

**ALA WAI CANAL FLOOD RISK MANAGEMENT STUDY**  
**O'AHU, HAWAI'I**

**FINAL FEASIBILITY STUDY REPORT WITH INTEGRATED**  
**ENVIRONMENTAL IMPACT STATEMENT**

---

**APPENDIX J**  
**FEDERAL ERRATA**

---

This page is intentionally left blank.



US Army Corps of Engineers  
BUILDING STRONG

Ala Wai Canal Flood Risk Management Study  
Final Feasibility Report and Environmental Impact  
Statement - ERRATA  
September 2018



The intent of this document is to document several edits and revisions to the report resulting from the FINAL review of the Feasibility Report and Integrated Environmental Impact Statement. Edits are primarily undertaken to clarify inconsistencies within the data associated with the report and/or to correct clerical errors in quantities. The revisions do not affect the selection of the recommended plan or other substantive considerations contemplated by the FEIS. Each edit is discussed further below. Errata include the following:

## Contents

Table ES-2. Summary of the Recommended Plan.....	1
Table 16. Summary of the Recommended Plan .....	3
Table 18. Summary of the Recommended NED Plan and Alternative 2A.....	5
Table 19. Estimated Excavation and Discharge of Fill within Waters of the U.S. ....	11
Table 20. Hydrologic Model Results for Peak Flow Discharge Values at Select Locations .....	12
Table 21. Approximate Average Bankfull Channel Capacities and Annual Chance Exceedance (Existing Conditions).....	12
Appendix D, Table 1. Summary of the Recommended Plan .....	13
Appendix E3, Table 1. Flood Risk Management Measures and Associated Compensatory Measures in the Recommended Plan .....	14
Appendix E3, Table 3. General Description of Construction-Related Excavation and Placement of Fill within Waters of the U.S.....	16
References .....	18
Narrative Revisions .....	18
Amendments.....	18

## Table ES-2. Summary of the Recommended Plan

Descriptions of the recommended plan were inconsistent throughout the report. This includes Table ES-2; Table 16; Table 18; Appendix D, Table 1; and Appendix E, Table 1. These tables describe the general dimensions and scale of the structural measures proposed, particularly the debris and detention basins in the upper watershed. The debris and detention basins are not uniform in size and therefore the descriptions were generalized, however, inconsistencies existed between descriptions. As such, the tables were revised to contain consistent values, utilizing the maximum dimensions as the general descriptors of the structures across all tables based on the design drawings previously included in the report. Edits to structural dimensions of the Waihi Debris and Detention Basin, the Waiakeakua Debris and Detention Basin, the Waiomao Debris and Detention Basin, the Pukele Debris and Detention Basin, the Makiki Debris and Detention Basin, and Kanewai Multi-Purpose Detention Basin were made consistent throughout each table. In addition, the excavation volume for the Makiki Debris and Detention Basin was included in the project feature description to clarify the amount of excavation necessary to meet upstream storage targets. No changes or revisions were required for descriptions of the Woodlawn Ditch Detention Basin, the Manoa In-Stream Debris Catchment, the Ala Wai Canal Floodwalls, the Husten Ditch Detention Basin, the Ala Wai Golf Course Multi-Purpose Detention Basin, the Floodwarning System or the environmental mitigation features in any of the referenced tables.

**Table ES-2. Summary of the Recommended Plan**

Flood Risk Management Measure	Description
Waihi Debris and Detention Basin	Earthen structure, approximately 42 feet high and 477 feet across; box culvert to allow small storm flows to pass; concrete spillway above culvert with grouted rip-rap on upstream and downstream side; debris catchment feature located on upstream end of culvert; approximately 150 feet of riprap for energy dissipation and scour protection downstream of culvert. New access road to be constructed for construction and O&M.
Waiakeakua Debris and Detention Basin	Earthen structure, approximately 37 feet high and 401 feet across; arch culvert to allow small storm flows to pass; concrete spillway above culvert with grouted rip-rap on upstream and downstream side; debris catchment feature located on upstream end of culvert; approximately 150 feet of riprap for energy dissipation and scour protection downstream of culvert.
Woodlawn Ditch Detention Basin	Three-sided berm, approximately 15 feet high and 840 feet across; arch culvert to allow small storm flows to pass; concrete spillway above culvert with grouted rip rap on upstream and downstream side.
Mānoa In-stream Debris Catchment	Concrete pad, approximately 8 feet wide and 60 feet across; steel posts (up to approximately 7 feet high) evenly spaced 4 feet apart along concrete pad.
Kanewai Field Multi-Purpose Detention Basin	Earthen berm, approximately 9 feet high, around 3 sides of the field; grouted rip-rap inflow spillway along bank of Mānoa Stream to allow high flows to enter the basin; existing drainage pipe at south end of basin to allow water to re-enter stream.
Wai'ōma'o Debris and Detention Basin	Earthen structure, approximately 34 feet high and 275 feet across; box culvert to allow small storm flows to pass; concrete spillway above culvert, with grouted rip-rap on upstream and downstream side; debris catchment feature located on upstream end of culvert; approximately 150 feet of riprap for energy dissipation and scour protection downstream of culvert. Excavation of approximately 3,060 yd <sup>3</sup> to provide required detention volume upstream of berm; new access road to be constructed for construction and O&M.
Pūkele Debris and Detention Basin	Earthen structure, approximately 35 feet high and 82 feet across; box culvert to allow small storm flows to pass; concrete spillway above culvert with grouted rip-rap on upstream and downstream side; debris catchment feature located on upstream end of culvert; approximately 150 feet of riprap for energy dissipation and scour protection downstream of culvert. Excavation of approximately 14,330 yd <sup>3</sup> to provide required detention volume upstream of berm; new access road to be constructed for construction and O&M.

