Spencer Island Estuary Restoration Project: Alternatives Analysis of Conceptual Restoration Designs Supplemental Report

This supplemental report includes 9 conceptual restoration designs, as well as preliminary analysis on the ecosystem benefits of the 9 alternative conceptual designs as well as a no action alternative, and maps displaying how the restoration concepts may change the pedestrian trail network on the island. The trail maps do not include any additional recreational features (e.g. boardwalk, viewing platform) that may be incorporated as additional design elements along with this current restoration effort or as part of a separate project.

The Spencer Island Project Delivery Team (PDT)—made up of subject matter experts in hydraulic engineering, civil engineering, biology, and planning from U.S. Army Corps of Engineers (USACE) and Washington Department of Fish and Wildlife (WDFW)—collaborated to develop the conceptual restoration designs and preliminary ecosystem benefits analysis. ***The material included in this report is for discussion and planning purposes only and will be further refined and evaluated throughout the planning and design process***. The alternative designs that are included are conceptual (10% design level).

For questions or additional information, please contact WDFW Project Manager Seth Ballhorn at seth.ballhorn@dfw.wa.gov.

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Spencer Island Summary by Alternative (Alt)

Alt	Name	Description	Breaches (#)				Levee/Dike Lowering and Levee Repair (LF)					Internal Grading (LF)		Cut/Fill (BCY)			Bridges			
			Union Slough	Steamboat Slough	North Cross-Dike	South Cross-Dike	Steamboat Slough Lowering	Union Slough Lowering	Union Slough Repair	Cross- Dike North	Cross- Dike South	Channels	Ditch Fill	Total excavation	Onsite Fill Placement	Offsite Disposal	#	Location	Span (LF)	Notes
1	No Action	No action	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2	Minimum Restoration	PSNERP 10% (updated for 2023 conditions) Min. Union breaches + Lower Steamboat dike & N. tip Union dike + Bridge	2	0	0	0	6,654	2,524	5,080	NA	NA	0	NA	89,300	89,300	-	1	US STA 10+60	128	US = Union Slough, SS = Steamboat Slough Access road material quantities not calculated. Off site disposal is assumed to be 0BCY. It is assumed the Onsite Placement will be a combination of approximately 3ft tall sidecast and ditch fill through out the site.
3a	Low Restoration w/o Bridges	Min. Union breaches + Min. Steamboat breaches + N. cross dike breach + Full Lower Steamboat dike+ Full Lower Union dike + + Min. interior channels & ditch fill	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Screened out because only makes sense to minimize restoration so much if it allows us to maintain rec access (i.e. build bridges across breaches).
3b	Low Restoration w/ Bridge	Min. Union breaches + Min. Steamboat breaches + N. cross dike breach + Full Lower Steamboat dike+ Lower N. tip Union dike + Levee Repair S segment Union Dike + Min. interior channels & ditch fill + Bridge	2	9	1	0	6,654	2,524	5,080	438	NA	1,225	NA	112,000	112,000	-	1	US STA 10+60	128	US = Union Slough, SS = Steamboat Slough Access road material quantities not calculated. Off site disposal is assumed to be 0BCY. It is assumed the Onsite Placement will be a combination of approximately 3ft tall sidecast and ditch fill through out the site.
4a	Moderate Restoration w/o Bridges	Med. Union breaches + Med. Steamboat breaches + N. cross dike breach + Full Lower Steamboat dike + Full Lower segment Union dike + Full Lower N. cross dike + Med. interior channels & ditch fill + Tide Gate Removal	4	9	1	0	6,654	7,604	0	438	NA	9,896	7545	219,600	219,600	-	-	-	-	US = Union Slough, SS = Steamboat Slough Access road material quantities not calculated. Off site disposal is assumed to be 0BCY. It is assumed the Onsite Placement will be a combination of approximately 3ft tall sidecast and ditch fill through out the site.
