St. George Harbor

Navigation Improvements

APPENDIX C: ECONOMICS

St. George, Alaska

September 16, 2018

US Army Corps of Engineers
Alaska District

CONTENTS

TABLES

FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

AAB	Average Annual Benefit
AAC	Average Annual Cost
ADF&G	Alaska Department of Fish and Game
AK	Alaska
Alaska District	The Alaska District of the US Army Corps of Engineers (also POA).
Alternative	A distinct plan formulation, made up of measures (engineered or non-structural project components).
APICDA	Aleutian Pribilof Island Community Development Association
APU	Alaska Pacific University
BCR	Benefit-to-Cost Ratio
BSAI	Bering Sea Aleutian Islands managed fishery.
CE/ICA	Cost Effectiveness/Incremental Cost Analysis
CFR	Code of Federal Regulations
Corps	U.S. Army Corps of Engineers
DCCED	Alaska Department of Commerce, Community, and Economic Development
EAB	Equivalent Annual Benefit
EAC	Equivalent Annual Cost
EGM	Economic Guidance Memorandum
EM	Engineering Manual
ER	Engineer Regulation
etc.	Et Cetera
F	Fahrenheit
FR/EA	Feasibility Report and Environmental Assessment
ft.	feet
FWOP	Future Without project Condition
FWP	Future With project Condition
GNF	General Navigation Feature
IDC	Interest During Construction
IWR	Institute for Water Resources
lbs.	Pounds
LERRDS	Lands, Easements, Relocations, Rights-of-Way, and Disposal Sites
LSF	Local Service Facilities
Measure	An engineered or non-structural project component.

MLLW	Mean Lower Low Water
MMPA	Marine Mammal Protection Act
NAAQS	National Ambient Air Quality Standards
NED	National Economic Development
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPV	Net Present Value
O&M	Operation and Maintenance (also OMRR&R)
OMB	Office of Management and Budget
OMRR&R	Operation, Maintenance, Repair, Replacement, and Rehabilitation
OSV	Offshore Supply Vessel
POA	The Alaska District of the US Army Corps of Engineers
PED	Preconstruction Engineering and Design
RECONS	Regional ECONomic System
Secretary	Assistant Secretary of the U.S. Army
SHPO	State Historic Preservation Officer
TSP	Tentatively Selected Plan
U.S.	United States
USACE	The US Army Corps of Engineers
USC	United States Code
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
VOC	Vessel Operating Cost
WRDA	Water Resources Development Act of the United States

NAVIGATION IMPROVEMENTS
ST. GEORGE, ALASKA

1. OVERVIEW

1.1 Bottom Line Up Front

This appendix presents the evaluation of a final array of six alternatives to provide navigation improvements at St. George, Alaska. These alternatives were carried forward from an initial array of ten alternatives.

The National Economic Development analysis did not yield any plans with a benefit-cost ratio greater than one, so Cost Effectiveness and Incremental Cost Analysis was utilized to support plan selection in accordance with the Remote and Subsistence Harbors authority.[1] The tentatively selected plan (TSP) is Alternative N-3, a 450-foot wide by 550-foot-long mooring basin dredged to -20 feet MLLW protected by a 1,731 foot long north breakwater and a 250-foot-long.

Table C-1 and Table C-2 summarize the results of the NED and CE/ICA analyses.

Table C-1: Summary of Costs and Benefits by Alternative

Alternative	Net Present Value	Equivalent Annual Cost (EAC)	Average Annual Benefits (AAB)	Average Annual Cost (AAC)	Benefit-to-Cost Ratio (BCR)
Z-3	($95,548,788)	$3,338,861	$11,343	$3,350,204	0.0034
Z-5	($361,616,997)	$12,636,359	$745,872	$13,382,231	0.0557
Z-7	($185,431,056)	$6,479,711	$12,378	$6,492,088	0.0019
N-1	($30,211,796)	$1,055,722	$71,862	$1,127,584	0.0637
N-2	($63,106,839)	$2,205,208	$827,695	$3,032,903	0.2729
N-3	($71,465,206)	$2,535,552	$1,036,667	$3,572,219	0.2362

The CE/ICA metric utilized in this analysis is “increased vessel opportunity days for safe access and moorage”, which directly addresses the project’s overall objective, which is to increase safe accessibility of marine navigation to the community of St. George. The CE/ICA yielded four cost effective plans, two of which are best buy plans (Alternatives N-3 and Z-5). Based on the incremental cost analysis of the two best buy plans, Alternative N-3 is the TSP. For Alternative Z-5, note the substantial increase in cost required to achieve a marginal increase in safe access and moorage days.

[1] Section 2006 of WRDA 2007 – Remote and Subsistence Harbors, as modified by Section 2104 of the Water Resources Reform and Development Act of 2014 (WRRDA 2014) and further modified by Section 1105 of WRDA 2016

Table C-2: Cost Effectiveness/Incremental Cost Analysis Summary

Alternative	Annual Cost	Days Gained	Annual Cost of Day Gained	Cost Effective	Best Buy	Incremental Cost of Day Gained (Annualized)
Z-3	$3,591,200	65	$55,249	No	No	
Z-5	$14,344,879	190	$75,420	Yes	Yes	$979,300
Z-7	$6,959,095	131	$53,123	No	No	
N-1	$1,208,696	38	$32,061	Yes	No	
N-2	$3,251,074	149	$21,863	Yes	No	
N-3	$3,572,219	179	$19,934	Yes	Yes	

1.2 Introduction

The purpose of the project is to increase safe accessibility of marine navigation to the community of St. George via meeting as many of the following objectives as practical:

- Improve wave and seiche conditions from what occurs in the existing entrance channel and harbor
- Provide for the safe maneuverability and protected mooring of the existing and anticipated fleet
- Increase the percentage of time that harbor facilities can be safely accessed

This economic analysis evaluates the economic justification of these proposed navigational improvements from both the NED and CE/ICA perspectives, as allowed by the study authority. NED benefits are defined as the change in value of goods and services that accrue to the nation as a whole as a result of constructing the project. The CE/ICA includes two distinct analyses that are conducted to evaluate the effects of alternative plans when selection of plan is based in part or whole on non-monetary units such as the Environment Quality (EQ) and Other Social Effects (OSE).

1.2.1 Study Authority

This study utilizes the project justification allowed under Section 2006 of WRDA 2007 – Remote and Subsistence Harbors, as modified by Section 2104 of the Water Resources Reform and Development Act of 2014 (WRRDA 2014) and further modified by Section 1105 of WRDA 2016. The authority specifically states that in conducting a study of harbor and navigation improvements the Secretary may recommend a project without demonstrating that the improvements are justified solely by NED benefits, if the Secretary determines that the improvements meet the following criteria:

1. The community to be served by the improvements is at least 70 miles from the nearest surface accessible commercial port and has no direct rail or highway link to another community served by a surface accessible port or harbor; or the improvements would

be located in the State of Hawaii or Alaska, the Commonwealth of Puerto Rico, Guam, the Commonwealth of the Northern Mariana Islands, the United States Virgin Islands; or American Samoa:

2. The harbor is economically critical such that over 80 percent of the goods transported through the harbor would be consumed within the region served by the harbor and navigation improvement as determined by the Secretary, including consideration of information provided by non-Federal interest; and

3. The long-term viability of the community in which the project is located, or the long-term viability of a community that is located in the region that is served by the project and that will rely on the project, would be threatened without the harbor and navigation improvement.

While determining whether to recommend a project under the criteria above, the Secretary will consider the benefits of the project to the following:

- Public health and safety of the local community and communities that are located in the region to be served by the project and that will rely on the project, including access to facilities designed to protect public health and safety;

- Access to natural resources for subsistence purposes;

- Local and regional economic opportunities;

- Welfare of the local population; and

- Social and cultural value to the local community and communities that are located in the region to be served by the project and that will rely on the project.

According to the Corps' Implementation Guidance for Section 1105 of WRDA 2016 issued on July 6, 2017, an NED analysis and identification of the NED Plan, if any, is required in conjunction with analyzing the above criteria as related to the St. George harbor project. If there is no NED Plan and/or selection of a plan other than the NED Plan is based in part or whole on non-monetary units, then the selection will be supported by a Cost Effectiveness/Incremental Cost Analysis (CE/ICA) consistent with ecosystem restoration evaluation procedures.

1.2.2 Meeting the Study Authority

Improvements to the St. George harbor appear to meet all the criteria of Section 2006 of WRDA 2007 as modified by Section 2104 of WRDA 2014 to recommend a project. Compliance with the previously described criteria of the authority are as follows and were confirmed by the Vertical Team during an In-Progress Review conducted on January 23, 2018:

1. The project is in Alaska,

2. Based upon their weight, commodities transported in the future with-project condition were analyzed to determine that more than 80 percent of the goods transported through the harbor (after construction) would be consumed within the region. Using metric tons as the basis of consumption is consistent with the Planning Guidance Notebook (PGN), the Waterborne Commerce Statistics Center (WCSC), and the Deep Draft Navigation Planning Center of Expertise (DDN-PCX). The region served by the navigation improvements was determined to be the island of St. George and the immediately surrounding marine area (about a 25-mile radius).

   To provide economic opportunities for the community, consistent with the authority, alternatives supporting fish and crab product exports from the island are considered. However, these exports were projected to weigh less than 20% of the total weight going through the harbor when considering market and institutional factors such as Community Development Quotas and prices. Total imports minus total exports was used in the projection. Imports included the weight of fuel, the weight of freight and construction materials, and the weight of raw fish. Exports included the weight of processed fish products leaving the island. Exports are estimated to range between 11 and 19 percent of harbor throughput, with an average of about 14 percent.

3. The cultural identity of Alaska Native Tribes is highly dependent upon subsistence activities tied to specific locations and deep historical knowledge of land and subsistence resources. Rural economies in Alaska, including that which exists on St. George, can be characterized as a mixed, subsistence-cash economy in which the subsistence and cash sectors are interdependent and mutually supportive. The ability to successfully participate in subsistence activities is highly dependent on the opportunity to earn some form of monetary income and access the resources needed to engage in subsistence activities. Without a safe and functioning harbor, economic opportunities in the community would continue to be hindered and the costs of basic essential goods required to support a subsistence lifestyle would remain prohibitively high, contributing to continued out-migration from St. George. When subsistence communities are forced to disband due to high costs of essential goods, including fuel, tribal identities and cultural communities are endangered. Reductions in costs of such basic essential goods are essential to community viability. In addition, a safe and functioning harbor would provide opportunities for development of a local economy based upon the marine resources of the region. Such economic opportunities are essential for supporting the mixed, cash-subsistence economies common throughout rural Alaska, combating out-migration, and helping to support the viability of the community on St. George.

1.3 Project Description

The City of St. George is located on the northeast shore of St. George Island, the southernmost of five islands in the Pribilof Islands, in the middle of the Bering Sea (Figure C-1). It lies 49.4 miles south of St. Paul Island, 750 air miles southwest of Anchorage,

and 250 miles northwest of Unalaska. St. George is accessible only by water and air. The Island is 34.8 square miles, approximately 12 miles across at its widest point from Dalnoi Point to Tolstoi Point, and 5.33 miles across in the perpendicular direction from Cascade Point to Bear Point. The Island rises to a maximum elevation of 1012 feet in the High Bluffs. The sea meets the island at large cliff faces along many sides, posing challenges to navigating to shore in these areas. Dangerous wave and seiche conditions at the existing harbor prevent safe access and moorage to the current fleet. This limits subsistence opportunities, impacts delivery of goods to the community, and threatens the long-term viability of the community.

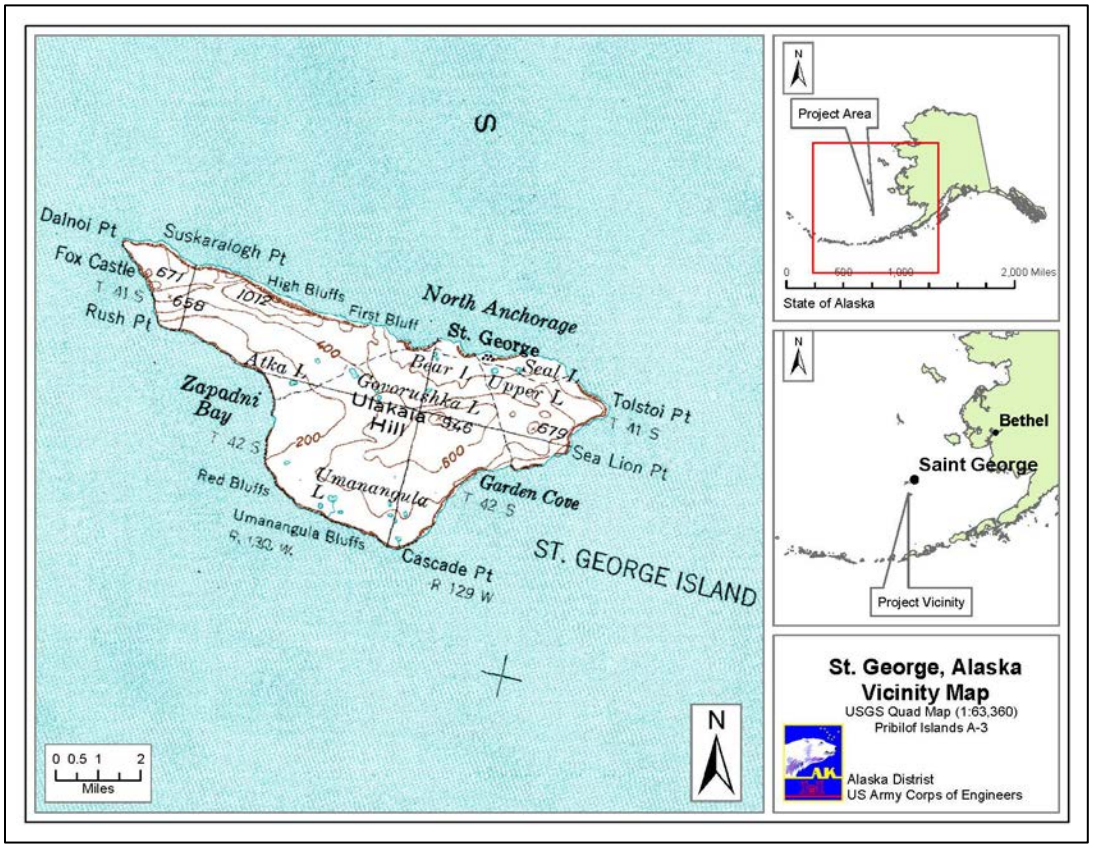

Figure C-1: St. George Island

1.4 Problems and Opportunities

The dangerous conditions of the existing harbor at Zapadni Bay impose significant safety risks and impedes accessibility to the harbor. This results in a number of problems that include:

- **High costs of essential goods.** Barge operators have difficulty delivering fuel and supplies to the community as the harbor is currently configured. As such costs of goods remain prohibitively high.

- **Unrealized Revenues.** The community is legally entitled to percentage of the Community Development Quota (CDQ) from the Aleutian Pribilof Island Community Development Association (APICDA) for crab. However without a safe harbor, commercial fishing fleet is unable to effectively utilize and access the harbor and St George is unable to realize that revenue benefit and the crab is delivered to neighboring St. Paul.

- **Reduced subsistence and activities and access to resources.** Residents at St. George have not attained a stable and sustainable marine resource economy sufficient to support their mixed, subsistence-cash economy.

- **Continued Out-migration.** Lack of economic opportunities in the community without a safe functioning harbor continues to result in Out-Migration from St. George

The above problems threaten the long term viability of St. George. However, the following are potential opportunities to be realized by improving navigation to/from St. George:

- Support the community viability
- Expand economic opportunities
- Reduce fuel costs
- Improve access to subsistence resources resulting in improved food security
- Provide more affordable access to goods, services and marine resources. This could include improved freight and barge services and a water taxi service to St. Paul
- Replace the former sealing economy with a self-sustaining marine resource based economy
- Reduce the costs of living
- Increase response capacity to environmental hazards (i.e. oil spills, ship wrecks)
- Increase the availability of dock space
- Promote increased commercial and subsistence harvests by reducing potential vessel insurance company restrictions upon using the existing harbor
- Provide harbor of refuge in the central Bering Sea
- Provide support to the local and regional mixed, subsistence-cash economy of St. George and the Pribilof Islands, similar to that which is provided by the harbor at St. Paul, Alaska.

2. OVERVIEW OF REGION AND SOCIOECONOMIC

This section provides an overview of the region and the socioeconomic composition of the study area. It aims to support planners and report reviewers' understanding of the community and region, infrastructure, local and state government organizations and where data allows, the level of economic activity.

2.1 Climate

Please see Appendix A, Hydraulic Design, for a detailed description of St. George's climate. Of special note, St. George is the northernmost ice free port in the United States; St. George's harbor can be open when St. Paul's harbor is closed due to ice. However, rare freezing conditions that would limit safe access and moorage are still considered as part of the analysis.

St. George gets 49 inches of snow and 23 inches of total precipitation yearly; mean temperatures vary from 24 to 52 degrees Fahrenheit. Cloudy, foggy weather is common during summer months. The maritime climate zone is characterized by persistent overcast skies, high winds, and frequent cyclonic storms. During storms, the sea presses into the island on all sides. High wave height and long-period waves cause difficulty in creating harbor designs that increase safe access and moorage. Difficulties include energy transmission through breakwaters and seiching among other problems.

2.2 Population

Census data shows a varying population over time; however, decadal assessments since 1970 show a declining population after the halting of fur seal harvest. Population increased between 1990 and 2000, which corresponds with when SnoPac Seafoods had a floating crab processor moored inside St. George Harbor from 1996 to 2000. Table C-3 shows St. George population estimates over time.

Table C-3: St. George Population[2]

Year	Population
2018	70
2017	72
2013	97
2010	102
2000	152
1990	138
1980	158

[2] Population data for 1880 through 2010 are from the US Census and the Alaska Department of Commerce, Community, and Economic Development department (DCCED). Population estimates after 2010 are from the State of Alaska and the Aleutian Pribilof Island Community Development Association (APICDA).

