1. Component NAVY	. Component NAVY FY 2024 SPECIAL PROJECTS PROGRAM 2. Date 17 MAR 2021				2. Date 17 MAR 2021		
3. Installation JBPHH PEARL HAR JOINT BASE PEAR	3. Installation(SA)& Location/UIC: N62813 JBPHH PEARL HARBOR HI JOINT BASE PEARL HARBOR-HICKAM, HAWAII			4. Project Title REPLACE 24-IN WATER TRANSMISSION LINE,			
5. Fund Type O&MN		6. Category Code 84210	7.	Project Number RM 19-0699	s 8. Projec	t Cost (\$000) \$15,604	
		9. CC	OST ES	STIMATES			
	Item		UM	Quantity	Unit Cost	Cost(\$000)	
POT WTR DIST SYS	3 - SHI	PEA FAC#204389	LF	4,000	3,440.00	13,760	
HAZARDOUS MATE	ERIAL AE	ATEMENT - Repair	LF	4,000	9.50	(38)	
SITEWORK - Rep	air		LF	4,000	1,411.75	(5,647)	
WATERLINE - Re	epair		LF	4,000	1,940.50	(7,762)	
TESTING, CHLOR - Repair	INATION	, & TRAFFIC CONTROL	LS	1	125,000.00	(125)	
FIRE PROTECTIC	N - Rep	air	EA	2	10,000.00	(20)	
CYBERSECURITY	- Repai	r	LS	1	168,000.00	(168)	
Subtotal						13,760	
Contingency (5%)						(688)	
STOH (8%)						(1,156)	
Total Funded Cos	t	916				15,604	
Classification o	f Work			đ			
Repair						15,604	
Special Interest	Codes					7	
Restoration and	nd Moder	mization				15,604	
Total Project Cos	st					15,604	
Planning and Desi	.gn (13%)			NON-ADD	(1,789)	
EQUIPMENT FROM OT	HER APP	PROPRIATIONS			NON-ADD	(57)	
10. Description of This project pr iron pipe with associated pipi Street, two fire hydram total of 12 re-	of Propo coposes polyeth ng, con ts alon connect	sed Construction to replace approximat ylene wrapped cement nections, and valves Street, Avenue g Avenue at ions to existing dist	ely 4 morta near nue, Join ribut	,000 linear fo ar lined ducti the existing will Avenue t Base Pearl F ion mains will	eet (LF) of 24- le iron pipe al water line alon e, and Harbor Hickam (L be provided,	inch cast ong with g Street and JBPHH). A nine of which	
100 X		the second s		2.000 million constants			

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1. Component NAVY		FY 2024 SPECIAL	PROJECTS PROG	RAM	2. Date 17 MAR 2021
3. Installation (SA) & Location/UIC: N62813 4. Project Title JBPHH PEARL HARBOR HI REPLACE 24-IN WATER TRANSMISSION LINE, JOINT BASE PEARL HARBOR-HICKAM, HAWAII Image: Comparison of the second s					
5. Fund Type O&MN	Type 6. Category Code 7. Project Number 8. Project Cost (\$000 0.000) 0&MN 84210 RM 19-0699 \$15,604			ect Cost (\$000) \$15,604	
directly serve construction. waterlines sha System control Aquisition (SC	e the Sh After w all be a .s shall CADA) sy	ipyard system. The ex aterline installation bandoned in place and be compatible with th stem and include Cyber	isting waterlines and service com filled with cont ne existing Super rsecurity certifi	s will remain i nections are con crolled low stra cvisory Control cation.	n service during mplete, existing ength material. and Data
11. Requirement					
FACILITY PLANN Planning Area MAIN SITE PROJECT:	ING DAT. CCN 84210	A: <u>Requirement</u> <u>UM</u> 617,656 LF	<u>Adequate</u> <u>Subs</u> 340,878	tandard Inadeq 293,072	<u>Deficit/</u> uate <u>Surplus</u> 0 16,294
Replace approx (Current Missi	imately on)	4,000 LF of 24-inch w	aterline from		
Provide an ade to the facilit: protection, and supports facilit	quate ar ies at 5 indust faci cy requi	ad safe waterline whic TBPHH. The existing wa wrial demands in the lity domestic and fir rements. At the time	h supplies potable ter main is the p protection dema his pipeline dire	le and fire pro primary feed fo . This pipeli ands, . ectly supports	tection water r potable, fire ne directly activities, and
CURRENT SITUATION Originally inst Street, is well replacement.	I: alled i reet, beyond	n 1943, the existing 2 Street, 1995 its design life of 50	24-inch cast iron Avenue, Avenue, o years, deterior	waterline, wh: Avenue, and rated, and in ne	ich runs along eed of
IMPACT IF NOT PRO	VIDED:				
Failure of this water outages t and industrial	line w: o facil:	ill impact s ities and operations a	nd inadequate wa	operations, o ter pressures f	ausing direct for operations
and and analysical and and and analysical analysical and analysical and analysical analysic	re. Fail	ure of this line will on, and chilled water wi	directly impact functions. Fail 11	ill be impacted the proposed ure of the main	by a near/in the
Form	_	····			