Makiki Debris and Detention Basin	Earthen structure, approximately 36 feet high and 100 feet across; arch culvert to allow small storm flows to pass; concrete spillway above culvert with grouted rip-rap on upstream and downstream side; debris catchment feature located on upstream end of culvert; approximately 150 feet of riprap for energy dissipation and scour protection downstream of culvert. Excavation of approximately 3,035 yd <sup>3</sup> to provide required detention volume upstream of berm; new access road to be constructed for construction and O&M.
Ala Wai Canal Floodwalls	Concrete floodwalls ranging up to approximately 4 feet high, offset from existing Canal walls. Existing stairs to be extended and new ramps to be installed to maintain access to Canal; floodgate to be installed near McCully Street. Two pump stations to accommodate storm flows and gates installed at existing drainage pipes to prevent backflow from the Ala Wai Canal during a flood event.
Hausten Ditch Detention Basin	Concrete floodwalls and an earthen berm (approximately 4.3 feet high) to provide detention for local drainage; install concrete wall with four slide gates adjacent to the upstream edge of the existing bridge to prevent a backflow from the Ala Wai Canal during a flood event.
Ala Wai Golf Course Multi-Purpose Detention Basin	Earthen berm, on average 2.7 feet high, around the north and east perimeter of the golf course; grouted rip rap inflow spillway along bank of Mānoa-Pālolo Drainage Canal to allow high flows to enter the basin; sediment basin within western portion of golf course; floodgate across the main entrance road; passive drainage back into Ala Wai Canal.
Floodwarning System	Installation of 3 real-time rain gages (Mānoa, Makiki, and Pālolo streams) and 1 real-time streamflow or stage gage (Ala Wai Canal) as part of flood warning system for Ala Wai Watershed.

**Table 16. Summary of the Recommended Plan**

Descriptions of the recommended plan were revised for consistency with Table ES-2. Project feature dimensions, project footprints, excavation volumes, and culvert lengths were each edited for consistency.

**Table 16. Summary of Design Changes between Draft and Final Report**

Flood Risk Management Measure	Original Design	Design Changes
Waihi Debris and Detention Basin	Earthen structure, approximately 24 feet high and 225 feet across; arch culvert to allow small storm flows to pass; concrete spillway above culvert with grouted rip rap on upstream and downstream side; debris catchment feature located on upstream end of culvert. New access road to be constructed for construction and O&M.	Structure height increased to 42 ft; length increased to 477 ft Arch culvert replaced with a 12'x6' box culvert Culvert length increased from 130 ft to 205 ft Approximately 150 linear feet of riprap scour protection added downstream of culvert Project footprint increased from 12,714 ft <sup>2</sup> to 35,200 ft <sup>2</sup>
Waiakeakua Debris and Detention Basin	Earthen structure, approximately 20 feet high and 185 feet across; arch culvert to allow small storm flows to pass; concrete spillway above culvert with grouted rip rap on upstream and downstream side; debris catchment feature located on upstream end of culvert; energy dissipation structure to be located on downstream end of culvert.	Structure height increased to 37 ft; length increased to 401 ft Arch culvert length increased from 110 to 200 ft Approximately 150 linear feet of riprap scour protection added downstream of culvert Project footprint increased from 29,180 ft <sup>2</sup> to 41,620 ft <sup>2</sup>
Woodlawn Ditch Detention Basin	Three-sided berm, approximately 15 feet high and 840 feet across; arch culvert to allow small storm flows to pass; concrete spillway above culvert with grouted rip rap on upstream and downstream side.	No change
Mānoa In-stream Debris Catchment	Concrete pad, approximately 8 feet wide and 60 feet across; steel posts (up to approximately 7 feet high) evenly spaced 4 feet apart along concrete pad.	No change
Kanewai Field Multi-Purpose Detention Basin	Earthen berm, approximately 7 feet high, around 3 sides of the field; grouted rip rap inflow spillway along bank of Mānoa Stream to allow high flows to enter the basin; existing drainage pipe at south end of basin to allow water to re-enter stream.	Berm height increased to 9 ft
Wai'ōma'o Debris and Detention Basin	Earthen structure, approximately 24 feet high and 120 feet across; arch culvert to allow small storm flows to pass; concrete spillway above culvert, with grouted rip rap on upstream and downstream side; debris catchment feature located on upstream end of culvert. Excavation of approx. 2,000 yd <sup>3</sup> to provide required detention volume upstream of berm; low-flow channel with existing substrate to be restored following excavation. New access road to be constructed for construction and O&M.	Structure height increased to 34 ft; length increased to 275 ft Arch culvert replaced with a 12'x6' box culvert Culvert length increased from 130 ft to 170 ft Approximately 150 linear feet of riprap scour protection added downstream of culvert Detention basin excavation increased to 3,060 yd <sup>3</sup> Project footprint increased from 6,985 ft <sup>2</sup> to 19,890 ft <sup>2</sup>
Pūkele Debris and Detention Basin	Earthen structure, approximately 24 feet high and 120 feet across; arch culvert to allow small storm flows to pass; concrete spillway above culvert with grouted rip rap on upstream and downstream side; debris catchment feature located on upstream end of culvert. New access road to be constructed for construction and O&M.	Structure height increased to 35 ft; length decreased to 82 ft Arch culvert replaced with a 12'x6' box culvert Culvert length increased from 130 ft to 160 ft Approximately 150 linear feet of riprap scour protection added downstream of culvert Excavation of 14,330 yd <sup>3</sup> from 15,620 ft <sup>2</sup> upstream of structure for additional detention capacity Project footprint increased from 2,920 ft <sup>2</sup> to 16,660 ft <sup>2</sup>
Makiki Debris and Detention Basin	Earthen structure, approximately 24 feet high and 100 feet across; arch culvert to allow small storm flows to pass; concrete spillway above culvert with grouted rip rap on upstream and downstream side; debris catchment feature located on upstream end of culvert. New access road to be constructed for construction and O&M.	Structure height increased to 36 ft Arch culvert length increased from 130 ft to 160 ft Approximately 150 linear feet of riprap scour protection added downstream of culvert Excavation of 3,035 yd <sup>3</sup> from 14,040 ft <sup>2</sup> upstream of structure for additional detention capacity Project footprint increased from 7,250 ft <sup>2</sup> to 17,165 ft <sup>2</sup>

