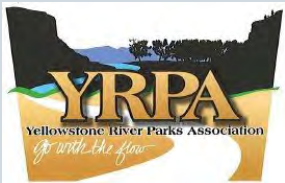


RIVER RANCH/DOVER ISLAND RESTORATION

YELLOWSTONE RIVER BILLINGS, MONTANA





U.S. Army Corps of Engineers
Omaha District



Yellowstone River
Conservation District Council



Yellowstone River Cumulative Effects Analysis

FINAL
December 2015





Final Programmatic Damage Assessment and Restoration Plan
and
Final Programmatic Environmental Assessment
for the
ExxonMobil Pipeline Company July 1, 2011 Yellowstone River Oil Spill



Prepared by State and Federal Trustees
State of Montana and U.S. Department of the Interior

January 2017





YELLOWSTONE RIVER PROJECT INVENTORY AND RANKING

OCTOBER 2017

PREPARED FOR:



Natural Resource Damage Program
1720 9th Avenue
PO Box 201425
Helena, Montana 59620-1425

PREPARED BY:

Geum
Environmental Consulting
Geum Environmental Consulting, Inc.
307 State Street
Hamilton, Montana 59840



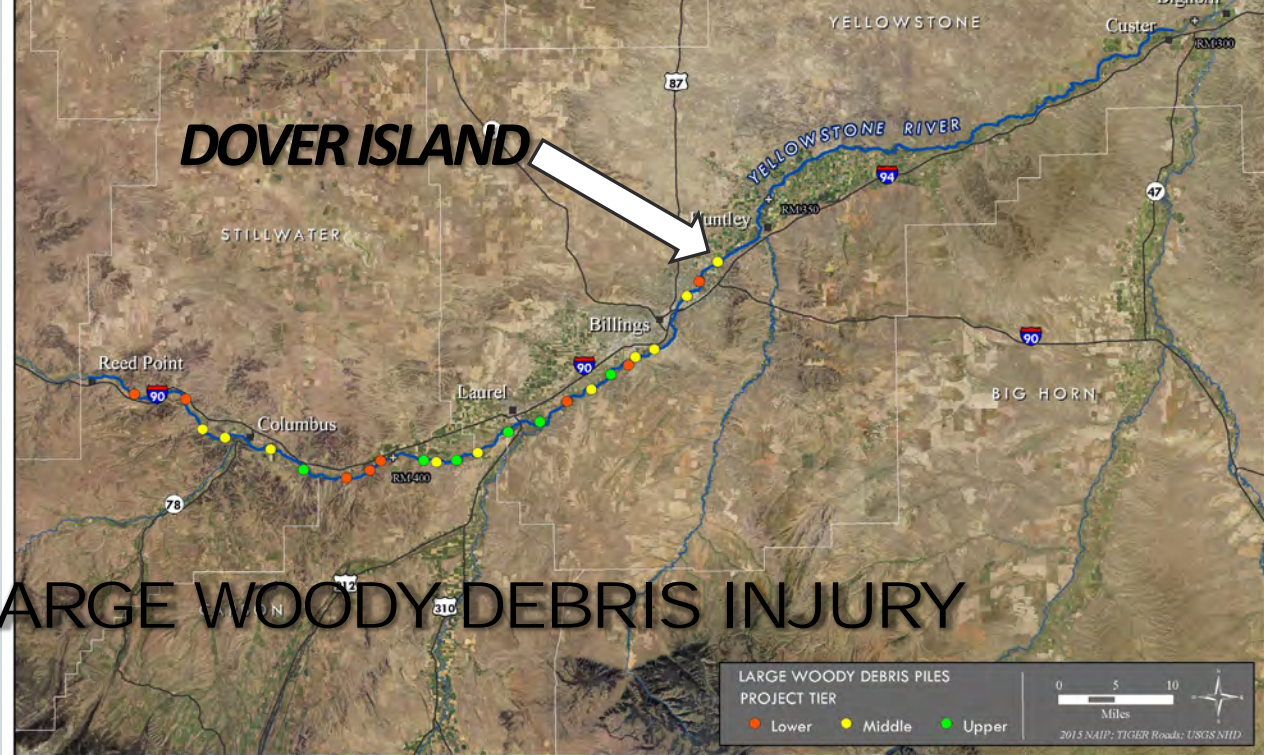
Applied Geomorphology, Inc.
211 North Grand Avenue, Suite C
Bozeman, Montana 59715

DTMCONSULTING
MAPPING SPECIALISTS
DTM Consulting, Inc.
211 North Grand Avenue, Suite J
Bozeman, Montana 59715

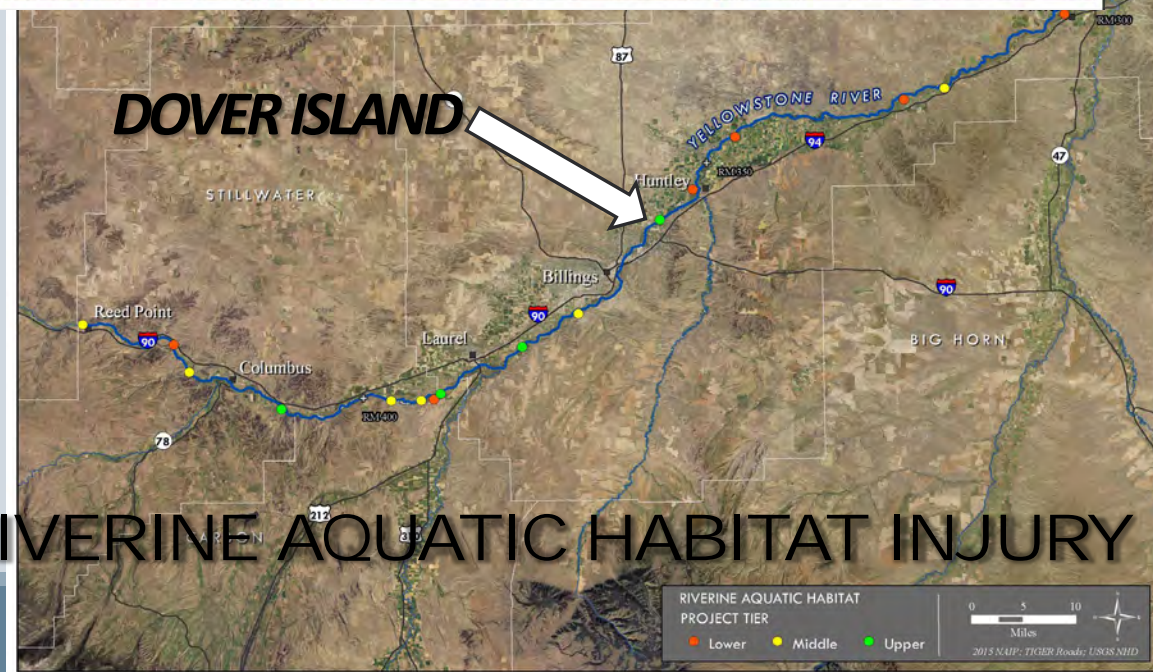
PIONEER
TECHNICAL SERVICES, INC.
Pioneer Technical Services, Inc.
106 Pronghorn Trail
Bozeman, Montana 59718