4b	Moderate Restoration w/ Bridges	Med. Union breaches + Med. Steamboat breaches + N. cross dike breach + Full Lower Steamboat dike + Lower N. segment Union dike + Levee Repair S. segment Union dike + Full Lower N. cross dike + Med. interior channels & ditch fill + Bridges	4	9	1	0	6,654	2,524	5,080	438	NA	9,896	7545	152,100	152,100	-	3	US STA 10+60 US STA 20+00 US STA 31+00	128 127 66	US = Union Slough, SS = Steamboat Slough Access road material quantities not calculated. Off site disposal is assumed to be 0BCY. It is assumed the Onsite Placement will be a combination of approximately 3ft tall sidecast and ditch fill through out the site.
5a	Medium Restoration w/o Bridges	Med. Union breaches + Max. Steamboat breaches + N. cross dike breach + Min. S. cross dike breaches + Full Lower Steamboat dike + Full Lower segment Union dike + Full Lower N. cross dike + Partial Lower S. cross-dike + Min. interior channels & ditch fill + Tide Gate Removal	4	14	1	2	6,654	7,604	0	438	797	1,393	NA	197,200	197,200	-	-	-	-	US = Union Slough, SS = Steamboat Slough Access road material quantities not calculated. Off site disposal is assumed to be 0BCY. It is assumed the Onsite Placement will be a combination of approximately 3ft tall sidecast and ditch fill through out the site.
5b	Medium Restoration w/ Bridges	Med. Union breaches + Max. Steamboat breaches + N. cross dike breach + Min. S. cross dike breaches + Full Lower Steamboat dike + Lower N. segment Union dike + Levee Repair S. segment Union dike + Full Lower N. cross dike + Partial Lower S. cross-dike + Min. interior channels & ditch fill + Bridges	4	14	1	2	6,654	4,504	3,100	438	797	1,393	NA	163,300	163,300	-	2	US STA 10+60 US STA 20+00	128 127	US = Union Slough, SS = Steamboat Slough Access road material quantities not calculated. Off site disposal is assumed to be 0BCY. It is assumed the Onsite Placement will be a combination of approximately 3ft tall sidecast and ditch fill through out the site.
6a	High Restoration w/o Bridges	Max. Union breaches + Max. Steamboat breaches + N. cross dike breach + Max. S. cross dike breaches + Full Lower Steamboat dike + Full Lower Union dike + Full Lower N. cross dike + Full Lower S. cross-dike + Min. interior channels & ditch fill + Tide Gate Removal	6	14	1	2	6,654	7,604	0	438	2,416	1,785	NA	204,300	204,300	-	-	-	-	US = Union Slough, SS = Steamboat Slough Access road material quantities not calculated. Off site disposal is assumed to be 0BCY. It is assumed the Onsite Placement will be a combination of approximately 3ft tall sidecast and ditch fill through out the site.
6b	High Restoration w/ Bridges	Max. Union breaches + Max. Steamboat breaches + N. cross dike breach + Max. S. cross dike breaches + Full Lower Steamboat dike + Lower N. segment Union dike + Levee Repair S. segment Union dike + Full Lower N. cross dike + Full Lower S. cross-dike + Min. interior channels & ditch fill + Bridges	6	14	1	2	6,654	4,504	3,100	438	2,416	1,785	NA	170,500	170,500	-	3	US STA 3+80 US STA 10+60 US STA 20+00	69 128 127	US = Union Slough, SS = Steamboat Slough Access road material quantities not calculated. Off site disposal is assumed to be 0BCY. It is assumed the Onsite Placement will be a combination of approximately 3ft tall sidecast and ditch fill through out the site.
7	Maximum Restoration	Max. Union breaches + Max. Steamboat breaches + Max. N. cross dike breach + Max. S. cross dike breaches + Full Lower Steamboat dike + Full Lower Union dike + Full Lower N. cross dike + Full Lower S. cross-dike + Max. interior channels + Max. ditch fill + Tide Gate Removal	6	14	1	2	6,654	7,604	0	438	2,416	13,546	6,413	257,000	257,000	-	-	-	-	US = Union Slough, SS = Steamboat Slough Access road material quantities not calculated. Off site disposal is assumed to be 0BCY. It is assumed the Onsite Placement will be a combination of approximately 3ft tall sidecast and ditch fill through out the site.