1. Component NAVY	FY 202	4 SPECIAL	PROJECTS	PROGRAM		2	. Date 17 MAR 20)21
3. Installation(SA)& Location/UIC: N62813 JBPHH PEARL HARBOR HI JOINT BASE PEARL HARBOR-HICKAM, HAWAII					LINE,			
5. Fund Type O&MN	6. Catego 8	ory Code 4210	7. Projec RM 1	t Number 9-0699	8. Pr	coject (Cost (\$00	0)
NOTES: Category Code	Number (CCN) 842	-10 Water Di	stribution	Line, Pota	ble is	a non-B	FR item.	
This project w	vill be Design-Bi	d-Build.						
The waterline	alignment will r nue and	equire cross . Alignment along	ing under will also Aven	traverse t ue.	hrough	the		
Floodplain Mar requirements c 2014, "Floodpl not reside in boundary").	agement: This pr of the Office of ain Management of the 100-year flo	oject has be the Under Se n Department odplain (now	en evaluate cretary of of Defense known as t	d in accor Defense Me Installat he "1% ann	dance w morandu ions." ' ual char	ith the m of 11 The pro nce of :	February ject does flood	r 5
Randolph Sheppard Act: This project has been evaluated in accordance with OPNAVINST 4535.1B and UFC 1-200-01, and the requirements of the Randolph Sheppard Act do not apply to this project as there are no buildings involved with this utility project.								
Cybersecurity: in UFC 4-010-0	This project has 6, UFGS 25-05-11	s been evalu and NIST 8	ated in acc 00-37, DON	ordance wi FRCS cyber	th the o security	criteria 7 commis	a delinea ssioning.	ted
Facilities imp Antiterrorism, ASHRAE, and Hi completion of	acted by repair/o Fire Suppression gh Performance Su the project.	construction 1, Wind Load Istainable Bu	will be in ing, Flood uilding cod	complianc Elevation, es and sta	e with a Seismic ndards (applicat c, Acces (as requ	ole ssibility uired) up	on
Project cost exceeds Plant Replacement Value (PRV). PRV in iNFADS is considered low as it does not take into consideration project location. Over half of the project's waterline replacement is within the Shipyard CIA. There is a high risk of increased costs because of delays due to Shipyard operations. Project cost also accounts for any unforeseen conditions and potential soil/groundwater contamination.								
An Electromagn installation o	etic Radiation Sa f a SCADA antenna	fety Request at the relo	t for Projected connected connected connected connected connected connected connected connected connected conne	ct Site App ection poir	proval i nt at Sc	s requi	red for tonue.	the
DDITIONAL: A. Facilities	Data:							
Fac No CCN UM	Facility ID Quantity	<u>Facility Na</u> PRV(\$000)	ame MDI CAP	CONF COI	<u>ND FCI</u>	Built	MUIC	<u>sc</u>
<u>204389</u> 84210 LF	<u>NFA200000541344</u> 4,000	POT WTR DI 9,871	<u>ST SYS -</u> 53 100	100 FAC#	<u>204389</u> 72 -39	2019	N62813	A

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1. Component FY 2024 SPECIAL PROJECTS PROGRAM 2. Date NAVY 17 MAR 2023			
3. Installation (JBPHH PEARL HARE JOINT BASE PEARL	SA)& Location/UIC: NG OR HI HARBOR-HICKAM, HAWAII	52813 4. Project Title REPLACE 24-IN W	e ATER TRANSMISSION LINE,
5. Fund Type O&MN	pe 6. Category Code 7. Project Number 8. Project Cost (\$00 MN 84210 RM 19-0699 \$15,604		
B. Hazardous M Contaminants Should the p concentratic levels or St managed as C (CERCLA) was	aterial Information: of concern (COC) exce project impact the envi on greater than the Enviate of Hawaii, Departr comprehensive Environmente.	eeding screening levels ironmental remediation s vironmental Protection A ment of Health environme ental Response, Compensa	may impact this project. site, excess soil with COC Agency regional screening ental action levels need to k ation, and Liability Act
C. Economic Ana	alysis:		
Economic Ana Economic Alte (1) Status Qu The existi Ingersoll	Lysis required per OPN ernatives Considered: to: Lng 24-inch cast iron Avenue, and Port Roya	AVINST 11010.20H 🔀 (Yes waterline along Reuben o l Avenue and two fire hy	s if Checked) James Street, Cushing Street, ydrants on Ingersoll Avenue
Status Que) is not a viable alter	rnative.	
This alter method inv space betw interior d ductile ir lost capac operations	native proposes to rep olves sliplining the e een the lining and the iameter of the pipe, a on pipe will be instal ity. Additional valves will be required to m	pair the pipe instead of existing pipe with a 20- e original pipe. Because an 8-inch polyethylene w lled adjacent to the exi s will be required to co maintain existing water	F replacing it. The repair Finch pipe and grouting the e sliplining reduces the wrapped cement mortar lined sting pipe to make up for th ontrol the water flow. Bypass service during construction.
Sustainmen Net Presen	t/Maintenance is a via t Value (NPV) = \$18,74	ble alternative. 8,672	
(3) Restoration Restoration to replace fire hydran pipe with 2 Street. To risky bypas construction	on/Modernization: n/Modernization Altern approximately 4,000 L hts, and appurtenances 24-inch polyethylene w et, Manufactor Street, Manufactor maintain the existing ssing operations, the operations, the operations, the stilled approximates of the still approximates of the stilled approximates of the still approximates of the stilled approximates of the still approximates o	ative #1 (Ductile Iron) F of 24-inch cast iron p . Work will replace the rapped cement mortar lin Avenue, Avenue, line level of service and to existing water lines will and abandoned after the	: This alternative proposes pipe, associated piping, two existing 24-inch cast iron ned ductile iron along Avenue, and o prevent use of costly and Il remain in service during waterline installation and