MARS
MONTANA AQUATIC RESOURCES SERVICES
Montana Aquatic Resource Services
7th West Main Street
Bozeman, Montana 59715

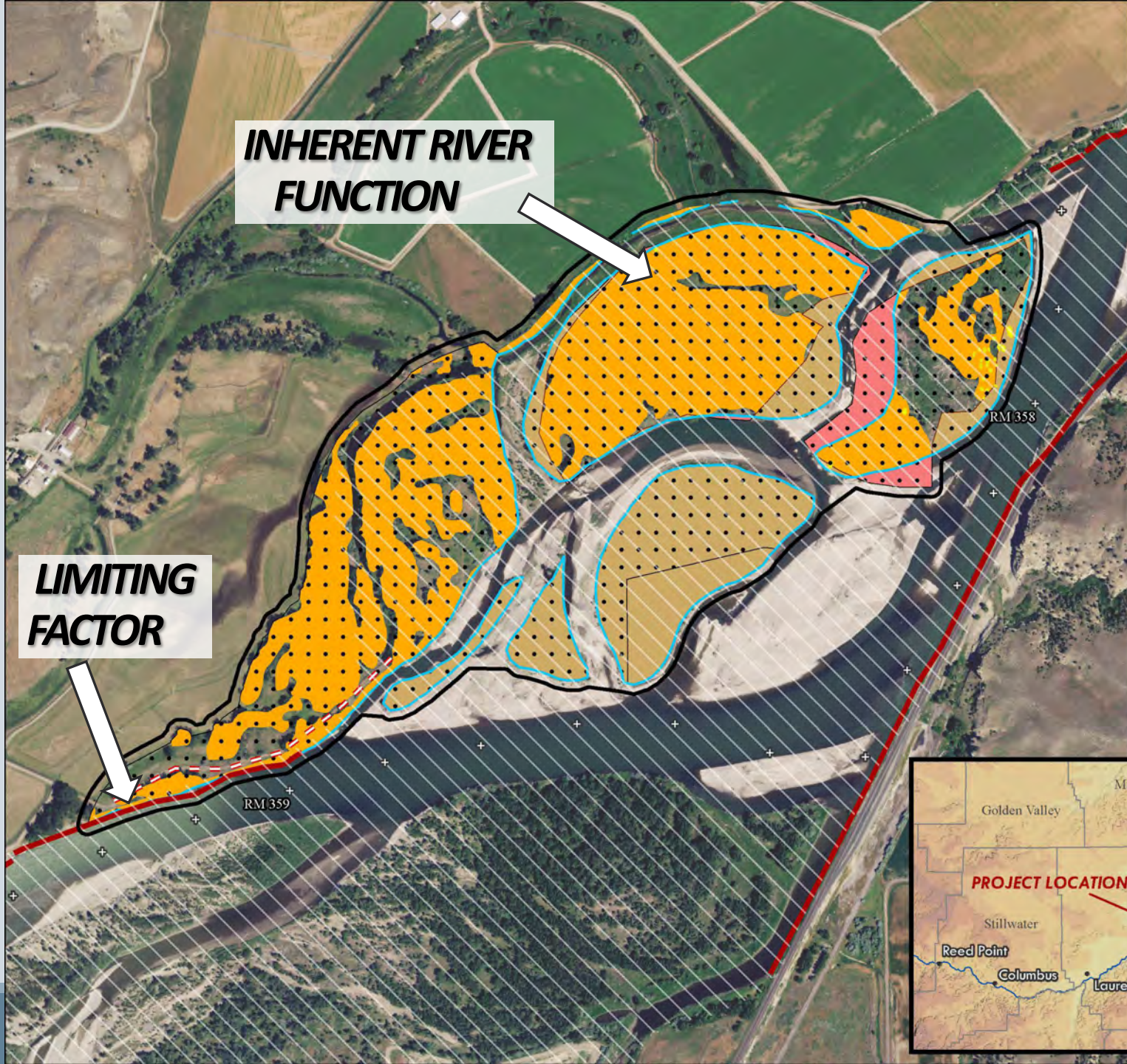
LARGE WOODY DEBRIS INJURY



RIVERINE AQUATIC HABITAT INJURY

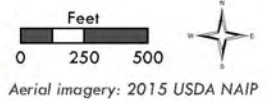


LARGE WOODY DEBRIS INJURY

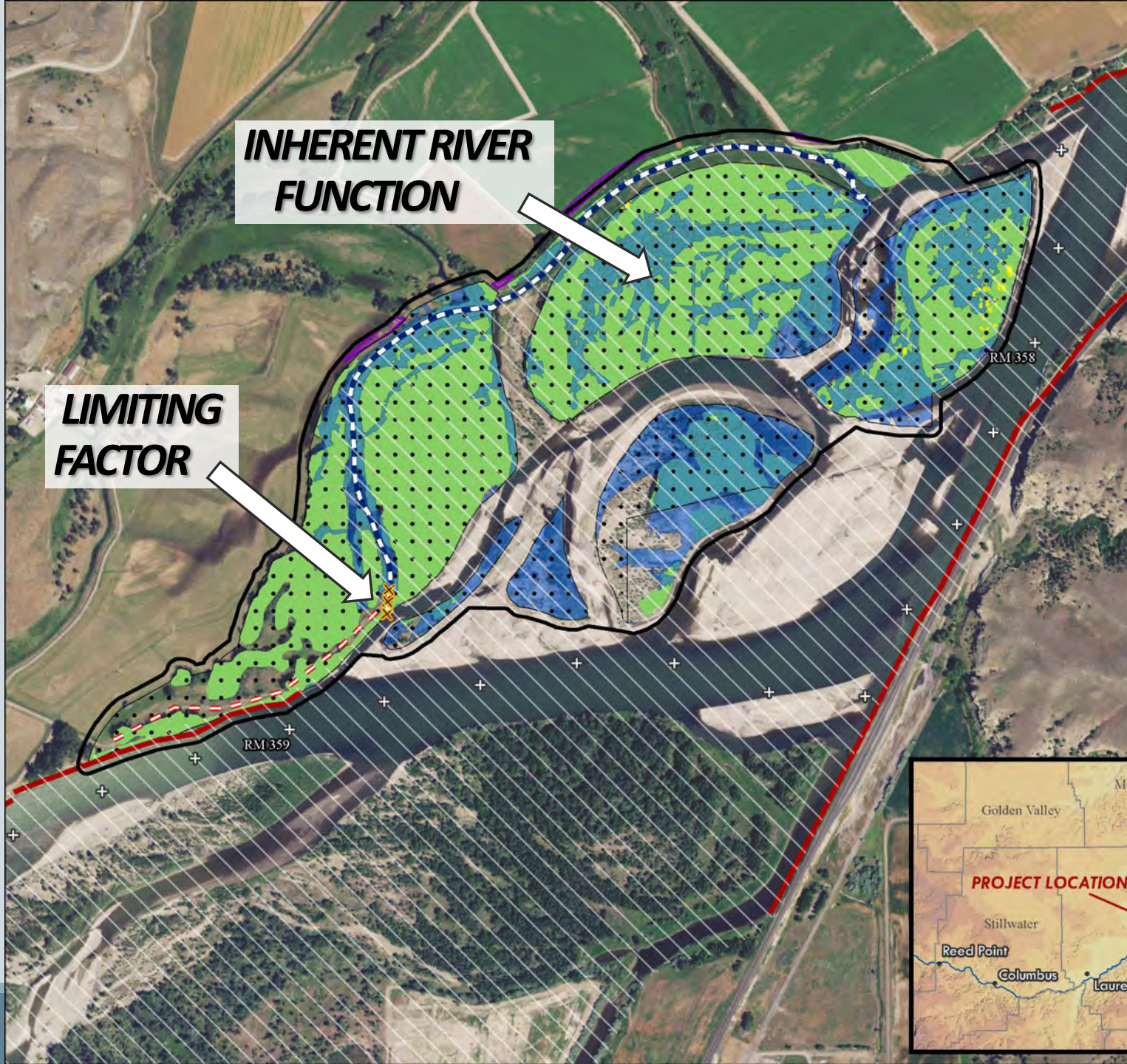


DOVER ISLAND
RM 359

- PROJECT AREA
- HISTORIC MIGRATION ZONE
- ACCRETED AREA
- ERODED AREA
- WOODY VEGETATION
- RUSSIAN OLIVE
- AGRICULTURAL LAND
- BANKLINE
- BANK ARMOR: FLOW DEFLECTOR/RIPRAP
