government hopper dredges considered in this analysis.
8. The current Corps hopper dredges are experiencing increasing age-related maintenance and repair costs. Since the 2011 MFCIR was prepared, the Corps approach to operation and maintenance of assets integrated the principles of life cycle asset management. These principles dictate that the floating plant assets should be replaced at some point in their life cycle, rather than continue to repair and maintain them indefinitely at ever increasing cost. This asset recapitalization approach was intended and financially supported through PRI payments to the PRIP. The existing financial obligations of individual dredges to the PRIP revolving fund would impact the replacement schedule without changes to the depreciation schedules and increment escalators.
9. There may be opportunities to optimize the operation and maintenance of the hopper dredges by consolidating and managing some aspects of the dredges as a national fleet, but in depth focus on this issue is beyond the scope of this analysis.

12.2. Recommendations

1. The Government's minimum hopper dredge fleet should remain at the same strength and positioned in the same geographic locations.
2. No significant change in Minimum Fleet dredge capabilities is recommended other than the foreseeable requirements to meet environmental standards and whatever efficiencies would be gained by having newer, contemporary features, such as electrical, hydraulic and mechanical systems. While the Minimum Fleet hopper dredges do some routine maintenance work, their emergency or urgent work is focused relieving channel obstructions and enhancing the national navigation resiliency, rather than constructing beach or other restoration type projects.
3. The current four hopper dredges should be replaced on a schedule consistent with both the financial obligations of the dredge fleet and demonstrated need informed by physical inspections of these dredges. This includes returning the ESSAYONS to a

[6] The Merchant Marine Act of 1920, known as "The Jones Act," was enacted to promote and maintain maritime workers and commerce in the territorial waters of the United States. Vessels engaged in US domestic commerce, including dredges, must be owned by U.S. citizens, operated by U.S. nationals (75% of the crew), registered in a U.S. port, and built in an American shipyard. The effect of this legislation on the dredging industry is that neither foreign owned companies nor foreign made dredges can work in the United States. This does not prevent US flagged ships from working abroad, however. Waivers may be granted but historically have only been given in cases of National Emergency or by request of the Secretary of Defense. Cabotage Laws similar to the Jones Act that regulate U.S. coastal trade have existed since the late 18th century.

replacement schedule ending in 2033, rather than 2059. The costs to construct and maintain new dredges represents a savings to the Corps Civil Works Program over continuing to repair and maintain the current fleet of hopper dredges. Recapitalization scheduling will be developed with consideration to maintain sufficient funding levels in the PRIP account.

4. Future Corps dredges must be maintained with adherence to industry standard life cycle asset management principles. The financial implications of this include shorter depreciation schedules that match current understanding of ship hull life, the planned periodic investment for the replacement of electronics, mid-life engine replacement, and a systematic evaluation of a hull and major system components before any major investment decisions. The resulting impacts to the daily rate from these changes are likely to be offsetting. Higher life time depreciation costs would be offset by lower PRI costs and a more realistic life cycle should decrease maintenance costs over the life of the vessel. The PRIP accounting regulations (ER 37-1-29, Financial Management of Capital Investments) for floating plant should be updated to reflect these expectations.
5. The assumptions for plant replacement value and need that are used for PRI calculations for each dredge should be adjusted as necessary given economic and material cost changes, but not less often than at ten year intervals.
6. A study should be undertaken to determine if or how efficiencies can be gained by consolidating the hopper dredge management to One Fleet, with national manning, training, maintenance and operating policies.

12.3. Path Forward

1. Complete in-depth physical inspections of critical components of the hopper dredges in the coming 18 months. The inspections will result in an assessment of the remaining life of key components of the dredges. The data from the inspections will be analyzed together with the costs to replace or repair at-risk components, ownership and operating costs to arrive at maintenance program that will enable the dredges to reach their replacement dates as cost efficiently as possible.
2. Continue planning for the recapitalization of the dredges as planned and as depreciation schedules and physical condition require. The principles of cost effective asset management should be considered at each decision point.
3. The Philadelphia District (NAP) and North Atlantic Division (NAD) will prepare a white paper detailing the costs savings in operations and ownership costs for the McFarland
4. Continue to incorporate the efficiencies that have been gained by utilizing national manning, training, maintenance and operating policies of the Corps dredges.

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Appendix A – Summary Findings from the Minimum Fleet Capital Investment Report 2012-2061

Table 2.1. Findings and Summary of Minimum Fleet Capital Investment Report 2012-2061

(page 22) "Analyzing the overall risk to navigation, the existing dredging policies and equipment for handling that risk, and the costs for both operating and replacing the minimum fleet dredges as needed leads to the following summary of findings:"

Area of Consideration	Finding	Agreement
Budgetary Considerations and Dredging Needs:	Traditional annual dredging locations to maintain current channel availability are generally known and predictable.	True
	Dredging quantities based on normal weather patterns and normal climactic events are generally predictable.	True
	Dredging needs based on severe or unusual patterns are not predictable, and severe events have been occurring with more frequency.	True for severe events
	Budgets will remain uncertain, including use of the Harbor Maintenance Trust Fund.	False
	The repayment process of PRIP investments necessitates adequate project funding over the projected life of the asset to recoup the investments.	True
	Targeted allocation of project funding is necessary for adequate financial support of the minimum fleet.	True
	Allowing reduced channel availability due to shoaling has been a short term response to funding constraints, but ultimately is not a long-term sustainable approach if the risk to navigation is to remain tolerable.	True
	Stakeholders' direct financial input for port construction or maintenance could help offset constrained funding budgets, but is not predictable.	True
	Dredging costs and short-term peak dredging demands for both minimum fleet and private industry are likely to continue to increase due to environmental windows, restrictions, disposal requirements, and other factors.	True but Impacts Better defined
	Changes in the size and composition of the dredge fleet are slow due to the lead time to bring new equipment on line.	True but Better Defined
Mission:	Although OPLANs for National Defense do not include dredging, it is clear that waterborne shipping of supplies and materials would be needed to support military or defense operations.	True Defense Needs Articulated
	Panama Canal expansion will continue to push ports toward deeper drafts and more waterborne transportation necessitating additional dredging to construct and maintain the projects.	True
	Under pressure from congestion on highways, there will be increased pressure for waterborne transportation.	True But incomplete
	Without a mechanism for imposing direct control of industry assets in time of emergency or national defense, contractual regulations and available industry capacity will impair response time.	True
Financial:	Significant capital costs have been recently invested in the Corps minimum fleet and overall current condition is very good.	False - Age Related issues underestimated
	PRIP alone cannot finance total projected minimum fleet replacement.	False
	Ongoing capital improvements are expensive but necessary for sustainment.	True
	Operating costs for the present minimum fleet are substantial and increasing, and will exceed current funding allocations within the next five years.	False
	Plant operating accounts will incur unrecoverable deficits without increased civil works allocations.	True