1970	163
1960	264
1950	No Data
1940	183
1930	153
1920	138
1910	90
1900	92
1890	93
1880	92

The DCCED commissioner recently certified the 2017 population as 72, which is historically low. The population decline also appears to be more rapid than the predicted trend for the Aleutians West Census Area, in which St. George lies. The DCCED's trend for the borough predicts an increasing decline, from 0.16% annually to 0.33% annually in 2045, before the decline eases back towards 0.16% annually (laborstats.alaska.gov). For St. George, this same trend would result in a population of 64 in 2050 and 60 in 2070, but the island is not likely to follow the same trend as the borough. Both of these arguments indicate that community viability is currently threatened, and that a Corps navigation improvements project could help if there were sufficient benefits from a project.

According to the 2010 census, there were 102 residents on St. George. Native Alaskans make 89% of the population. The gender breakdown is approximately 58% male and 42% female compared to 52% male and 48% female for the State of Alaska. The median age of St. George residents is 39 years, slightly above the median age of 34 years for the state. 2010 census shows the community's age and sex profile as follows:

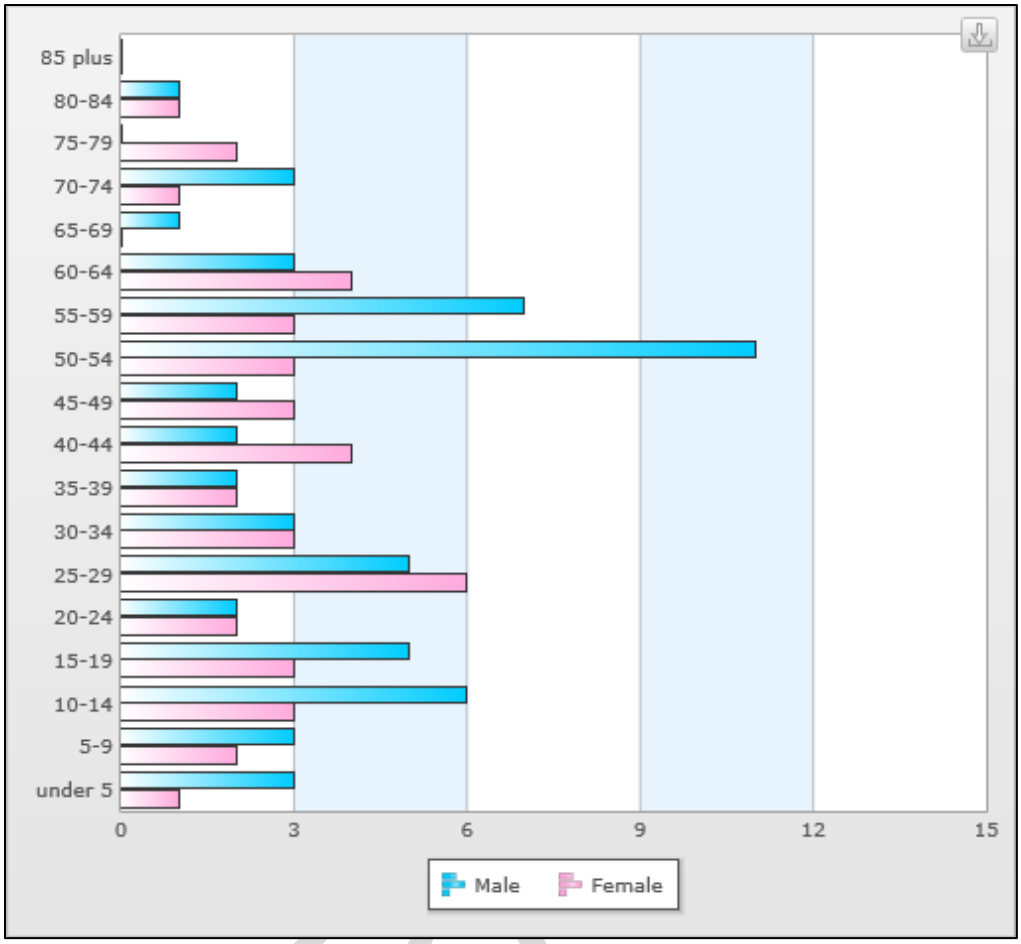

Figure C-2: St. George Demographics (Age vs. Number of Residents)

2.3 Employment and Income

The City of St. George serves as a major employer for residents; however, the tax base is not sufficient to sustain employee pay or the City's expenses (Colt, 2018). The Tanaq Corporation, an Alaska Native Claims Settlement Act (ANCSA) village corporation, and St. George Tribe are other major employers.

The Aleutian Pribilof Island Community Development Association (APICDA), a 501(c)(3) non-profit, and APICDA joint ventures (AJV) employed 92 residents across its 6 communities[3] with a payroll of approximately $2.4 million in 2016. APICDA participates with the State of Alaska in the Community Development Quota program set out in the Magnuson-Stevens Fisheries Conservation and Management Act (MSFCMA, or Magnuson-Stevens Act). The CDQ program, including how revenues are distributed to participating communities, is described in subsequent sections of this appendix. APICDA may also receive money from various grants for community development projects. For example, a grant from the U.S. Department of Commerce's Economic Development

[3] Akutan, Atka, False Pass, Nelson Lagoon, Nikolski, and St. George

Administration helped fund the seafood handling facility, which is currently dormant at Zapadni Bay Harbor (APICDA Decennial Review, 2012).

AJV also works with the St. George Fishermen's Association to harvest halibut in the region. AJV owns (or has partial interest in) a portion of the halibut fleet operating out of St. George. The joint venture is also referred to as Puffin Seafoods LLC. Puffin Seafoods would likely operate a seafood handling facility, owned by Kayuk Development, if it was functional. The existing facility was worth approximately $3.5 million at the time it was constructed. AJV also purchases crab, such as through Ocean Prowler LLC. AJV purchases both individual fishing quota (IFQ) as well as CDQ crab share.

The DCCED reported that while there were 14 halibut permit holders in St. George in 2016, only 6 permit holders fished. That accounted for a little more than 50,000 lbs. of halibut caught. One local resident described in June 2017, that if he caught enough halibut it would likely be the only source of income for his family that year.

An estimated eleven residents live below the poverty line. This number has held steady while the overall population has declined; therefore, the percentage of residents below the poverty line has increased (from 7.9% in 2000 to 17.2% in 2010; DCCED estimated 24.2% in 2014). The table below shows income from the Alaska Department of Labor and Workforce Development.

Table C-4: St. George Income Levels

Year	Employed	Total Wages	Average Wages
2016	39	$1,096,585	$28,118
2015	47	$1,198,904	$25,509
2014	54	$1,417,153	$26,244
2013	53	$1,414,019	$26,680
2012	49	$1,199,667	$24,483
2011	52	$1,369,758	$26,342
2010	62	$1,453,575	$23,445
2009	59	$1,139,455	$19,313
2008	58	$1,160,552	$20,010
2007	59	$1,310,116	$22,205
2006	62	$1,401,945	$22,612
2005	65	$1,321,065	$20,324
2004	70	$1,367,195	$19,531
2003	79	$1,787,105	$22,622
2002	73	$1,453,976	$19,917
2001	72	$1,528,803	$21,233
Averages	**60**	**$1,351,242**	**$23,037**

2.4 Government

2.4.1 City of St. George

The City of St. George was incorporated in 1983 as a second class city in the Aleutians West Census Area. The City's incorporation was in coordination with the Fur Seal Act Amendments of that year. The City operates under a Mayor elected to one-year terms and seven council members, all of whom are elected at-large. Currently, the City levies a 0.00 mill property tax, 3% sales tax, and 6% raw fish tax.

2.4.2 Saint George Island/St. George Traditional Council

The federally recognized tribe is Saint George Island, which is also referred to as the St. George Traditional Council.

2.4.3 St. George Tanaq Village Corporation

The St. George Tanaq Corporation is the ANCSA village corporation. Tanaq has many business interests including joint ventures with APICDA, land ownership, and rent generating projects.

2.4.4 Aleut Corporation

The Aleut Corporation is one of the 13 regional Native corporations that was established in 1972 under the terms of the Alaska Native Claims Settlement Act (ANCSA). The Aleut Corporation received a settlement of $19.5 million, 66,000 acres of surface lands, and 1.572 million acres of subsurface estate. The corporation has economic, social, and cultural responsibilities to its approximately 3,250 shareholders. Operations of the Aleut Corporation and subsidiaries include Government Contracting, Telecommunications, Environmental Remediation, Fuel Sales, and Real Estate Management. The Company also participates in various partnerships, joint ventures and other business activities.

2.4.5 Other Entities

2.4.5.1 Aleutian Pribilof Island Community Development Association

The Aleutian Pribilof Island Community Development Association (APICDA) was initially established in 1992 as an Alaska Seafood company dedicated to sustaining six rural villages in the Aleutian-Pribilof region. These six village communities are Akutan, Atka, False Pass, Nelson Lagoon and St. George. APICDA has evolved over the years to become one of the Western Alaska Community Development Quota (CDQ) corporations. The CDQ program allocates a percentage of all Bering Sea and Aleutian Islands quotas for ground fish, halibut and crab to eligible CDQ groups that represent 65 villages. APICDA and its subsidiary companies generate proceeds through the management of the quotas and uses proceeds to sustaining the communities of which St. George is

included. APICDA projects on St. George include harbor improvements at Zapadni Bay and building a fish handling facility.

2.4.5.2 Aleutian Pribilof Islands Association Inc

The Aleutian Pribilof Islands Association Inc. (APIA) provides an array of services under health care, education, employment and family services to its member communities. On St. George Island APIA operates the health clinic. APIA represents the following 13 communities: Akutan, Atka, Belkofski, False Pass, King Cove, Nelson Lagoon, Nikolski, Pauloff Harbor, Sand Point, St. George, St. Paul, Unalaska and Unga. It also partners with APICDA, Aleut Corporation and others on renewable energy initiatives.

2.5 Public Social Services

2.5.1 Health Clinic

The St. George Health Center is a community health center managed by the Aleutian Pribilof Islands Association, Inc. The health center serves Indian Health Services-eligible beneficiaries via a contract with the St. George Traditional Council, and also serves Veterans via an agreement with the Veterans Administration. It is staffed with one mid-level provider, a nurse practitioner or physician assistant clinical who usually serves as the Clinic Coordinator, one community health aide, and one community wellness advocate. Also, immediately available by tele-behavioral health is a licensed community psychologist.

The health center offers emergency, primary, and behavioral healthcare as well as community wellness activities with a focus on elders. It is equipped with a tele-pharmacy, x-ray, small lab, and treatment room. The health clinic lacks beds but there is a holding area since the health center serves as an emergency stabilization site for medical evacuations to Anchorage.

2.5.2 Schools

The closure of the public school in 2017 further indicates the continued out-migration from St. George. St. George School held classes from pre-kindergarten to 12th grade on St. George. Only six students were enrolled in 2016/2017 declining from 10 students in the previous school year. The students were taught by one teacher. As a result of school closure, students must attend school on neighboring St. Paul or attend Mt. Edgecumbe High School in Sitka, AK a boarding school. Other options include the Pribilof School District (PSD) Correspondence Program which teaches grades from kindergarten to 10th grade. Eight students were enrolled in this program for the 2017/2018 school year.

2.6 Retail Services and Lodging

St. George's remoteness and inaccessibility are reaffirmed by the limited services available on the island. The community is serviced by two small stores that sell frozen and canned foods as well as subsistence products such as locally produced caribou sausage, halibut cheeks, and other items. Basic sundries can also be found. For visitors, there is the Aikow Inn also known as the St. George Hotel, built in the 1930s. It has 10 rooms and a community kitchen. The hotel is closed when there are too few guest bookings in which case visitors find accommodation at the school or other establishments.

2.7 Infrastructure

2.7.1 Utilities

The City of St. George operates the public water systems including distribution, wastewater collection, and wastewater treatment. A landfill is also operated by the City. Fire and EMS is a volunteer service. In addition to municipal facilities, state, tribal, educational, and health service organizations may assist with providing utility and community services.

Electricity is a City diesel and wind project; however, the wind turbine caught fire and is in disrepair at this time. Fuel is delivered several times per year. Fuel costs for electricity are subsidized by the State of Alaska's power cost equalization (PCE) program. "Participating utilities are required to reduce each eligible customer's bill by the amount that the State pays for PCE"[4]. Approximately 73% of fuels used in St. George are used for electricity generation (St. George Delta Fuel and AEA reports). The 27% of remaining fuel use largely goes towards heating needs, but a portion also goes to powering vehicles and generators, construction projects, and halibut fishing vessels.

2.7.2 Road System

St. George has a road system including a 6-mile long road out to Zapadni Bay and the airport, with turnoffs to the landfill and two rock quarries. Roads are unpaved, and 4-wheelers are used more prevalently than trucks for short trips between residences, workplaces, and locations of interest.

2.7.3 Airport

The St. George Airport is normally serviced by PenAir and Ace Air Cargo by scheduled prop-jet and commuter airline. The airport has a 4,980 foot long paved runway. Flights go from Anchorage, or Dillingham, to St. Paul and St. George, then back. One way from Anchorage to St. George takes about three hours. The airport has fuel storage for Jet-A, brought in by barge; however, if refueling is done in the Pribilofs, it's usually done in St. Paul. Perishable and ordered goods arrive by jet, both on PenAir and on Ace Air Cargo.

[4] http://www.akenergyauthority.org/Programs/PCE

Tourists, construction, and government workers, as well as St. George residents typically use PenAir to get on and off the island. PenAir has filed for bankruptcy protection but still operates flights to St. George and other communities in Alaska.[5]

2.7.4 Marine Facilities

2.7.4.1 Village Boat Launch

The village boat launch, on the north side of the island, near the village site, is a rough graded drive down type launch. The rutted dirt connects to a broken concrete slab that is mostly covered with beach rock. This boat launch was formerly used to launch small skiff but no longer functions as intended.

2.7.4.2 St. George Harbor at Zapadni Bay

The city-constructed St. George Harbor (Figure C-3) is St. George's current boat harbor. It is a 3-acre boat basin enclosed by two rubble mound breakwaters. A third inner breakwater protects the inner harbor. The entrance channel is 280 feet wide at the water line. In its existing condition, the depth of the entrance channel varies from -26 to -18 feet MLLW with shallow areas consisting of rock pinnacles. Maneuvering is limited by pinnacles, by breakwaters that are too long, and a wind and wave climate that cause damages and delays to vessels entering, exiting, and moored within the harbor.

[5] http://www.kucb.org/post/penair-files-bankruptcy-protection-ceo-promises-refocus-alaska-routes

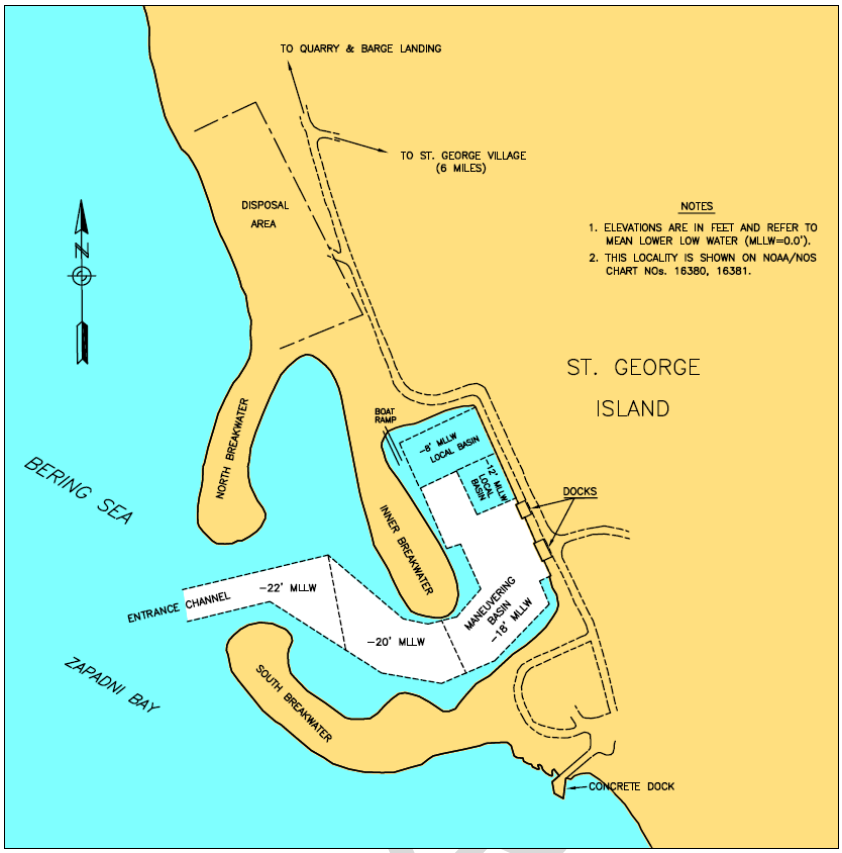

Figure C-3: St. George Harbor in Zapadni Bay

Design of the harbor utilizing conventional breakwaters was initiated by Alaska Department of Transportation & Public Facilities (AKDOT&PF) at the Danish Hydraulic Institute in the early 1980s. Physical model testing of harbor designs consisting of conventional breakwaters were completed at the Danish Hydraulic Institute and Oregon State University's coastal engineering lab. Due to lack of sufficient state funding for construction, the project was put on hold. The City felt that the harbor could be constructed for less by utilizing a recently developed breakwater technology known as berm breakwater design. Final design of the harbor incorporating the berm breakwater design was completed by the City pursuant to a Transfer of Responsibility Agreement from the State of Alaska. The City awarded a construction contract in September 1984. The contractor was unable to complete the terms of the contract by 1986. The City completed the project by mining local armor rock in 1986 and 1987 and constructing the north, south, and inner breakwaters and utilizing the excavated quarry as the harbor basin. The harbor ultimately constructed by the City differed markedly from the original design physically modeled in that it utilized a berm breakwater design placed further inland in shallower water (Figure C-4).