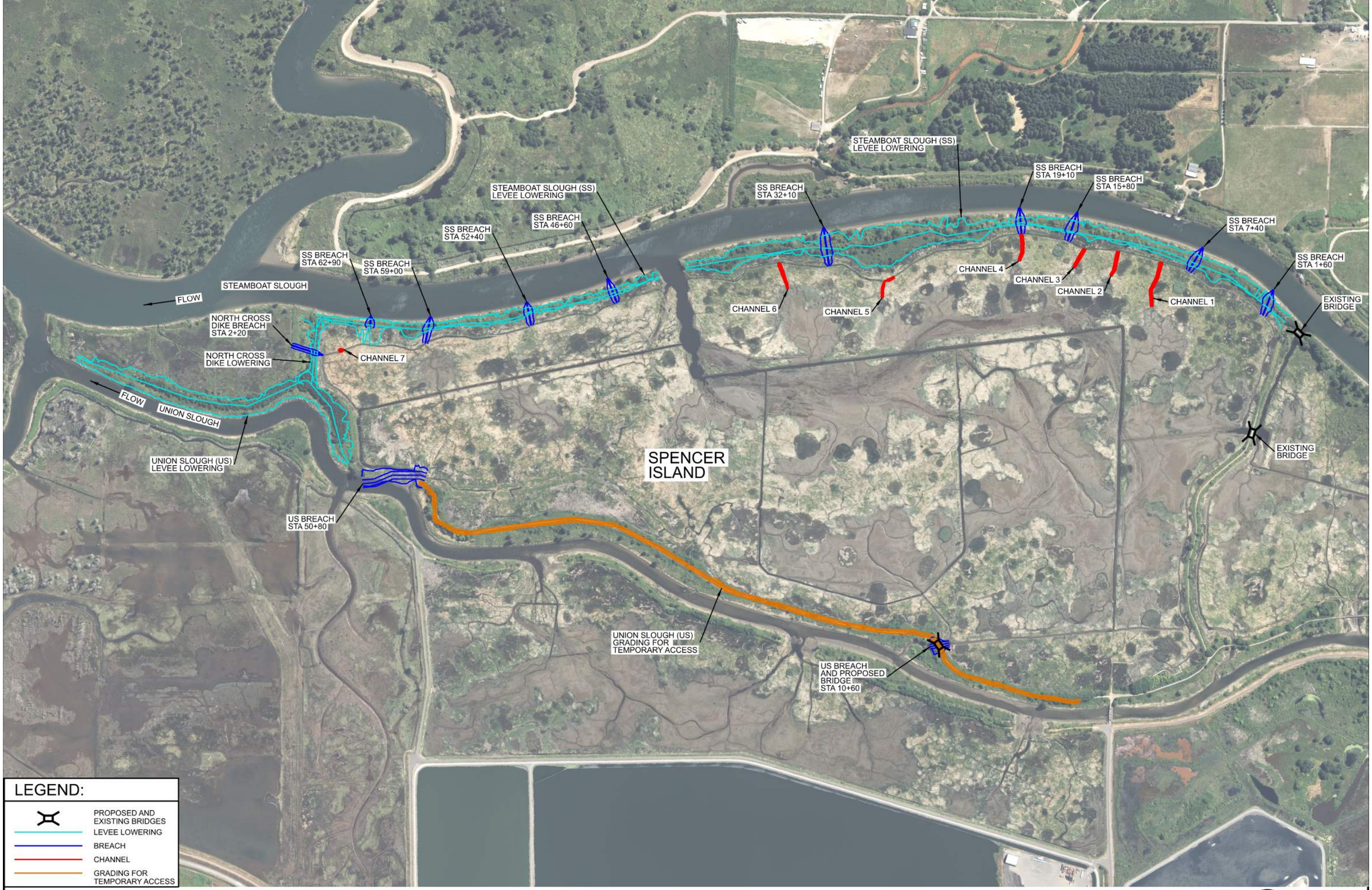
A1 SPENCER ISLAND ALTERNATE 2

1" = 300'

N

0 300' 600'