- BANK ARMOR: DIKE/LEVEE
- EASEMENT OR PUBLIC LAND OWNERSHIP



RIVERINE AQUATIC HABITAT INJURY

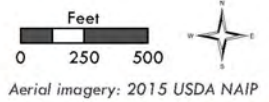


**INHERENT RIVER
FUNCTION**

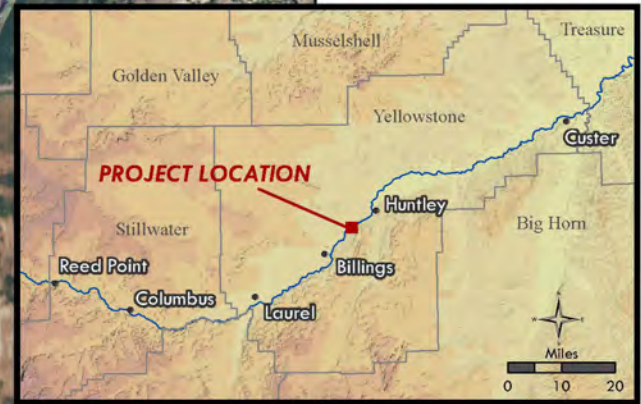
**LIMITING
FACTOR**

DOVER ISLAND
RM 359

- PROJECT AREA
- HISTORIC MIGRATION ZONE
- 2-YEAR INUNDATION
- NATURAL COVER
- RUSSIAN OLIVE
- AGRICULTURAL LAND WITHIN 100' BUFFER
- SIDE CHANNEL
- SIDE CHANNEL BLOCKAGE
- BANK ARMOR: FLOW DEFLECTOR/RIPRAP
- BANK ARMOR: DIKE/LEVEE
- EASEMENT OR PUBLIC LAND OWNERSHIP