1. Component NAVY	FY 2024 SPECIAL	PROJECTS PROGRAM		2. Date 17 MAR 2021
3. Installation JBPHH PEARL HAR JOINT BASE PEAR	(SA)& Location/UIC: N62813 BOR HI L HARBOR-HICKAM, HAWAII	4. Project Title REPLACE 24-IN WATER T	RANSMISSIC	DN LINE,
5. Fund Type O&MN	6. Category Code 84210	7. Project Number RM 19-0699	8. Projec	t Cost (\$000) \$15,604
Restorat NPV = \$1	ion/Modernization Alternative	#1 (Ductile Iron) is a	a viable a	lternative. This
Restorat alternat associat Alternat PVC is n - Duct to b - Dire like - A PV of o - Ther PVC Restorat (4) Lease:	<pre>ive proposes to replace appro ed piping, two fire hydrants, ive #1, but using PVC. Replace ot recommended based on the f ile iron has a higher tensile e damaged than PVC. ct tapping of a ductile iron ly to be damaged than PVC. C pipe is more vulnerable to ther utility lines than ducti e are areas of contaminated s and shorten its lifespan. ion/Modernization Alternative</pre>	<pre>#2 (POFyVIN)1 childrate primately 4,000 LF of 24 and appurtenances alor ing the existing cast i collowing: strenth than PVC and i pipe is easier than PVC puncture or damage duri le iron. oil along the waterline #2 (PVC) is not a viak vstem available to lease</pre>	4-inch cash ng the same iron water. is less lil C and is le ing excavat e that can ble alterna	t iron pipe, e route as line with kely ess tion weaken ative.
required Lease is	water service to meet the ne not a viable alternative.	eds of the area.		
(5) New Footprint: The New Footprint alternative would replace the water transmission system in the area. Since Restoration/Modernization Alternative #1 (Ductile Iron) replaces the deteriorated portion of the waterline pipeline in its entirety, the New Footprint alternative will duplicate the Restoration/Modernization alternative. Therefore, to simplify the analysis, the New Footprint alternative is not included.				
New Footj	print is not a viable alterna	tive.		
(6) Analysis Results: Status Quo, Restoration/Modernization #2 (PVC), Lease, and New Footprint were evaluated and eliminated as viable alternatives. Costs and benefits of the Restoration/Modernization Alternative #1 (Ductile Iron) and Sustainment/Maintenance alternatives were analyzed over a 32-year period (initial investment in 2024 with two-year lead time plus 30-year economic life). Costs were discounted at a -0.3 percent rate and NPV costs were calculated.				

1. Component NAVY		FY 2024 SPECI	AL PROJECTS	PROGRAM		2. Date 17 MAR 2021
3. Installation JBPHH PEARL HAR JOINT BASE PEAR	I(SA)& LO BOR HI I HARBOR	cation/UIC: N6281 -HICKAM, HAWAII	4. Projec REPLACE 2 HOSPITAL	t Title 24-IN WATER 7 PT TO HICKAN	ransmissio 1	N LINE,
5. Fund Type O&MN		6. Category Code 84210	7. Projec RM 1	t Number 9-0699	8. Project	: Cost (\$000) \$15,604
The anal economic results, determin alternat	ysis ind advantag the prop ed to be ive.	icates that Restor ge over the Sustai posed project to r the most cost eff	ration/Moderni inment/Mainten replace the wa fective and, t	zation #1 (D ance alterna terline with herefore, th	uctile Iror tive. Based a ductile e recommend	n) has an 1 on the NPV iron pipe is led
D. Phasing (\$ E. Other Prop	000): No osed Proj	ne ects:				
F. Status of) G. Equipment a appropriat	Design: P associate ions:	reliminary Plannin d with this proje	ng ct which will	be provided	from other	
<u>Major Equipme</u> Water Meter & Equipment Activity POC:	nt SCADA	<u>Funding</u> Fund <u>Source</u> <u>Year</u> OMN 2024 10	<u>Installation</u> <u>Start-End</u> <u>Mo/Yr</u> 0/2025 10/2025	<u>Shakedow</u> <u>Start-En</u> <u>Mo/Yr</u> 11/2025 11/ Phone No:	<u>m 100</u> 3 <u>d Date Mo/Y1</u> 2025 11/202	<u>c Cost</u> 25 _, 57,000
Attachments: 1 Vicinity M 2 Site Plan 3 Detailed (4 Economic M 5 SME Cert 6 FOM22 Sign	Map Cost Esti Analysis ned 1391	mate				
12. Signatures Electronic Sig	gnature	Position Public Works Regional Engi	Officer neer			<u>Date</u>
HARMEYEI .ERNEST.1 R. E. HAN Captain, Public Wo	R.RANDALL 186692663 RMEYER CEC, U.S orks Offi	Digitally signed by HARMEYER.RANDALL.ERNEST.1 6692663 Date: 2021.05.17 11:53:34 -10'00' . Navy	J. G. Captai Region	MEYER .n, CEC, U.S. hal Engineer	L\MAY 202 Navy	<u>e(</u>

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Date Generated: 17 March 2021 Time Generated: 14.42.43 Version: ECONPACK 4.0.45

RM190699 24in Water Trans Line POM24 Economic Analysis

Executive Summary Report

Project Title	:Replace 24in Water Transmission Line
Type of Analysis	:Mission Requirement - Full
Discount Rate	:-0.3%
Period of Analysis	:30 years
Start Year	:2024
Base Year	:2024
Dollar Analysis	:Constant Dollars
Project Objective	:Provide an adequate and safe waterline, which supplies potable and fire protection water to the facilities at Joint Base Pearl Harbor Hickam (JBPHH).