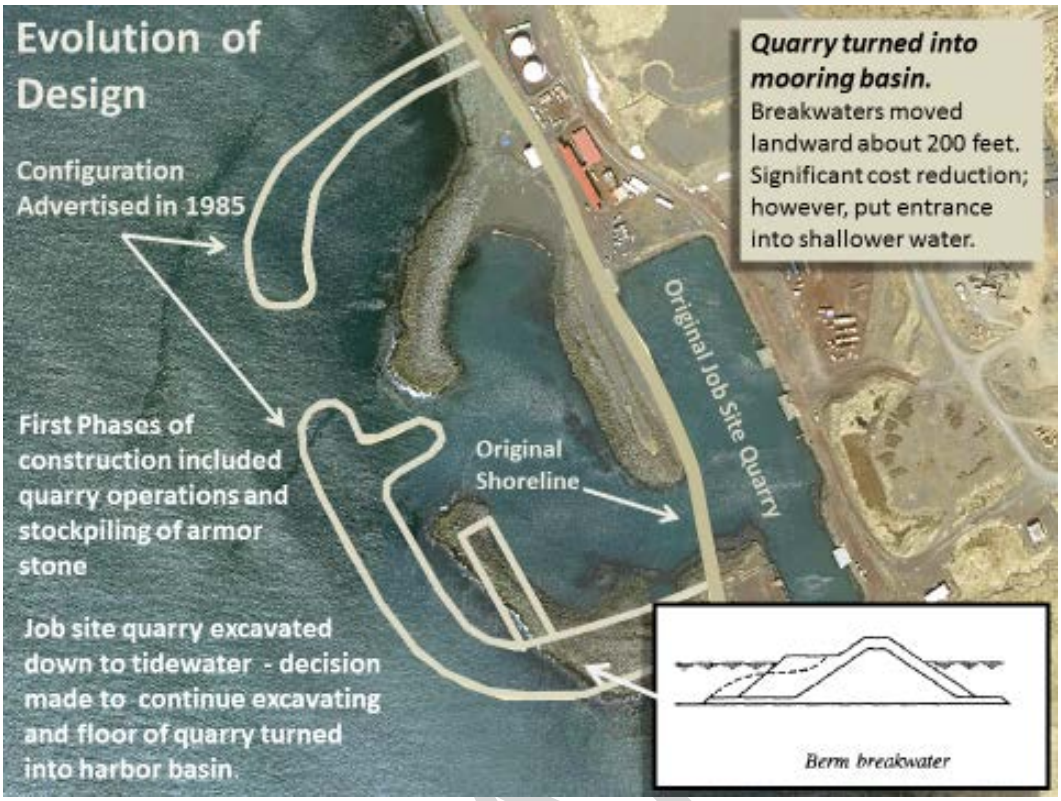

Figure C-4: Comparison of Constructed Harbor to Original Design (courtesy DOT&PF)

In 1988, the City entered into a Section 107 Agreement for the Corps to deepen the St. George Harbor and entrance channel to design depth. Dredging of the Federal project, consisting of a 3-acre boat basin and 2 feet of advance maintenance dredging was initiated in April 1989. Dredging efforts were completed the following summer. Federal project channel depths, ranging from -22 feet MLLW to -18 feet MLLW, were achieved in most areas; however, due to difficulties encountered, the contractor failed to achieve contract depth in some areas, leaving several rock pinnacles within the entrance channel. Further attempts to attain project depth throughout the project in 1995 were unsuccessful. Since the City was unable to enter into a cost-sharing agreement to complete the dredging project, Federal maintenance obligations were suspended in 1996. The Federal portion of the project is indicated in white in Figure 4.

In 2004, the south breakwater was damaged, and displaced rock was deposited in the entrance channel limiting the use of the harbor. The Federal Emergency Management Agency provided $8 million for repairs, which included placing 15,000 CY of armor rock in 2006 and removing 12,000 CY of material from the entrance channel in 2008.

From 2011 to 2015, the City-AKDOT&PF Feasibility Study was completed at a cost of $2 million. The study included hydrographic and topographic surveys, geotechnical studies, wave modeling, and sedimentation analysis. In cooperation with the users, over 15

alternatives plans were developed, evaluated, and compared. All alternatives considered were constrained to an estimated maximum construction cost of $30 million due to financial limitations. This constraint limited the identification of an alternative addressing all the problems experienced in the harbor, and some issues, such as inner harbor seiche and fuel barge navigation, were not addressed with these concepts. The City selected a preferred plan based on the numerous meetings, technical studies, and evaluation of a wide array of viable alternatives. The Corps has utilized work completed as part of these efforts to the greatest extent possible.

Shortly after initiation of this study in December 2015, the south breakwater of the existing harbor suffered damage again from storm generated waves (Figure C-5 and Figure C-6). The damage is evident in the following before-and-after photos. As a result of this damage, the City obtained state and Federal disaster funding to repair the south breakwater. The Federal Emergency Management Agency program under which repair funds were obtained only allows repairs to restore existing structures to their pre-damaged state. Repairs included adding 6- to 10-ton stone to the breakwater trunk in 2016 to return the breakwater crest to its design elevation and adding a 50-foot rock berm in 2017 to the seaward face of the south breakwater. The problem of navigation to and within the harbor or problems with harbor resonance discussed in this report will not be improved by these repair efforts since disaster funding is only available to restore the breakwater to its pre-storm condition as opposed to improving the ability of boats, barges, and other water craft to safely navigate into the harbor.

Figure C-5: Breakwater After December 2015 Storms

Given the current state of the harbor, St. George residents continue to face difficulties in attaining a stable and sustainable marine resource economy sufficient to support a local

seafood processing facility and related services as envisioned by the CDQ program and other legislative acts. The City of St. George believes that survival of the community is dependent upon a more accessible harbor as there can be no viable long-term economy on St. George without it.

Figure C-6: Breakwater After Repairs, 2017

3. MARINE RESOURCES

In the Pribilof Islands, there is a subsistence fishery, a commercial crab and fish industry, and potentially a small sport/tourism fishery. Fisheries are managed such that subsistence needs are prioritized followed by commercial participation and sport.

3.1 Subsistence

Fishing activities can be year-round under subsistence rights. For St. George, halibut, cod, sablefish, salmon, snails and urchins are essential to community livelihood. These species, together with fur seal, provide about 40% of the dietary needs for the community. Other subsistence foods are also traded with other Aleutian communities. Local knowledge adds value to the subsistence harvest in many ways, such as understanding species diversification. The harvest, stock, and community demand of all of these species vary from year-to-year and from family-to-family. The supply of subsistence seafood resources generally exceeds demand; however, accessing marine resources is still costly, both in monetary terms and in terms of required effort. Since periods of safe access and moorage conditions in St. George Harbor is limited, there is additional demand for

fishing activity that's not being met. Subsistence vessels need a wave 4 feet or less in the entrance channel and 1.6 feet at the boat launch to haul out.

Subsistence activities also include terrestrial hunting and gathering. Caribou and the northern fur seal may be hunted for subsistence on St. George. Land-based subsistence activities may be initiated by boat or have a portion of the activity that use navigable waters. For example, caribou herds which roam parts of the island inaccessible on land may be reached by vessel. In addition, wild berries, greens, roots, birds and bird eggs are harvested on land or from cliff faces by vessel

3.2 Commercial

In the Bering Sea the annual harvest quota for groundfish (consisting of pollock, Pacific cod, flatfish Atka mackerel, Pacific Ocean Perch, and other species) is approximately two million metric tons. St. George is located right in the middle of these fisheries. In addition to groundfish, there are also shellfish or crab fisheries that harvest tens of millions of pounds of king, snow, and bairdi crab every year.

Most fisheries in the Bering Sea are rationalized, which means one of several management systems is in place to manage over-capitalization and eliminate the race to fish. These generally consist of an Individual Fishing Quota (IFQ) issued to an individual or a corporation, usually coupled with an Individual Processing Quota (IPQ) issued to a processing company, or harvest and/or catch rights issued to a cooperative. Transfers of both IFQ and IPQ are allowed, meaning they can be sold from one harvester or processor to another, or leased. Either system results in the same outcome: the harvester, whether an individual or a corporation, and the processor each have a defined amount of the species' quota they can harvest and/or process each year. When the programs were designed and implemented, each participant in a fishery about to be rationalized was given credit for their historical catching or processing history, which is then converted into a percentage of all future quota available for harvesting and processing. These are generically referred to as catch share systems. The three catch share systems most germane to St. George are the crab IFQ/IPQ program, the Pacific cod Freezer Longline Cooperative, and the halibut IFQ program.

In the crab IFQ/IPQ program, 100 percent of the quota available for harvest is issued to crab harvesters to catch, and 90 percent of the quota is issued to crab processors to purchase from the crab harvesters and process and market. The 10 percent difference allows the crab harvesters to sell that crab to any processing company they wish, thus encouraging competition. The prices paid to crab harvesters are determined by a formula agreed to by both the harvesters and the processors, with disputes settled by binding arbitration.

The crab fleet consists of large vessels generally longer than 100 feet. The crab fisheries in the Bering Sea begin in October with red king crab, followed immediately by St. Matthew's blue king crab (when there is a season), and then by snow crab and bairdi generally beginning in January. The length of each season is primarily dependent upon

the size of the quota, although weather and ice have resulted in lengthy delays in the past.

The Freezer Longline Cooperative is a different catch share system that the IFQ/IPQ program. Freezer longline vessels are large vessels (generally 100 to 160 feet long) that fish with longlines baited with hooks on the bottom. Some vessels are capable of fishing 60,000 or more hooks per day. The vessels are also equipped with factories on board, so they are also referred to as “catcher-processing vessels.” They produce the finest quality of cod in the world. The amount of Pacific cod allocated to the Freezer Longline Coalition in 2018 is 89,000 metric tons.

About 28 vessels belong to the Freezer Longline Coalition, which manages the cooperative. Each company is allocated a percentage of the annual quota and a percentage of the prohibited species (halibut – which must be immediately returned to sea when taken as bycatch) allocated to the cooperative. The percentage is based upon each company’s historical harvest during a defined number of years prior to the cooperative’s creation. As with crab, cooperative percentages may be traded among companies.

The last of the catch share program of importance to St. George is the halibut IFQ program. This program was the first IFQ program implemented in Alaska, going into effect in 1995. This is a simply IFQ plan where individual harvesters received an initial IFQ based upon their historical landings or subsequently bought in to the program. There is no associated IPQ allocation; IFQ holders can deliver where they wish.

There are approximately 12,000 pounds of IFQ owned by residents of St. George. There is significantly more owned by residents of St. Paul, possibly in excess of 200,000 pounds. APICDA also owns halibut IFQ in the area around the Pribilof Islands – around 30,000 pounds.

For many years, the halibut harvested by St. George fishermen was transported to St. Paul for processing at the Trident Seafoods processing plant. According to the Alaska Department of Commerce, Community and Economic Development (DCCED) a total of 50,000 pounds of halibut was harvested in 2016 by St. George residents and commercial fishing permit holders. The halibut fishery could be open any time from March to mid-November with season dates established by the International Pacific Halibut Commission under the Halibut Act. This fish is iced, handled, and transported by tender vessels over to Trident Seafoods in St. Paul where it is processed with another 400,000 pounds from St. Paul.

3.3 Sport

St. George does not have any known charter or lodge businesses, however, the opportunity to sell Bering Sea experiences to tourists is possible and would be better served with a fully functioning harbor. While there is an abundant opportunity for sport fishing and crabbing, the expense of travel and the difficulty of access limits participation.

3.4 Community Development Quota Program

The CDQ program was designed to provide a means for economically distressed communities in the Bering Sea/Aleutian Islands to generate capital that would, in turn, allow them to invest in Alaska's seafood industry to generate jobs and financial resources to build local economies. There are 67 communities (some 27,000 residents) that participate in the program; those communities formed six CDQ groups, more or less along geographical lines (St. Paul is the only single-community CDQ group). This section discussion allocations to APICDA as the CDQ Corporation for St. George.

3.4.1 Fisheries CDQ Allocations

APICDA receives a CDQ allocation of roughly 31,000 metric tons of groundfish and 315,000 pounds of crab to help support the communities of Akutan, Atka, False Pass, Nelson Lagoon, Nikolski, and St. George. These allocations generate over $12 million a year in royalties to APICDA. By quantity, the largest allocation is of pollock (19,400 metric tons). APICDA's pollock allocation is harvested 100% by trawl catcher processors.

The second most important species to APICDA is Pacific cod, for which they receive an allocation of slightly more than 3,000 metric tons. APICDA's Pacific cod allocation has nearly always been harvested by longline catcher processors. APICDA does retain the right to harvest Pacific cod using vessels other than longline catcher processors in order to meet community needs.

3.4.2 Crab Fishery CDQ Allocation

The catch limits and data collection from commercial vessels are done by the North Pacific Fishery Management Council (NPFMC) which is a program under National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Services (NMFS). The crab catch limits in the BSAI-management area are based on a complex set of regulations found in 50 Code of Federal Regulations (CFR) 680. The Total Allocated Catch (TAC) for the nine crab fisheries is divided into IFQ and CDQ. The CDQ is then further divided amongst the following community development corporations; APICDA, Bristol Bay Economic Development Corporation (BBEDC), Central Bering Sea Fishermen's Association (CBSFA), Coastal Village Region Fund (CVRF), Norton Sound Economic Development Corporation (NSEDC), Yukon Delta Fisheries Development Association (YDFDA) and the Adak Community Development Corporation (ACDC). Table C-4 below shows the percentage allocation of the different crab fisheries among the corporations for the period 2003-2015/16.

Of the 10% of Bering Sea catch that goes to the corporations listed above, APICDA is allocated 50% of St. Matthew Blue (SMB), 17% of Bristol Bay Red (BBR), 10% of Eastern and Western Bering Tanner (EBT and WBT), and 8% of Snow Crab (BSS), Western Aleutian Scarlet King (WAI), and Eastern Aleutians Golden (EAG).

APICDA supports the communities of Akutan, Atka, False Pass, Nelson Lagoon, Nikolski, and St. George. As such profits from APICDA CDQs for crab allocation is further divided to support the six communities. CDQ are divided among the communities based on population size. For St. George this is 7.9% (Colt, 2018).

	Percent allocation by group[a]						
Fishery	APICDA	BBEDC	CBSFA	CVRF	NSEDC	YDFDA	ACDC
Bristol Bay Red King Crab	17	19	10	18	18	18	0
Pribilof Red & Blue King Crab	0	0	100	0	0	0	0
St. Matthew Blue King Crab	50	12	0	12	14	12	0
Norton Sound Red King Crab	0	0	0	0	50	50	0
Eastern Bering Sea Tanner Crab	10	19	19	17	18	17	0
Western Bering Sea Tanner Crab	10	19	19	17	18	17	0
Bering Sea Snow Crab	8	20	20	17	18	17	0
Aleutian Islands Red King Crab (west of 179°W long)[b]	8	18	21	18	21	14	0
Eastern Aleutian Islands Golden King Crab (east of 174°W long)[b]	8	18	21	18	21	14	0
Western Aleutian Islands Golden King Crab (west of 174°W long)	0	0	0	0	0	0	100

[a] APICDA (Aleutian Pribilof Island Community Development Association).
BBEDC (Bristol Bay Economic Development Corporation).
CBSFA (Central Bering Sea Fishermen's Association).
CVRF (Coastal Villages Region Fund).
NSEDC (Norton Sound Economic Development Corporation).
YDFDA (Yukon Delta Fisheries Development Association).
ACDC (Adak Community Development Corporation).

[b] Aleutian Islands red king crab west of 179°W long and Eastern Aleutian Islands golden king crab east of 174°W long were not part of the CDQ program until the initiation of Crab Rationalization in the 2005/06 season.

Figure C-7: 2003-2015/16 Community Development Quota (CDQ) and Adak Community Allocation percent allocation by crab fishery to each group

While there has been 7.8 million to 20.3 million lbs. of crab harvested in the Bering Sea annually since 2007, for St. George CDQ this amount is multiplied by 10%, then by 8–50%, then by 7.9%. CDQ allocated amounts for St. George are only 62,000 lbs. on average, and despite a $120 million to $240 million industry depending on the year, the amount which St. George would get through the community development quota system, i.e. in the situation where APICDA directs all 62,000 lbs. to be processed in St. George and they keep all profits, is only $182,000 (on average). APICDA has the legal right (called the right of first refusal in 50 CFR 680) and can direct this amount of crab to be processed by a processor in St. George. This would create some jobs and benefits associated with Corps navigation improvements.

Furthermore, APICDA purchases individual fishing quota (IFQ). APICDA reported a four year average amount of red, snow, blue, and tanner crab, of both CDQ and IFQ, of approximately 2,424,000 pounds annually. This results in 192,000 lbs. for St. George,

and at a conservative $2.00 a pound average price across these species, results in the same profit as if the community got 1/6 of the CDQ allocation instead of 7.9% – $384,000. Therefore, the Corps' conservative estimate of the benefit from crab processing is $384,000 annually. APICDA's actual profit sharing practices with St. George (1/6th or 7.9%) will be verified prior to the Agency Decision Milestone.

4. GENERAL METHODOLOGY

This section describes the methods used to conduct the economic analysis of the proposed navigation improvements at St. George. The study was conducted and the report prepared in accordance with goals and procedures for water resources planning as contained in Engineer Regulation 1105-2-100, Planning Guidance Notebook, and the project authorization. Alternatives were examined for their feasibility, considering engineering, economic, environmental, and other criteria. The analysis follows implementation guidance for Section 2006 authorized projects as referenced in the Study Authority section.

Compilation of this report included a literature review of published information on the history, present status, and future prospects for harbor operations at St. George. Primary Data collection were conducted through personal interviews with local officials, harbor users and maritime specialists operating at St. George. Additionally, an Office of Management and Budget (OMB)-approved survey was distributed and completed by mail as well as in-person at the community with the Economics Team. Survey efforts encountered challenges to response rate and current arrangement of quota transfers at St. George. Data collection was strengthened through focus groups, personal interviews, and other follow-up research and data gathering.