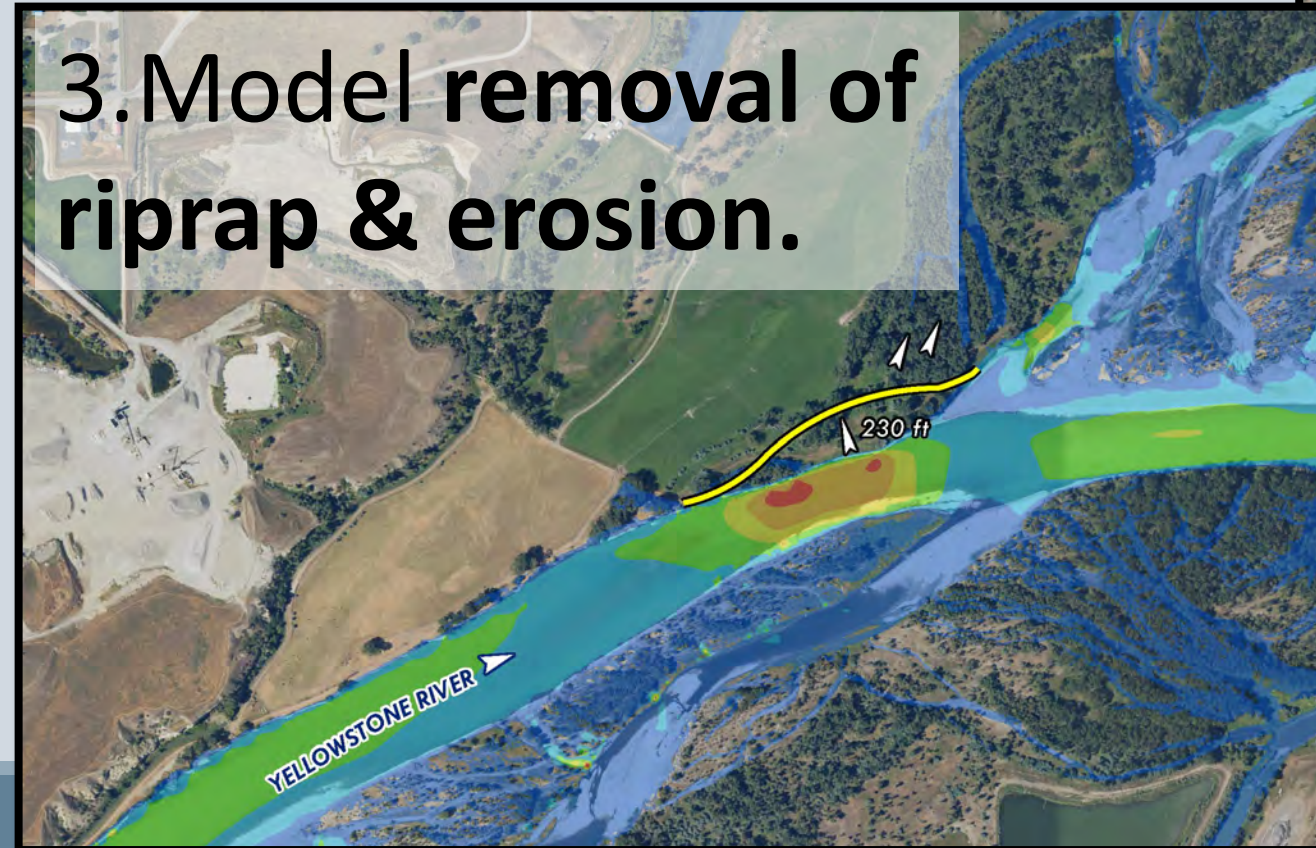
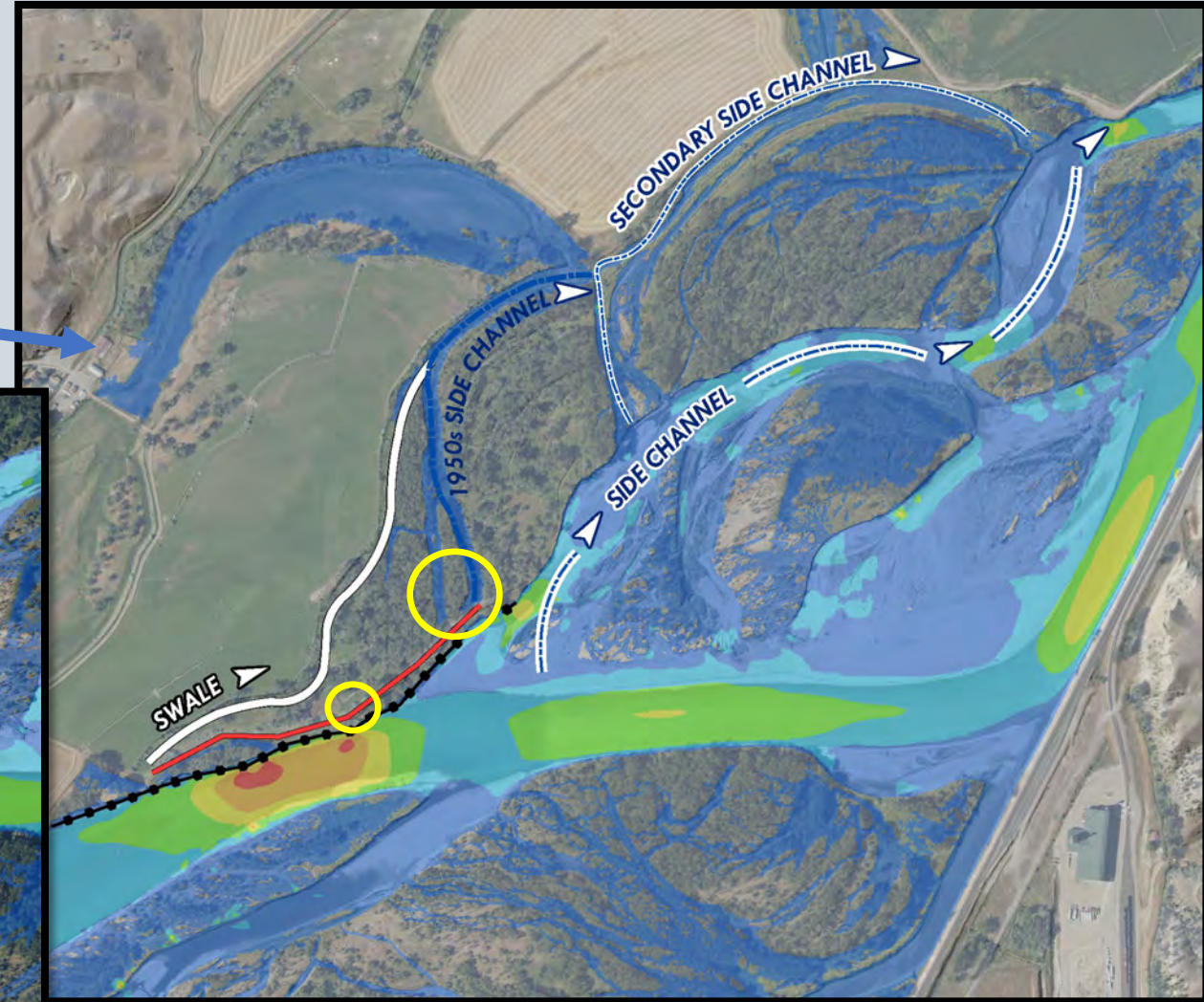
Aerial imagery: 2015 USDA NAIP