Background:

Originally installed in 1943, the existing 24-inch cast iron pipe is the primary feed into the

potable water and fire protection distribution system. This piperine directly supports facility and fire protection demands, dry dock activities, and nuclear facility requirements. The pipeline is also a primary feed for domestic, fire protection, and industrial demands at the second seco

Alternatives Considered for this Analysis:

Status Quo (Current Operations) - The existing 24-inch cast iron waterline along Street, Street, Avenue, and Avenue and two fire hydrants on life of 50 years, deteriorated, and in need of replacement. This alternative is nonviable.

Sustainment/Maintenance - This alternative proposes to repair the pipe instead of replacing it. The repair method involves sliplining the existing pipe with a 20-inch pipe and grouting the space between the lining and the original pipe. Because sliplining reduces the interior diameter of the pipe, an 8-inch polyethylene wrapped cement mortar lined ductile iron pipe will be installed adjacent to the existing pipe to make up the reduced capacity. Additional valves will be required to control the water flow and bypass operations will be required to maintain existing water service during construction. This is a viable alternative.

Restoration/Modernization #1 (Ductile Iron) - This alternative proposes to replace approximately 4,000 LF of 24-inch cast iron pipe, associated piping, two fire hydrants, and appurtenances. Work will replace the existing pipe with 24-inch polyethylene wrapped cement mortar lined ductile iron along Street, Street, Avenue, Avenue, Avenue, and Street. To maintain the existing level of service and to prevent use of costly and risky bypassing operations, the existing waterlines will remain in service during construction and will be filled and abandoned after the waterline installation and service connections are complete.

This is a viable alternative.

Restoration/Modernization #2 (Polyvinyl Chloride (PVC)) - This alternative proposes to replace approximately 4,000 LF of 24-inch cast iron pipe, associated piping, two fire hydrants, and appurtenances along the same route as Alternative #1, but using PVC. Replacing the existing cast iron waterline with PVC is not recommended based on the following:

- Ductile iron has a higher tensile strength than PVC and is less likely to be damaged than PVC.
- Direct tapping of a ductile iron pipe is easier than PVC and is less likely to be damaged than PVC.
- A PVC pipe is more vulnerable to puncture or damage during excavation of other utility lines than ductile iron.
- There are areas of contaminated soil along the waterline that can weaken PVC and shorten its lifespan. This alternative is nonviable.

Lease - There is no equipment, facility, or system available to lease that could provide the required water service to meet the needs of the area. This alternative is nonviable.

New Footprint - The New Footprint alternative would replace the water transmission system in the area. Since Restoration/Modernization Alternative #1 (Ductile Iron) replaces the deteriorated portion of the waterline pipeline in its entirety, the New Footprint alternative will duplicate the Restoration/Modernization alternative. Therefore, to simplify the analysis, the New Footprint alternative is not included.

This alternative is nonviable.

Assumptions of the Analysis:

- 1. Per OMB Circular No. A-94, Appendix C (revised Nov 2020), a discount rate of -0.3 percent is used.
- 2. All costs occur throughout the year and will be discounted using a "middle-of-year" convention.
- 3. The costs for operating and annual utilities for the Sustainment/ Maintenance and Restoration/Modernization alternatives are assumed to be the same. Therefore, these costs are not included in the Net Present Value (NPV) calculations.
- 4. The construction period is two years. The project is programmed for FY24 with a Beneficial Occupancy Date (BOD) in year three (FY26).
- 5. The economic life is 30 years. The period of analysis will be 32 years.
- 6. Sustainment costs are based on the DoD Facilities Pricing Guide, UFC 3-701-01, Change 8, 3 February 2021. Escalation rates for both alternatives are based on the NAVFAC Building Cost Index 2020-02-27(1200).
- 7. The Restoration/Modernization alternative costs are based on the estimate for Special Project RM19-0699 24-in Water Transmission Line,

Economic Indicators:

Alternative	NPV
Sustainment/Maintenance	\$ 18,748,672
Restoration/Modernization #1 (Ductile Iron)	\$ 15,874,157

Non-Monetary Considerations:

Restoration/Modernization Alternative #1 (Ductile Iron)

Advantages:

- Shorter construction time
- Minor impact to base operations
- Ductile iron has a higher tensile strength and is not as easily damaged as other materials

Sustainment/Maintenance

Disadvantages:

- Not recommended for high pressure pipe applications because the high pressure will reduce the durability and life of the liner
- Requires existing waterlines to be taken out of service, which compromises the flow rate and pressure and, in case of a fire, is a safety issue
- Requires a risky bypass operation
- Sliplining material is subject to degradation/damage
- Reduces the diameter of the pipe, therefore reducing the capacity of the pipe
- Difficult to determine the areas where there are bends and changes in elevation, and each area where the pipe bends will require the pipe to be exposed and cut open to access the pipe

Results and Recommendations:

Status Quo, Restoration/Modernization Alternative #2 (PVC), Lease, and New Footprint were evaluated and eliminated as viable alternatives. Costs and benefits of the Restoration/Modernization Alternative #1 (Ductile Iron) and Sustainment/Maintenance alternatives were analyzed over a 32-year period (initial investment in 2024 with two-year lead time plus 30-year economic life). Costs were discounted at a -0.3 percent rate and NPV costs were calculated.

The analysis indicates that Restoration/Modernization Alternative #1 (Ductile Iron) has an economic advantage over the Sustainment/Maintenance alternative. Based on the NPV results, the proposed project to replace the waterline with a ductile iron pipe is determined to be the most cost effective and, therefore, the recommended alternative.