Appendix B – Optimizing Fleet Capacity

5.3. Optimizing Fleet Capacity, continued.

To be meaningful, the question of adequate capacity within the U.S. hopper fleet should consider more than just the individual dredge production rates extrapolated across a full dredging year. Scheduling constraints such as environmental and seasonal work windows, required maintenance downtime, and travel time between locations should also be considered in order to gage the effective fleet capacity relative to dredging requirements. Formulated in this context, the problem reduces to an established job scheduling/assignment problem commonly encountered in operations research fields and industrial logistics optimization. Such a formulation can account for the scheduling bottlenecks that typically occur whenever there is some unexpected reduction in availability of the baseline dredging fleet or a surge of dredging requirements within the slate of regular maintenance dredging jobs.

The Corps' Engineer Research and Development Center (ERDC) has developed a scheduling optimization model through its Dredging Innovations Group (DIG) in order to provide insight into ways to increase efficiencies within the Corps dredging program. Technical details of the model formulation and approach to optimization are provided in papers published in *Transportation Research Record* (Nachtmann, Mitchell, et al.) and the *European Journal of Operations Research* (Gedik, Rainwater, et al.). The scheduling optimization model employs interval variables and a constraint programming approach to search for the most efficient possible work plan, a list of dredges from the modeled fleet assigned to and sequenced across the slate of required maintenance dredging jobs. The model is data-intensive, and requires inputs for daily production rates (cubic yard per day) and unit costs ($/CY) for each dredge in the fleet at each location to be dredged, CY requirements and available project budgets at each location, the start and end dates of any applicable environmental or seasonal work restrictions, and a distance matrix to account for the time required to mobilize dredges between projects.

The original intent of the model was to provide quantitative insight into the constraining effect of individual environmental work restrictions, which are typically applied at the project level; the idea was to pinpoint where to focus sustained research into threatened and endangered species behavior at the most critical locations in order to provide the scientific rigor required to pursue relaxation of restrictions on dredging operations. However, since its initial development, the ERDC Dredge Fleet Scheduling Optimization model has made its most valuable contributions when applied in support of dredging practitioners at the District and Division levels. Beginning FY2015, the Corps districts that coordinate through the Pacific Navigation Community of Practice (PACNAVCOP) has used the model to inform discussions during its annual work plan development meeting for the west coast hopper fleet and Regional Hopper Contract. In FY2016, the model was implemented as part of a Regional Sediment Management (RSM) pilot demonstration project across the entirety of the South Atlantic Division (SAD), showing potential savings in mobilization costs alone on the order of

$20M annually.

It is important to note that many of the inferences on fleet capacity that can be drawn from the model require that sensitivity analysis be conducted across various scenarios under consideration. The fleet scheduling model only provides output concerning where and when to send dredges to the various projects included in the work plan. The model does not make predictions on future CY requirements, future composition/availability of the U.S. fleet, future budgets, or future durations of work restrictions. Rather, all of those factors are considered as inputs to the model; the value the model provides is then used in analyzing the differences in the resulting optimized dredging work plans across the range of scenarios being considered. Beyond the differences that can be observed in the individual work plans produced by the model for each scenario, the summary, diagnostic quantities such as total cubic yards dredged nationally (or regionally), total travel days, total dredging days, and overall unit costs are useful for drawing inferences on fleet capacity.

Application of the dredge scheduling optimization model in support of the hopper fleet PDT necessitated one significant change in the underlying formulation from earlier regional treatments on the Pacific Coast and South Atlantic. Whereas those implementations used a slate of dredging jobs that largely aligned with the actual Navigation and beach nourishment project definitions used by the respective Corps Districts, this national view of the U.S. hopper fleet aggregates the individual project dredging requirements, production rates, and unit costs into a relative handful of large, regional jobs. The model in turn can then assign multiple dredges to each job (region), working either consecutively or simultaneously, as is the case with the real-world execution of the Corps' O&M dredging work plan. To accomplish this, the model employs a subtask feature for each region, with the number of subtasks matching the number of possible hopper dredges needed to fully execute the respective regional dredging requirements. The model is allowed to invoke multiple subtasks (dredges), but it is not required to do so, provided the minimum dredging requirements for the region can be satisfied by a single dredge. This subtask approach allows the model to iteratively search for the optimal number of hoppers per region to satisfy minimum dredging requirements within the allowable work window while also maximizing the availability of the rest of the U.S. fleet to perform work in other parts of the country.

The model seeks to maximize an objective function that prioritizes total cubic yardage (CY) dredged, but subject to an additional consideration for the additional costs. In general, the model will iterate towards solutions that move more and more CY, but only to the point that costs do not increase excessively. For this particular implementation of the model the effective unit cost threshold used by the model in the objective function came to $10/CY. Stated differently, the model will consider a solution that dredges even 1 addition CY of material to be better so long as the unit cost for that additional CY does not exceed $14.