US Army Corps of Engineers®



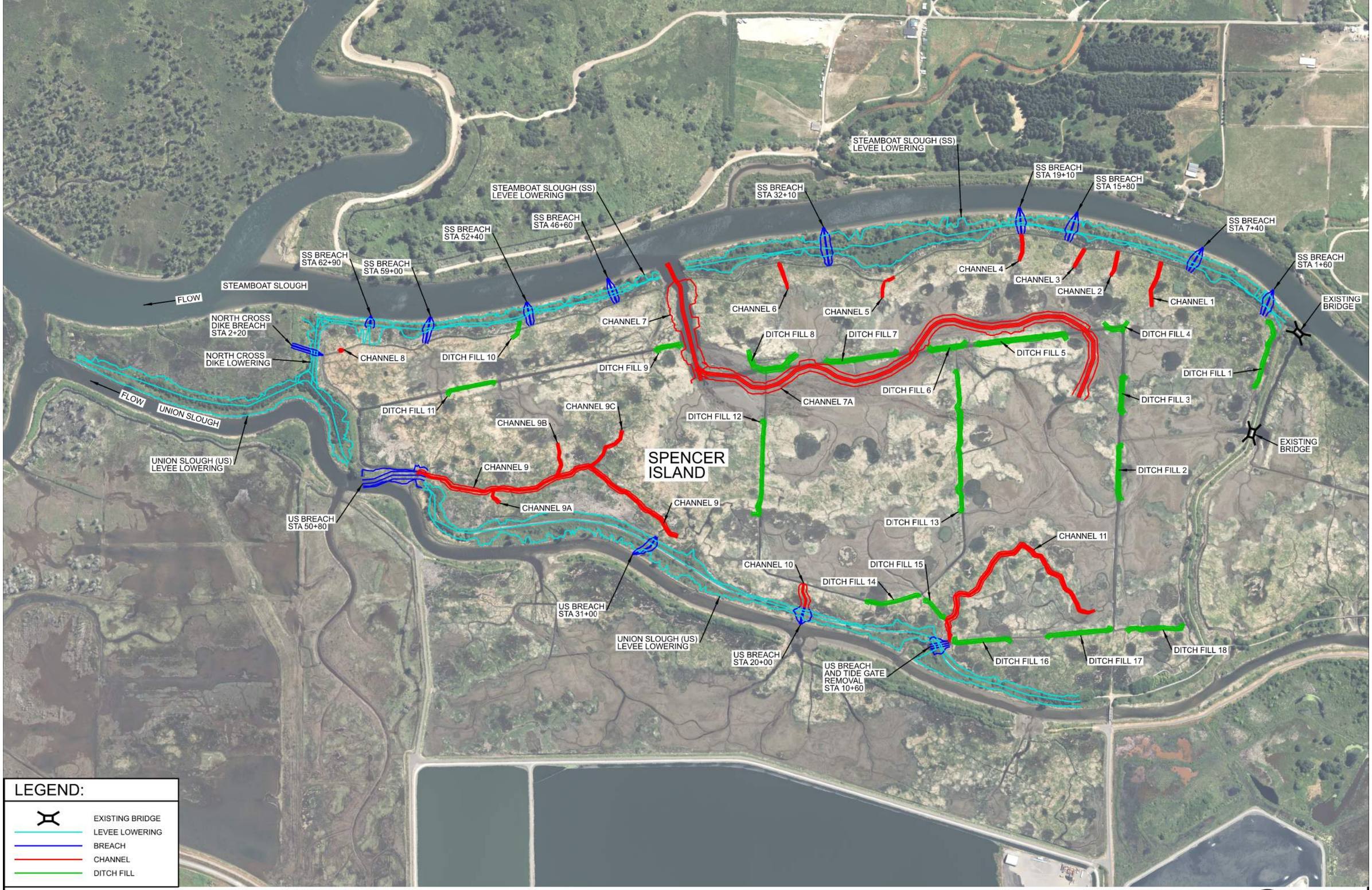
A1 SPENCER ISLAND ALTERNATE 3B

1" = 300'

N