FEASIBILITY ANALYSIS

1. Model existing conditions.
2. Model levee breach and re-connect 1950s side channel & swale.

3. Model removal of riprap & erosion.



— DIKE/LEVEE

●●● ROCK RIPRAP

Q2 RETURN FLOW INNUNDATION (2022)
High : 15.5
Low : 0.0
APPROXIMATE WATER DEPTH (FT)

Q2 RETURN FLOW INNUNDATION (2004)
High : 10
Low : 0
APPROXIMATE WATER DEPTH (FT)

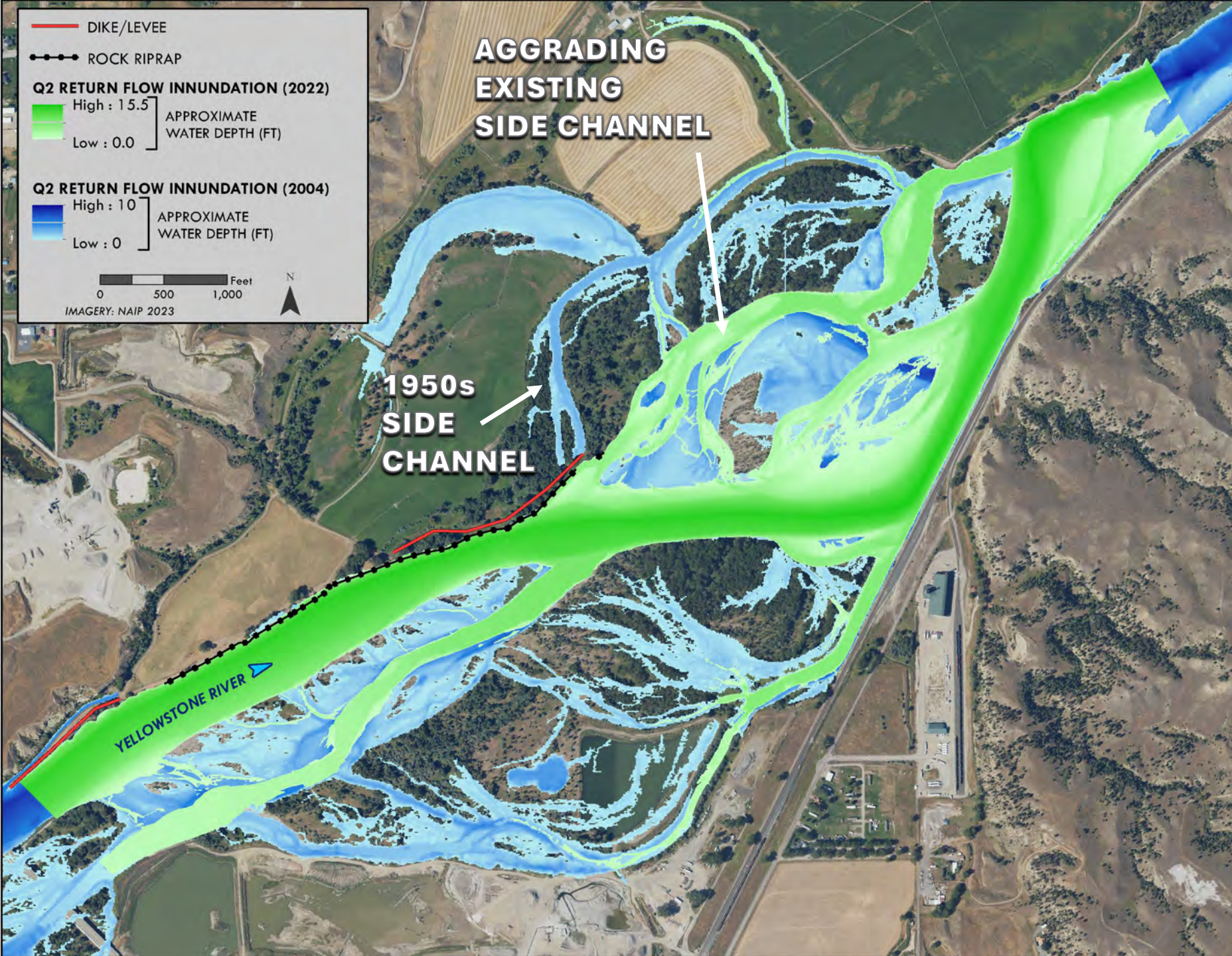
0 500 1,000 Feet

IMAGERY: NAIP 2023

**AGGRADING
EXISTING
SIDE CHANNEL**

**1950s
SIDE
CHANNEL**

YELLOWSTONE RIVER





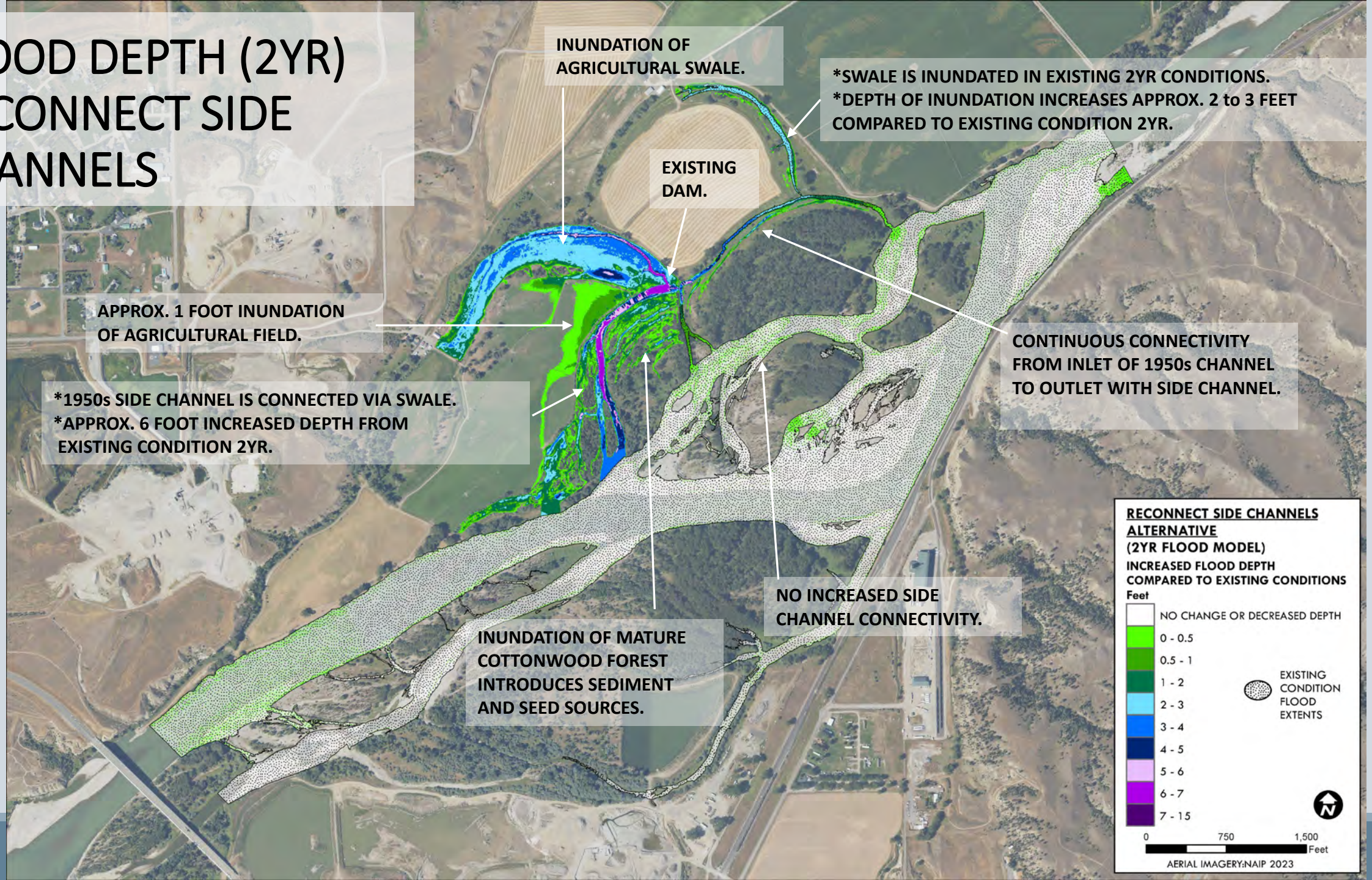
**AGGRADING
EXISTING
SIDE CHANNEL**

**1950s
SIDE
CHANNEL**

YELLOWSTONE RIVER

Yellowstone River

FLOOD DEPTH (2YR) RECONNECT SIDE CHANNELS



INUNDATION OF AGRICULTURAL SWALE.

*SWALE IS INUNDATED IN EXISTING 2YR CONDITIONS.
*DEPTH OF INUNDATION INCREASES APPROX. 2 TO 3 FEET COMPARED TO EXISTING CONDITION 2YR.