Practical Scheduling Constraints Captured by the Model

Corps project managers and industry contractors frequently encounter a host of logistical and operational constraints in the course of executing maintenance dredging jobs. Below is a description of some of these constraints as well as an explanation of how they are handled by the formulated optimization model:

- *Environmental work restrictions* – Temporal restrictions on dredging operations have become common throughout the country since the 1970s. On the east coast, these restrictions affect both operational aspects and scheduling of dredging activities and are intended to minimize impacts to protected turtles, fish, whales and bird species. On the west coast, there are multiple anadromous fish populations, endangered whales, crab fisheries, and protected water fowl. These constraints may force dredging into winter weather months, restrict the operation of pumps, overflow weirs, vessel speed, and in-water disposal sites. The model accounts for these restrictions through a set of explicit temporal constraints that are applied to each respective job (region) as necessary. These constraints are referred to as Restricted Periods (RPs), and the required parameters of each include start and end dates (between 1 and 365, the duration of the modeled dredging year) and an Operations Rate parameter that can capture reductions in dredging productivity that stop short of an absolute restriction. This latter parameter allows for reduced vessel speeds, further distances to open-water placement sites, and weather-induced slow-downs to be captured within the model solution space.

- *Historic dredging efficiency at specific projects* – Individual dredge plant productivity rates (CY/day) and unit costs ($/CY) can vary significantly from one project/region to another owing to numerous factors, including sediment grain size, channel dimensions relative to dredge size, prevailing wind/wave conditions, and distances to placement areas. These plant-project specific productivity rates and unit costs can be derived from historical dredging data if it is available in statistically robust quantities, or they can be estimated by dredging project managers based on the size and horsepower ratings of each hopper dredge and the local characteristics of each dredging project. Two key inputs into the model are the Productivity Rate Matrix and the Unit Cost Matrix, both of which feature rows representing each dredge in the fleet and columns corresponding to each project or region.

- *Channel dimensions* – Shallow draft and narrow ocean entrances are not good dredging locations for large dredges, and conversely, the deepest channels with the widest tidal fluctuations are out of reach for dredges with either limited dredging depth or hopper capacity. To accommodate this real-world constraint, the various regions considered by the model are subdivided into respective categories that indicate which size(s) of hopper is capable of conducting the dredging. The cubic yardage requirements for each sub-region are determined by summing the project-level amounts falling into each category. This resulted in up to three subcategories for

each geographic region: 1) small hoppers only, 2) large or medium hoppers only, and 3) small, medium or large hoppers for projects where channel dimensions do not constrain the size of the dredge. Once the projects have been categorized, the model can then control which dredges (depending on their size) are allowed to work by way of artificially low productivity rates (1 CY/day) or artificially high unit costs ($99/CY). Either value will effectively prohibit selection of the corresponding dredge for work in the respective project/region.

- *Air Quality Standards* – In addition to the national requirement for the use of ultra-low sulfur fuels, the State of California Air Quality Board, has a tight emission standard on harbor craft, including hopper dredges. As of December 31, 2013, dredges constructed prior to 1985, which operate longer than 80 hours in the state, must have had their engines replaced with Tier II or higher engines or provide satisfactory evidence that emissions fall within the Tier II thresholds. Local air quality permits may be required for specific restriction on vessels having only Tier 1 engines. For the purposes of this analysis, it is assumed that several of the older dredges have not had their pump engines replaced, would not easily pass the emissions requirements and could not work on the west coast in a contract including California entrances. As with constraints from channel dimensions, this constraint is implemented within the model by setting the production rates for these dredges to an artificially low 1 CY per day for the west coast jobs.

- *Maintenance Days* – Hopper dredges must undergo maintenance on a regular basis, and the time required to conduct this maintenance reduces the overall effective availability of each plant throughout the dredging year. To capture this real-world constraint, each dredge in the model is capped at 265 days of utilization over the full year, equating to a maximum availability of 72.6%.

- *Other considerations* – Mobilization time between the Gulf Coast and the West Coast. On average, it requires 21 days to transit between the Gulf Coast and the mouth of the Columbia River for a medium or large hopper dredge and an additional 8 days to get to Honolulu or Anchorage. The transit time is not only costly, but negatively impacts response time for emergency work. It is a constraint for dredges moving east or west and is an added burden for job schedules already constrained by environmental windows. The model uses a distance matrix that captures the distances between, and therefore the travel times required for dredges to move from one region to another. The model assumes an average distance traveled per day for each dredge in transit, as well as an average transportation cost per mile for the purposes of calculating travel costs.

It is worth stressing that the model in its present form is only capturing a single 365-day dredging year. As such, multi-year dredging cycles at some projects that coincide every few years leading to surges in the overall CY requirements are not directly captured.

Table B.5.1 shows the regional delineations used in formulating the model. These regional delineations were chosen in part to provide insight into how the dredging requirements within the different regions of the country are addressed under various fleet configuration scenarios. The other consideration is that by directly providing for the geographic dispersion of the hopper dredging project portfolio, the model can more accurately account for the required travel times of dredges as they move between regions.

Table B.5.1 – Regional Dredging Requirements and Work Window Durations, Baseline Scenario

Region (type of dredge used)	Minimum CY Requirement	Primary Work Window	Secondary Work Window
North Atlantic (Large, Med., or Small)	8.0M	15 NOV – 15 MAY	16 MAY – 15 JUN
South Atlantic (Large, Med., or Small)	15.1M	23 NOV – 19 APR	N/A
Gulf of Mexico (Large, Med., or Small)	20.1M	Year round	N/A
Gulf of Mexico (Large or Med.)	6.05M	Year round	N/A
Gulf of Mexico (Small only)	0.20M	Year round	N/A
West Coast (Large, Med., or Small)	1.07M	21 JAN – 22 MAY*	23 MAY – 20 JAN+
West Coast (Large or Med.)	2.04M	21 JAN – 22 MAY*	23 MAY – 20 JAN+
West Coast (Small only)	0.80M	21 JAN – 22 MAY*	23 MAY – 20 JAN+
Columbia River (Large or Med.)	9.76M	21 JAN – 22 MAY*	23 MAY – 20 JAN+
TOTAL:	**63.1M**		

* These dates are derived from weighted averages of the project-level cubic yardage requirements and associated work window durations; as such, these days do not coincide with typical work window durations for west coast projects.