Economic Analysis Graph

Alternative: Sustainment/Maintenance

Year	Investment Cost	Sustainment	Total Annual Outlays	Middle of Year Discount Factors	Present Value
2024	\$18,219,000	\$0	\$18,219,000	\$1	\$18,246,390
2025	\$0	\$0	\$0	\$1	\$0
2026	\$0	\$16 , 524	\$16 , 524	\$1	\$16,649
2027	\$0	\$16,524	\$16,524	\$1	\$16,699
2028	\$0	\$16,524	\$16,524	\$1	\$16,749
2029	\$0	\$16,524	\$16,524	\$1	\$16,799
2030	\$0	\$16 , 524	\$16,524	\$1	\$16 , 850
2031	\$0	\$16,524	\$16,524	\$1	\$16,901
2032	\$0	\$16,524	\$16,524	\$1	\$16 , 951
2033	\$0	\$16,524	\$16,524	\$1	\$17,002
2034	\$0	\$16,524	\$16,524	\$1	\$17,054
2035	\$0	\$16,524	\$16,524	\$1	\$17,105
2036	\$0	\$17,394	\$17,394	\$1	\$18,060
2037	\$0	\$17,394	\$17,394	\$1	\$18,114
2038	\$0	\$17,394	\$17,394	\$1	\$18,169
2039	\$0	\$17,394	\$17,394	\$1	\$18,223
2040	\$0	\$17,394	\$17,394	\$1	\$18,278
2041	\$0	\$17,394	\$17,394	\$1	\$18 , 333
2042	\$0	\$17,394	\$17,394	\$1	\$18,388
2043	\$0	\$17,394	\$17,394	\$1	\$18,444
2044	\$0	\$17,394	\$17,394	\$1	\$18,499
2045	\$0	\$17,394	\$17,394	\$1	\$18 , 555
2046	\$0	\$17,394	\$17,394	\$1	\$18,611
2047	\$0	\$17,394	\$17,394	\$1	\$18 , 667
2048	\$0	\$17,394	\$17,394	\$1	\$18,723
2049	\$0	\$17,394	\$17,394	\$1	\$18 , 779
2050	\$0	\$17,394	\$17,394	\$1	\$18,836
2051	\$0	\$17,394	\$17,394	\$1	\$18,892
2052	\$0	\$17,394	\$17,394	\$1	\$18,949
2053	\$0	\$17,394	\$17,394	\$1	\$19,006
%NPV	97.32%	2.68%			
	\$18,246,390	\$502 , 282			
Discounting Convention	М-О-У	М-О-У			
Inflation Schedule	No Inflation	No Inflation			
Category / Residual Schedule	Non-Recurring Costs	Recurring Costs			

Alternative: Sustainment/Maintenance

Year	Cumulative Net Present Value	
2024	\$18,246,390	
2025	\$18,246,390	
2026	\$18,263,039	
2027	\$18,279,737	
2028	\$18,296,486	
2029	\$18,313,286	
2030	\$18,330,136	
2031	\$18,347,036	
2032	\$18,363,988	
2033	\$18,380,990	
2034	\$18,398,044	
2035	\$18,415,148	
2036	\$18,433,208	
2037	\$18,451,322	
2038	\$18,469,491	
2039	\$18,487,714	
2040	\$18,505,992	
2041	\$18,524,325	
2042	\$18,542,713	
2043	\$18,561,157	
2044	\$18,579,656	
2045	\$18,598,210	
2046	\$18,616,821	
2047	\$18,635,487	
2048	\$18,654,210	
2049	\$18,672,989	
2050	\$18,691,825	
2051	\$18,710,717	
2052	\$18,729,666	
2053	\$18,748,672	

Discount Rate: -0.3% Period of Analysis: 30 years

Alternative: Restoration/Modernization #1 (Ductile Iron)

Year	Investment Cost	Sustainment	Total Annual Outlays	Middle of Year Discount Factors	Present Value
2024	\$15,604,000	\$0	\$15,604,000	\$1	\$15,627,459
2025	\$0	\$0	\$0	\$1	\$0
2026	\$0	\$7 , 827	\$7 , 827	\$1	\$7 , 886
2027	\$0	\$7 , 827	\$7 , 827	\$1	\$7,910
2028	\$0	\$7 , 827	\$7 , 827	\$1	\$7,934
2029	\$0	\$7 , 827	\$7,827	\$1	\$7 , 957
2030	\$0	\$7 , 827	\$7 , 827	\$1	\$7 , 981
2031	\$0	\$7 , 827	\$7,827	\$1	\$8,005
2032	\$0	\$7 , 827	\$7 , 827	\$1	\$8,029
2033	\$0	\$7 , 827	\$7,827	\$1	\$8,054
2034	\$0	\$7 , 827	\$7 , 827	\$1	\$8 , 078
2035	\$0	\$7 , 827	\$7 , 827	\$1	\$8,102
2036	\$0	\$8,697	\$8,697	\$1	\$9,030
2037	\$0	\$8,697	\$8,697	\$1	\$9,057
2038	\$0	\$8,697	\$8,697	\$1	\$9,084
2039	\$0	\$8,697	\$8,697	\$1	\$9,112
2040	\$0	\$8,697	\$8,697	\$1	\$9,139
2041	\$0	\$8,697	\$8,697	\$1	\$9,167
2042	\$0	\$8,697	\$8,697	\$1	\$9,194
2043	\$0	\$8,697	\$8,697	\$1	\$9 , 222
2044	\$0	\$8,697	\$8,697	\$1	\$9,250
2045	\$0	\$8,697	\$8,697	\$1	\$9,277
2046	\$0	\$8,697	\$8,697	\$1	\$9,305
2047	\$0	\$8,697	\$8,697	\$1	\$9 , 333
2048	\$0	\$8,697	\$8,697	\$1	\$9 , 361
2049	\$0	\$8,697	\$8,697	\$1	\$9,390
2050	\$0	\$8,697	\$8,697	\$1	\$9,418
2051	\$0	\$8,697	\$8,697	\$1	\$9,446
2052	\$0	\$8,697	\$8,697	\$1	\$9,475
2053	\$0	\$8,697	\$8,697	\$1	\$9 , 503
%NPV	98.45%	1.55%			
	\$15,627,458	\$246,698			
Discounting Convention	М-О-Ү	М-О-У			
Inflation Schedule	No Inflation	No Inflation			
Category / Residual Schedule	Non-Recurring Costs	Recurring Costs			