0 300' 600'

US Army Corps of Engineers®



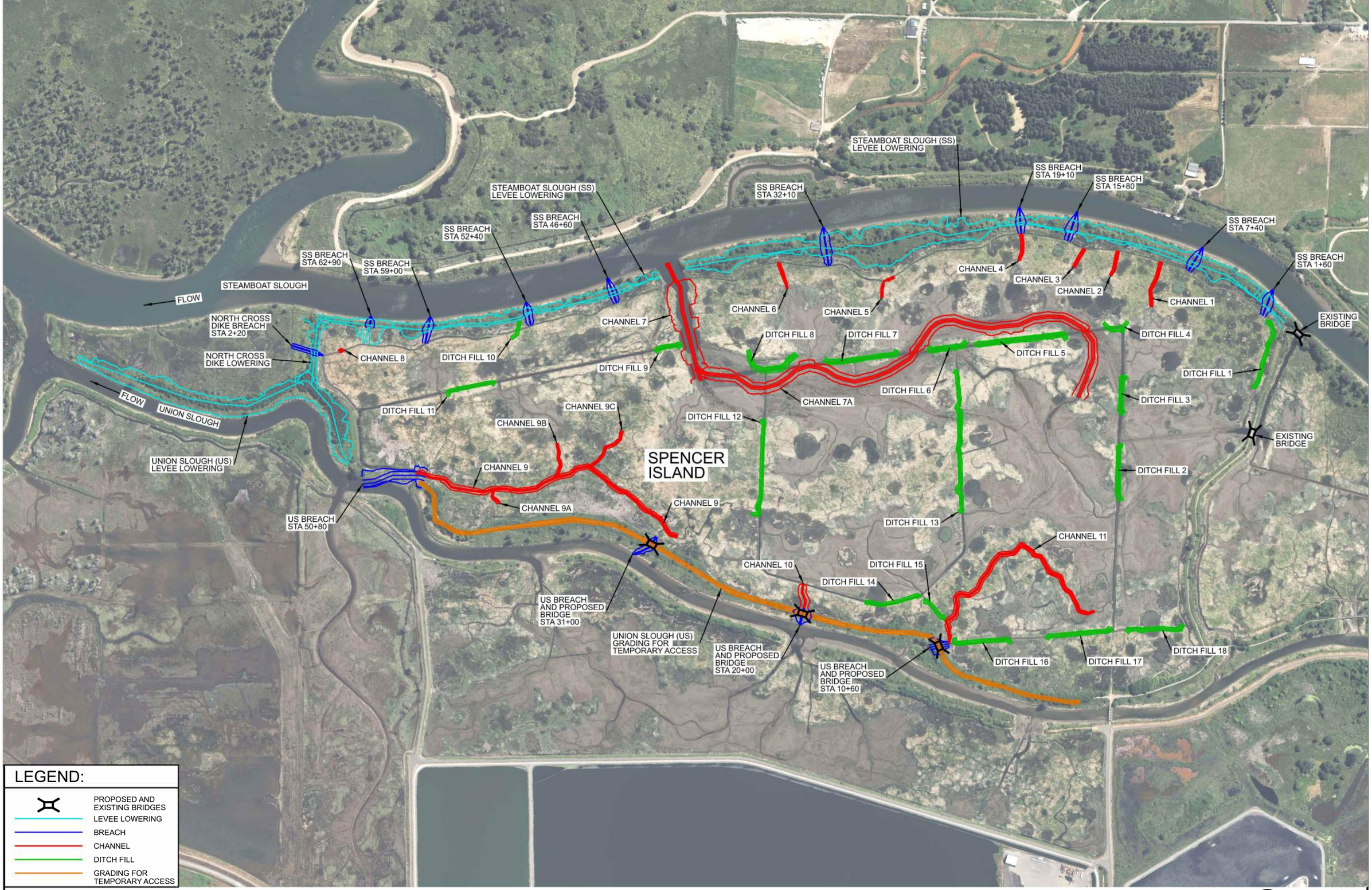
A1 SPENCER ISLAND ALTERNATE 4A

1" = 300'