+ Here are many work restrictions on the west coast and they are spread throughout the calendar year. To accommodate this within the existing model formulation, a productivity rate reduction between 40% and 45% of normal was applied during the start/end dates shown for this secondary work window.

Table B.5.2 – Baseline Hopper Fleet and Size Classifications

Large Hoppers	Medium Hoppers	Small Hoppers
Essayons	R.N. Weeks	Yaquina
Wheeler	B. E. Lindholm	Westport
McFarland	Dodge Island	Atchafalaya
Liberty Island	Padre Island	
Terrapin Island	Bayport	
Glenn Edwards	Newport	
Stuyvesant	Columbia	

In addition to this existing fleet of dredges, two additional large hopper dredges, the Ellis Island and the Magdalen, expected to come online in the next few years, were also considered. Historic O&M hopper dredging requirements as well as projections based on planned or anticipated deepening projects and offshore sand mining for beach nourishment

were all tabulated to set minimum dredging requirements for the model to consider, as shown in Table B.5.4. In order to provide insight into the question of *fleet capacity*, that is, how much can the fleet possibly dredge in a 1-year timeframe, this baseline CY total derived from historic hopper dredge activity was further increased by 50%. This figure is of course much higher than requirements in typical dredging years, but was purposefully chosen in order to keep the model from simply finding ever more efficient work plans for full execution of the baseline CY requirements.

Model Runs

Five different fleet configurations were considered for evaluation by the model:

1. Existing baseline U.S. hopper dredge fleet plus two additional plants (the Ellis Island and the Magdalen) expected to come online in the next few years; this configuration is referred to as the "new fleet" when describing the other scenarios below
2. The new fleet, but without the Essayons and McFarland Government plants; these two dredges were removed completely from the model.
3. The new fleet, but with all four of the Government hopper dredges placed in Ready Reserve status. The real-world complexity governing the use of the Ready Reserve fleet precluded a true simulation within the model. As a proxy, each of the four Government hopper dredges was capped at 165 days of utilization. This represents a reduction of 100 dredging days for each Government dredge relative to the 265-day limit placed on the rest of the fleet. This 100-day reduction is intended to reflect the Raise the Flag process required before Ready Reserve dredges can actually be used.
4. The new fleet, but without the Yaquina or the Wheeler Government plants; these two dredges were removed completely from the model.
5. The existing baseline U.S. hopper dredge fleet without inclusion of the Ellis Island and the Magdelen. This scenario also assumes that the four Corps dredges can be fully utilized throughout the year (no forced Ready Reserve status).

For each scenario, the optimizer iteratively searches the respective solution space, which can vary dramatically in size depending on the specific fleet being analyzed. For this reason, the time required for the model to converge upon a stable set of near-optimal dredging work plans for each scenario can vary considerably. For consistency, the model was allowed to search for solutions to each scenario for 17 hours using commercial optimization software. For all scenarios, the model is able to achieve most of its gains over the initial solutions within the first hour or two of searching.

Interpretation of Model Output

It should be stressed that each implementation of the model generates copious amounts of output that must be parsed, collated, and analyzed before making any determinations. As it iteratively searches the solution space, the model records each feasible solution with an objective function value greater than the one found previously. Each model solution takes the form of a dredging work plan, as shown in Table B.5.3.

Table B.5.3 – Example work plan output, Projected Future CY Requirements, Baseline Existing Fleet							
Project	**Vessel**	**Start Date**	**End Date**	**CY Removed (x1M)**	**Dredging Cost (x$1M)**	**Travel Cost (x$1M)**	**Eff. Unit Cost ($/CY)**
NAD either #0	B.E. Lindholm	14-Nov	26-Jun	4,784	$28.70	$0.30	$6.06
NAD either #7	Wheeler	14-Nov	2-Aug	5,037	$30.22	$0.24	$6.05
Gulf either #10	Newport(M)	1-Oct	13-Dec	3,650	$14.60	$1.50	$4.41
Gulf either #2	Terrapin Island	14-Oct	25-Jun	15,240	$60.96	$0.45	$ 4.03
Gulf either #3	Atchafalaya(S)	5-Oct	20-Jun	3,612	$14.45	$0.30	$ 4.08
Gulf either #5	GlennEdwards	1-Oct	1-Dec	3,660	$14.64	$1.50	$4.41
Gulf either #6	McFarland	1-Oct	13-Dec	3,650	$14.60	$1.80	$4.49
Gulf either #8	Columbia	1-Oct	23-Jun	13,250	$53.00	$0.45	$4.03
Gulf either #9	Stuyvesant(L)	1-Oct	1-Dec	3,660	$14.64	$0.45	$4.12
Gulf Large #0	McFarland	15-Dec	2-Apr	5,400	$21.60	$0.36	$4.07
Gulf Large #3	Terrapin Island	1-Oct	12-Oct	660	$2.64	$1.50	$6.27
Gulf small #1	Atchafalaya	1-Oct	3-Oct	28	$0.11	$0.20	$11.14
Gulf small #2	Westport(S)	1-Oct	14-Oct	182	$0.73	$0.20	$5.10
SAD either #0	Bayport(M)	24-Nov	19-Apr	3,358	$16.79	$0.45	$5.13
SAD either #1	R.N. Weeks	24-Nov	7-Apr	3,082	$15.41	$0.90	$5.29
SAD either #2	Newport(M)	18-Dec	19-Apr	2,806	$14.03	$1.50	$5.53
SAD either #3	DodgeIsland	24-Nov	1-Mar	2,231	$11.16	$0.45	$5.20
SAD either #5	LibertyIsland	24-Nov	19-Apr	5,548	$27.74	$0.90	$5.16
SAD either #6	GlennEdwards	6-Dec	19-Apr	5,092	$25.46	$1.50	$5.29
West Coast either #6	GlennEdwards	14-May	2-Jul	1,080	$8.64	$7.50	$14.94
West Coast Large #6	Yaquina	1-Oct	28-Feb	2,050	$16.40	$0.15	$8.07
West Coast small #3	Yaquina	2-Mar	3-Apr	800	$6.40	$0.15	$ 8.19
Columbia River #1	PadreIsland	1-Oct	21-Mar	2,575	$20.60	$8.25	$11.20
Columbia River #5	Essayons	1-Oct	22-Jun	7,200	$57.60	$0.30	$ 8.04