Then, a selection and description of NED benefits and related construction and life cycles were made for the proposed alternatives that appear cost effective and achievable. For the NED analysis, average annual benefits are compared to average annual costs expected to be derived from each alternative evaluated. All costs were calculated using Fiscal Year (FY) 2018 (October 2017) price levels and then converted to Average Annual Equivalent values using the FY 2018 Federal discount rate of 2.750 percent, assuming a 50-year period of analysis.

NED benefits are assessed for the alternatives identified in the Project Alternatives section and follow the methodology for small boat harbor navigation analysis described in the Planning Guidance Notebook and other relevant Corps of Engineers regulations and policy guidance. Benefits equal the difference between without- and with-project costs associated with transportation delays, damages to vessels and harbor infrastructure, and enhanced access for commercial fishing and subsistence activities.

As previously noted, this study utilizes the authority of Section 2006 of WRDA, *Remote and Subsistence Harbors,* as modified by Section 2104 of the WRRDA of 2014 and further modified by Section 1105 of WRDA 2016. The authority specifies that in the absence of a NED Plan and/or the selection of a plan other than the NED Plan is based in part or whole on non-monetary units (Environmental Quality (EQ) and Other Social Effects (OSE) accounts, then the selection will be supported by a Cost Effectiveness/Incremental Cost Analysis (CE/ICA) consistent with ecosystem restoration evaluation procedures. The with- and without-project evaluation framework is similar for both the NED analysis and CE/ICA, and is described in subsequent sections as appropriate.

5. EXISTING CONDITIONS

The preceding Overview and Marine Resources sections discussed the facilities on St. George and current conditions of the harbor at Zapadni Bay. This section describes current conditions including vessel classifications and operations at the harbor.

5.1 Vessel Classifications

The following table presents the characteristics of existing and anticipated future fleet to call regularly at St. George.

Table C-5: Vessel Class Summary

Class	Dimensions	Entrance Wave	Dock Wave
Subsistence	28'L, 10'W, 4'D	4'	1.5'
Crabber	155'L, 38'W, 14'D	9.75'	1.5'
Barge & Landing Craft	200'L, 54'W, 10'D	3.3'	1.5'
Water Taxi	81'L, 24'W, 8'D*	9.75'	1.5'
Transient Vessels	244'L, 40'W, 27'D**	3.3'	1.5'

* Atka Pride's dimensions preliminary.
** Coastal Transportation's Progress and Nomad pass-pass freight vessels were used here.

5.1.1 Subsistence Vessels

The total number of subsistence vessels that operate at the harbor is between 8 and 12 depending on the year. Six of the subsistence vessels which consider St. George as home port are permitted to participate in longline fishing, mechanical jig and fish for miscellaneous finfish according to ADF&G. The longest vessel of this class is 28 feet, all and are under 230 horsepower. As indicated in the table above, entrance wave requirements for this vessel class into current harbor is a four foot wave at the entrance channel and approximately a 2 foot wave at the dock and boat launch, necessary to safely moor or trailer these vessels.

The best data available indicates that 206 lbs. of subsistence foods are harvested in the Aleutians per person annually (Fall, 2016). For St. George Island in 2017 with a

population of 72, this is 14,832 lbs. However, St. George may harvest more food per person than other communities in the borough. Next, understanding that not all subsistence harvesting activities are initiated by vessel, but considering that most are, an approximation is that 136 lbs. of food are harvested per day for each of the 109 days that Zapadni Bay harbor is usable in the summer. Given 8 to 12 subsistence vessels, this is 13.6 lbs. per boat per day.

The value of the haul is estimated by their replacement cost or closest substitute. It is what an island resident would likely pay for meat and other foods in a nearby grocery store. The prices of beef, pork, chicken, fresh fish, and other products were considered. Information from ADF&G suggests that the replacement cost is between $4.25 and $8.50 per pound; however, market price for halibut, porterhouse steak, king crab, or other premium meats is often higher than $8.50 a pound. Thus, USACE estimated the value of subsistence foods to have a minimum value of $4.25, a most likely value of $8.50, and maximum value of $24.86 (using store prices for premium meats in Alaska).[6] Vessel operating costs were then subtracted from the value of the harvest. This results in a value from $85,800 to $261,500 annually with 80% confidence.

5.1.2 Commercial Vessels

As indicated, numerous vessels harvest crab in the Bering Sea and Pribilof Island region. Commercial vessel operators were surveyed during the study. There is a total of 84 vessels with lengths ranging between 80 to 170 feet, between 24 and 46 feet wide and drafting 7.9 to 16.5 feet. Commercial vessels often seek safe refuge to escape extreme weather conditions or make repairs. The harbor entry requirement for this vessel class is a ~10 foot wave while requirement for safe moorage is a ~2 foot wave. There are 37 days in the winter and 12 days in the summer when entrance conditions exceed the vessel class criteria. While these vessels currently do not process crab harvests in St. George, with safer harbor access and moorage these vessels would bring in an amount of CDQ crab into St. George. From the crab density maps in Figure C-6 through Figure C-8, a general estimate is that fishing grounds are equally good in any direction from a midway point, halfway between St. George and St. Paul. The sailing distance from Zapadni Bay Harbor to the St. Paul Harbor is approximately 49.4 miles. Therefore, vessels south of the midway point (50% of the crab fleet), bypass St. George and travel to St. Paul to offload product currently. As very little of the fleet actually fishes between the two islands, the most likely distance for boats bypassing St. George to travel is 49.4 miles.[7] Bypass costs $5,000 to $25,000 to the fleet annually with 80% certainty. Additionally, APICDA currently transfers $181,900 to $383,800 of CDQ crab to St. Paul to be processed.

6 Obtained from Economic Value of Subsistence Activity Little Diomede, Alaska 2011 survey by Tetra Tech Inc.

7 A triangular distribution with a minimum bypass distance of 24.7 miles, a maximum bypass distance of 49.4 miles, and most likely bypass distance of 49.4 miles was used.

5.1.3 Barges, Tugs and Landing Craft

Barges and tug traffic bring fuel, freight, and construction material into St. George. Landing crafts are also occasionally used. Other tugs and barges can be seen sailing; by the north side of the island from time to time heading to St. Paul. For the fuel barge or tug it is set up as a line haul. Vessel dimensions for the primary barge for St. George are 180 feet in length, 54 feet wide and draft at 13 feet. However for maneuverability the fuel vessel only loads to 10' D and towed by a tug measuring 80'L, 25' W and 10'D.

According to an interview with the delivery company in 2017, the tug and barge wait for weather on the north side of the island or outside Zapadni Bay harbor until the tug can make up alongside the barge's hip and bring it in. This requires a 3 foot wave outside the harbor and is one of the limiting factors causing delays and increasing costs. With this configuration, the tug captain is able to maneuver the tug and barge past underwater pinnacles, shallows, and outer and inner breakwaters, and swing the barge into the inner basin. However, breaking waves near the harbor entrance or outside breakwaters, significant directional wind that would blow the barge sideways into obstacles (especially with the tug on hip limiting maneuverability), or seiche activity in the inner basin also delay delivery. The barge requires a 2 foot wave at the dock to unload.

The fuel barge and tug currently call on St. George two to six times a year. There are 100 days in the winter (October to March) when sea conditions are too rough to enter the current harbor, and there are 90 days in the summer (April to September) when the harbor is inaccessible. Additionally, there are 36 days annually when the 1.5 foot threshold inside the harbor is exceeded. If a barge was moored at the dock during these conditions, extreme pressure on the docks, cables, and bollards pulling and beating against one another could cause lines to break, and damages to the vessel and harbor infrastructure.

Occasional supply barges such as the "Lash 200" barge (200'L, 54'W, 10'D) bring construction equipment to St. George (such as during September 2013). The Lash 200 barge uses the same tug as the 180 foot long fuel barge above and requires the same harbor entrance and moorage conditions. The Lash 200 and intermittent construction vessels infrequently call on Zapadni Bay harbor. These vessels have the same constraints as the fuel tug and barge. Currently, these vessels make it into St. George zero to 1 time per year, with once every 5 years estimated as the average or most likely occurrence rate. The estimate was determined through discussions with Mayor Pletnikoff and the barge company. However, the SamB and LA B were obviously sailing to St. George quite a bit in 2016 and 2017. Inaccessibility and unsafe moorage days for freight vessels is the same as for the fuel barge above.

Interviewed stakeholders reported that weather attempted to be timed, but delays per trip were between zero and 20 hours. If delays were longer than 20 hours, the tug and barge would return to Dutch Harbor. In 2016 and 2017 Brice Marine sailed to St. George to deliver rock to conduct the breakwater repair previously discussed. An

articulated tug barge, the SamB (tug) with the LA B (barge), was used to push equipment and rock up onto shore within the Zapadni Bay inner harbor, then trucked it to the outer breakwater where it was “locked in” using a front-end loader. Figure C-7 and Figure C-8 show the barge and breakwater repair work in progress.

Figure C-8: Brice Hauling Rock

Figure C-9: Locking Armor Stone into the Breakwater

5.2 Vessel Damages

Vessel operating costs for these vessels averaged $369.43 per hour. Bypass and delay costs totaled $34,429 to $248,970 annually (with 80% confidence). This averages to $115,409 +/- $5,086 or a cost of $1,603 for each resident on the island (as much as 6.5% of each islander's total annual income). Damages to barges are estimated from $0 annually to their historic maximum of $64,000 annually.

In addition, it is not just getting into the harbor, but also getting out, especially when the barge is lighter and more susceptible to being moved around by the weather and sea. It is unknown if the barge has to pay a wharfage fee (or a per gallon fee) when in the harbor and offloading, but, "all delay costs are passed on to the consumers on the island."

5.3 Crab Fishery Outlook

Given the significant crab fishery economic opportunities across the region and the currently unrealized profits at St. George due to harbor inaccessibility and lack of processing facility. Analyses on the outlook of crab fishery is conducted here utilizing limited data available at present.

The outlook for the crabbing industry is largely a function of managing the stock to maintain its stability. A crab handling or processing facility would process any amount of

crab that St. George could bring in. This amount is dependent on management institutions and quotas previously described in the CDQ Program.

NOAA's Alaska Fisheries Science Center- Shellfish Assessment Program provides a representation of location and amount of snow crab (*Chionoecetes opilio*) in the Pribilof Islands region in 2017. These figures are only meant to be illustrative – depicting that millions of crab are everywhere around St. George. As indicated by the Map legend, Stars represent more than 100,000 animals in an area, where large circles represent 10,000 to 100,000 animals, medium sized and small circles represent 100 to 10,000 animals.

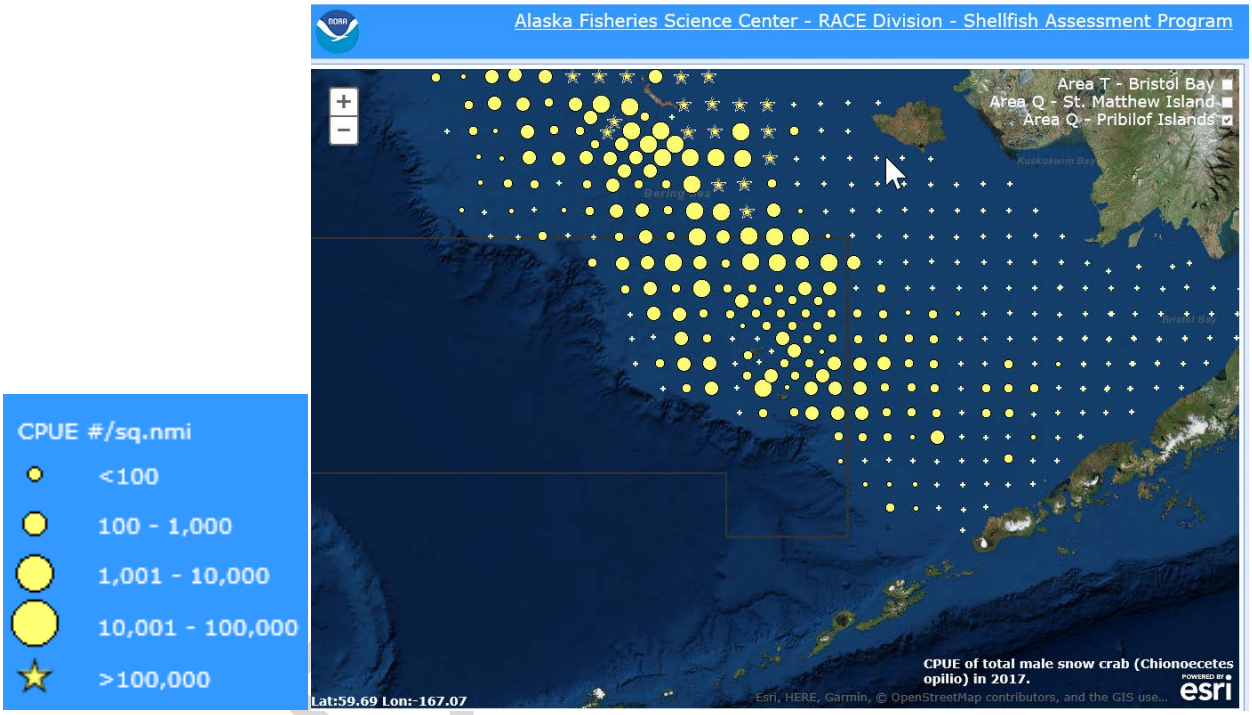

Figure C-10: Snow Crab numbers across the Bering Sea, 2014-2017

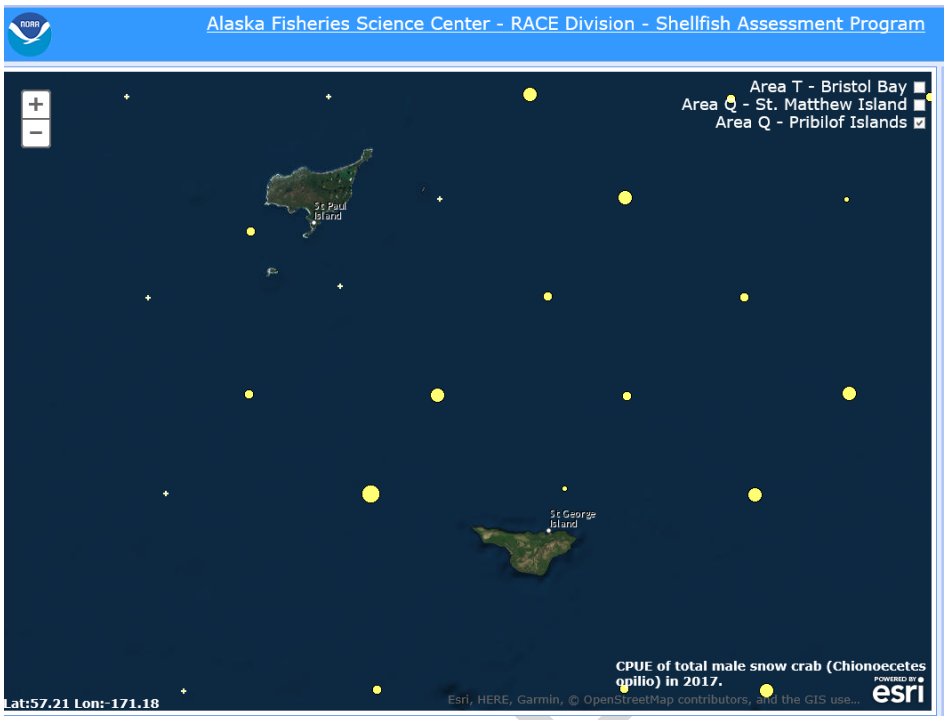

Figure C-11. Snow Crab numbers in close proximity to St. George, 2017

In practice it is the established Total Allowable Catch (TAC) rather than the number of crabs observed to be available provides a clearer outlook of the crab fishery. The following tables assess the harvest values for select species from the Bering Sea from 20017-2016. Table C-6 shows an example of the allowable catch amounts of Bristol Bay Red king crab for the period analyzed, and the exvessel value of that catch

Table C-6: Example - Bristol Bay Red King Crab Annual Catch and Harvest Value

Bristol Bay Red King	Total Allowable Catch	Harvest	%	$/lb.	Total (Millions)
2016	9,974,000	9,969,964	100.0%	$7.03	$68.8
2015	9,986,000	9,987,008	100.0%	$6.05	$59.8
2014	8,600,000	8,600,476	100.0%	$6.36	$54.4
2013	7,853,000	7,849,835	100.0%	$7.27	$56.9
2012	7,834,000	7,833,594	100.0%	$8.96	$69.9
2011	14,839,000	14,833,828	100.0%	$6.28	$92.5
2010	16,009,000	15,932,654	99.5%	$4.43	$70.1
2009	20,364,000	20,329,402	99.8%	$4.98	$100.4
2008	20,383,000	20,366,065	99.9%	$4.15	$84.0
2007	15,527,000	15,616,816	100.6%	$3.45	$52.8

While the price for red king crab varied from $3.45 per pound to $8.96 per pound depending on the year, 99.5% to 100.6% of the catch was harvested each season.

Additionally, the decline in supply from 2011 to 2012 was nearly 7 million lbs.; however, in response, an increase in price can be seen indicating price elasticity.

Under BSAI, nine crab fisheries were looked at: Bristol Bay Red king crab (BBR), Bering Sea Snow crab (BSS), Eastern Aleutian Golden king crab (EAG), Eastern Bering Sea Tanner crab (EBT), Pribilof Island King crab (PIK), St. Matthew Island Blue king crab (SMB), Western Aleutian Golden king crab (WAG), Aleutian Island Red King Crab (WAI), and Western Bering Sea Tanner crab (WBT). Only BBR, BSS, EAG, and WAG were open every year of the period analyzed, indicating that some stocks of crab could be at-risk populations.

Table C-7 shows the total Bering Sea harvest for the 2015/2016 fishing season.