Flood Risk Management Measure	Original Design	Design Changes
Ala Wai Canal Floodwalls	Concrete floodwalls ranging up to approximately 4 feet high, offset from existing Canal walls. Existing stairs to be extended and new ramps to be installed to maintain access to Canal; floodgate to be installed near McCully Street. Two pump stations to accommodate storm flows and gates installed at existing drainage pipes to prevent backflow from the Ala Wai Canal during a flood event.	Floodwall height optimized as described below. The floodwall near the outlet to the ocean was extended at an elevation of 7.9 ft MSL between the Kalakaua Bridge and the Ala Moana Bridge to account for future sea level rise (described in Section 8.3).
Hausten Ditch Detention Basin	Concrete floodwalls and an earthen berm (approximately 4.3 feet high) to provide detention for local drainage; install concrete wall with four slide gates adjacent to the upstream edge of the existing bridge to prevent a backflow from the Ala Wai Canal during a flood event.	Floodwall and berm heights optimized as described below.
Ala Wai Golf Course Multi-Purpose Detention Basin	Earthen berm, averaging 4 feet high, around the north and east perimeter of the golf course; grouted rip rap inflow spillway along bank of Mānoa-Pālolo Drainage Canal to allow high flows to enter the basin; sediment basin within western portion of golf course; floodgate across the main entrance road; passive drainage back into Ala Wai Canal.	Berm height increased to an elevation ranging between 10.0-11.9 ft MSL; berm averages 2.7 feet in height above the existing surface

**Table 18. Summary of the Recommended NED Plan and Alternative 2A**

Descriptions of the recommended plan were revised for consistency with Table ES-2. Clarification that the Manoa-Palolo Drainage Canal Floodwall is not included in the recommended plan has also been included in the table.

**Table 18. Summary of the Recommended NED Plan and Alternative 2A**

Measure	Alternative		Description of Measure	O&M Requirements	Total Area of Disturbance		Permanent Structure Footprint		Temporary Disturbance (e.g. staging), (ac)	Vegetation Management		Extent of Inundation (duration for 1% ACE)
	2A	NED			Total Area (ac)	Length of Stream (ft)	Total Area (ac)	Length of Stream (ft)		Total Area (ac)	Length of Stream (ft)	
<b>MĀNOA</b>												
Waihi Debris and Detention Basin		●	Earthen structure, approximately 42 feet high and 477 feet across; box culvert to allow small storm flows to pass; concrete spillway above culvert with grouted rip-rap on upstream and downstream side; debris catchment feature located on upstream end of culvert; approximately 150 feet of riprap for energy dissipation and scour protection downstream of culvert. New access road to be constructed for construction and O&M.	Cut/clear vegetation within cleared zoned (20 feet around perimeter of structure) twice per year, allowing no woody vegetation to grow in this area. Clear accumulated debris following flood event and annually.	1.5	355	0.8	355	0.1	0.3	40	1.35 acres inundated for up to 4.5 hours
Waihi Debris Catchment	●		Concrete pad, approximately 8 feet wide and 140 feet across; steel posts (up to approximately 7 feet high) evenly spaced 4 feet apart along concrete pad.	Cut/clear vegetation within cleared zoned (20 feet around perimeter of concrete pad) twice per year, allowing no woody vegetation to grow in this area. Clear accumulated debris following flood event and annually.	0.3	48	0.07	8	0.1	0.2	40	None
Waiakeakua Debris and Detention Basin		●	Earthen structure, approximately 37 feet high and 401 feet across; arch culvert to allow small storm flows to pass; concrete spillway above culvert with grouted rip-rap on upstream and downstream side; debris catchment feature located on upstream end of culvert; approximately 150 feet of riprap for energy dissipation and scour protection downstream of culvert.	Cut/clear vegetation within cleared zoned (20 feet around perimeter of structure) twice per year, allowing no woody vegetation to grow in this area. Clear accumulated debris following flood event and annually.	1.7	350	1.0	350	0.1	0.5	40	3.2 acres inundated for up to 9 hours
Waiakeakua Debris Catchment	●		Concrete pad, approximately 8 feet wide and 140 feet across; steel posts (up to approximately 7 feet high) evenly spaced 4 feet apart along concrete pad.	Cut/clear vegetation within cleared zoned (20 feet around perimeter of concrete pad) twice per year, allowing no woody vegetation to grow in this area. Clear accumulated debris following flood event and annually.	0.2	48	0.03	8	0.1	0.2	40	None
Woodlawn Ditch Detention Basin	●	●	Three-sided berm, approximately 15 feet high and 840 feet across; arch culvert to allow small storm flows to pass; concrete spillway above culvert with grouted rip-rap on upstream and downstream side.	Cut/clear vegetation within cleared zoned (20 feet around perimeter of berm) twice per year, allowing no woody vegetation to grow in this area.	1.9	120	1.1	60	0.1	1	40	1.7 acres inundated for up to 10 hours



Measure	Alternative		Description of Measure	O&M Requirements	Total Area of Disturbance		Permanent Structure Footprint		Temporary Disturbance (e.g. staging), (ac)	Vegetation Management		Extent of Inundation (duration for 1% ACE)
	2A	NED			Total Area (ac)	Length of Stream (ft)	Total Area (ac)	Length of Stream (ft)		Total Area (ac)	Length of Stream (ft)	
Po'elua Place Debris Catchment	●		Earthen berm and debris catcher with metal poles to capture debris on east side of Mānoa Stream; grate with inlet to culvert for intake of water to the Mānoa District Park multi-purpose detention basin.	Cut/clear vegetation within cleared zoned (20 feet around perimeter of berm) twice per year, allowing no woody vegetation to grow in this area. Clear accumulated debris following flood event and annually.	0.6	165	0.2	0	0.1	0.1	0	None
Mānoa In-stream Debris Catchment		●	Concrete pad, approximately 8 feet wide and 60 feet across; steel posts (up to approximately 7 feet high) evenly spaced 4 feet apart along concrete pad.	Cut/clear vegetation within cleared zoned (20 feet around perimeter of concrete pad) twice per year, allowing no woody vegetation to grow in this area. Clear accumulated debris following flood event and annually.	0.1	48	0.01	8	0.1	0.1	40	None
Mānoa District Park Multi-Purpose Detention Basin	●		Earthen berm (approximately 13 feet high) around 3 sides of Mānoa District Park; 600-foot-long culvert from Poelua Place to detention basin; concrete spillway with grouted rip-rap on detention and stream side; 2-foot drain pipe to release water back to Mānoa Stream	Cut/clear vegetation within cleared zoned (20 feet around perimeter of berm) twice per year, allowing no woody vegetation to grow in this area. Area within berm to be maintained as a field for park use (with no woody vegetation) during non-flood conditions.	12.9	600	2.2	0	0.1	9.4	0	6.6 acres inundated for up to 10 hours
Innovation Center Improvements	●		Decrease existing grade to allow high flows onto the site; debris catcher installed with metal pipes along edge of site to catch debris as flows re-enter Mānoa Stream.	Cut/clear vegetation within cleared zoned (entire site) twice per year, allowing no woody vegetation to grow in this area. Clear accumulated debris following flood event and annually.	1.1	0	1	0	0.1	1	0	None
Kanewai Field Multi-Purpose Detention Basin	●	●	Earthen berm, approximately 9 feet high, around 3 sides of the field; grouted rip-rap inflow spillway along bank of Mānoa Stream to allow high flows to enter the basin; existing drainage pipe at south end of basin to allow water to re-enter stream.	Cut/clear vegetation within cleared zoned (20 feet around perimeter of berm) twice per year, allowing no woody vegetation to grow in this area. Area within berm to be maintained as a field for park use (with no woody vegetation) during non-flood conditions.	6.1	70	0.9	70	0.1	5.5	0	5.1 acres inundated for up to 10 hours