EXISTING DAM.

APPROX. 1 FOOT INUNDATION OF AGRICULTURAL FIELD.

CONTINUOUS CONNECTIVITY FROM INLET OF 1950s CHANNEL TO OUTLET WITH SIDE CHANNEL.

*1950s SIDE CHANNEL IS CONNECTED VIA SWALE.
*APPROX. 6 FOOT INCREASED DEPTH FROM EXISTING CONDITION 2YR.

NO INCREASED SIDE CHANNEL CONNECTIVITY.

INUNDATION OF MATURE COTTONWOOD FOREST INTRODUCES SEDIMENT AND SEED SOURCES.

**RECONNECT SIDE CHANNELS
ALTERNATIVE
(2YR FLOOD MODEL)
INCREASED FLOOD DEPTH
COMPARED TO EXISTING CONDITIONS**

Feet

White	NO CHANGE OR DECREASED DEPTH
Light Green	0 - 0.5
Green	0.5 - 1
Yellow-Green	1 - 2
Yellow	2 - 3
Orange	3 - 4
Dark Orange	4 - 5
Purple	5 - 6
Dark Purple	6 - 7
Black	7 - 15

EXISTING CONDITION FLOOD EXTENTS

0 750 1,500 Feet

AERIAL IMAGERY:NAIP 2023

FLOOD DEPTH (10YR) RECONNECT SIDE CHANNELS

INCREASED INUNDATION DEPTH IN
AGRICULTURAL SWALE COMPARED TO
EXISTING CONDITION 10YR.