Table C-7: Example – 2015/2016 Crab Fishery Value

2015/2016					Reported Exvessel Value	
Fishery	**Total Allowable Catch**	**Harvest**	**%**	**Deadloss**	**$/lb.**	**Total (Millions)**
BBR	9,974,000	9,969,964	100.0%	182,833	$7.03	$68.8
BSS	40,611,000	40,611,446	100.0%	379,167	$1.97	$79.2
EAG	3,310,000	3,302,480	99.8%	53,160	$3.64	$11.9
EBT	11,272,000	11,263,562	99.9%	120,187	$2.19	$24.4
PIK	Fishery Closed					
SMB	411,000	106,449	25.9%	1,439	$4.03	$0.4
WAG	2,980,000	Confidential	N/A	Confidential	$3.25	$7.0
WAI	Fishery Closed					
WBT	8,396,000	8,378,816	99.8%	52,546	$2.19	$18.2
Total	76,954,000				$3.47	$209.9

Based on accessible and available data, the total exvessel value ranged from $120 million to $240 million from 2006/2007 to 2015/2016. These are the profits made by fishing vessels and processors. While St. Matthew blue king crab had less than full effort to harvest the total allowable catch in the 2015/2016 example above, this was an outlier, and most fisheries, in most years, saw close to 100% of the allowable catch harvested.

Despite current and historic closures of some fisheries, and catch limits in the region, the crabbing industry in the Bering Sea is sustainable. Over the 50-year period of analysis considered for the St. George navigation improvements project, the total biological stock available is expected to vary from year-to-year, but is considered stable overall.

5.3.1 Sport Fish

The island does not have any charter or lodge businesses however, the opportunity to sell Bering Sea experiences to tourists is possible and would be better served with a fully functioning harbor. Local sport fishing is nearly non-existent; for example, even if fish are caught by locals during an open sport season, they are usually caught for a subsistence need. This differs from other regions in Alaska, but not from most Alaskan villages that are smaller in size.

While there is an abundance of opportunity for sport fishing and sport crabbing, the expense of travel and the difficulty of access limits participation.

5.4 Transportation

The use of a water taxi or inter-island ferry service was explored in 2015 by APICDA. The F/V Atka Pride could transport six passengers (at $100 one way for residents, or $300 for non-residents) and 30,000 lbs. of goods.

Figure C-12: FV Atka Pride, Used for an Inter-Island Ferry Service

5.4.1 Water Taxi

There is demand for a water taxi or inter-island ferry service; however, this vessel class is only made up of the Atka Pride at this time. Mayor Pat Pletnikoff mentioned interest in a 58' to 60' catamaran, but it's unlikely that such a vessel will be employed (kmxt.org, 2015). As such, the water taxi's safe entrance and moorage requirements are the same as crabbing vessels.

5.4.2 Transient Vessels

Cod and pollock fishing vessels are nearby as discussed in 3.2.2.4. Additionally, a pass-pass cargo barge sails to St. Paul and is known to be in the area; however, it drafts -27 ft. (is usually loaded to -22 ft.) and freight can be brought into St. George by other means.

5.1 Fuel and Freight

The Alaska District anticipates that a project which could lower fuel and freight cost may increase fuel and freight quantity ordered; however, survey instruments and focus groups were not successful in determining the response to lowered prices. At the same time, it is expected that shipping companies would be able to respond to any increase in demand for fuel and freight ordered.

For heating oil, the most conservative assumption is that homes are heated to the level of warmth comfortable for a family and thus no price elasticity exists. Other energy sources are similar, except for when used in vehicles or for subsistence purposes. In these cases, more diesel and other energy would be purchased in line with lower prices and the availability of increased safe access to resources from a harbor.

Residential construction material purchases could also increase with easier and less expensive importation. Similarly, purchases of durable goods and household furnishings may increase. Barge service to bring in large items like new private vehicles (including skiffs) has been rare in the past several years, but their demand is unknown. Non-perishable foods and dry goods, are also expected to increase, potentially by 500 lbs. per week, if a freight service was established and could replace expensive air transportation for these goods.

Fuel and freight in total metric tons received is shown in the table below. This table does not include fish. Other data, such as fuel deliveries and recent construction materials, also appears to be lacking, but what this table could show is the range of demand historically:[8]

[8] The Lash 200 called on St. George in 2013, and Brice in 2016. Presumably, the community needs fuel every year, so any year where zero metric tons are reported are in error.

Table C-8: Example - Commodities Transported (in Metric Tons)

Waterborne Commerce Statistics Center Reported Commodities Received	
Year	**Metric Tons**
1998	539
1999	7382
2000	35153
2001	97700
2002	599
2003	1112
2004	967
2005	513
2006	5056
2007	0
2008	0
2009	206
2010	678
2011	797
2012	10805
2013	0
2014	0
2015	0
2016	0

5.2 Infrastructure Damages

5.2.1 Harbor

The harbor currently suffers damages from storms. Operations and maintenance expenses were financed in 1994 and 1995 for $30,500 and $1,991,300. Repairs were needed, but never occurred. The cost of 2006 and 2008 breakwater repairs (from the 2004 storm) was $8 million. The cost of 2016 and 2017 breakwater repairs (from the 2015 storm) was $14 million. The economic cost of repairs is estimated to be $724,800 annually.

5.2.2 Other

The fish handling facility and former crab processing facilities are in disrepair due to non-use. The tank farm and gas pumps potentially need maintenance as they have rust damage. St. George's windmill is currently inoperable and likely needs complete replacement. The status of other infrastructure is unknown, but again, infrastructure projects could benefit from reduced transportation costs stemming from a harbor project.

6. FUTURE WITHOUT PROJECT CONDITIONS

The future without project (FWOP) conditions mirror those under the Existing Conditions. Absent USACE action, it is unlikely that another entity will take action to improve the harbor due to budgetary constraints. FEMA will only make repairs to restore the harbor to its "as-built" condition, not make improvements. The expected without project conditions form the basis of evaluation against which FWP conditions are compared.

Harbor Operations. The Harbor will continue to be severely underutilized, inaccessible with limited safe moorage days as described in the existing conditions for all vessel classes.

Harbor Damages Infrastructure damages at Zapadni Bay are expected to continue to occur from storms in the frequency and severity of the existing condition. Repairs by FEMA are also expected continue.

Out-Migration. As the cost of essential goods remain high as a result of few barge deliveries coupled with dwindling economic opportunities, St George residents will continue to out migrate for better opportunities.

Fuel and Energy Prices The fuel service barge will continue to experience delays at the same frequency as the existing condition; however, the U.S. Energy Information Authority expects the cost of marine diesel to increase throughout the period of analysis. In their 2018 Annual Energy Outlook there are three scenarios: a low price case of $2.56 in 2050, a reference case of $4.13 in 2050, and a high price case of $7.02 in 2050. These price increases were included in the future vessel operating costs and delays to St. George. With cost growth, total delays for the FWOP scenario were then calculated to be $2,694,865 ± $59,977 (80% CI) in present dollars. This is $33,436 in delays annually.

Vessel Damages. Damages to vessels entering Zapadni Bay Harbor are currently unknown, but without harbor improvements they could be as much as the historical maximum of $64,000.

Unrealized Crab Fishery Benefits. The value of CDQ crab allocated to APICDA and intended for St George is estimated at approximately $384,000 annually. Without a project, this will continue to be delivered to St. Paul for processing.

7. FUTURE WITH PROJECT CONDITIONS

The following section describes the anticipated conditions at St. George assuming that a project has been constructed. The expected changes in the operating procedures at the harbor are the basis for the economic analysis.

Several critical assumptions were made when conducting the future with-project economic analysis. Chief among them is that the existing fisheries in the region will continue to support the fleet. This is a critical assumption supported by the fact that all fisheries present in the St. George area are highly regulated in order to assure future viability of the resource.

It is also assumed that a quota portion of the Bering Sea commercial crab and fish catch would be transferred back to St. George (currently all of this quota is processed in St. Paul).

The value of CDQ crab allocated to APICDA and intended for St George is estimated at approximately $384,000 annually. Without a project, it is expected that this catch would continue to be delivered to St. Paul.

7.1 Project Alternatives

Eleven alternatives were initially considered in the final array – one Alternative being No Action. Details can be found in the Main Report and in the Hydraulics and Hydrology, and Cost Appendices. Alternatives listed here focus on the important features that contribute to costs and benefits.

Perhaps the most important variable is the location of the harbor on the north or south side of the island. Wave conditions on the north side of the island indicate that a smaller breakwater height and smaller armor rock (A Rock) (in weight or tons) can be used. North alternatives are referred to as N-1 through N-3, whereas south island alternatives are referred to as Z-1 through Z-7 for Zapadni Bay. Next, some designs require more material removal and are less dependent on breakwaters. This factor also changes the cost of designs.

Most designs accommodate a 14’ vessel draft, a 200’ length (LOA), and a 54’ width. This accounts for all vessel classes (and 85% of the crabbing fleet). Three designs, N-1, Z-4 and N-2 differ. N-1 supports only the subsistence fleet. Alternatives Z-4 and N-2 support only the fuel and freight fleet. The anticipated fleet for each design is discussed below.

7.1.1 No Action

The no action alternative does not improve harbor conditions. Access, use, moorage, damages, and delays are those described in the FWOP condition. There are no additional costs for this alternative.

7.1.2 Alternative Z-1 – Altered Navigation

Alternative Z-1 (Figure C-13) includes constructing an 800 foot long extension to the existing south breakwater with a crest elevation of +35 feet MLLW, a 500 foot jetty off the existing north breakwater with a crest elevation of +10 feet MLLW, three 1,000 foot long submerged reefs with crest elevations of -12 feet MLLW, a new inner breakwater

with a crest elevation of +20 feet MLLW with a spending beach sloped at 10H:1V, and a new navigation channel with a depth of -22 feet MLLW. A new turning basin with a depth of -20 feet MLLW is also part of the design. This alternative re-routes vessel traffic to the north end of the harbor in an attempt to reduce the occurrence of storm waves entering the harbor from the southwest direction.

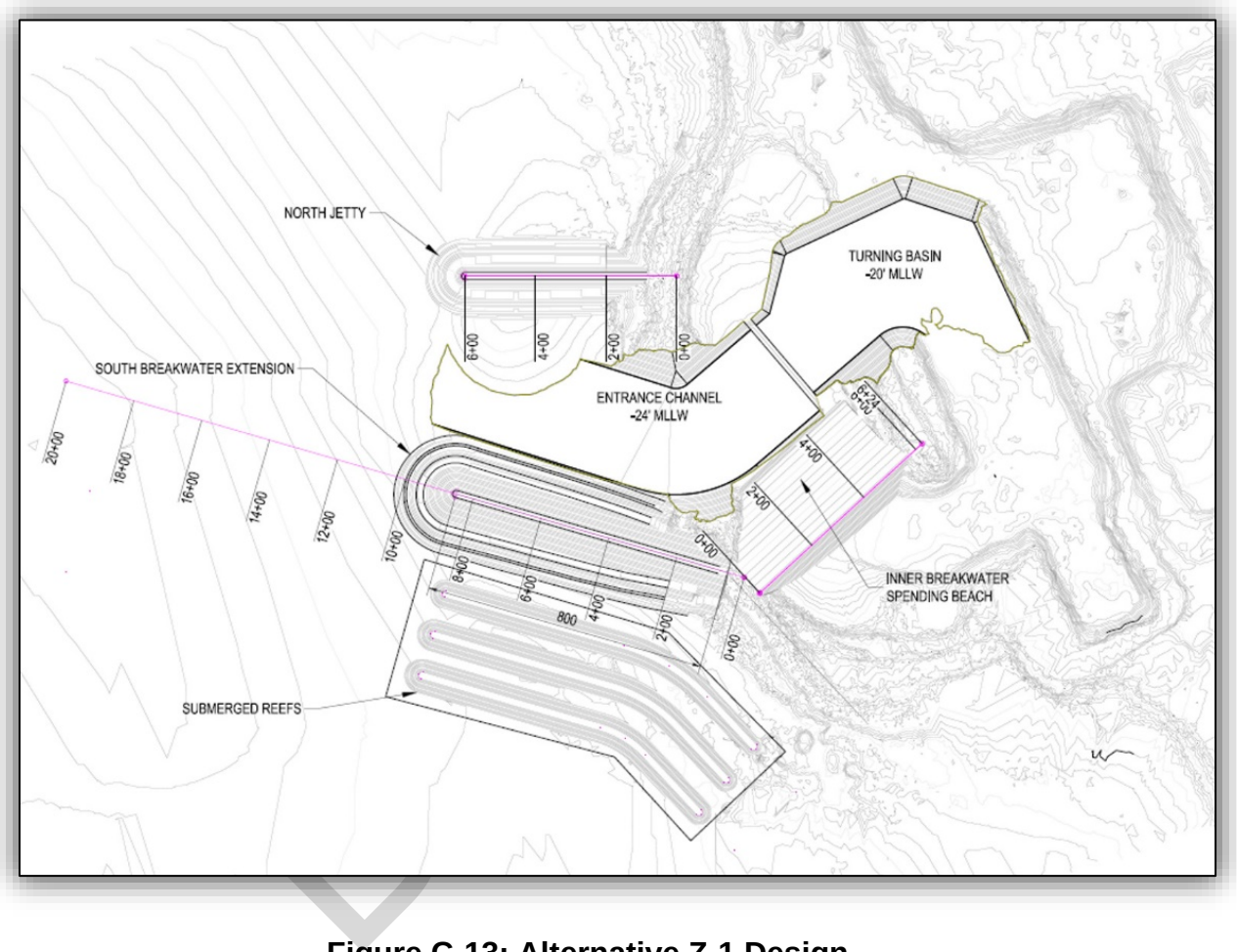

Figure C-13: Alternative Z-1 Design

Construction of this alternative would take two seasons (or 24 months). This alternative expects to drill/blast/dredge 234,858 CY of material from the existing harbor site. It uses 142,223 CY of 60,000 lb. armor rock (A Rock). Numerous other features such as B Rock, C Rock, and reef material add a large amount to the overall cost and can be found detailed in the Cost Engineering Appendix. The rough order of magnitude (ROM) present value cost estimate for this alternative, with interest during construction (IDC) and O&M is $169 million. The average annual cost is $6.0 million.

This design would reduce FWOP infrastructure damages to the Zapadni Bay harbor by $724,800 annually, but annualized O&M for dredging and rock replacement (22,000 CY every 5 years for dredging, and 2.5% A Rock replacement every 25 years) was

estimated to be $2.1 million, thus exceeding the benefit. It should be noted that most of the O&M cost is mob/demob.

Alternative Z-1 was modeled with FUNWAVE (as described in the Hydraulics Appendix) to ascertain when conditions in the Z-1 harbor would meet the wave height thresholds for safe access and moorage for the different vessel classes anticipated for the Z-1 harbor. The anticipated fleet for this design is all of the vessel classes specified in Section 5.1. However, this design provided zero additional safe access days and zero additional safe moorage days. If this alternative was constructed, St. George would claim their first right to crab quota; however, due to the continued risk of vessel damages, deliveries would not be made.

Since this alternative does nothing to reduce vessel delays or damages, this alternative is eliminated from further consideration.

7.1.3 Alternative Z-2 – North Overlap

Alternative Z-2 (Figure C-14) constructs a 1,050 foot long cap and extension to the existing south breakwater with a crest elevation of +35 feet MLLW, a 400 foot jetty north of the new breakwater with a crest elevation of +10 feet MLLW and a new navigation channel and turning basin. The navigation channel has a depth of -22 feet MLLW and the turning basin has a depth of -20 feet MLLW. The existing north breakwater would be demolished to allow vessels to pass through this area. The construction provides a breakwater overlap of the inner harbor facilities in attempt to provide improved protection to the existing docks.

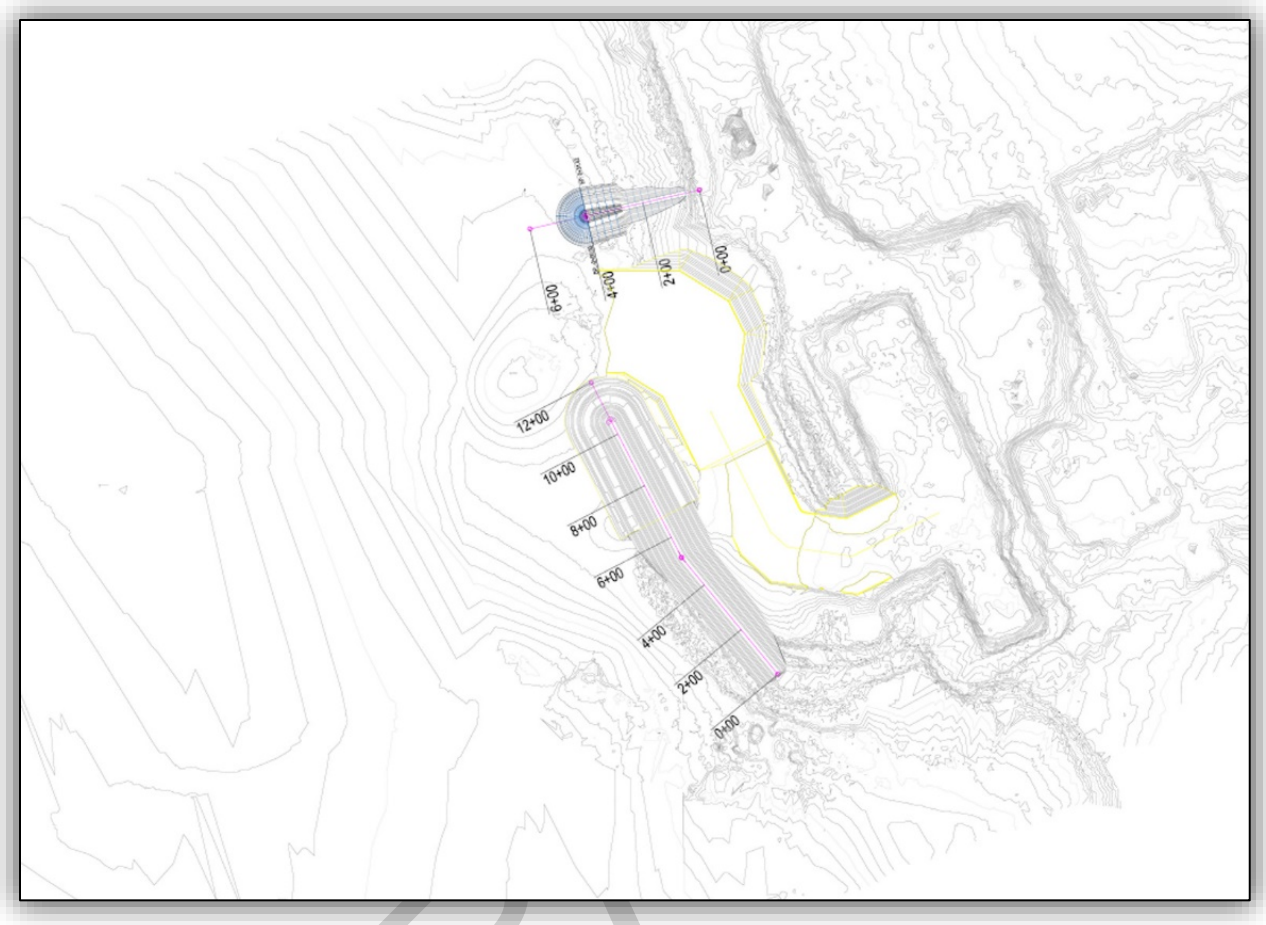

Figure C-14: Alternative Z-2 Design

Construction would take two seasons (or 24 months). Drilling, blasting, and dredging (including demolition) would remove 290,075 CY of material. New A Rock needed would be 124,490 CY of 60,000 lb. (30 ton) rock. Other details are in the H&H and Cost Appendixes. The ROM PV cost is $114 million and the average annual cost is $4.0 million.