Alternative: Restoration/Modernization #1 (Ductile Iron)

Year	Cumulative Net Present Value	
2024	\$15,627,459	
2025	\$15,627,459	
2026	\$15,635,345	
2027	\$15,643,255	
2028	\$15,651,188	
2029	\$15,659,146	
2030	\$15,667,127	
2031	\$15,675,132	
2032	\$15,683,162	
2033	\$15,691,215	
2034	\$15,699,293	
2035	\$15,707,395	
2036	\$15,716,425	
2037	\$15,725,482	
2038	\$15,734,566	
2039	\$15,743,678	
2040	\$15,752,817	
2041	\$15,761,984	
2042	\$15,771,178	
2043	\$15,780,399	
2044	\$15,789,649	
2045	\$15,798,926	
2046	\$15,808,232	
2047	\$15,817,565	
2048	\$15,826,926	
2049	\$15,836,316	
2050	\$15,845,733	
2051	\$15,855,180	
2052	\$15,864,654	
2053	\$15,874,157	

Discount Rate: -0.3% Period of Analysis: 30 years

Sources and Derivations:

1. Sustainment/Maintenance

a.Investment Cost Repair 4,000 LF of 24-inch waterline by sliplining with 20-inch pipe and installing an 8-inch polyethylene wrapped cement mortar lined ductile iron pipe.

Investment (Repair) Cost	\$ 16,066,000
Contingency (5%)	\$ 803,000
Subtotal	\$ 16,869,000
SIOH (8%)	\$ 1,350,000
Investment Cost	\$ 18,219,000

b.Sustainment

Based on the DoD Facilities Pricing Guide, annual sustainment costs are determined as follows:

Sustainment Cost = Facility Quantity X Sustainment Unit Cost X
Area Cost Factor X Inflation Factor

Although the existing 24-inch waterline will experience significant repairs, this analysis will not reduce the expected maintenance costs by 10% for the first 10 years.

Annual Sustainment Cost (years 3-32) = \$8,697

Since the 8-inch waterline is brand new, reduce the expected maintenance costs by 10% for the first 10 years:

90% Sustainment Cost = \$8,697 X 90% = \$7,827

Annual Sustainment Cost (years 3-12) = \$7,827 + \$8,697 = \$16,524 Annual Sustainment Cost (years 13-32) = \$8,697 + \$8,697 = \$17,394

2. Restoration/Modernization #1 (Ductile Iron) a.Investment Cost Replace 4,000 LF of 24-inch waterline with polyethylene wrapped cement mortar lined ductile iron pipe. Investment (Repair) Cost \$ 13,760,000 Contingency (5%) \$ 688,000 _____ Subtotal \$ 14,448,000 SIOH (8%) \$ 1,156,000 _____ \$ 15,604,000 Investment Cost b.Sustainment Based on the DoD Facilities Pricing Guide, annual sustainment costs are determined as follows: Sustainment Cost = Facility Quantity X Sustainment Unit Cost X Area Cost Factor X Inflation Factor Facility Quantity = 4,000 LF FAC Code 8421 (Water Distribution Line, Potable) Sustainment Unit Cost = \$.83/SF (Oct 2020) Area Cost Factor = 2.42 Sustainment for Pearl Harbor Inflation Factor = 6723 (Oct 2024) / 6211 (Oct 2020) = 1.082
Sustainment Cost = 4,000 LF X \$.83/SF X 2.42 X 1.082 = \$8,697 Since the 24-inch waterline is brand new, reduce the expected maintenance costs by 10% for the first 10 years: 90% Sustainment Cost = \$8,697 X 90% = \$7,827 Annual Sustainment Cost (years 3-12) = \$7,827 Annual Sustainment Cost (years 13-32) = \$8,697

Cost Sensitivity Analysis

Title: Vary SM Investment Cost

This sensitivity analysis checks for alternative Sustainment/Maintenance to be ranked least cost as a result of changes in the expenses listed below:

Alternative	Expenses
Sustainment/Maintenance	Investment Cost
Restoration/Modernization #1 ((Ductile ** Nothing Changed **

The selected expenses are allowed to vary from a value of -100.0% to 200.0% of their original values.

NPV

Alternative

AILEINALIVE		 141 0
Sustainment/Maintenance		\$ 18,748,672
Restoration/Modernization	#1	\$ 15,874,157



Results: For alternative Sustainment/Maintenance to be ranked least cost, decrease the selected expense(s) by more than 15.75%.

Expense	NPV Before	Change	NPV After
Investment Cost	\$ 18,246,390	-\$ 2,873,806	\$ 15,372,583

Cost Sensitivity Analysis

Title: Vary SM Sustainment

This sensitivity analysis checks for alternative Sustainment/Maintenance to be ranked least cost as a result of changes in the expenses listed below:

Alternative			Exp	enses		
Sustainment/Maintenance			Sus	tainment		
Restoration/Modernization	#1	(Ductile	* *	Nothing	Changed	**

The selected expenses are allowed to vary from a value of -100.0% to 200.0% of their original values.