It is important not to place too much emphasis on the assignments of the individual dredges to specific regions, nor to the cumulative totals dredged by each. The model generally considers hopper dredges in the same size category (Large, Medium, Small) to have equivalent daily production rates, so in most cases dredges within the same size group can be considered interchangeable.

The output can also be grouped into regional summaries to make it easier to identify trends nationally and where the model directs limited dredging resources in seeking to maximize the objective function.

Table B.5.4 – Regional Summaries of Model Output for Projected Future CY Requirements, Baseline Existing Fleet			
Region	**Min. CY Requirement (x1M)**	**Actual CY Dredged**	**% of Min. Requirement**
North Atlantic	12.0M	12.01M	100.1%
South Atlantic	22.1M	22.12M	100.1%
Gulf of Mexico	42.3M	53.0M	125.2%
West Coast	13.7M	13.71M	100.3%

In all five scenarios analyzed by the model, the trends seen in Figure B.5.1 hold; owing to the generally lower dredging unit costs in the Gulf of Mexico, as well as a lack of seasonal work restrictions, the model iterates towards relatively more dredging in this region while still meeting minimum dredging requirements in other regions.

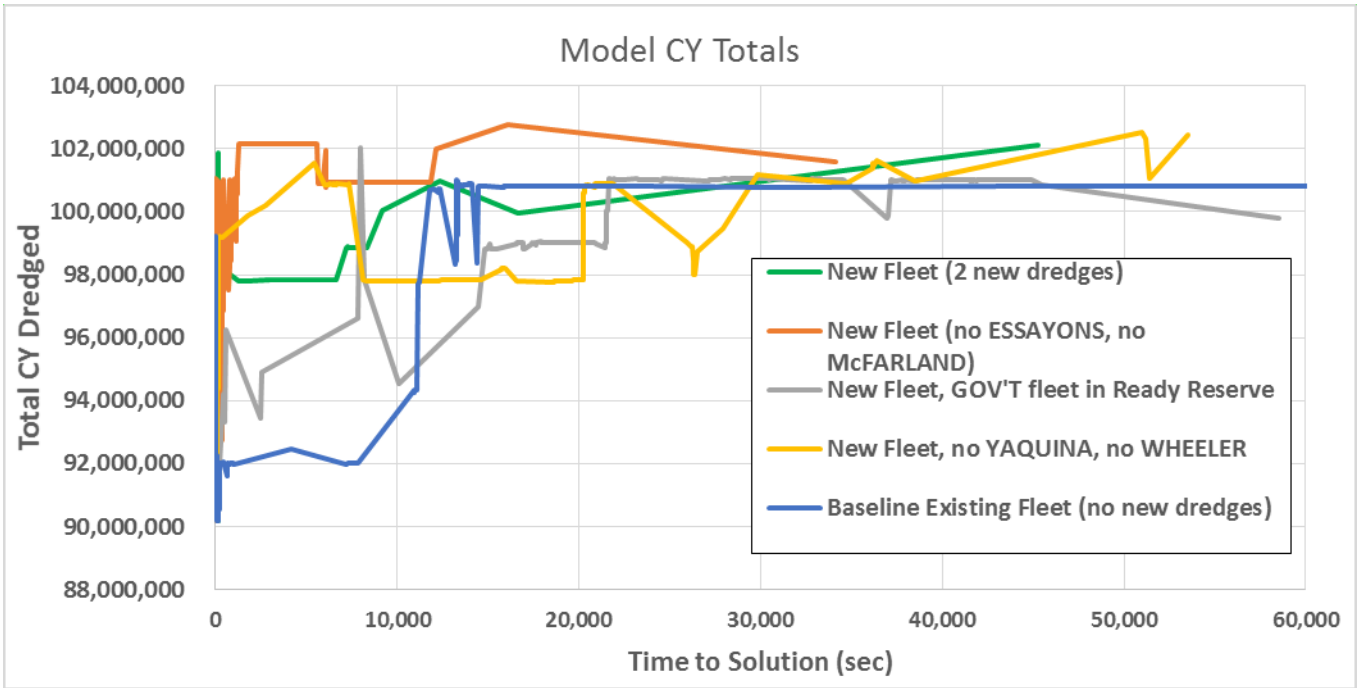

Figure B.5.1 – CY Totals through time as model iteratively obtains work plan solutions

It is noted that all five scenarios actually tend to converge at just over 100M cy dredged for the year. While perhaps surprising given the varying fleet configurations being evaluated, these results largely speak to the minimum dredging requirements by region, the environmental work restrictions by region, and unit cost variations by region. As noted previously, in all five instances the model settles upon solutions which direct relatively more dredging resources at the Gulf of Mexico owing to the lower unit costs and lack of work restrictions. Given that the model objective function does include consideration for dredging unit costs, combined with the factors listed above, the practical result is that this is relatively little variation in the total possible CY dredged across the five scenarios.