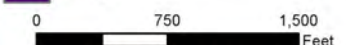
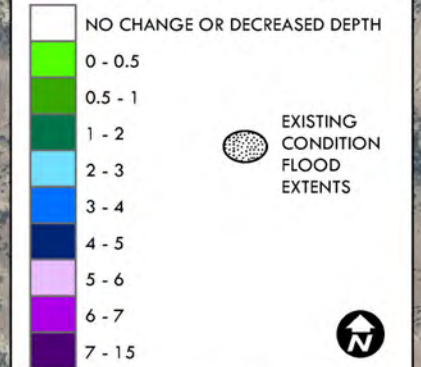
* EXPANDED INUNDATION EXTENTS
* APPROX. 1 to 4 FEET INUNDATION
OF AGRICULTURAL FIELD.

APPROX. 1 to 3 FEET INUNDATION
OF AGRICULTURAL FIELD.

NO INCREASED SIDE
CHANNEL CONNECTIVITY.

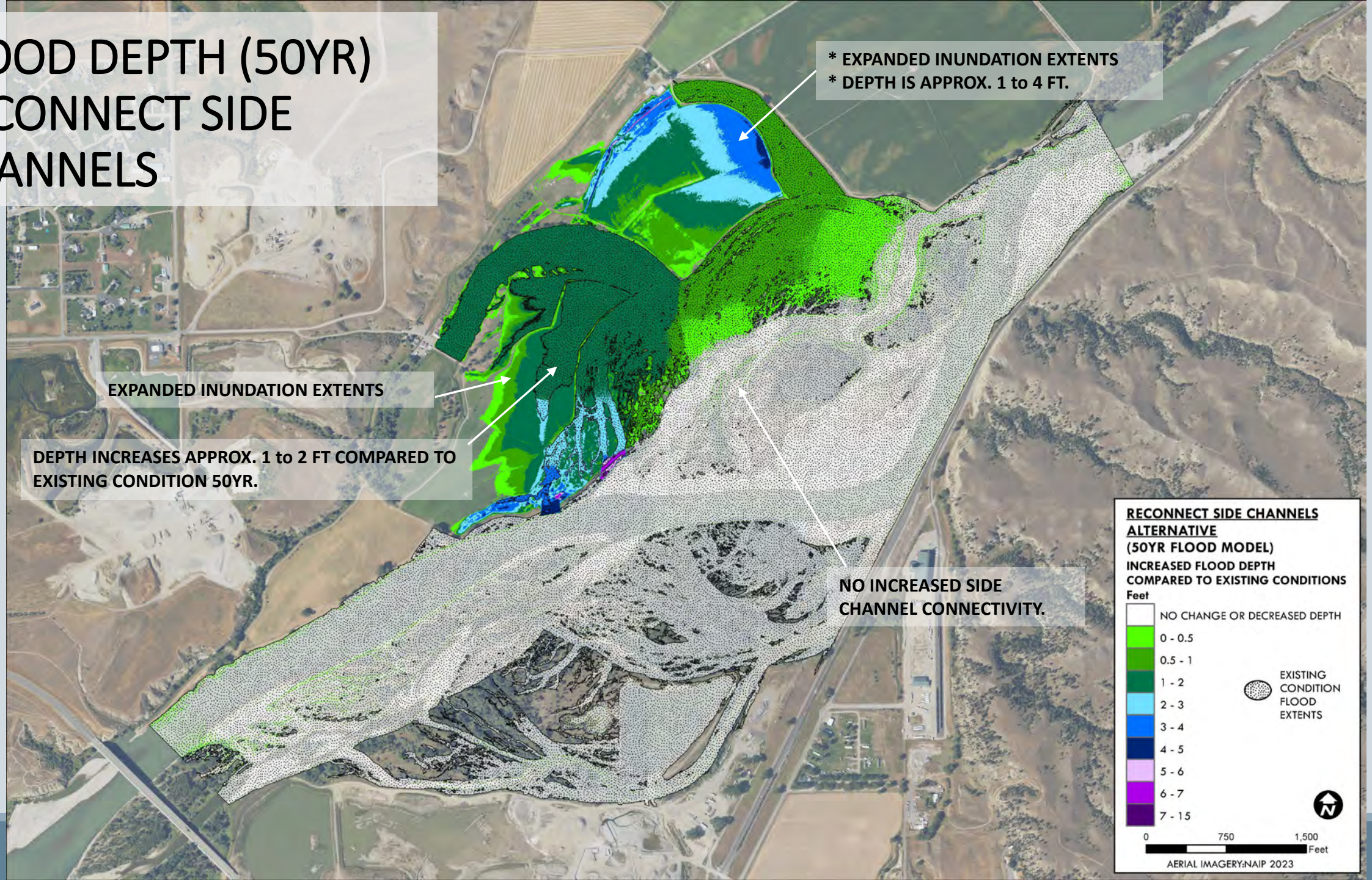
EXTENSIVE INUNDATION OF
MATURE COTTONWOOD
FOREST INTRODUCES
SEDIMENT AND SEED
SOURCES.

**RECONNECT SIDE CHANNELS
ALTERNATIVE
(10YR FLOOD MODEL)
INCREASED FLOOD DEPTH
COMPARED TO EXISTING CONDITIONS**
Feet



AERIAL IMAGERY: NAIP 2023

FLOOD DEPTH (50YR) RECONNECT SIDE CHANNELS



**RECONNECT SIDE CHANNELS
ALTERNATIVE
(50YR FLOOD MODEL)
INCREASED FLOOD DEPTH
COMPARED TO EXISTING CONDITIONS**

Feet

White	NO CHANGE OR DECREASED DEPTH
Light Green	0 - 0.5
Green	0.5 - 1
Dark Green	1 - 2
Light Blue	2 - 3
Blue	3 - 4
Dark Blue	4 - 5
Purple	5 - 6
Dark Purple	6 - 7
Black	7 - 15

EXISTING CONDITION FLOOD EXTENTS

0 750 1,500 Feet

AERIAL IMAGERY:NAIP 2023

FLOOD DEPTH (2YR) REMOVE RIPRAP (10 YEARS EROSION)

MINIMAL INUNDATION OF AGRICULTURAL SWALE.