This design would reduce FWOP infrastructure damages to the Zapadni Bay harbor by $724,800 annually, but annualized O&M for dredging and rock replacement (22,000 CY every five years for dredging, and 2.5% A Rock replacement every 25 years) was estimated to be $2.1 million – exceeding the benefit. Again, most of the O&M cost comes from mob/demob.

The anticipated fleet for this design is all vessel classes specified in Section 5.1. However, this design provided zero additional safe access days and zero additional safe moorage days according to FUNWAVE modeling. This alternative therefore, does nothing to reduce vessel delays or damages and is eliminated from further consideration.

7.1.4 Alternative Z-3 – Inland Basin

Alternative Z-3 (Figure C-15) constructs a new 700 ft. long by 500 ft. wide mooring basin to the northeast of the existing harbor. The new basin would be connected to the existing harbor by a navigation channel. Excavation of the new basin includes constructing a road around its perimeter to allow vehicles to traverse the perimeter of the harbor. The north end of the existing inner basin and the new inner basin would be sloped at 5H:1V to reduce wave reflection. The existing harbor breakwaters would remain in their existing condition and the existing channel would be widened to a minimum of 200 feet at the head of the inner breakwater and dredged to a depth of -22 feet MLLW.

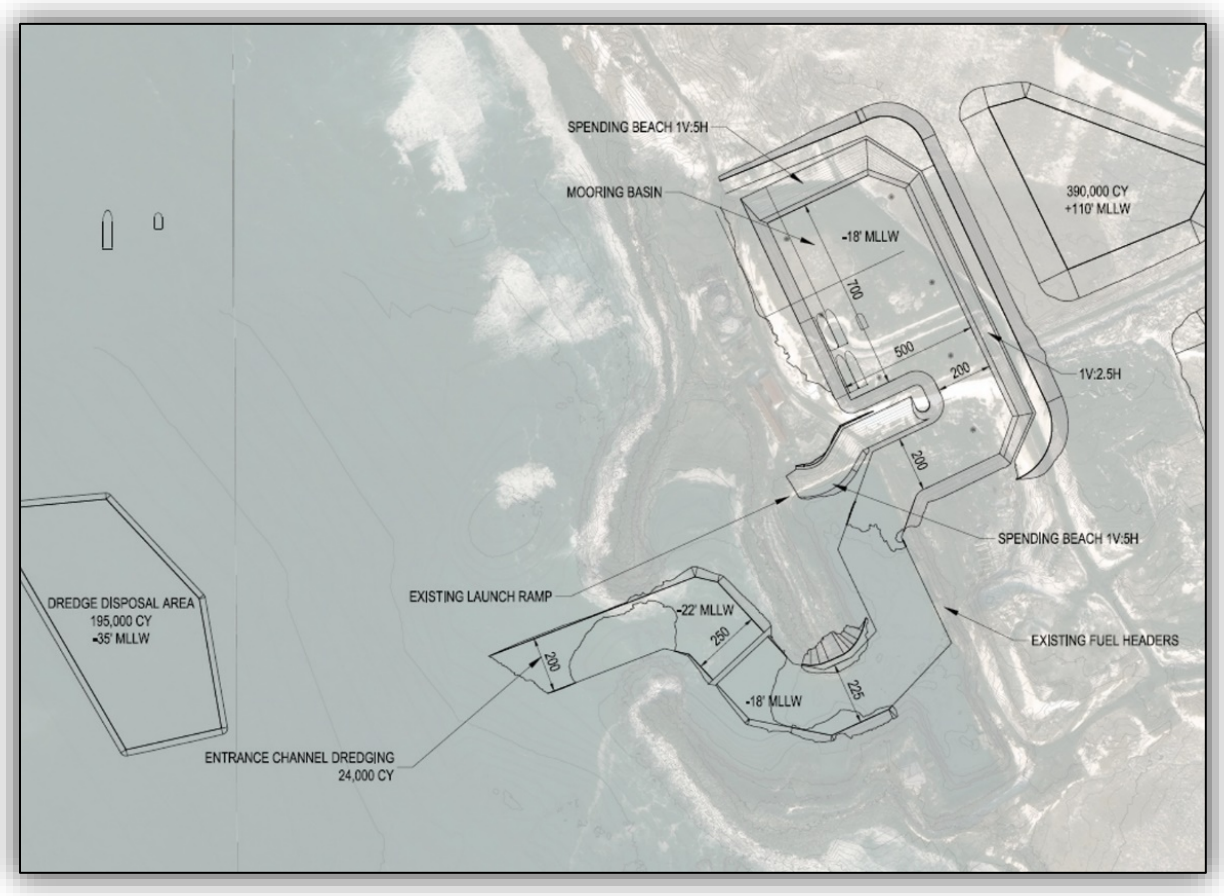

Figure C-15: Alternative Z-3 Design

Excavation quantities for this alternative are approximately 2 million CY of material. Other details can be found in the H&H and Cost Appendixes. The ROM PV cost is $101 million or $3.6 million annually. Construction would take two seasons (or 24 months).

This design would not reduce FWOP infrastructure damages. There would still be a repair cost of approximately $724,800 annually. Additionally, 22,000 CY of material would need to be removed every 5 years. Mob/demob for O&M dredging is less expensive than the other alternatives due to upland access; however, the majority of

O&M cost is still mob/demob. O&M dredging is $1.6 million annually (in addition to the $724,800 expected repair costs for the outer breakwaters). Total OMRR&R is therefore $2.5 million. Cost risk will be added to this figure at a later time.

This design does not provide for improved access, but it does provide 13 calendar days of additional safe moorage. This opportunity is provided for all five vessel classes: fuel, freight, subsistence, crabber, and water taxi. Therefore, total safe access and moorage gained is 13 times 5, or 65.

This design is not expected to reduce delays; however, it would reduce damages to vessels, bollards, lines, and dock faces etc. The annual probability of damage reduction is 3.6%. Annual damages therefore reduced are between $0 and $2,304.

This design does achieve project depths for a greater portion of the crabbing fleet. And while delays for the crabbing fleet are the same as in the FWOP condition, for Alternative Z-3, St. George would get a regional transfer from St. Paul by claiming their first right to CDQ crab quota. This benefit is $383,800 annually. For deliveries of this amount of crab, there are also transportation cost savings for the fleet (those described in Section 5.1.2). Travel cost savings for crabbers delivering product to St. George instead of St. Paul is estimated to be between $5,000 and $25,000 annually.

Separate from the travel cost savings pictured above, total NED benefits have a mean of $14,158 annually +/- $466.

Increased safe access and moorage days is 65 over the FWOP condition. This can be thought of as a total opportunity increase. Z-3 provides additional safe moorage for each vessel class: 13 days for the fuel barge, 13 days for freight, 13 days for subsistence, 13 for crabbers, and 13 days for the water taxi. This alternative is carried forward for further analysis.

7.1.5 Alternative Z-4 – OHC

Alternative Z-4 (Figure C-17) was adapted from the plan developed by the State of Alaska Department of Transportation and Public Facilities (ADOT&PF) and HDR Inc. prior to initiation of the USACE feasibility effort. The plan was then modified to meet revised navigation requirements for the fuel barge; however, the parallel jetties still pose an impediment for the barge to clear the outer breakwaters. This alternative includes constructing 400 foot long jetties at the ends of the north and south breakwaters with a crest elevation of +35 feet MLLW, a 500 foot inner north breakwater with a crest elevation of +20 feet MLLW, and a north mooring basin with a depth of -10 feet MLLW.

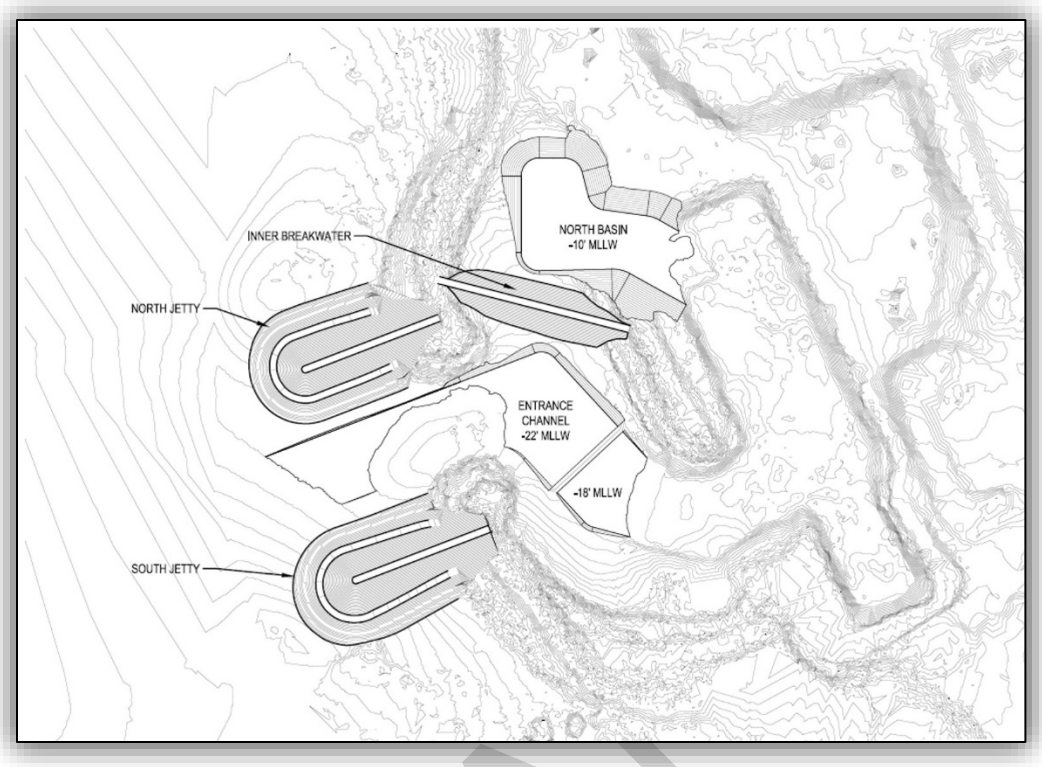

Figure C-16: Alternative Z-4 Design

90,003 CY of 30 ton rock and 96,402 CY of dredged material would be needed for this alternative. Additional details can be found in the other appendixes. The ROM PV cost is $104 million, $3.7 million annually.

This design would reduce FWOP infrastructure damages to the Zapadni Bay harbor by $724,800 annually, but annualized O&M for dredging and rock replacement (22,000 CY every five years for dredging, and 2.5% A Rock replacement every 25 years) was estimated to be $2.1 million – exceeding the benefit. The design provided zero additional safe access days and zero additional safe moorage days according to FUNWAVE modeling. This alternative therefore, does nothing to reduce vessel delays or damages. This alternative is eliminated from further consideration.

7.1.6 Alternative Z-5 – Outer Breakwater

Alternative Z-5 includes demolishing the existing south breakwater and constructing a 3,000 foot long breakwater from the ice plant to an overlap position seaward of the existing north breakwater with a crest elevation of +35 feet MLLW. A 300 foot long extension of the north breakwater would be constructed with a crest elevation of +20 feet MLLW perpendicular to the new breakwater to define the mooring basin behind the new breakwater. New docks would be constructed on the inside of the new main breakwater with the entire basin enclosed by the new breakwaters being dredged to -22

feet MLLW. The back slope of the existing inner harbor would be filled at a 10H:1V slope to provide a spending beach in the new mooring basin.

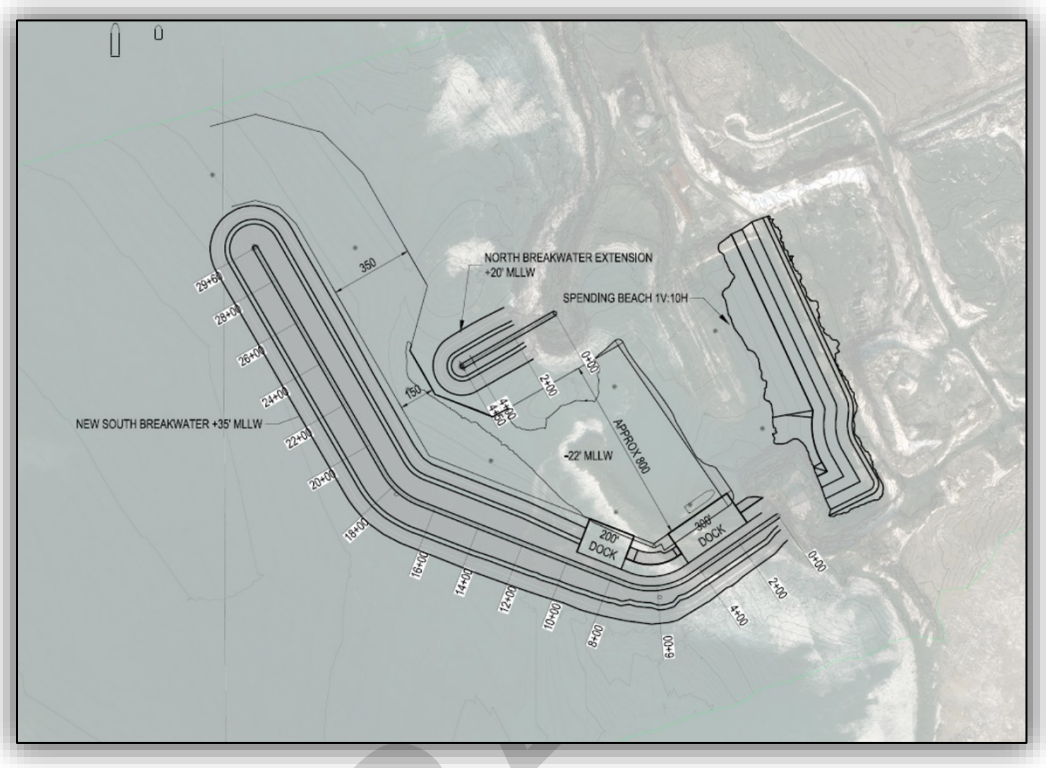

Figure C-17: Alternative Z-5 Design

This alternative is two to four times as expensive as most others. It requires 447,012 CY of A Rock. More details can be found in the other appendixes. The ROM PV cost is $404 million, $14.3 million annually.

This design does provide a reduction of FWOP infrastructure damages of $724,800 annually. It also provides increased safe moorage at both docks. This reduces potential annual damages to vessels of 5.2% and 8.3% respectively at each dock. If this harbor was constructed, St. George would claim its right to CDQ quota resulting in a regional transfer of approximately $383,800 annually. Additionally, travel cost savings for the crabbers delivering product to St. George would equal about $13,000 annually. Resulting Annual NED benefits are therefore $911,400 to $946,600. Increased safe access and moorage days (the total opportunity increase) is 190 days over the FWOP condition when the safe moorage increase is multiplied across all vessel classes. This alternative is carried forward for additional analysis.

7.1.7 Alternative Z-6 – Berm Breakwater

Alternative Z-6 was adapted from the original design for St. George Harbor developed in 1984; modified to include the existing inner harbor. The inner harbor was modified by filling the north and south ends in at a 10H:1V slope to reduce wave reflection.