However, the previous statement should not be misinterpreted as a conclusion that the configuration of fleet has little to do with ultimate fleet *capacity*. Rather, total CY dredged is only one metric of fleet capabilities. Table B.5.5 provides some of the other model outputs generated across the five scenarios, with the quantities shown obtained by averaging the final 100 solutions obtained:

Table B.5.5 – Optimization model output summary from five selected fleet configurations

	Avg. Total CY (x1M)	Avg. $/CY	Avg. Total Travel Costs (x$1M)	Avg. Total # Dredging Days	Total # of Feasible Solutions
New Fleet (existing +2 new)	96.8	$5.87	$77.1	2801	110
New Fleet, no Essayons, no McFarland	101.0	$5.36	$35.9	3142	462
New Fleet, GOV'T Fleet in Ready Reserve	101.0	$5.43	$42.5	3114	600
New Fleet, no Yaquina, no Wheeler	100.2	$5.52	$49.4	2991	333
Baseline existing fleet (no new dredges)	100.8	$5.32	$32.0	3360	411

Again, perhaps surprisingly, the New Fleet scenario which adds the Ellis Island and the Magdalen to the existing fleet actually returns a lower CY total and much higher overall travel costs. This is likely a function of the larger fleet creating a larger solution space for the model to explore, since in theory if nothing else the model could simply use the same solutions for the New Fleet scenario as it found for the Baseline fleet scenario and achieve a better objective function score. More work is needed to train the starting locations of the model within the solution space to help ensure that local maxima are not governing the model output, though that is always a possibility with iterate search optimizers such as the one used in this analysis.

As noted previously, the total overall CY that can be dredged is not necessarily the best or only measure of the hopper fleets suitability to meet future dredging requirements nationally. Real-world constraints such as contracting delays, budgetary uncertainty, storm event responses, and inherently random shoaling processes will always act to disrupt out-year dredge project scheduling. Therefore, a strong argument can be made that availability and/or flexibility of the U.S. fleet to respond to unexpected surges in demand is a better gage of true fleet *capacity* than a theoretical total CY calculation, even one such as the model used here that factors in seasonal scheduling constraints, required maintenance downtime, and travel time between regions.

With this in mind, one final output metric from the dredge fleet scheduling/assignment model is presented here to hopefully shed insight into the relative suitability of the five selected fleet

configurations for meeting nationwide dredging requirements. To do this, the fifth column from Table B.5.5 is subtracted from the total possible number of dredging days for each scenario. This quantity is simply the sum product of the number of dredges in the fleet and the respective maximum number of days per year each dredge can be utilized. Table B.5.5 summarizes the results, with quantities shown averaged over the final 100 solutions found, as in Table B.5.6.

Table B.5.6 – Summary of Unused Dredging Days across Five Scenarios Evaluated

	Avg. Unused Dredge-Days	Total Possible Dredge Days	% Unused Dredge-Days
New Fleet (existing +2 new)	2,345	5,300	44.2%
New Fleet, no Essayons, no McFarland	1,587	4,770	33.3%
New Fleet, GOV'T Fleet in Ready Reserve	1,181	4,900	24.1%
New Fleet, no Yaquina, no Wheeler	1,709	4,770	35.8%
Baseline existing fleet (no new dredges)	1,369	4,770	28.7%

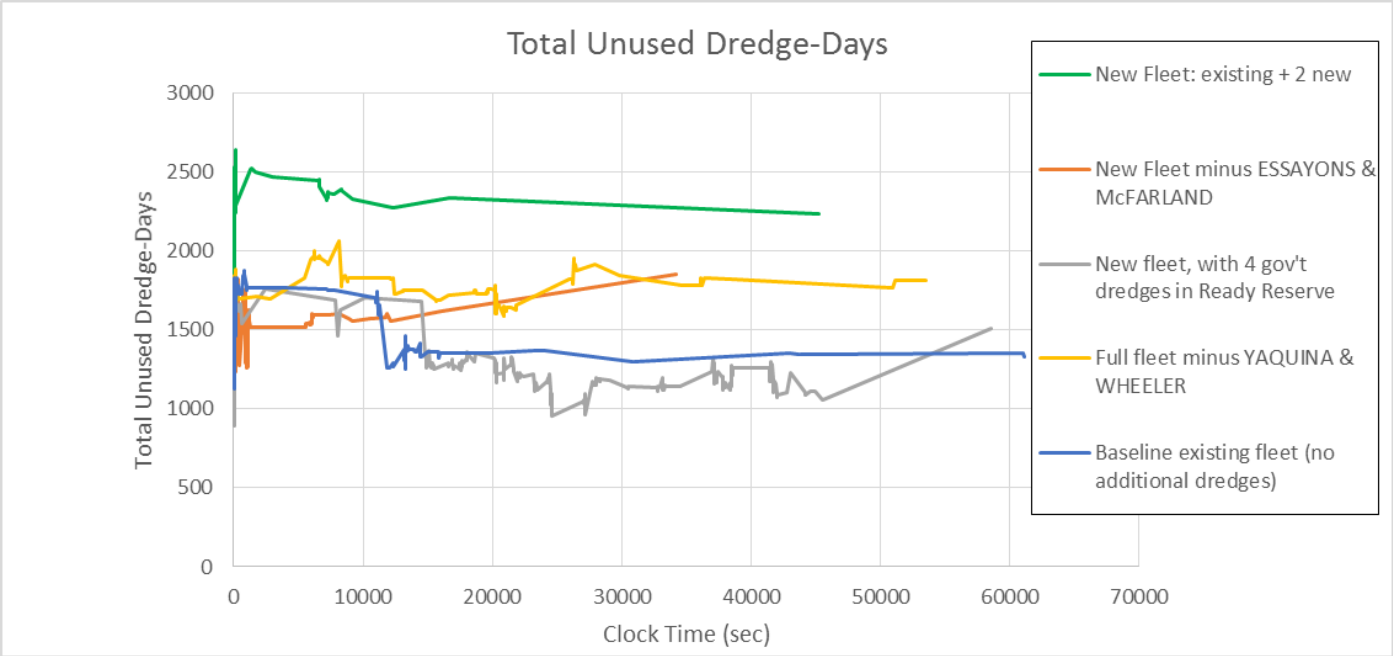

Figure B.5.2 – Total Unused Dredge-Days as Model Iteratively Explores Solution Space

Figure B.5.2 shows the same trends emerging as the model iteratively searches the solution space. The most important implication of this is that the scenario with the new dredges added

and all four Corps dredges are placed in Ready Reserve status (model capped their maximum annual utilization at 165 days instead of 265) has less remaining capacity than does the Baseline Existing fleet (albeit with no enforced Ready Reserve status). Stated differently, the gains provided by the two additional dredges towards overall fleet capacity, at least as captured by this Unused Dredge-Days metric, are largely negated by then placing the four Corps dredges in Ready Reserve status.