*SWALE IS INUNDATED IN EXISTING 2YR CONDITIONS.
*DEPTH OF INUNDATION INCREASES APPROX. 1 FOOT COMPARED TO EXISTING CONDITION 2YR.

EXISTING DAM.

*1950s SIDE CHANNEL IS CONNECTED VIA SWALE.
*DEPTH IS ~2 to 3 FEET LESS THAN RECONNECTION SCENARIO.

* CONTINUOUS CONNECTIVITY FROM INLET OF 1950s CHANNEL TO OUTLET WITH SIDE CHANNEL.
* DEPTH IS ~2 to 3 FEET LESS THAN RECONNECTION SCENARIO.

APPROX. 10 YEARS OF EROSION.

NO INCREASED SIDE CHANNEL CONNECTIVITY.

NO INUNDATION OF MATURE COTTONWOOD FOREST.

REMOVE RIPRAP 10YR ALTERNATIVE (2YR FLOOD MODEL)
INCREASED FLOOD DEPTH COMPARED TO EXISTING CONDITIONS
Feet

White	NO CHANGE OR DECREASED DEPTH
Light Green	0 - 0.5
Green	0.5 - 1
Dark Green	1 - 2
Light Blue	2 - 3
Blue	3 - 4
Dark Blue	4 - 5
Purple	5 - 6
Dark Purple	6 - 7
Black	7 - 15

EXISTING CONDITION FLOOD EXTENTS

0 750 1,500 Feet
AERIAL IMAGERY:NAIP 2023

WETLAND DELINEATION

- Additional evidence of loss of connectivity
- Soil redox features found on high surfaces



DESIGN UPDATES

1950's side channel activation at
1.5 year return flow

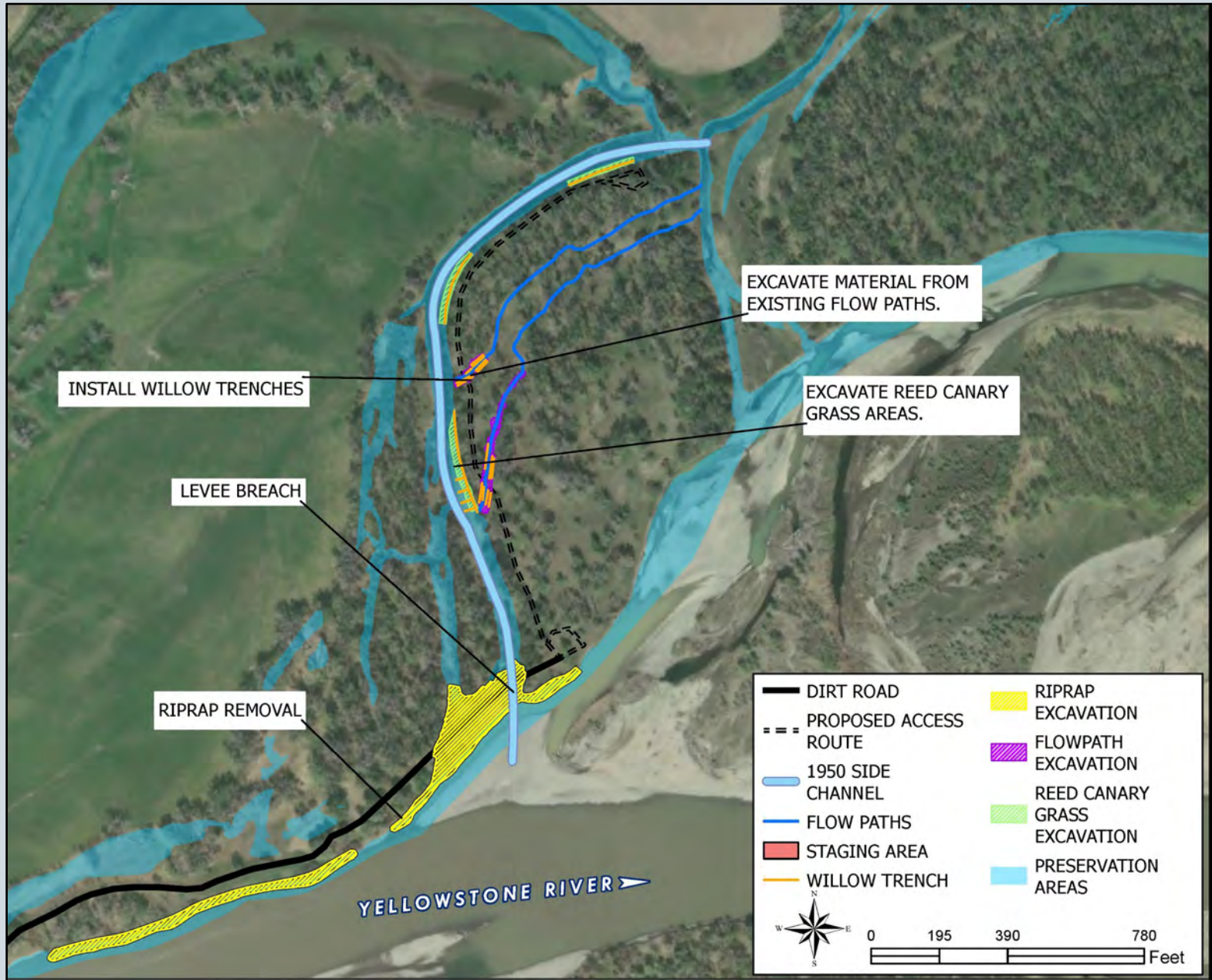


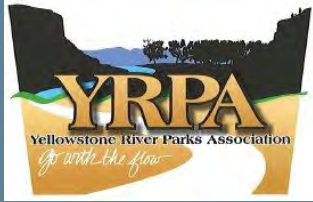
DESIGN UPDATES

Excavation of flow path entrances to distribute flows across the mature cottonwood forest

Installation of willow trenches

Potential reed canary grass removal





MARISA SOWLES: msowles@geumconsulting.com