Measure	Alternative		Description of Measure	O&M Requirements	Total Area of Disturbance		Permanent Structure Footprint		Temporary Disturbance (e.g. staging), (ac)	Vegetation Management		Extent of Inundation (duration for 1% ACE)
	2A	NED			Total Area (ac)	Length of Stream (ft)	Total Area (ac)	Length of Stream (ft)		Total Area (ac)	Length of Stream (ft)	
<b>PĀLOLO</b>												
Wai'ōma'o Debris and Detention Basin		●	Earthen structure, approximately 34 feet high and 275 feet across; box culvert to allow small storm flows to pass; concrete spillway above culvert, with grouted rip-rap on upstream and downstream side; debris catchment feature located on upstream end of culvert; approximately 150 feet of riprap for energy dissipation and scour protection downstream of culvert. Excavation of approximately 3,060 yd <sup>3</sup> to provide required detention volume upstream of berm; new access road to be constructed for construction and O&M.	Cut/clear vegetation within cleared zoned (20 feet around perimeter of structure and excavation area) twice per year, allowing no woody vegetation to grow in this area. Clear accumulated debris following flood event and annually.	1.6	720	0.5	320	0.1	1.1	40	1.0 acre inundated for up to 10 hours
Wai'ōma'o Debris Catchment		●	Concrete pad, approximately 8 feet wide and 50 feet across; steel posts (up to approximately 7 feet high) evenly spaced 4 feet apart along concrete pad.	Cut/clear vegetation within cleared zoned (20 feet around perimeter of concrete pad) twice per year, allowing no woody vegetation to grow in this area. Clear accumulated debris following flood event and annually.	0.4	48	0.1	8	0.1	0.1	40	None
Pūkele Debris and Detention Basin		●	Earthen structure, approximately 35 feet high and 82 feet across; box culvert to allow small storm flows to pass; concrete spillway above culvert with grouted rip-rap on upstream and downstream side; debris catchment feature located on upstream end of culvert; approximately 150 feet of riprap for energy dissipation and scour protection downstream of culvert. Excavation of approximately 14,330 yd <sup>3</sup> to provide required detention volume upstream of berm; new access road to be constructed for construction and O&M.	Cut/clear vegetation within cleared zoned (20 feet around perimeter of structure) twice per year, allowing no woody vegetation to grow in this area. Clear accumulated debris following flood event and annually.	1.6	810	0.4	310	0.1	0.1	40	0.8 acre inundated for up to 9 hours
Pūkele Debris Catchment		●	Concrete pad, approximately 8 feet wide and 25 feet across; steel posts (up to approximately 7 feet high) evenly spaced 4 feet apart along concrete pad.	Cut/clear vegetation within cleared zoned (20 feet around perimeter of concrete pad) twice per year, allowing no woody vegetation to grow in this area. Clear accumulated debris following flood event and annually.	0.2	48	0.1	8	0.1	0.1	40	None

Measure	Alternative		Description of Measure	O&M Requirements	Total Area of Disturbance		Permanent Structure Footprint		Temporary Disturbance (e.g. staging), (ac)	Vegetation Management		Extent of Inundation (duration for 1% ACE)
	2A	NED			Total Area (ac)	Length of Stream (ft)	Total Area (ac)	Length of Stream (ft)		Total Area (ac)	Length of Stream (ft)	
Mānoa-Pālolo Canal Floodwalls	●		Add concrete floodwalls (9 to 12 feet high) along the right bank of the Canal from the Ala Wai Canal to Date Street.	Cut/clear vegetation within cleared zoned (20 feet around perimeter of floodwalls) twice per year, allowing no woody vegetation to grow in this area.	2.1	0	0.03	0	0.1	0	0	None
<b>MAKIKI</b>												
Roosevelt Debris and Detention Basin	●		Earthen structure, approximately 24 feet high and 260 feet across; arch culvert to allow small storm flows to pass; concrete spillway with grouted rip-rap on the upstream and downstream side; 20-foot-wide perimeter to be maintained as cleared around perimeter of berm.	Cut/clear vegetation within cleared zoned (20 feet around perimeter of structure) twice per year, allowing no woody vegetation to grow in this area. Clear accumulated debris following flood event and annually.	1.1	170	0.5	120	0.1	0.2	40	0.8 acre inundated for up to 9 hours
Makiki Debris and Detention Basin	●	●	Earthen structure, approximately 36 feet high and 100 feet across; arch culvert to allow small storm flows to pass; concrete spillway above culvert with grouted rip-rap on upstream and downstream side; debris catchment feature located on upstream end of culvert; approximately 150 feet of riprap for energy dissipation and scour protection downstream of culvert. Excavation of approximately 3,035 yd <sup>3</sup> to provide required detention volume upstream of berm; new access road to be constructed for construction and O&M.	Cut/clear vegetation within cleared zoned (20 feet around perimeter of structure) twice per year, allowing no woody vegetation to grow in this area. Clear accumulated debris following flood event and annually.	1.5	780	0.4	310	0.1	0.1	40	0.5 acre inundated for up to 9 hours
<b>ALA WAI</b>												
Ala Wai Canal Floodwalls	●	●	Concrete floodwalls, offset from existing Canal walls. Floodwalls would range up to 4 feet high for the recommended plan and up to 5 feet high for Alt. 2A. Existing stairs to be extended and new ramps to be installed to maintain access to Canal; floodgate to be installed near McCully Street. Three pump stations to accommodate storm flows and gates installed at existing drainage pipes to prevent backflow from the Ala Wai Canal during a flood event.	Cut/clear vegetation within cleared zoned (20 feet around perimeter of floodwalls) twice per year, allowing no woody vegetation to grow in this area. Periodically inspect drainage pipes and gates, and remove any impediments to movement. Inspect, test, and maintain pump systems annually. Paint and/or grease metal parts, as needed.	11.8	0	0.3	0	0.3	0	0	None