Alternative	NPV
Sustainment/Maintenance	\$ 18,748,672
Restoration/Modernization #1	\$ 15,874,157

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Results: The ranking of alternatives is insensitive to changes in the selected expense(s), within the allowable range of variation.

Cost Sensitivity Analysis

Title: Vary RM Investment Cost

This sensitivity analysis checks for alternative Sustainment/Maintenance to be ranked least cost as a result of changes in the expenses listed below:

Alternative	Expenses
Restoration/Modernization #1 (Ductile	Investment Cost
Sustainment/Maintenance	** Nothing Changed **

The selected expenses are allowed to vary from a value of -100.0% to 200.0% of their original values.

Alternative		NPV
Restoration/Modernization	#1 \$	15,874,157
Sustainment/Maintenance	\$	18,748,672



Results: For alternative Sustainment/Maintenance to be ranked least cost, increase the selected expense(s) by more than 18.39%.

Expense	NPV Before	Change	NPV After
Investment Cost	\$ 15,627,458	\$ 2,873,890	\$ 18,501,348

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Cost Sensitivity Analysis

Title: Vary RM Sustainment

This sensitivity analysis checks for alternative Sustainment/Maintenance to be ranked least cost as a result of changes in the expenses listed below:

Alternative	Expenses
Restoration/Modernization #1 (Ductile	Sustainment
Sustainment/Maintenance	** Nothing Changed **

The selected expenses are allowed to vary from a value of -100.0% to 200.0% of their original values.

Alternative	NPV
Restoration/Modernization #1	\$ 15,874,157
Sustainment/Maintenance	\$ 18,748,672



Results: The ranking of alternatives is insensitive to changes in the selected expense(s), within the allowable range of variation.

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Discount Rate Sensitivity Analysis

NPV rankings change at the following discount rates: No changes

Table of Net Present Values for each Discount Rate

Discount Rate =	-2.0%	Discount Rate =	0.4%
Restoration/Modernization #1	\$ 16,093,322	Restoration/Modernization #1	\$ 15,792,992
Sustainment/Maintenance	\$ 19,075,811	Sustainment/Maintenance	\$ 18,631,345
Discount Rate =	-1.8%	Discount Rate =	0.6%
Restoration/Modernization #1	\$ 16,065,629	Restoration/Modernization #1	\$ 15,770,601
Sustainment/Maintenance	\$ 19,033,647	Sustainment/Maintenance	\$ 18,599,338
Discount Rate =	-1.6%	Discount Rate =	0.8%
Restoration/Modernization #1	\$ 16,038,496	Restoration/Modernization #1	\$ 15,748,538
Sustainment/Maintenance	\$ 18,992,567	Sustainment/Maintenance	\$ 18,567,952
Discount Rate =	-1.4%	Discount Rate =	1.0%
Restoration/Modernization #1	\$ 16,011,899	Restoration/Modernization #1	\$ 15,726,789
Sustainment/Maintenance	\$ 18,952,520	Sustainment/Maintenance	\$ 18,537,159
Discount Rate =	-1.2%	Discount Rate =	1.2%
Restoration/Modernization #1	\$ 15,985,813	Restoration/Modernization #1	\$ 15,705,343
Sustainment/Maintenance	\$ 18,913,456	Sustainment/Maintenance	\$ 18,506,934
Discount Rate =	-1.0%	Discount Rate =	1.4%
Restoration/Modernization #1	\$ 15,960,214	Restoration/Modernization #1	\$ 15,684,187
Sustainment/Maintenance	\$ 18,875,331	Sustainment/Maintenance	\$ 18,477,252
Discount Rate =	-0.8%	Discount Rate =	1.6%
Restoration/Modernization #1	\$ 15,935,082	Restoration/Modernization #1	\$ 15,663,308
Sustainment/Maintenance	\$ 18,838,100	Sustainment/Maintenance	\$ 18,448,091
Discount Rate =	-0.6%	Discount Rate =	1.8%
Restoration/Modernization #1	\$ 15,910,395	Restoration/Modernization #1	\$ 15,642,697
Sustainment/Maintenance	\$ 18,801,722	Sustainment/Maintenance	\$ 18,419,429
Discount Rate =	-0.4%	Discount Rate =	2.0%
Restoration/Modernization #1	\$ 15,886,134	Restoration/Modernization #1	\$ 15,622,343
Sustainment/Maintenance	\$ 18,766,159	Sustainment/Maintenance	\$ 18,391,245
Discount Rate =	-0.2%	Discount Rate =	2.2%
Restoration/Modernization #1	\$ 15,862,280	Restoration/Modernization #1	\$ 15,602,235
Sustainment/Maintenance	\$ 18,731,374	Sustainment/Maintenance	\$ 18,363,519
Discount Rate =	0.0%	Discount Rate =	2.4%
Restoration/Modernization #1	\$ 15,838,816	Restoration/Modernization #1	\$ 15,582,365
Sustainment/Maintenance	\$ 18,697,332	Sustainment/Maintenance	\$ 18,336,234
Discount Rate =	0.2%	Discount Rate =	2.6%
Restoration/Modernization #1	\$ 15,815,725	Restoration/Modernization #1	\$ 15,562,724
Sustainment/Maintenance	\$ 18,663,999	Sustainment/Maintenance	\$ 18,309,370