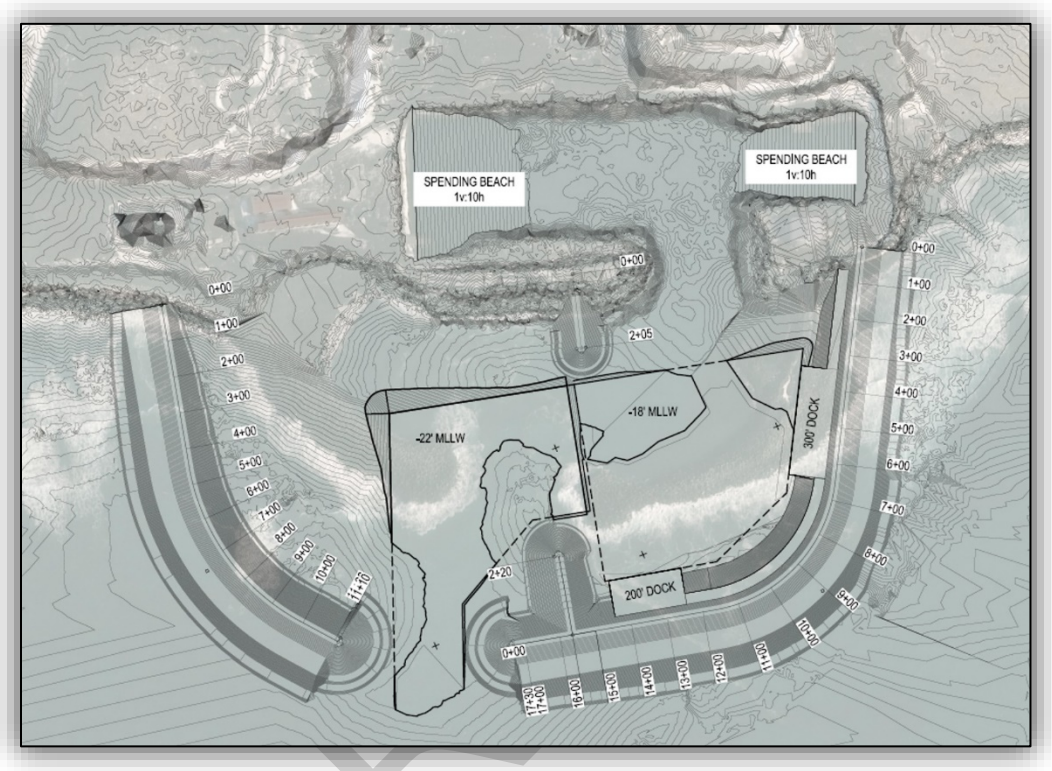

Figure C-18: Alternative Z-6 Design

30 ton rock needed equals 327,870 CY contributing to the ROM PV cost of $181 million or $6.3 million annually. Additional details on design and cost can be found in the other appendixes.

This design would reduce FWOP infrastructure damages to the Zapadni Bay harbor by $724,800 annually, but annualized O&M was estimated to be $2.3 million – exceeding the benefit. The design provided zero additional safe access days and zero additional safe moorage days according to FUNWAVE modeling. This alternative therefore, does not reduce vessel delays or damages and is eliminated from further consideration.

7.1.8 Alternative Z-7 – Half Moon Harbor

Alternative Z-7 includes constructing a new 900 foot radius semi-circular mooring basin into the eastern edge of the existing inner harbor. The side slope of the new basin would be 10H:1V to reduce reflection in the mooring area. Excavation of the new mooring basin included excavation to construct a road around its perimeter. The

existing harbor breakwaters would remain in their existing condition and the existing channel would be widened to 200 feet at the head of the inner breakwater and dredged to a depth of -22 feet MLLW.

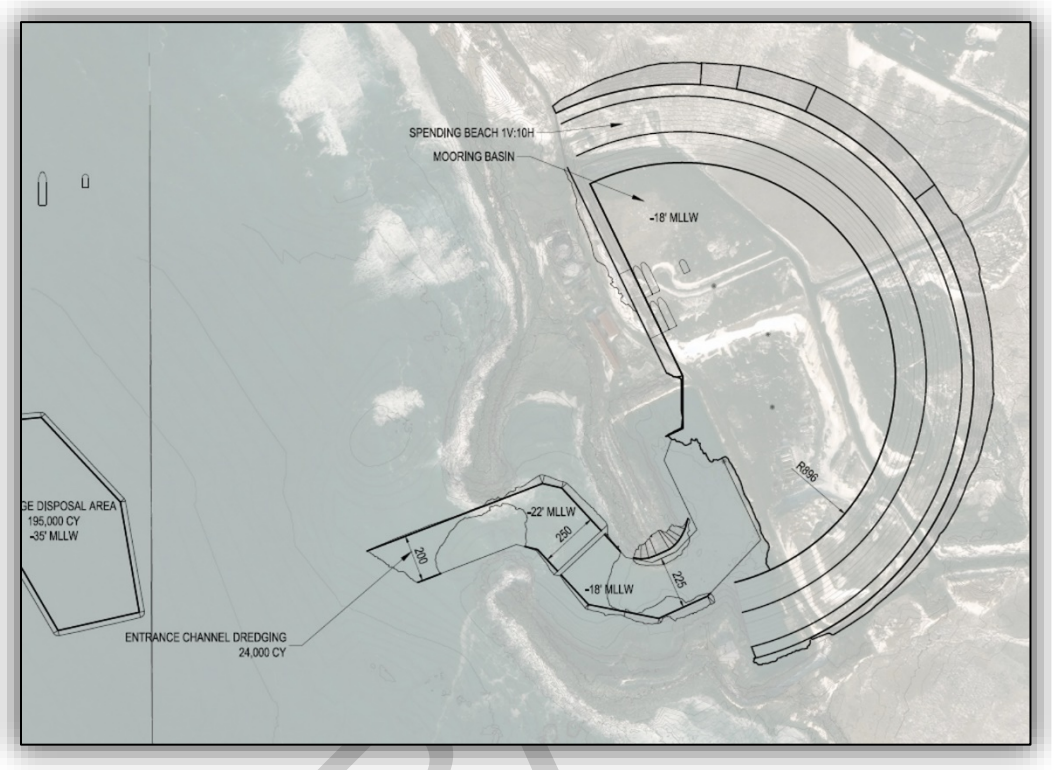

Figure C-19: Alternative Z-7 Design

Excavation quantities for this alternative are approximately 6 million cubic yards of material. Costs are $196 million, $7.0 million annually (as a rough order of magnitude in present value including interest during construction and estimated O&M).

Z-7 provides 26 increased safe moorage days annually. This reduces potential annual damages to vessels of $0 to $4595, provides a regional transfer of crab quota worth approximately $384 K, and travel cost savings for crabbers of about $13 K annually. Increased safe access and moorage days (opportunity increase) is 131 days for all vessel classes. This alternative is carried forward.

7.1.9 Alternative N-1 – Subsistence Vessel Launch Harbor

Alternative N-1 is a subsistence vessel launch harbor with a 775 foot long breakwater, a 700 foot long entrance channel dredged to -10 feet MLLW with a launch zone dredged to -8 feet MLLW. Subsistence vessels use the harbor through concrete launch ramp to -5 feet MLLW providing full tide access for launching. Approximately 1.6 acres of uplands support vessel preparation and launching operations.

Figure C-20: Alternative N-1 Design

This alternative is about three times less expensive than other alternatives, but it only supports skiffs and halibut vessels. Dredging the channel for this alternative requires removal of 10,015 cubic yards of material as well as 19,488 CY of A Rock. However, armor stones for alternatives on the north side of the island are only 10 ton, so the cost per cubic yard is reduced when compared to Zapadni Bay alternatives. The ROM PV cost for N-1 is $34 million, which equates to $1.2 million annually.

Fuel (and occasional freight or construction materials) would still have to come into Zapadni Bay; therefore, Zapadni Bay harbor would still need repairs averaging $724,800 annually. N-1 would provide additional safe access and moorage for subsistence vessels, 29 days annually. The increase this design provides, occurs in the summer, when the majority of subsistence vessel activity is occurring. Economic rationality stipulates that, on average, hours spent subsisting are at least worth their hourly cost. Vessel operating costs for vessels in the subsistence vessel class (which includes commercial halibut vessels) are $23.03. This indicates that Alternative N-1 could provide a subsistence opportunity equivalent to a value of $43,700 annually. Some reduced damages to vessels currently operating out of Zapadni Bay are also expected. This alternative is carried forward for further analysis.

7.1.10 Alternative N-2 – Subsistence Fleet and Fuel Barges

Alternative N-2 consists of a 450-foot wide by 550-foot-long mooring basin dredged to -16 feet MLLW protected by a 1,730-foot-long north breakwater and a 250-foot-long stub breakwater at the west edge of the basin. The basin connects to the Bering Sea with a 250-foot wide navigation channel dredged to -18 feet MLLW.

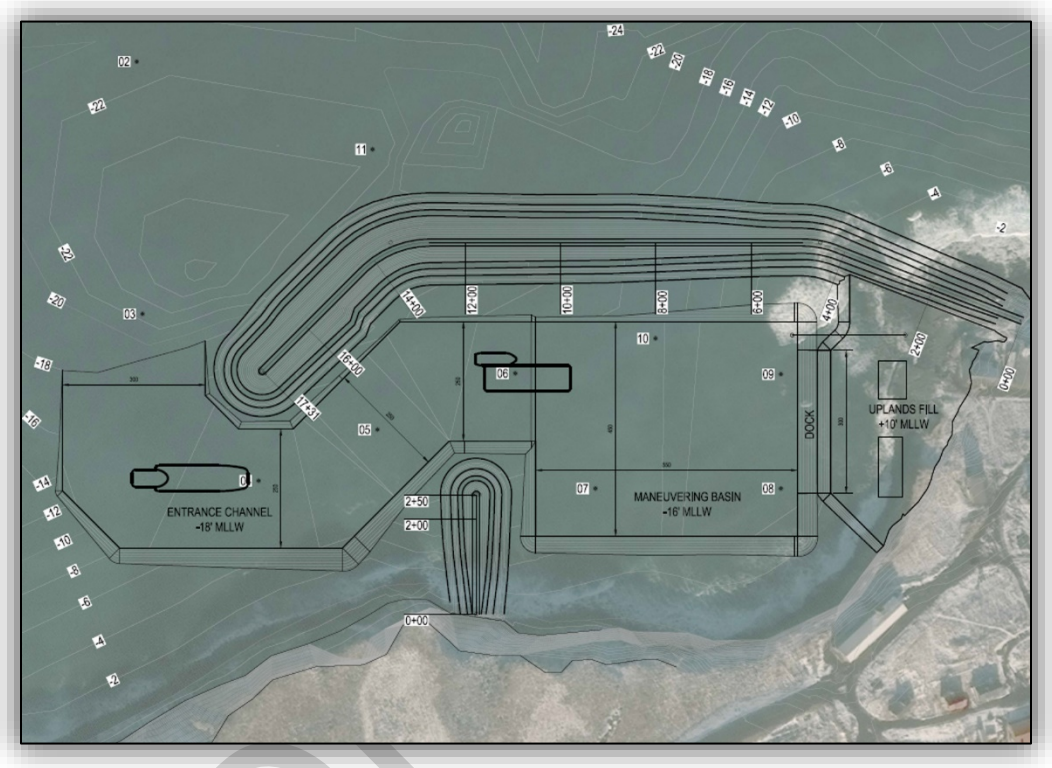

Figure C-21: Alternative N-2 Design

Dredging the channel and basin for this alternative requires removal of approximately 230,000 cubic yards of material. Inner harbor facilities include 2.6 acres of uplands area filled to +10 feet MLLW with a 300-foot-long pile supported dock and a concrete boat launch ramp to -5 feet MLLW for full tide launching access. This alternative provides access for the subsistence fleet, the fuel barge, and 26% of the commercial fishing fleet (the 26% which draft less than 10 feet). N-2 costs $92 million, $3.3 million annually (ROM PV cost).

As all vessel classes could use this harbor, repairs at Zapadni Bay harbor would no longer be necessary, resulting in an OMRR&R benefit of $724,800 annually. This harbor also reduces the probability of fuel and freight barge delays, and damages, and provides an opportunity for increased subsistence activity, and water taxi activity, as well as travel cost savings for a portion of the crabbing fleet (although the sailing distance is only 0.4 miles shorter than to Zapadni Bay). St. George would also get an RED benefit for the portion of the crab quota transferred from St. Paul of $384 K

annually. N-2 provides 148.7 increased safe access and moorage days. This alternative is carried forward for further analysis.

7.1.11 Alternative N-3 – CDQ Supporting Harbor

Alternative N-3 is the same as N-2, but dredged to -20 feet MLLW to allow access for 85% of the crabbing fleet.

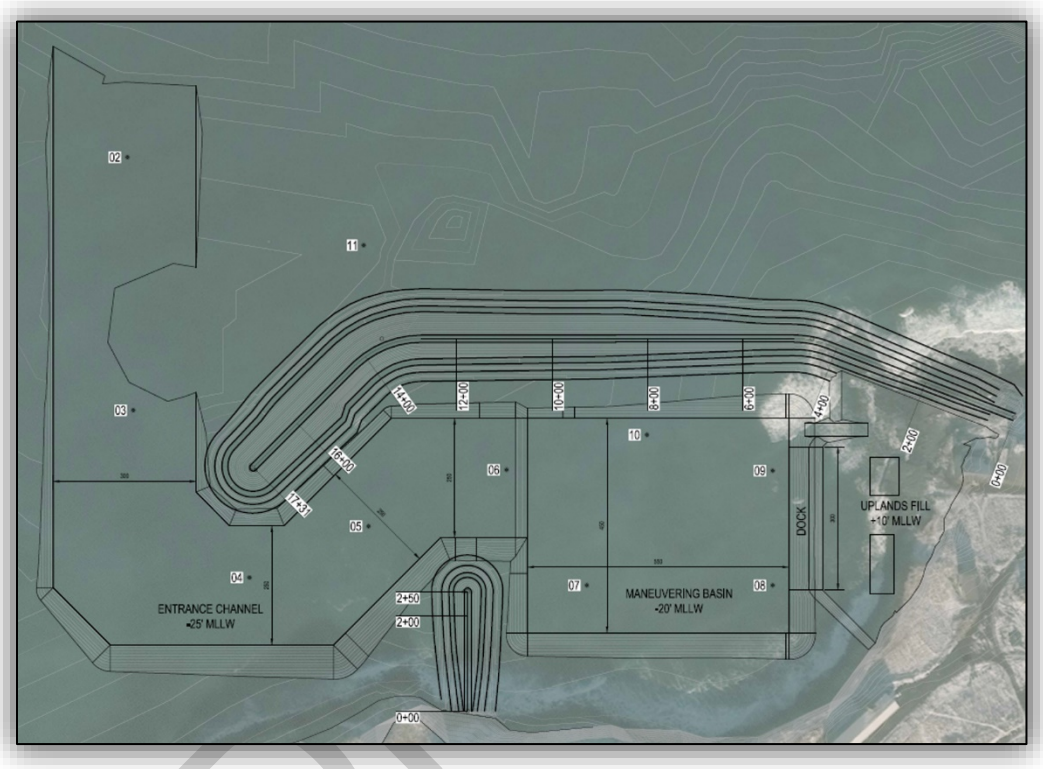

Figure C-22: Alternative N-3 Design

Primary armor stone on the north breakwater has a median weight of 10 tons. Total 10 ton armor rock is 93,871 CY. This rock is larger than what is used at Zapadni Bay, so no material from that harbor could be moved to the North site for construction. Dredging the channel and basin for this alternative requires removal of approximately 430,000 cubic yards of material. Inner harbor facilities include 2.6 acres of uplands area filled to +10 feet MLLW. A 300-foot-long pile supported dock and a concrete boat launch ramp to -5 feet MLLW for full tide launching access would be constructed. The dock would support two crabbing vessels at a time. The rough order of magnitude present value cost that includes interest during construction and estimated operations, maintenance, repair, replacement, and rehabilitation is $101 million dollars with an average annual cost of $3.6 million dollars.

This alternative provides increased access for the subsistence fleet (37.7 days), the fuel barge (44.7 days), freight barge (44.7), commercial fishing fleet (34.4), and the

replenished/anticipated water taxi service (17.7). Total increased safe access and moorage days (or total opportunity gained) equals 179.2 days. RED benefits on the crab quota transferred to St. George are $383,800 annually.

7.2 Project Costs

Rough Order of Magnitude (ROM) costs for each alternative including those to construct and maintain facilities are shown in the table below. Interest during construction assumes a 2-year construction window. Initial estimates of operations and maintenance assume dredging would occur every 10 years, and 2.5 percent of breakwater armor rock would be replaced in 25 years. Project costs were developed without escalation and are in 2018 dollars.

Table C-9: Project Costs by Alternative

Alternative	Project Cost	IDC	Operations & Maintenance	Total PV Costs	Annual Cost
Z-1	$154,739,366	$4,274,802	$59,761,111	$168,924,791	$5,993,372
Z-2	$94,973,124	$2,623,710	$59,344,836	$113,723,863	$4,034,869
Z-3	$87,088,293	$2,405,885	$47,028,988	$101,218,945	$3,591,200
Z-4	$84,758,409	$2,341,521	$58,805,481	$104,133,017	$3,694,590
Z-5	$408,267,296	$11,278,719	$65,202,037	$404,314,263	$14,344,879
Z-7	$190,123,483	$5,252,317	$47,028,988	$196,143,960	$6,959,095
N-1	$22,379,365	$618,248	$32,054,158	$34,067,433	$1,208,696
N-2	$84,488,142	$2,334,054	$33,086,817	$91,632,396	$3,251,074
N-3	**$94,313,027**	**$2,605,475**	**$33,086,817**	**$100,683,939**	**$3,572,219**

7.3 Alternatives Carried Forward

Due to the minimal increases in safe access and moorage days and negligible change in harbor access realized for large expenditures, further consideration for Alternatives Z-1, Z-2 and Z-4 was suspended. The alternatives carried forward for further consideration are:

Table C-10: Alternatives Carried Forward

Alt. No	Description
Z-3	Inland Basin
Z-5	Outer Breakwater
Z-7	Half Moon Harbor
N-1	Subsistence Vessel Launch Harbor
N-2	Subsistence Fleet and Fuel Barges
N-3	CDQ Supporting Harbor

7.4 Net Benefits and Benefit Cost Ratio

Net benefits and the benefit cost ratio are determined using the average annual benefits and average annual costs for each alternative. Net benefits are determined by subtracting the average annual equivalent costs from the average annual benefits for each alternative; the benefit cost ratio is determined by dividing average annual benefits by average annual costs. Table C-13 summarizes project costs, benefits, and the benefit-cost ratio by alternative. Table C-14 summarizes benefits by category and alternative. Since no alternative has a BCR greater than 1, plan selection is based on CE/ICA per Corps guidance on remote and subsistence harbors projects.[9]

Table C-11: NED Summary

Alternative	NPV	EAC	AAB	AAC	BCR
Z-3	($95,548,788)	$3,338,861	$11,343	$3,350,204	0.0034
Z-5	($361,616,997)	$12,636,359	$745,872	$13,382,231	0.0557
Z-7	($185,431,056)	$6,479,711	$12,378	$6,492,088	0.0019
N-1	($30,211,796)	$1,055,722	$71,862	$1,127,584	0.0637
N-2	($63,106,839)	$2,205,208	$827,695	$3,032,903	0.2729
N-3	($71,465,206)	$2,535,552	$1,036,667	$3,572,219	0.2362

Categorical benefits for each alternate are as follows:

Table C-12: NED Benefits by Category

Alternative	Expected Infrastructure Damages Prevented	Vessel Damages Prevented	Vessel Delays Prevented	Crabber Transportation Costs Savings	Increased Subsistence Foods Harvested Value
Z-3		$1,136		$12,953	
Z-5	$724,800	$4,339		$12,953	
Z-7		$2,298		$12,953	
N-1		$762			$43,700
N-2	$724,800	$762	$25,462	$3,419	$43,700
N-3	$724,800	$762	$25,462	$13,015	$43,700

While these values represent NED benefits resulting from navigation improvements at St. George, they do not represent the full scale of benefits that could be realized if Federal action is taken. The NED analysis does not tell the whole story of the importance of a safe and functioning harbor at St. George, so additional benefits are considered based on guidelines of the Remote and Subsistence Harbors authority.