Appendix C – List of Acronyms

ARRA	The American Recovery and Reinvestment Act
ASA-CW	Assistant Secretary of the Army for Civil Works
BOA	Basic Ordering Agreement
BOEM	Bureau of Ocean Energy Management
CCA	Continuing Cost Analysis of Dredging
CERF	Corps of Engineers Reserve Fleet
CPT	Channel Portfolio Tool
DIS	Dredging Information System
DQM	Dredging Quality Management Program
ERDC	Engineer Research and Development Center (USACE)
GAO	Government Accountability Office
HMTF	Harbor Maintenance Trust Fund
IGE	Independent Government Estimate
LMR	Lower Mississippi River
MARAD	Maritime Administration
MFCIR	Minimum Fleet Capital Investment Report
MSC	Military Sealift Command
MsCIP	Mississippi Coastal Improvement Program
NPRN	The National Port Readiness Network
NRDA	The Natural Resource Damage Assessment
PRI	Plant Depreciation and Plant Replacement Increment
PRIP	Plant Replacement and Improvement Program
SDDC	Surface Deployment and Distribution Command
USCG	U.S. Coast Guard
WCSC	Waterborne Commerce Statistics Center
WIIN	Water Infrastructure Improvements for the Nation Act of 2016
WRDA	Water Resources Development Acts (1996 and 2007)
WRRDA	Water Resources Reform and Development Act of 2014

Appendix D – List of Prior Corps Studies and Memo to POTUS (1983)

Prior Corps Studies

1. Hopper Dredge Requirements of the U.S. Army Corps of Engineers Minimum Fleet
    a. Date: September 1978. Requirements approved by the Chief of Engineers February 1979.
    b. Performed by/for: by the U.S. Army Corps of Engineers; for the Office of Management and Budget (OMB)

2. Report to Congress, Minimum Dredge Fleet Study
    a. Date: April 1982
    b. Performed by/for: by the Corps Water Resources Support Center; for Congress

3. Report on the U.S. Army Corps of Engineers Minimum Fleet Requirements
    a. Date: January 1983
    b. Performed by/for: The Corps, coordinate with OMB

4. Analyzing the Corps of Engineers Dredge Fleet
    a. Date: July 1991
    b. Performed by/for: Engineers Study Center; U.S. Army Corps of Engineers

5. Minimum Dredge Fleet Study
    a. Date: October 1997
    b. Performed by/for: Corps Headquarters – Draft

6. Dredge WHEELER Ready Reserve Status Report
    a. Date: April 2000
    b. Performed by/for: Corps Headquarters in accordance with WRDA 1996

7. U.S. Army Corps of Engineers, Report to Congress, Hopper Dredges
    a. Date: 3 June 2005
    b. Performed by/for: Corps Headquarters

8. The Minimum Fleet Capital Investment Report 2012-2061
    a. Date: 12 April 2012
    b. Performed by/for: Corps Headquarters

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
WASHINGTON, D.C. 20310

11 MAR 1983

Honorable George Bush
President of the Senate
Washington, D. C. 20510

Dear Mr. President:

I am transmitting herewith a report regarding the Corps of Engineers' minimum dredge fleet. The report is in response to Public Law 95-269, enacted April 26, 1978.

The Corps' minimum dredge fleet shall consist of six non-hopper dredges and four hopper dredges. The Corps has been requested to reduce its fleet to six hopper dredges by the end of Fiscal Year 1983, with a further reduction to four hopper dredges by the end of Calendar Year 1983, depending upon the success of the Corps of Engineers' Reserve Fleet (CERF).

The CERF concept, patterned after similar air and sealift augmentation programs utilized by the United States Air Force and the United States Navy, was developed within the past six months and the Corps plans full implementation during 1983. On the basis of recent mobilization exercises during which the reserve dredging fleet was tested, I am optimistic that the Corps' minimum fleet of ten federally-owned dredges is justified and is in the national interest. The Corps' minimum dredge fleet, with the reserve fleet backup, should adequately respond to national defense and emergency requirements and do so with significantly reduced Federal capital outlays which would otherwise be required to obtain new replacement Federal dredges.

The Office of Management and Budget advises that there is no objection to the submission of this report to the Congress.

Sincerely,

WR Gianelli

William R. Gianelli
Assistant Secretary of the Army
(Civil Works)

Enclosure

REPORT ON THE U. S. ARMY CORPS OF ENGINEERS' MINIMUM DREDGE FLEET REQUIREMENTS

1. PURPOSE: To determine the appropriate number of federally-owned dredges to be included in the U. S. Army Corps of Engineers' Minimum Dredge Fleet, consistent with the provisions of Public Law 95-269, enacted April 26, 1978.