N

0 300' 600'

US Army Corps of Engineers®



LEGEND:

- PROPOSED AND EXISTING BRIDGES
- LEVEE LOWERING
- BREACH
- CHANNEL
- DITCH FILL
- GRADING FOR TEMPORARY ACCESS

A1 SPENCER ISLAND ALTERNATE 4B

1" = 300'

N

0 300' 600'

US Army Corps of Engineers®


STEAMBOAT SLOUGH (SS) LEVEE LOWERING
SS BREACH STA 36+50
SS BREACH STA 32+10
SS BREACH STA 26+40
SS BREACH STA 19+10
SS BREACH STA 15+80
SS BREACH STA 11+20
SS BREACH STA 7+40
SS BREACH STA 1+60
CHANNEL 6
CHANNEL 5
CHANNEL 4
CHANNEL 3
CHANNEL 2
CHANNEL 1
STEAMBOAT SLOUGH (SS) LEVEE LOWERING
SS BREACH STA 62+90
SS BREACH STA 59+00
SS BREACH STA 55+90
SS BREACH STA 52+40
SS BREACH STA 49+50
SS BREACH STA 46+60
STEAMBOAT SLOUGH
FLOW
NORTH CROSS DIKE BREACH STA 2+20
NORTH CROSS DIKE LOWERING
CHANNEL 7
FLOW
UNION SLOUGH
UNION SLOUGH (US) LEVEE LOWERING
SOUTH CROSS DIKE BREACH AND EXISTING BRIDGE REMOVAL STA 21+16.69
SOUTH CROSS DIKE LOWERING
SOUTH CROSS DIKE BREACH AND EXISITNG BRIDGE REMOVAL STA 16+00
SPENCER ISLAND
US BREACH STA 50+80
US BREACH STA 31+00
UNION SLOUGH (US) LEVEE LOWERING
CHANNEL 8
US BREACH STA 20+00
US BREACH AND TIDE GATE REMOVAL STA 10+60
LEGEND:
EXISTING BRIDGE
LEVEE LOWERING
BREACH
CHANNEL
A1
SPENCER ISLAND ALTERNATE 5A
1" = 300'
N
0
300'
600'
US Army Corps of Engineers®
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STEAMBOAT SLOUGH (SS) LEVEE LOWERING
SS BREACH STA 36+50
SS BREACH STA 32+10
SS BREACH STA 26+40
SS BREACH STA 19+10
SS BREACH STA 15+80
SS BREACH STA 11+20
SS BREACH STA 7+40
SS BREACH STA 1+60
STEAMBOAT SLOUGH (SS) LEVEE LOWERING
SS BREACH STA 46+60
SS BREACH STA 52+40
SS BREACH STA 55+90
SS BREACH STA 49+50
SS BREACH STA 62+90
SS BREACH STA 59+00
STEAMBOAT SLOUGH
FLOW
CHANNEL 6
CHANNEL 5
CHANNEL 4
CHANNEL 3
CHANNEL 2
CHANNEL 1
NORTHCROSS DIKE BREACH STA 2+20
NORTH CROSS DIKE LOWERING
CHANNEL 7
FLOW
UNION SLOUGH
SOUTH CROSS DIKE BREACH AND EXISTING BRIDGE REMOVAL STA 21+16.69
SPENCER ISLAND
SOUTH CROSS DIKE BREACH AND EXISTING BRIDGE REMOVAL STA 16+00
SOUTH CROSS DIKE LOWERING
UNION SLOUGH (US) LEVEE LOWERING
US BREACH STA 50+80
US BREACH STA 42+80
US BREACH STA 31+00
UNION SLOUGH (US) LEVEE LOWERING
CHANNEL 8
US BREACH STA 20+00
US BREACH AND TIDE GATE REMOVAL STA 10+60
CHANNEL 9
US BREACH STA 3+80
SOUTH CROSS DIKE BREACH STA 1+60
LEGEND:
EXISTING BRIDGE
LEVEE LOWERING
BREACH
CHANNEL
A1
SPENCER ISLAND ALTERNATE 6A
1" = 300'
N
0
300'
600'
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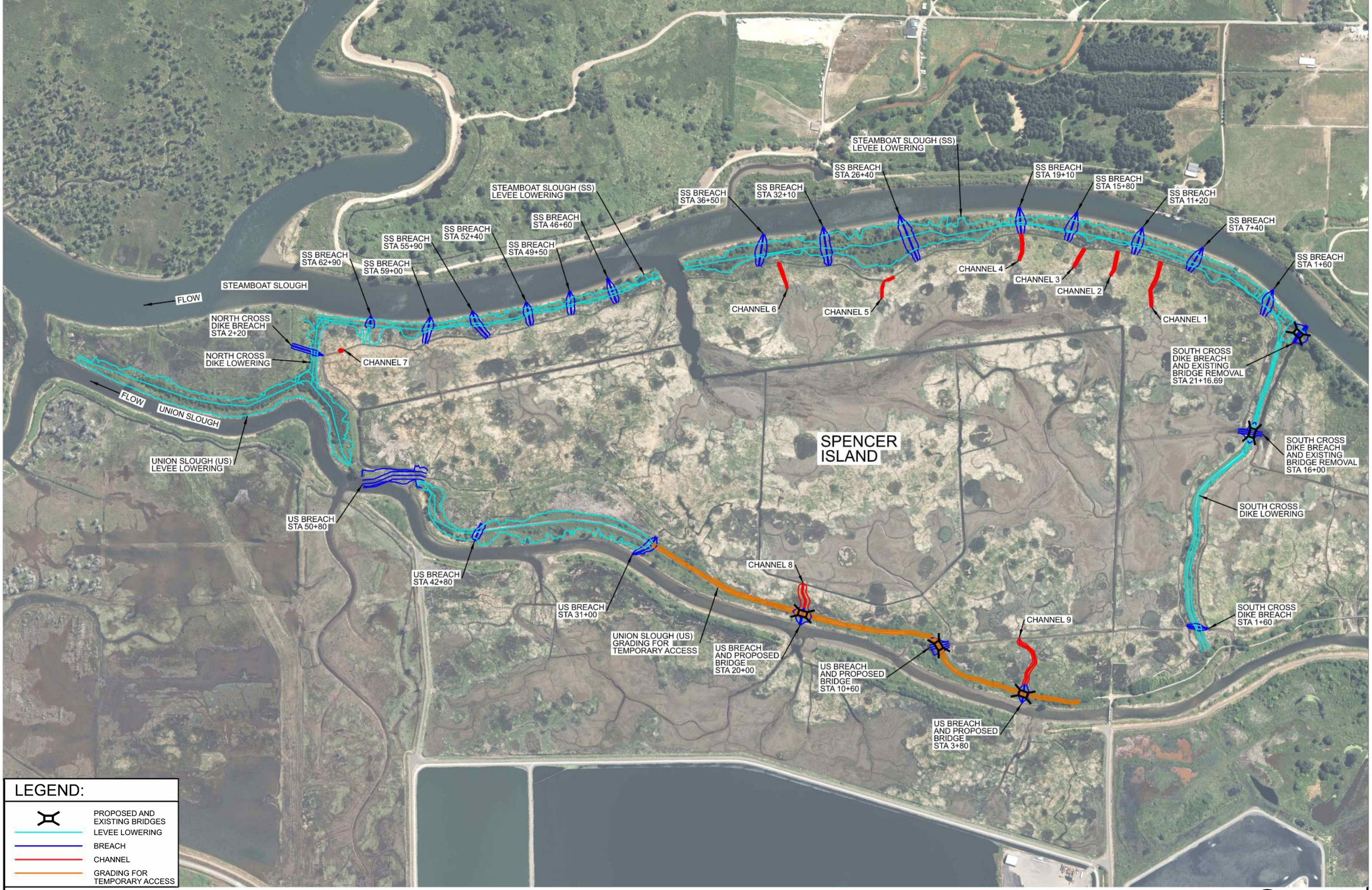