Measure	Alt.		Description of Measure	O&M Requirements	Total Area of Disturbance		Permanent Structure Footprint		Temporary Disturbance (e.g. staging), (ac)	Vegetation Management		Extent of Inundation (duration for 1% ACE)
	2A	NED			Total Area (ac)	Length of Stream (ft)	Total Area (ac)	Length of Stream (ft)		Total Area (ac)	Length of Stream (ft)	
Hausten Ditch Detention Basin	●	●	Concrete floodwalls and an earthen berm (approximately 7 feet high) to provide detention for local drainage; install concrete wall with four slide gates adjacent to the upstream edge of the existing bridge to prevent a backflow from the Ala Wai Canal during a flood event.	Cut/clear vegetation within cleared zoned (20 feet around perimeter of berm and floodwalls) twice per year, allowing no woody vegetation to grow in this area. Area within berm to be maintained as a field for recreational use during non-flood conditions. Periodically inspect slide gates and actuators and remove any impediments to movement. Paint and/or grease metal parts, as needed.	1.4	70	0.2	35	0.1	1.1	35	3.5 acres inundated for up to 4 hours
Ala Wai Golf Course Multi-Purpose Detention Basin	●	●	Earthen berm, up to approximately 7 feet high, around the north and east perimeter of the golf course; grouted rip-rap inflow spillway along bank of Mānoa-Pālolo Drainage Canal to allow high flows to enter the basin; sediment basin within western portion of golf course; floodgate across the main entrance road; passive drainage back into Ala Wai Canal.	Cut/clear vegetation within cleared zoned (20 feet around perimeter of berm) twice per year, allowing no woody vegetation to grow in this area. Area within berm to be maintained as a golf course (with no woody vegetation in sediment basin) for recreational use during non-flood conditions. Periodically inspect floodgate and remove any impediments to movement. Paint and/or grease metal parts, as needed.	25.6	70	4	70	0.6	8.4	0	134 acres inundated for up to 10 hours
<b>NON-STRUCTURAL</b>												
Floodwarning System	●	●	Installation of 3 real-time rain gages (Mānoa, Makiki, and Pālolo streams) and 1 real-time streamflow or stage gage (Ala Wai Canal) as part of flood warning system for Ala Wai Watershed.	Periodically inspect gages for proper operating conditions. Keep area around sensors free from sediment deposits and plant growth, or other impediments to data collection.	minimal	minimal	minimal	minimal	minimal	0	0	None
<b>COMPENSATORY MITIGATION</b>												
Falls 7 and 8	●	●	Installation of grouted stones to eliminate passage barrier by providing a suitable surface for migration of native species at 2 in-stream structures.	Periodically inspect in-stream structure for potential erosion or undercutting; reinforce as needed.	0.05	110	0.004	10	0.05	0	0	None
<b>TOTAL FOR ALTERNATIVE 2A</b>					<b>67.3</b>	<b>2347</b>	<b>11.1</b>	<b>707</b>	<b>2.3</b>	<b>27</b>	<b>315</b>	<b>152.6</b>
<b>TOTAL FOR ALTERNATIVE 3A-2.2 (NED Plan)</b>					<b>57.0</b>	<b>3503</b>	<b>9.5</b>	<b>1898</b>	<b>2.0</b>	<b>18</b>	<b>315</b>	<b>147.7</b>

## Table 19. Estimated Excavation and Discharge of Fill within Waters of the U.S.

Data displayed in Table 19 neglected to include the excavation required for the Makiki Debris and Detention Basin and errantly included figures for excavation of the Ala Wai Multi-Purpose Detention Basin, which does not constitute a jurisdictional impact to Waters of the U.S. In addition, at the request of the Environmental Protection Agency (EPA), an additional column detailing the volume of fill associated with the construction has been included in the table. Consistent with Appendix E3, Table 3, Table 19 below has been updated to accurately reflect the impacts of excavation and fill in jurisdictional areas.

**Table 19. Estimated Excavation and Discharge of Fill within Waters of the U.S.**

Measure	Length of Stream to be Disturbed (feet)	Length of Stream in Permanent Footprint (feet)	Construction			O&M	
			Excavation	Fill	Fill	Excavation	Fill
			(yd <sup>3</sup> ) <sup>a</sup>	(yd <sup>3</sup> ) <sup>a</sup>	(acre) <sup>a</sup>	(yd <sup>3</sup> ) <sup>a</sup>	(yd <sup>3</sup> ) <sup>a</sup>
Waihi debris and detention basin <sup>b</sup>	355	355	0	676	0.8	300	0
Waiakeakua debris and detention basin <sup>b</sup>	350	350	0	828	1.0	400	0
Woodlawn Ditch detention basin	120	60	0	10	1.1	0	0
Mānoa in-stream debris catchment	48	8	0	36	0.01	25	0
Kanewai Field multi-purpose detention basin	70	70	0	41	0.9	0	0
Wai'ōma'o debris and detention basin <sup>b</sup>	720	320	3,060	730	0.5	300	0
Pūkele debris and detention basin <sup>b</sup>	810	310	14,330	677	0.4	100	0
Makiki debris and detention basin <sup>b</sup>	780	310	3,035	674	0.4	250	0
Ala Wai Canal floodwalls	0	0	0	0	0	0	0
Hausten Ditch detention basin	70	35	0	26	0.2	0	0
Ala Wai Golf Course multi-purpose detention basin	70	70	0	30	0.2	200	0
Flood warning system	0	0	0	0	0	0	0
Mitigation – Falls 7	50	5	0	4	0	0	0
Mitigation – Falls 8	60	5	0	3	0	0	0
<b>TOTAL</b>	<b>3,503</b>	<b>1,898</b>	<b>20,425</b>	<b>3,734</b>	<b>5</b>	<b>1,575</b>	<b>0</b>

## Table 20. Hydrologic Model Results for Peak Flow Discharge Values at Select Locations

A formatting error resulted in the inaccurate display of discharge frequencies in Table 20. The table has been corrected with the appropriate values from the analysis detailed in Appendix A.