2. BACKGROUND:

a. Public Law 95-269 requires the Secretary of the Army, acting through the Chief of Engineers, to reduce the existing Federal dredge fleet to a minimum number of vessels capable of responding to the emergency and national defense needs of the country. In addition, the law directs the Secretary of the Army to undertake a study to determine the minimum federally-owned fleet required to perform emergency and national defense work. The Chief of Engineers submitted his final report on this matter to the Office of the Secretary of the Army in April 1982. The report, which recommended a minimum fleet of eight hopper dredges and nine non-hopper dredges, has been reviewed thoroughly by the Secretary's office and fully considered in developing the final position of the Secretary on the configuration of the minimum fleet of federally-owned dredges.

b. Since the submission of the final report by the Chief of Engineers, the Corps has developed a concept for a civil reserve fleet which would augment the Corps' minimum dredge fleet. This concept is similar to equipment augmentation programs utilized for sealift by the United States Navy and airlift by the United States Air Force. It would provide the guaranteed response of private sector dredges to augment the minimum federally-owned dredge fleet during responses to national defense or emergency situations. This civil reserve dredging fleet concept, which the Corps has designated as the Corps of Engineers' Reserve Fleet (CERF), was successfully tested during a recent worldwide defense mobilization exercise and will be fully implemented during 1983. The implementation of this concept does not require additional authority, does not employ subsidies, and is fully endorsed by the private dredging contractors.

c. Consistent with the provisions of Public Law 95-269, that the federally-owned minimum fleet of

dredges be maintained to technologically modern and efficient standards, including replacement, if necessary, a large minimum fleet would require large Federal outlays to replace the Corps' older existing dredges. Even with a lower number of dredges, some replacement will be required, albeit at significant savings from the cost associated with a larger minimum fleet recommended by the Chief of Engineers.

3. DISCUSSION:

The private sector has recently developed a fleet of ten hopper dredges and another is under construction. For the most part, the industry fleet of hopper dredges has been underutilized. However, vessels in the industry fleet have been made available for Federal emergencies, including defense-related requirements in the past, and can be relied upon to augment the Corps' minimum fleet to meet future requirements. Therefore, a significantly lower number of Federal dredges will be required, without accepting inordinate risks. Increased market availability of Federal dredging will stimulate the private sector and improve the economic integrity of the large capital investment by the dredging contractors and do so with the avoidance of large capital outlays by the Federal Government.

4. CONCLUSIONS:

a. A minimum fleet of federally-owned dredges is necessary to provide a nucleus resource for immediate response to meet national defense and emergency requirements, but it should be limited to the absolute minimum required for this purpose.

b. The development of the reserve dredging fleet concept supports a reduced number of federally-owned dredges.

c. Federal outlays for the acquisition of new Federal dredges in excess of the absolute minimum number are inconsistent with the Administration's overall policy to reduce Federal budget deficits.

5. FINDING: The Corps' minimum dredge fleet sufficient to meet national defense and emergency requirements should consist of four hopper dredges and six non-hopper dredges.

V → WRSC

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
WASHINGTON, D.C. 20310

20 SEP 1982

Honorable David A. Stockman
Director
Office of Management and Budget
Washington, D. C. 20503

Dear Mr. Stockman:

I am submitting a copy of the report on the Corps of Engineers' Minimum Dredge Fleet Study, which is furnished in accordance with Executive Order 12322 dated September 17, 1981. The report has been prepared in response to Public Law 95-269, enacted April 26, 1978.

The Chief of Engineers has determined that eight hopper and nine non-hopper dredges are required to respond to possible emergency and defense missions. It is obviously difficult to specifically define an emergency requirement, due to the many uncertainties and assumptions involved.

Whatever the emergency requirements turn out to be, it seems to me that the private sector can fulfill a major portion of these needs if satisfactory arrangements can be made with the dredging industry. Such arrangements would include having adequate private sector dredges in locations where the need may arise and having them available upon short notice and not at extravagant prices. The Corps is in the process of developing this concept, known as the Corps of Engineers Reserve Fleet (CERF), with the industry.

Pending the results of the CERF effort, I believe progress can be made toward reducing the Corps dredging fleet. I would suggest that the Corps be requested to reduce the number of federally-owned dredges to six hopper dredges and six non-hopper dredges within the next 12 months. In the meantime, if at the end of six months from now, the Corps and the dredging industry have not reached agreement on the number of federal dredges to be maintained and arrangements for the use of such private sector dredges during times of emergency it would be my intent to engage the services of an outside entity to further evaluate the problem and to make recommendations for our review as to the proper meld of federal and private dredges to be maintained to meet emergency requirements.

CW2
DAEN-CWX / WRS
Ei

Please provide information as to the relationship of the Minimum Dredge Fleet Study to the program of the President. A proposed draft letter transmitting this report to Congress is enclosed.

Sincerely,

(Signed)

William R. Gianelli
Assistant Secretary of the Army
(Civil Works)

Enclosures

cf: SACW(read,file,sign)
SASG
LTC Gross/vm/20 Sep 82

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
WASHINGTON, D.C. 20310

Honorable Thomas P. O'Neill, Jr.
Speaker of the House of Representatives
Washington, D. C. 20515

Dear Mr. Speaker:

I am transmitting herewith a report dated April, 1982 from the Chief of Engineers, Department of the Army, on the Minimum Dredge Fleet Study. The report has been prepared in response to Public Law 95-269, enacted April 26, 1978.

As an alternative to a Corps of Engineers-owned fleet of 17 dredges, a reserve dredging fleet concept is under review which is similar to that utilized by the Air Force and Navy for air and sealift. The implementation of this concept would offer the potential for further reducing the number of active Corps dredges and the capital outlays which would otherwise be required to acquire new replacement dredges. In the meantime, we are requesting that the Corps reduce the number of federally-owned dredges to six hopper dredges and six non-hopper dredges within the next year which represents the maximum number of federal dredges to be maintained.

The Office of Management and Budget advises that there is no objection to the submission of the Chief of Engineers' report to the Congress. A copy of the letter from the Office of Management and Budget is enclosed as part of the report.

Sincerely,

William R. Gianelli
Assistant Secretary of the Army
(Civil Works)

Enclosure

(A similar letter will be sent to Honorable George Bush, President of the Senate)

cf: SACW(read,file,sign)
SASG
LTC Gross/vm/20 Sep 82

Dredge WHEELER

Dredge McFARLAND

Dredge ESSAYONS

Dredge YAQUINA