[9] Section 2006 of WRDA 2007 – Remote and Subsistence Harbors, as modified by Section 2104 of the Water Resources Reform and Development Act of 2014 (WRRDA 2014) and further modified by Section 1105 of WRDA 2016.

These include benefits of the proposed project to the public health and safety of the community; access to natural resources for subsistence purposes; local and regional economic opportunities; welfare of the local and regional population; and social and cultural value to the community of St. George.

7.5 Regional Economic Development Analysis

The Regional Economic Development (RED) account measures changes in the distribution of regional economic activity that would result from each alternative. Evaluations of regional effects are measured using nationally consistent projection of income, employment, output and population. In addition to these regional effects, there is potential to realize local and regional economic opportunities through the delivery commercial fishing harvests to St. George. It is estimated that approximately $384,000 worth of CDQ crab that is allocated to St. George but currently delivered to St. Paul would be processed at St. George.

The community would potentially get several permanent jobs as a direct result of an implemented project. The jobs could include seafood plant manager, quality assurance manager, and perhaps one other processing job. Two other jobs are captain and deck hand on the water taxi. Indirect jobs, come from increased activity on the island like store sales, hotel use, marine services, tourism, etc. Benefits from the navigation improvement project related to tourism might also include additional imports of supplies for visitors, or new hard goods for the hotel transported by barge. Charter and ferry services is another potential opportunity. Subsistence is also a job, so the increase in foods harvested also supports livelihood.

The USACE Online Regional Economic System (RECONS) is a system designed to provide estimates of regional, state, and national contributions of Federal spending associated with Civil Works and American Recovery and Reinvestment Act (ARRA) Projects. It also provides a means for estimating the forward linked benefits (stemming from effects) associated with non-Federal expenditures sustained, enabled, or generated by USACE Recreation, Navigation, and Formally Utilized Sites Remedial Action Program (FUSRAP). Contributions are measured in terms of economic output, jobs, earnings, and/or value added. The system was used to perform the following regional analysis for the Whittier Navigation Improvements Project. A summary of the USACE regional economic system (RECONS) analysis is included below. Please see the RECONS addendum for detailed analysis of each alternative.

Construction of a new harbor would also create jobs and regional economic opportunities. Most of the work would be contracted to firms operating or based out of Alaska. Some work could benefit national firms. A smaller portion would benefit companies based in the Aleutians West Borough; however, the local production coefficient of the construction effort (perhaps the benefit to St. George and St. Paul) is estimated to be only 1% of the total construction spending. The break out of benefits for

N-3 would be similar to the below. Other alternatives can be found summarized in RECONS addendum.

Table C-13: RECONS Summary for Alternative N-3

		Regional	State	National
Total Spending		$100,683,900	$100,683,900	$100,683,900
Direct Impact	Output	$1,015,241	$77,220,557	$99,778,652
	Job	13.77	1,033.94	1,356.75
	Labor Income	$427,313	$34,609,331	$45,891,361
	GRP	$642,344	$52,178,491	$66,885,117
Total Impact	Output	$1,361,477	$129,027,349	$259,051,011
	Job	16.93	1,390.29	2,345.26
	Labor Income	$531,105	$52,214,295	$100,022,601
	GRP	$842,290	$83,327,319	$159,357,783

As shown in the table above, construction of the new harbor could also provide as many as 17 jobs in the region.

7.6 Other Social Effects

The Other Social Effects (OSE) account focuses on social well-being factors that represent non-monetary benefits to the people and residents of a community. It includes cultural vulnerability, environmental justice (or disproportionate environmental impacts on segments of the population), and health and safety issues. Additionally, in Alaska, "subsistence," or the ability to live off of the land, is a source of well-being for Alaskans, and especially Alaska native groups. Given that the National Economic Development analysis did not yield any plans with a benefit-cost ratio greater than one, a Cost Effectiveness and Incremental Cost Analysis (CE/ICA) was utilized to support plan selection.

7.6.1 Cost Effectiveness/Incremental Cost Analysis

7.6.1.1 Metric Description

The CE/ICA metric for this study is increased safe access and moorage days. Increased vessel opportunity days for safe access and moorage allows for vessel-class specific evaluation of improved wave and seiche conditions in comparison to the existing entrance channel and inner harbor. It also allows for the evaluation of vessel-class specific safe maneuverability and mooring of the anticipated fleet and the percentage of time (in days) that harbor facilities can be safely accessed. Therefore, this metric directly addresses the study's objectives.

As the output of the CE/ICA, increased vessel opportunity days for safe access and moorage are also significant for non-monetary benefits in terms of the output's institutional, public, and technical significance, as defined in ER 1105-2-100.

By analyzing harbor designs that crabbers and fishing vessels can access as part of the anticipated fleet, the metric brings institutional significance to the study—specifically, crab quota regulations intended to support community development, and life, health, and safety laws that help protect mariners.

Increased vessel opportunity days for safe access and moorage is publically significant in that it specifies the amount of additional local subsistence use and procurement of resources expected to occur, while also increasing the continuity of cultural heritage customs associated with subsistence harvests.

Last, the metric is technically significant in that without increased vessel opportunities for safe access and moorage, out-migration from St. George is likely to continue. This has consequences that include sociological, psychological, health, and anthropological effects that are tied to the cultural identity associated with a narrow geographic range (i.e. St. George Island).

7.6.1.2 CE/ICA Evaluation

Based on the anticipated fleet and the wave criteria for safe access and moorage shown in Table C-14 and Table C-15, a CE/ICA was conducted to support selection of the TSP.

Table C-14: Future With-Project Anticipated Fleet

Vessel Class	Vessel Draft (ft)
Fuel Barge & Tug	10 (Light Loaded)
Freight Barge & Tug	10
Subsistence Vessels	4
Crabbing Vessels (x2)	14
Water Taxi	14

Table C-15: Wave Criteria for Anticipated Fleet

Wave Location	Fuel Barge	Freight Barge	Subsistence Vessel	Crabber	Water Taxi
Entrance and Outside Harbor Wave Height (ft)	3.3	3.3	3.9	9.8	9.8
Dock Wave Height (ft)	1.6	1.6	1.6	1.6	1.6

Figure C-22 shows the IWR Planning Suite output for the cost effectiveness analysis. This analysis yielded four cost effective plans, two of which are best buy plans (Alternatives N-3 and Z-5). The best buy plans were further evaluated through incremental cost analysis, as shown in Figure C-23.

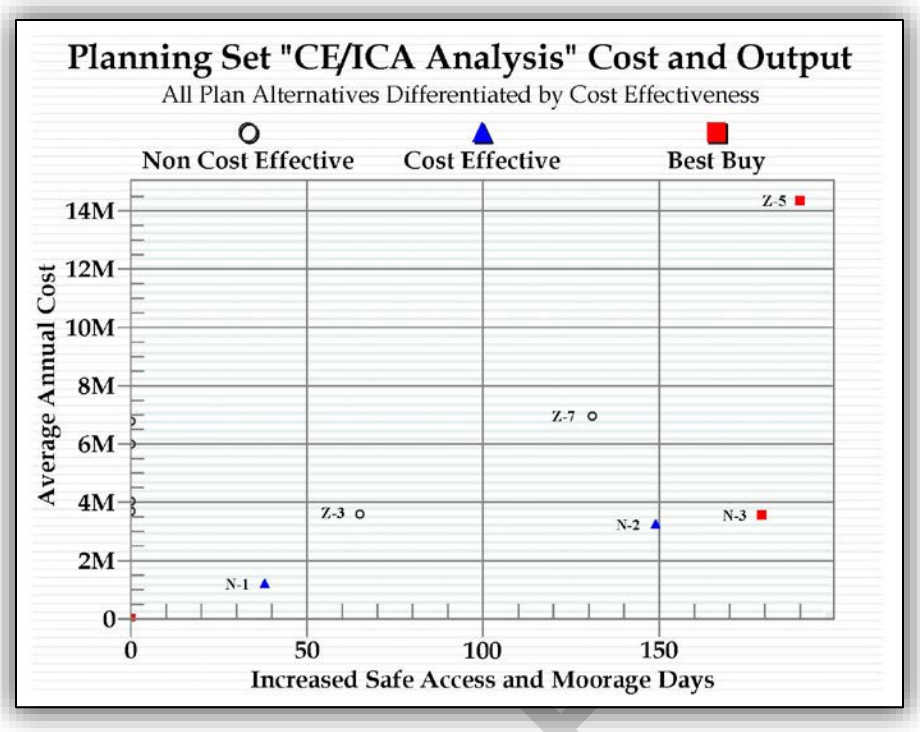

Figure C-23: Cost Effectiveness Analysis: Increased Vessel Opportunity Days for Safe Access and Moorage

The incremental cost analysis compared the incremental cost per unit of output (vessel opportunity days for safe access and moorage) for Alternatives N-3 and Z-5, as shown in Table C-16 and Figure C-23 below. For Alternative Z-5, note the substantial increase in cost required to achieve a marginal increase in output. Based on this analysis, Alternative N-3 is identified as the Tentatively Selected Plan. Table C-16 summarizes CE/ICA results, with the TSP highlighted in yellow.

Table C-16: Incremental Cost vs. Output for Best Buy Alternatives

Incremental Cost for Cost Effective Alternatives		
Alternative	**Additional Days**	**Incremental Cost of Day Gained (Annualized)**
N-3	-	$19,934
Z-5	11	$979,333

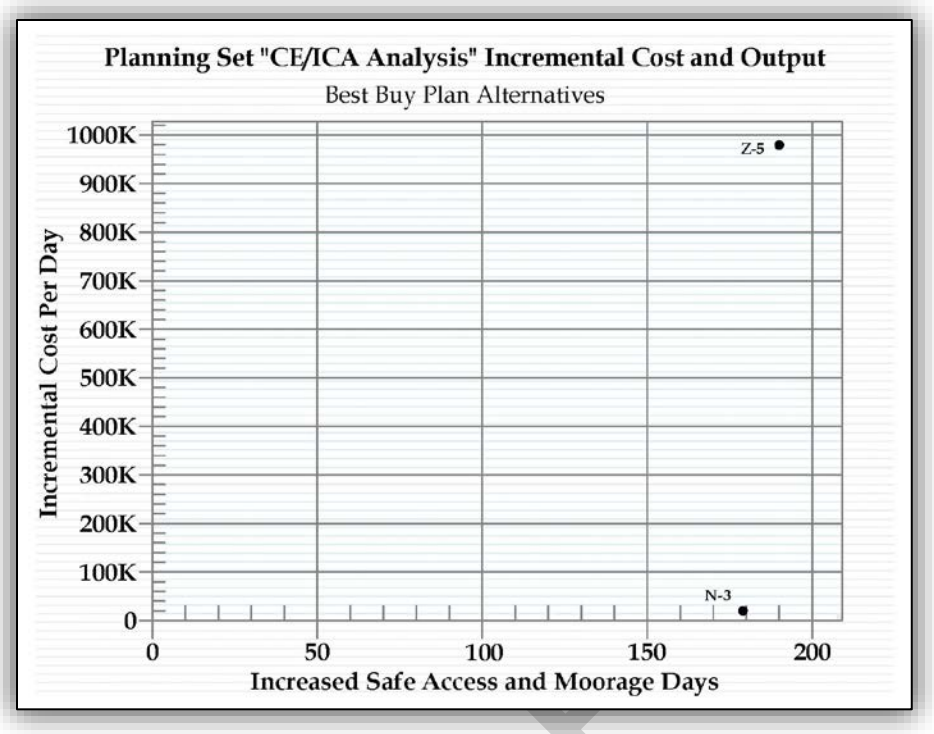

Figure C-24: Incremental Cost Analysis: Increased Vessel Opportunity Days for Safe Access and Moorage

Table C-17 summarizes project costs and non-monetary benefits evaluated in the CE/ICA for each alternative.

Table C-17: CE/ICA Summary

Alternative	Annual Cost	Days Gained	Annual Cost of Day Gained	Cost Effective	Best Buy
Z-3	$3,591,200	65	$55,249	No	No
Z-5	$14,344,879	190	$75,420	Yes	Yes
Z-7	$6,959,095	131	$53,123	No	No
N-1	$1,208,696	38	$32,061	Yes	No
N-2	$3,251,074	149	$21,863	Yes	No
N-3	$3,572,219	179	$19,934	Yes	Yes

7.7 Tentatively Selected Plan

In consideration of the CE/ICA presented above, the Tentatively Selected Plan is Alternative N-3. This alternative consists of a 450-foot wide by 550-foot-long mooring basin dredged to -20 feet MLLW protected by a 1,731-foot-long north breakwater and a 250-foot-long stub breakwater at the west edge of the basin. The basin connects to the Bering Sea with a 250-foot wide navigation channel dredged to -25 feet MLLW. Inner

harbor facilities include 2.6 acres of uplands area filled to +10 feet MLLW with a 300-foot-long pile supported dock and a concrete boat launch ramp to -5 feet MLLW for full tide launching access.

The north breakwater requires approximately 85,000 cubic yards of armor stone, 54,000 cubic yards of B rock and 80,000 CY of core rock. The stub breakwater requires approximately 9,000 CY of armor stone, 6,500 CY of B rock and 5,000 CY of core rock. The basin and navigation channel require removal of approximately 430,000 CY of material to reach the proposed maximum depths for the project. Uplands construction requires approximately 45,000 CY of fill.

The dredging characteristics of the bottom material at the north site are not well known. Large boulders on the shoreline could be representative of bottom conditions, but it is not known if material within the dredge prism is sand and gravel, cobbles and boulders, or bedrock. The characteristic of this material greatly affects the requirements for dredging, and it is currently assumed that blasting and mechanical removal is required.

Alternative N-3 is expected to produce an additional 179 safe access and moorage days for the anticipated fleet. There are still 153 calendar days in a year when sea conditions are too rough for the fuel barge or freight barges to access N-3. There are also 139 calendar days in a year when subsistence vessels would not launch, and 40 when crabbers would bypass St. George. Similarly, there are 40 days when the anticipated water taxi would not sail. And last, there are 27 days when no vessel could safely moor within the harbor.

7.8 Four Accounts Summary

USACE planning guidance establishes four accounts to facilitate and display effects of alternative plans. Previous studies have relied primarily on the use of the NED account showing the changes in the economic value of the national output of goods and services. As previously noted, the analysis described in this report follows implementation guidance for Section 2006 authorized projects, which allows for plan selection based on CE/ICA.

7.8.1 National Economic Development

The results of the NED analysis were discussed in previous sections. No alternative has a benefit-cost ratio greater than one so CE/ICA was used to inform plan selection.

7.8.2 Regional Economic Development

Economic benefits that accrue to the region but not necessarily the nation include increased income and employment associated with the construction of a project, as well as realization of local and regional economic opportunities through the delivery of commercial fishing harvests to St. George.

7.8.3 Environmental Quality

Environmental Quality displays the non-monetary effects of the alternatives on natural resources and is described in the environmental assessment sections of the draft feasibility report.

7.8.4 Other Social Effects

St. George, like many rural economies throughout Alaska, is a mixed, subsistence-cash economy in which the subsistence and cash sectors are interdependent and mutually supportive. The ability to successfully participate in subsistence activities is highly dependent on the opportunity to earn some form of monetary income and access the resources need to engage in these activities. Without a safe and functioning harbor that provides access for subsistence vessels, fuel and freight delivery, and a portion of the commercial fishing fleet, economic opportunities in the community would continue to be hindered and the costs of basic essential goods required to support a subsistence lifestyle would remain prohibitively high, contributing to continued out-migration from St. George. When subsistence communities are forced to disband due to high costs of essential goods, including fuel, tribal identities and cultural communities are threatened. A safe and functioning harbor that improves access to St. George would provide opportunities for development of a local economy based upon the marine resources of the region. Such economic opportunities are essential for supporting St. George's mixed, subsistence-cash economy, combating out-migration, and helping to strengthen the viability of the community on St. George.

7.8.5 Four Accounts Evaluation Summary

Based on this analysis of the four accounts, each alternative has positive effects for the RED and OSE accounts, and temporary negative effects for the EQ account. Table C-18 shows a summary of the four accounts for all alternatives, with the TSP highlighted in yellow.

Table C-18: Four Accounts Evaluation Summary

Alternative	Benefit-Cost Ratio	Average Annual Cost	EQ	RED	OSE (increased access & moorage days)
No Action	N/A	$0	Neutral	Neutral	0
Z-3	0.034	$3,591,200	Negative	Increased employment and income for the region and state	65
Z-5	0.0557	$14,344,879	Negative	Increased employment and income for the region and state	190
Z-7	0.0019	$6,959,095	Negative	Increased employment and income for the region and state	131
N-1	0.0637	$1,208,696	Negative	Increased employment and income for the region and state	38
N-2	0.2729	$3,251,074	Negative	Increased employment and income for the region and state	149
N-3	0.2362	$3,572,219	Negative	Increased employment and income for the region and state	179

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