**Table 20. Hydrologic Model Results for Peak Flow Discharge Values at Select Locations**

Stream Location	Annual Chance Exceedance (ACE)							
	50%	20%	10%	5%	2%	1%	0.50%	0.20%
Makiki Stream (at confluence with Ala Wai Canal)	900	1,700	2,600	3,300	4,500	5,700	6,800	8,000
Mānoa Stream (at confluence with Pālolo Stream)	2,600	4,450	6,150	7,800	9,700	11,200	12,500	15,300
Pālolo Stream (at confluence with Mānoa Stream)	1,300	2,600	3,500	4,800	6,300	7,600	9,400	12,000
Ala Wai Canal (at mouth)	8,000	11,500	13,500	16,000	18,000	19,500	20,900	23,200

## Table 21. Approximate Average Bankfull Channel Capacities and Annual Chance Exceedance (Existing Conditions)

A formatting error resulted in the inaccurate display of annual chance exceedance frequencies in Table 21. The table has been corrected with the appropriate values from the analysis detailed in Appendix A.

**Table 21. Approximate Average Bankfull Channel Capacities and Annual Chance Exceedance (Existing Conditions)**

Stream	Reach	Reach Designation	Average Bankfull Peak Discharge Capacity (ft <sup>3</sup> /s)	Annual Chance Exceedance (%)
Ala Wai	Lower	ALA 1	12,200	20
Ala Wai	Middle	ALA 2	6,900	20
Ala Wai	Upper	ALA 3	1,300	20
Kanahā	Ditch	KAH 1, KAH 2	350	50
Kanahā	Split	KAO 1	N/A	20
Makiki	Upper	MAK 3, MAK 4	1,200	5
Makiki	Lower	MAK 1, MAK 2	650	50
Mānoa	Main	MAN 1	4,300	20
Mānoa	Main	MAN 2	7,600	2
Mānoa	Main	MAN 3 to MAN 6	3,500	20
Mānoa	Main	MAN 7	5,400	2
Pālolo	Main	PAL 1, PAL 2	6,000	2
Pālolo	Main	PAL 3, PAL 4	3,400	10
Pālolo	Lower	MPC 1, MPC 2	15,400	2
Pūkele	Tributary	PUK 1	2,700	2
University	UH Split	UNI 1, UNI 2	N/A	10
Wai'ōma'o	Tributary	WAI 1	2,600	2

## Appendix D, Table 1. Summary of the Recommended Plan

Descriptions of the recommended plan were revised for consistency with Table ES-2.

**Appendix D, Table 1. Summary of the Recommended Plan**

Flood Risk Management Measure	Description
Waihi Debris and Detention Basin	Earthen structure, approximately 42 feet high and 477 feet across; box culvert to allow small storm flows to pass; concrete spillway above culvert with grouted rip-rap on upstream and downstream side; debris catchment feature located on upstream end of culvert; approximately 150 feet of riprap for energy dissipation and scour protection downstream of culvert. New access road to be constructed for construction and O&M.
Waiakeakua Debris and Detention Basin	Earthen structure, approximately 37 feet high and 401 feet across; arch culvert to allow small storm flows to pass; concrete spillway above culvert with grouted rip-rap on upstream and downstream side; debris catchment feature located on upstream end of culvert; approximately 150 feet of riprap for energy dissipation and scour protection downstream of culvert.
Woodlawn Ditch Detention Basin	Three-sided berm, approximately 15 feet high and 840 feet across; arch culvert to allow small storm flows to pass; concrete spillway above culvert with grouted rip rap on upstream and downstream side.
Mānoa In-stream Debris Catchment	Concrete pad, approximately 8 feet wide and 60 feet across; steel posts (up to approximately 7 feet high) evenly spaced 4 feet apart along concrete pad.
Kanewai Field Multi-Purpose Detention Basin	Earthen berm, approximately 9 feet high, around 3 sides of the field; grouted rip-rap inflow spillway along bank of Mānoa Stream to allow high flows to enter the basin; existing drainage pipe at south end of basin to allow water to re-enter stream.
Wai'ōma'o Debris and Detention Basin	Earthen structure, approximately 34 feet high and 275 feet across; box culvert to allow small storm flows to pass; concrete spillway above culvert, with grouted rip-rap on upstream and downstream side; debris catchment feature located on upstream end of culvert; approximately 150 feet of riprap for energy dissipation and scour protection downstream of culvert. Excavation of approximately 3,060 yd <sup>3</sup> to provide required detention volume upstream of berm; new access road to be constructed for construction and O&M.
Pūkele Debris and Detention Basin	Earthen structure, approximately 35 feet high and 82 feet across; box culvert to allow small storm flows to pass; concrete spillway above culvert with grouted rip-rap on upstream and downstream side; debris catchment feature located on upstream end of culvert; approximately 150 feet of riprap for energy dissipation and scour protection downstream of culvert. Excavation of approximately 14,330 yd <sup>3</sup> to provide required detention volume upstream of berm; new access road to be constructed for construction and O&M.
Makiki Debris and Detention Basin	Earthen structure, approximately 36 feet high and 100 feet across; arch culvert to allow small storm flows to pass; concrete spillway above culvert with grouted rip-rap on upstream and downstream side; debris catchment feature located on upstream end of culvert; approximately 150 feet of riprap for energy dissipation and scour protection downstream of culvert. Excavation of approximately 3,035 yd <sup>3</sup> to provide required detention volume upstream of berm; new access road to be constructed for construction and O&M.
Ala Wai Canal Floodwalls	Concrete floodwalls ranging up to approximately 4 feet high, offset from existing Canal walls. Existing stairs to be extended and new ramps to be installed to maintain access to Canal; floodgate to be installed near McCully Street. Two pump stations to accommodate storm flows and gates installed at existing drainage pipes to prevent backflow from the Ala Wai Canal during a flood event.
Hausten Ditch Detention Basin	Concrete floodwalls and an earthen berm (approximately 4.3 feet high) to provide detention for local drainage; install concrete wall with four slide gates adjacent to the upstream edge of the existing bridge to prevent a backflow from the Ala Wai Canal during a flood event.
Ala Wai Golf Course Multi-Purpose Detention Basin	Earthen berm, on average 2.7 feet high, around the north and east perimeter of the golf course; grouted rip rap inflow spillway along bank of Mānoa-Pālolo Drainage Canal to allow high flows to enter the basin; sediment basin within western portion of golf course; floodgate across the main entrance road; passive drainage back into Ala Wai Canal.
Floodwarning System	Installation of 3 real-time rain gages (Mānoa, Makiki, and Pālolo streams) and 1 real-time streamflow or stage gage (Ala Wai Canal) as part of flood warning system for Ala Wai Watershed.