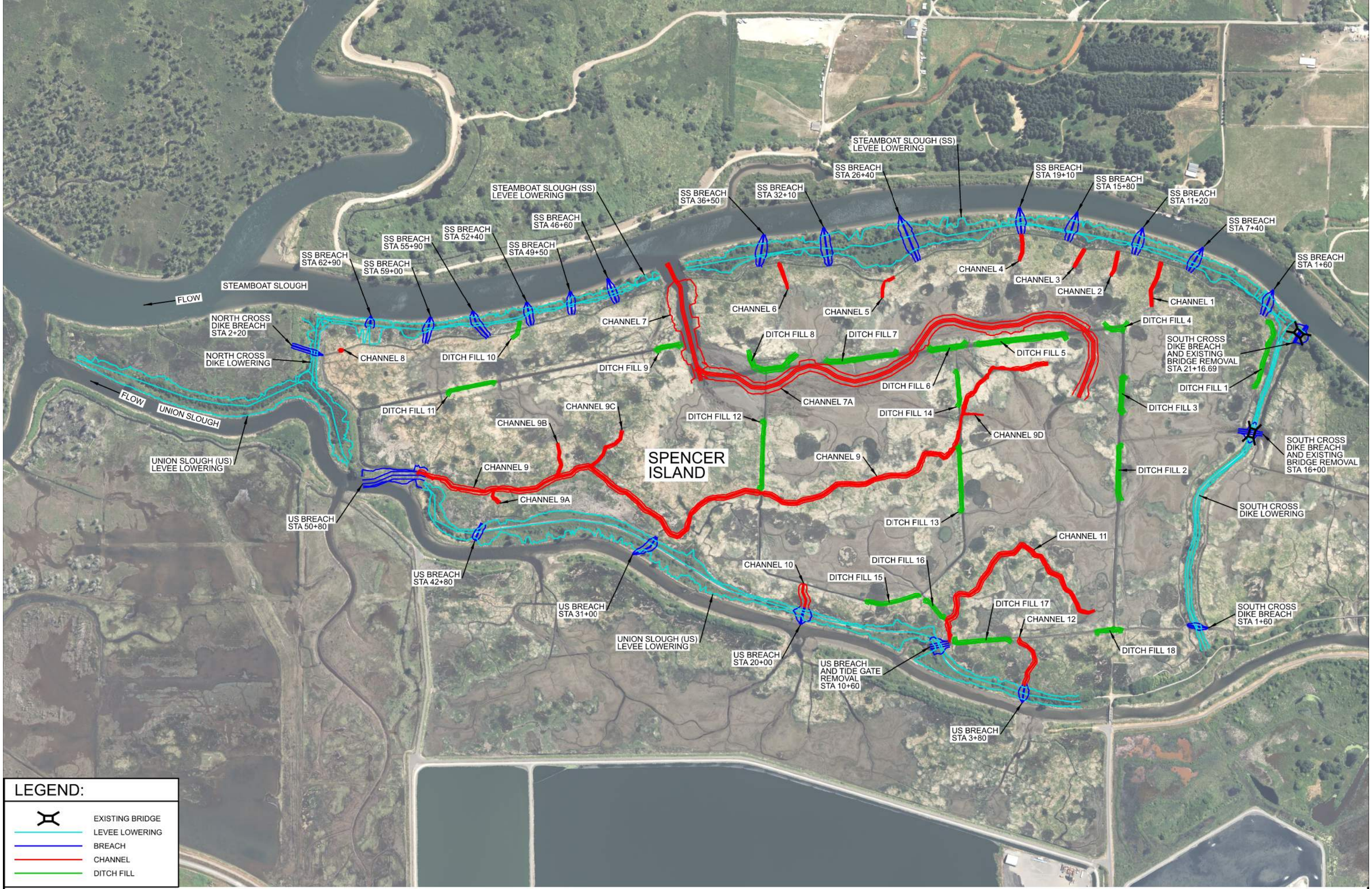

A1 SPENCER ISLAND ALTERNATE 7

1" = 300'

Preliminary Ecosystem Benefits Analysis

Table 1 Effectiveness Metrics

Metric	Process	Threshold	Quality	Quantity
Tidal channel connectivity	Exchange of aquatic organisms (fish access)	Velocities at hot spots (barriers) less then swim speed for chinook smolt in June	% of time hot spots under barrier threshold	Area of inundation at MLLW (or MTL)
Marsh connectivity	Tidal flux to/from distributaries into/out of marsh	Number of connections relative to Hood (2015) regression prediction for Spencer Island	# breach connections / regression prediction	Area of inundation at MTL
Floodplain connectivity	Fluvial and tidal flooding, erosion, sedimentation, woody debris dynamics	Perimeter shoreline below ordinary fluvial high-water elevation	Length of shoreline where elev < threshold / total shoreline perimeter	Area of inundation at Q2 or MHHW + 2’

Table 2 Metrics and Potential Management Measures

Metric	Potential Management Measures
Tidal channel connectivity	• Increase number of outlets connecting marsh channels to distributaries, • Increase size of outlet and/or interior channels, • Block ditches, • Remove undersized hydraulic structures, • Increase length (sinuosity) of interior channels, • Flatten side slopes of interior channels, • Add roughness (wood) in interior channels
Marsh connectivity	• Add levee breaches (outlets) • Increase depth or width of existing outlets
Floodplain connectivity	• Lower levees • Add levee breaches

Table 3 Preliminary Ecosystem Benefits

Alternative	Preliminary Net Benefits (Habitat Units)	% Increase Over No Action
1. No Action	0	0
2. Minimum Restoration	63	39%
3. Low Restoration w/ Bridge	91	56%
4a. Moderate Restoration w/o Bridges	147	89%
4b. Moderate Restoration w/ Bridges	101	62%
5a. Medium Restoration w/o Bridges	172	105%
5b. Medium Restoration w/ Bridges	146	89%
6a. High Restoration w/o Bridges	190	116%
6b. High Restoration w/ Bridges	164	100%
7. Maximum Restoration	219	134%