Discount Rate Sensitivity Analysis

NPV rankings change at the following discount rates: No changes

Table of Net Present Values for each Discount Rate

Discount Rate =	2.8%	Discount Rate =	5.2%
Restoration/Modernization #1	\$ 15,543,302	Restoration/Modernization #1	\$ 15,324,812
Sustainment/Maintenance	\$ 18,282,912	Sustainment/Maintenance	\$ 17,991,878
Discount Rate =	3.0%	Discount Rate =	5.4%
Restoration/Modernization #1	\$ 15,524,093	Restoration/Modernization #1	\$ 15,307,637
Sustainment/Maintenance	\$ 18,256,842	Sustainment/Maintenance	\$ 17,969,474
Discount Rate =	3.2%	Discount Rate =	5.6%
Restoration/Modernization #1	\$ 15,505,087	Restoration/Modernization #1	\$ 15,290,599
Sustainment/Maintenance	\$ 18,231,147	Sustainment/Maintenance	\$ 17,947,308
Discount Rate =	3.4%	Discount Rate =	5.8%
Restoration/Modernization #1	\$ 15,486,279	Restoration/Modernization #1	\$ 15,273,692
Sustainment/Maintenance	\$ 18,205,811	Sustainment/Maintenance	\$ 17,925,373
Discount Rate =	3.6%	Discount Rate =	6.0%
Restoration/Modernization #1	\$ 15,467,660	Restoration/Modernization #1	\$ 15,256,913
Sustainment/Maintenance	\$ 18,180,820	Sustainment/Maintenance	\$ 17,903,661
Discount Rate =	3.8%	Discount Rate =	6.2%
Restoration/Modernization #1	\$ 15,449,225	Restoration/Modernization #1	\$ 15,240,257
Sustainment/Maintenance	\$ 18,156,162	Sustainment/Maintenance	\$ 17,882,163
Discount Rate =	4.0%	Discount Rate =	6.4%
Restoration/Modernization #1	\$ 15,430,966	Restoration/Modernization #1	\$ 15,223,722
Sustainment/Maintenance	\$ 18,131,824	Sustainment/Maintenance	\$ 17,860,874
Discount Rate =	4.2%	Discount Rate =	6.6%
Restoration/Modernization #1	\$ 15,412,879	Restoration/Modernization #1	\$ 15,207,304
Sustainment/Maintenance	\$ 18,107,793	Sustainment/Maintenance	\$ 17,839,787
Discount Rate =	4.4%	Discount Rate =	6.8%
Restoration/Modernization #1	\$ 15,394,956	Restoration/Modernization #1	\$ 15,190,999
Sustainment/Maintenance	\$ 18,084,059	Sustainment/Maintenance	\$ 17,818,894
Discount Rate =	4.6%	Discount Rate =	7.0%
Restoration/Modernization #1	\$ 15,377,194	Restoration/Modernization #1	\$ 15,174,805
Sustainment/Maintenance	\$ 18,060,611	Sustainment/Maintenance	\$ 17,798,190
Discount Rate =	4.8%	Discount Rate =	7.2%
Restoration/Modernization #1	\$ 15,359,585	Restoration/Modernization #1	\$ 15,158,718
Sustainment/Maintenance	\$ 18,037,438	Sustainment/Maintenance	\$ 17,777,669
Discount Rate =	5.0%	Discount Rate =	7.4%
Restoration/Modernization #1	\$ 15,342,126	Restoration/Modernization #1	\$ 15,142,735
Sustainment/Maintenance	\$ 18,014,530	Sustainment/Maintenance	\$ 17,757,325

Discount Rate Sensitivity Analysis

NPV rankings change at the following discount rates: No changes

Table of Net Present Values for each Discount Rate

Discount Rate =	7.6%	Discount Rate =	10.0%
Restoration/Modernization #1 Sustainment/Maintenance	\$ 15,126,854 \$ 17,737,153	Restoration/Modernization #1 Sustainment/Maintenance	\$ 14,943,353 \$ 17,506,815
Discount Rate =	7.8%		
Restoration/Modernization #1 Sustainment/Maintenance	\$ 15,111,073 \$ 17,717,148		
Discount Rate =	8.0%		
Restoration/Modernization #1 Sustainment/Maintenance	\$ 15,095,387 \$ 17,697,305		
Discount Rate =	8.2%		
Restoration/Modernization #1 Sustainment/Maintenance	\$ 15,079,796 \$ 17,677,618		
Discount Rate =	8.4%		
Restoration/Modernization #1 Sustainment/Maintenance	\$ 15,064,296 \$ 17,658,084		
Discount Rate =	8.6%		
Restoration/Modernization #1 Sustainment/Maintenance	\$ 15,048,886 \$ 17,638,698		
Discount Rate =	8.8%		
Restoration/Modernization #1 Sustainment/Maintenance	\$ 15,033,564 \$ 17,619,456		
Discount Rate =	9.0%		
Restoration/Modernization #1 Sustainment/Maintenance	\$ 15,018,327 \$ 17,600,354		
Discount Rate =	9.2%		
Restoration/Modernization #1 Sustainment/Maintenance	\$ 15,003,173 \$ 17,581,388		
Discount Rate =	9.4%		
Restoration/Modernization #1 Sustainment/Maintenance	\$ 14,988,100 \$ 17,562,554		
Discount Rate =	9.6%		
Restoration/Modernization #1 Sustainment/Maintenance	\$ 14,973,107 \$ 17,543,850		
Discount Rate =	9.8%		
Restoration/Modernization #1 Sustainment/Maintenance	\$ 14,958,192 \$ 17,525,271		