## Appendix E3, Table 1. Flood Risk Management Measures and Associated Compensatory Measures in the Recommended Plan

Descriptions of the recommended plan were revised for consistency with Table ES-2.

**Appendix E3, Table 1. Flood Risk Management Measures and Associated Compensatory Measures in the Recommended Plan**

Flood Risk Management Measure	Description
Waihi Debris and Detention Basin	Earthen structure, approximately 42 feet high and 477 feet across; box culvert to allow small storm flows to pass; concrete spillway above culvert with grouted rip-rap on upstream and downstream side; debris catchment feature located on upstream end of culvert; approximately 150 feet of riprap for energy dissipation and scour protection downstream of culvert. New access road to be constructed for construction and O&M.
Waiakeakua Debris and Detention Basin	Earthen structure, approximately 37 feet high and 401 feet across; arch culvert to allow small storm flows to pass; concrete spillway above culvert with grouted rip-rap on upstream and downstream side; debris catchment feature located on upstream end of culvert; approximately 150 feet of riprap for energy dissipation and scour protection downstream of culvert.
Woodlawn Ditch Detention Basin	Three-sided berm, approximately 15 feet high and 840 feet across; arch culvert to allow small storm flows to pass; concrete spillway above culvert with grouted rip rap on upstream and downstream side.
Mānoa In-stream Debris Catchment	Concrete pad, approximately 8 feet wide and 60 feet across; steel posts (up to approximately 7 feet high) evenly spaced 4 feet apart along concrete pad.
Kanewai Field Multi-Purpose Detention Basin	Earthen berm, approximately 9 feet high, around 3 sides of the field; grouted rip-rap inflow spillway along bank of Mānoa Stream to allow high flows to enter the basin; existing drainage pipe at south end of basin to allow water to re-enter stream.
Wai'ōma'o Debris and Detention Basin	Earthen structure, approximately 34 feet high and 275 feet across; box culvert to allow small storm flows to pass; concrete spillway above culvert, with grouted rip-rap on upstream and downstream side; debris catchment feature located on upstream end of culvert; approximately 150 feet of riprap for energy dissipation and scour protection downstream of culvert. Excavation of approximately 3,060 yd <sup>3</sup> to provide required detention volume upstream of berm; new access road to be constructed for construction and O&M.



Pūkele Debris and Detention Basin	Earthen structure, approximately 35 feet high and 82 feet across; box culvert to allow small storm flows to pass; concrete spillway above culvert with grouted rip-rap on upstream and downstream side; debris catchment feature located on upstream end of culvert; approximately 150 feet of riprap for energy dissipation and scour protection downstream of culvert. Excavation of approximately 14,330 yd <sup>3</sup> to provide required detention volume upstream of berm; new access road to be constructed for construction and O&M.
Makiki Debris and Detention Basin	Earthen structure, approximately 36 feet high and 100 feet across; arch culvert to allow small storm flows to pass; concrete spillway above culvert with grouted rip-rap on upstream and downstream side; debris catchment feature located on upstream end of culvert; approximately 150 feet of riprap for energy dissipation and scour protection downstream of culvert. Excavation of approximately 3,035 yd <sup>3</sup> to provide required detention volume upstream of berm; new access road to be constructed for construction and O&M.
Ala Wai Canal Floodwalls	Concrete floodwalls ranging up to approximately 4 feet high, offset from existing Canal walls. Existing stairs to be extended and new ramps to be installed to maintain access to Canal; floodgate to be installed near McCully Street. Two pump stations to accommodate storm flows and gates installed at existing drainage pipes to prevent backflow from the Ala Wai Canal during a flood event.
Hausten Ditch Detention Basin	Concrete floodwalls and an earthen berm (approximately 4.3 feet high) to provide detention for local drainage; install concrete wall with four slide gates adjacent to the upstream edge of the existing bridge to prevent a backflow from the Ala Wai Canal during a flood event.
Ala Wai Golf Course Multi-Purpose Detention Basin	Earthen berm, on average 2.7 feet high, around the north and east perimeter of the golf course; grouted rip rap inflow spillway along bank of Mānoa-Pālolo Drainage Canal to allow high flows to enter the basin; sediment basin within western portion of golf course; floodgate across the main entrance road; passive drainage back into Ala Wai Canal.
Floodwarning System	Installation of 3 real-time rain gages (Mānoa, Makiki, and Pālolo streams) and 1 real-time streamflow or stage gage (Ala Wai Canal) as part of flood warning system for Ala Wai Watershed.
Compensatory mitigation measures (Falls 7 and 8)	Removal of passage barrier at two separate in-stream structures. Each of the structures currently has an overhanging lip, such that the stream flow over these structures is free-falling and does not maintain contact with the surface of the structure, creating a barrier to upstream passage for native species. The proposed mitigation involves installation of grouted stones as part of the existing in-stream structure to provide a suitable surface for migration of the native species to upstream habitat.

## Appendix E3, Table 3. General Description of Construction-Related Excavation and Placement of Fill within Waters of the U.S.

Data displayed in Table 3 of Appendix E3 neglected to include a summary of fill volumes constituting jurisdictional impacts to Waters of the U.S. The table below has been updated to accurately reflect the impacts of excavation and fill in jurisdictional areas and is consistent with Table 19 (above).