Potential Changes to Spencer Island Trail Network

Table 4: Current trail network and ownership

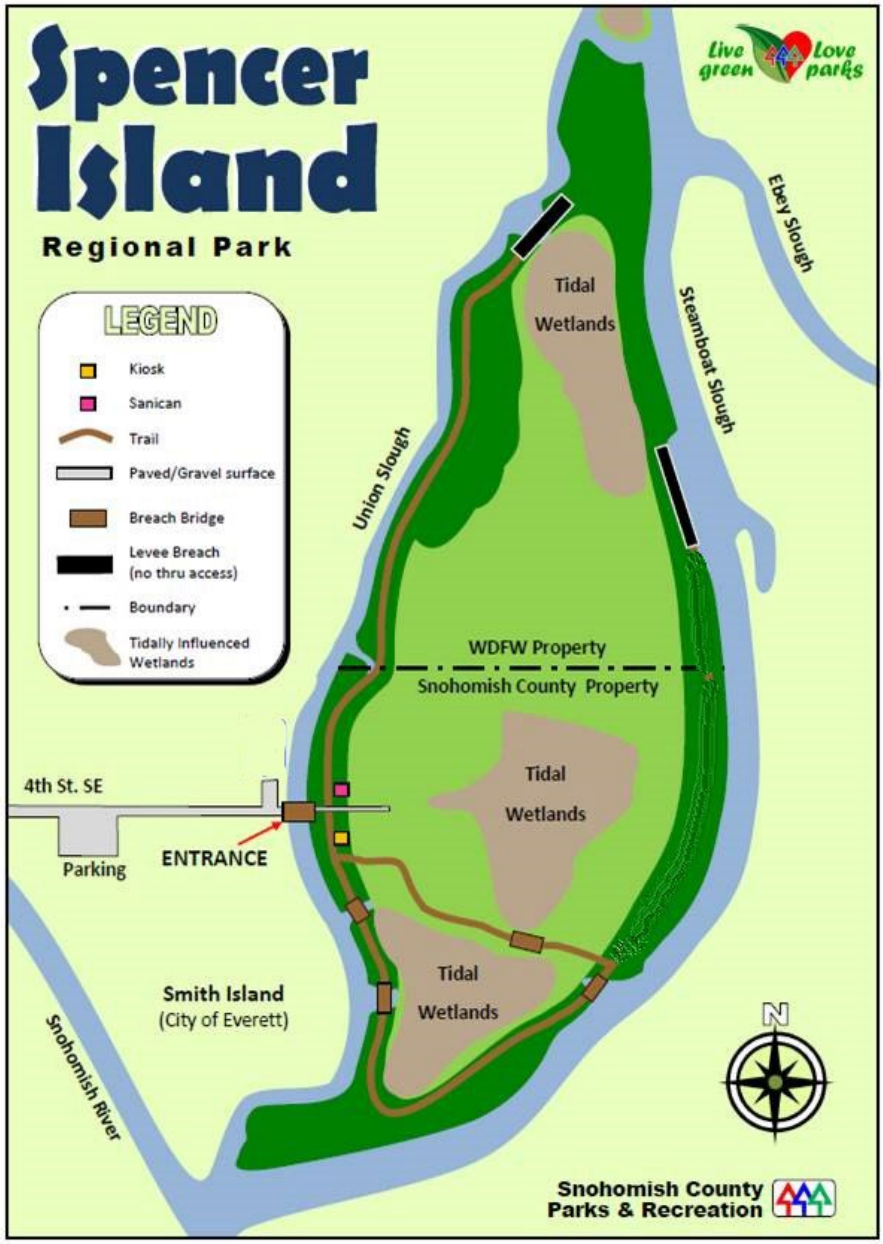

Table 5: Alts. 2 & 3a/b trail network

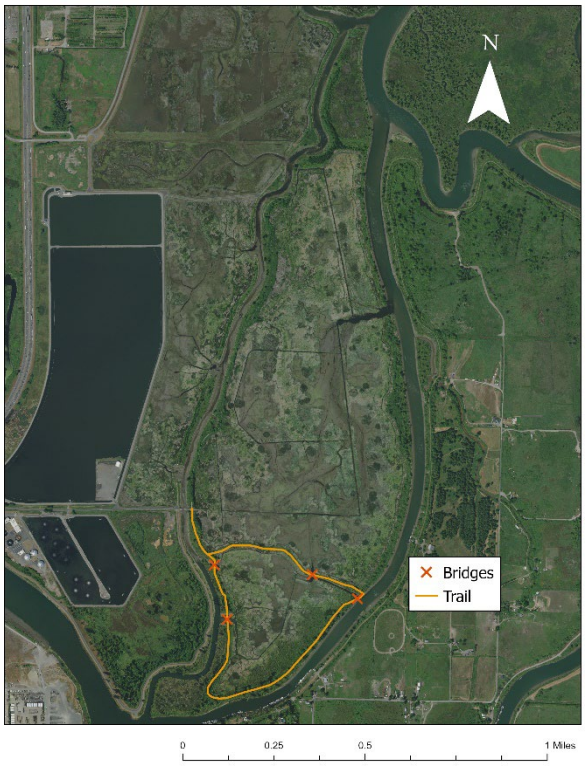

Table 6: Alts. 4a trail network

Table 7: Alt. 4b trail network

Table 8: Alt. 5a trail network

Table 9: Alt. 5b trail network

Table 10: Alts. 6a & 7 trail network

Table 11: Alt 6b trail network