**Appendix E3, Table 3. General Description of Construction-Related Excavation and Placement of Fill within Waters of the U.S.**

Measure	Component of Measure	Excavated Material			Fill Material		
		Description	Quantity	Unit	Description	Quantity	Unit
Waihi debris and detention basin	Culvert				Concrete box, 12'x6'	160	Lin. ft
	Detention berm				Compacted fill Grouted rip-rap	140 3	yds <sup>3</sup> yds <sup>3</sup>
	Scour Protection				Stone rip-rap	500	yds <sup>3</sup>
	Debris catchment feature				Concrete footing	19	yds <sup>3</sup>
					Steel posts (8" dia.)	7	posts
Access road				Base course (gravel)	2	yds <sup>3</sup>	
Waiakeakua debris and detention basin	Culvert				Concrete footing	7	yds <sup>3</sup>
	Detention berm				Compacted fill Grouted rip-rap	290 12	yds <sup>3</sup> yds <sup>3</sup>
	Debris catchment feature				Concrete footing	19	yds <sup>3</sup>
					Steel posts (8" dia.)	7	posts
Scour Protection				Stone rip-rap	500	yds <sup>3</sup>	
Woodlawn Ditch detention basin	Culvert				Concrete footing	6	yds <sup>3</sup>
	Detention berm				Compacted fill Grouted rip-rap	3 1	yds <sup>3</sup> yds <sup>3</sup>
Manoa in-stream debris catchment	Debris catchment feature				Concrete footing	36	yds <sup>3</sup>
					Steel posts (8" dia.)	14	posts
Kanewai Field multi- purpose detention basin	Spillway				Grouted rip-rap	41	yds <sup>3</sup>
Waiomao debris and detention basin	Culvert				Concrete box, 12'x6'	170	Lin. ft
	Detention berm				Compacted fill Grouted rip-rap	140 3	yds <sup>3</sup> yds <sup>3</sup>
	Scour Protection				Stone rip-rap	500	yds <sup>3</sup>
	Debris catchment feature				Concrete footing	15	yds <sup>3</sup>
					Steel posts (8" dia.)	5	posts
	Access road				Base course (gravel)	60	yds <sup>3</sup>
Detention Basin	Excavation	3,060	yds <sup>3</sup>	none	-	-	

Measure	Component of Measure	Excavated Material			Fill Material		
		Description	Quantity	Unit	Description	Quantity	Unit
Pukele debris and detention basin	Culvert				Concrete box, 12'x6'	160	Lin. ft
	Detention berm				Compacted fill Grouted rip-rap	140 6	yds <sup>3</sup> yds <sup>3</sup>
	Scour Protection				Stone rip-rap	500	yds <sup>3</sup>
	Debris catchment feature				Concrete footing	15	yds <sup>3</sup>
					Steel posts (8" dia.)	5	posts
	Access road				Base course (gravel)	4	yds <sup>3</sup>
Detention Basin	Excavation	14,330	yds <sup>3</sup>	none	-	-	
Makiki debris and detention basin	Culvert				Concrete footing	9	yds <sup>3</sup>
	Detention berm				Compacted fill Grouted rip-rap	140 6	yds <sup>3</sup> yds <sup>3</sup>
	Scour Protection				Stone rip-rap	500	yds <sup>3</sup>
	Debris catchment feature				Concrete footing	15	yds <sup>3</sup>
					Steel posts (8" dia.)	5	posts
	Access road				Base course (gravel)	4	yds <sup>3</sup>
Detention Basin	Excavation	3,035	yds <sup>3</sup>	none	-	-	
Ala Wai Canal floodwalls	Floodwalls				None	-	-
	Access stairs				None	-	-
	Slide/flap gates				Metal slide/flap gates	47	gates
Hausten Ditch detention basin	Concrete wall				Concrete	26	yds <sup>3</sup>
	Slide gates				Metal slide gates	4	gates
Ala Wai Golf Course multi-purpose detention basin	Spillway				Grouted rip-rap	30	yds <sup>3</sup>
Flood warning system	Sensors				Prefabricated hoses	1	hoses
Mitigation– Falls 7	Species passage				Grouted stone	4	yds <sup>3</sup>
Mitigation– Falls 8	Species passage				Grouted stone	3	yds <sup>3</sup>
<b>TOTAL</b>		<b>Total Excavation</b>	<b>20,425</b>	<b>yds<sup>3</sup></b>	Concrete	167	yds <sup>3</sup>
					Compacted fill	853	yds <sup>3</sup>
					Grouted rip-rap	109	yds <sup>3</sup>
					Base course (gravel)	70	yds <sup>3</sup>
					Stone rip-rap	2500	yds <sup>3</sup>
					Posts	35	yds <sup>3</sup>
					<b>Total Fill</b>	<b>3734</b>	<b>yds<sup>3</sup></b>

## References

A number of references to tables in the report require correction:

Section	Page	Paragraph	Reference	Revision
3.10.1	3-40	1	Table 17	Table 18
4.2.2	4-3	1	Table 17	Table 18
4.2.3	4-3	2	Table 17	Table 18
5.2.2.2	5-6	2	Table 17	Table 18
5.2.2.3	5-7	2	Table 17	Table 18
5.3.2.2	5-8	3	Table 17	Table 18
5.6.2.3	5-29	2	Table 17	Table 18
5.10.2.2	5-59	3	Table 17	Table 18
8.1	8-1	1	Table 17	Table 18

## Narrative Revisions

The following revision (strikethrough/bold insert) is required to achieve consistency between the narrative of the report with the Clean Water Act Section 404(b)(1) evaluation included in Appendix E3:

“The project would involve placement of approximately ~~1,234~~ **3,734** yd<sup>3</sup> of fill material in jurisdictional Waters of the U.S.; in addition, excavation would also be required for construction of ~~one~~ **three** of the in-stream detention basins, as well as for routine maintenance (removal of debris and sediment).”  
(Section 8.1, par. 5, page 8-1).

## Amendments

The Record of Decision (ROD) regarding the EIS was signed by the Assistant Secretary of the Army (Civil Works) on 13 September 2018. The signed ROD has been inserted into Appendix E.