4.3.3.2.1 Impact HYD-1: Change in occurrence of flows exceeding the maximum existing conditions monthly flow from the Sacramento River into the Yolo Bypass

Alternative 1 compared to Existing Conditions

The CalSim II modeling uses a monthly time step, which is inappropriate for flood control analysis; however, flood management operations at upstream reservoirs would not change for Alternative 1 relative to existing conditions. Although a slight increase in the frequency of high flows in the bypass under Alternative 1 would be possible because of the increased weir capacity at Fremont Weir, Alternative 1 would not increase the occurrence of monthly flows above 136,869 cfs (the maximum existing conditions monthly flow). Based on the CalSim II model results at Fremont Weir with 2030 hydrology and infrastructure, monthly flows at Fremont Weir greater than 136,869 cfs would not occur under either Alternative 1 or existing conditions.

Alternative 1 compared to the No Action Alternative

Based on the CalSim II results at Fremont Weir with 2070 hydrology, infrastructure, and sea level rise, the number of occurrences of flow above 136,869 cfs would remain the same under Alternative 1 relative to the No Action Alternative. Although there would be differences in month-to-month flow in the bypass under Alternative 1 compared to the No Action Alternative, monthly flows at Fremont Weir greater than 136,869 cfs would occur in two months under both Alternative 1 and the No Action Alternative.

CEQA Conclusion

The effect of Alternative 1 on flows from the Sacramento River into the Yolo Bypass would be **less than significant** relative to existing conditions because Alternative 1 would not increase or decrease the number of occurrences of flows exceeding the maximum existing conditions monthly average flow from the Sacramento River into the Yolo Bypass.

4.3.3.2.2 Impact HYD-2: Change in occurrence of flows exceeding the maximum existing conditions monthly flow in the Sacramento River at Freeport

Alternative 1 compared to Existing Conditions

The CalSim II modeling uses a monthly time step, which is inappropriate for flood control analysis; however, flood management operations at upstream reservoirs would not change for Alternative 1 relative to existing conditions. A slight decrease in the frequency of high flows in the Sacramento River at Freeport under Alternative 1 would be possible because of the increased weir capacity at Fremont Weir. Alternative 1 would not increase the occurrence of monthly flows above 72,231 cfs (the maximum existing conditions monthly flow). Based on the CalSim II model results at Freeport with 2030 hydrology and infrastructure, monthly flows at Freeport greater than 72,231 cfs would not occur under either Alternative 1 or existing conditions.

Alternative 1 compared to the No Action Alternative

Based on the CalSim II results at Freeport with 2070 hydrology, infrastructure, and sea level rise, the number of occurrences of flow above 72,231 cfs would remain the same under Alternative 1 relative to the No Action Alternative. Although there would be differences in month-to-month Sacramento River flow at Freeport under Alternative 1 compared to the No Action Alternative, monthly flows at Freeport greater than 72,231 cfs would occur in 2 months under both the No Action Alternative and Alternative 1.

CEQA Conclusion

The effect of Alternative 1 on flows in the Sacramento River at Freeport would be **less than significant** relative to existing conditions because Alternative 1 would not increase or decrease the number of occurrences of flows exceeding the maximum existing conditions monthly average flow at Freeport.

4.3.3.2.3 Impact HYD-3: Change in 100-year flood hazard area

Alternative 1 compared to Existing Conditions

For a given flood or high-flow hydrograph, peak WSE is expected to remain similar to existing conditions. Tables 4-3 and 4-4 show a comparison of maximum WSE for Alternatives 1 through 3 versus the existing conditions along the Sacramento River and the Yolo Bypass, respectively.

Table 4-3. Maximum WSE Changes between Existing Conditions and Alternatives 1, 2, and 3 along the Sacramento River at Key Locations

Locations along the Sacramento River	Maximum WSE (ft. NAVD88)		Difference (ft.)
	Existing Conditions	Alternatives 1, 2, and 3	
Upstream of Fremont Weir	41.02	40.98	-0.04
Natomas Cross Canal	41.24	41.21	-0.03
Verona gage	41.15	41.12	-0.03
Interstate 5	37.79	37.77	-0.02
Upstream of Sacramento Weir	33.89	33.88	-0.01
Interstate 80	34.37	34.36	-0.01
Bryte gage	34.38	34.37	-0.01
American River	34.37	34.36	-0.01
I Street Bridge	33.85	33.84	-0.01
Pioneer Memorial Bridge	32.62	32.61	-0.01
Freeport bridge	27.72	27.71	-0.01
Snodgrass Slough	22.92	22.91	-0.01
Sutter Slough	21.35	21.34	-0.01
Steamboat Slough	20.47	20.46	-0.01
Walnut Grove gage	17.43	17.43	0

Locations along the Sacramento River	Maximum WSE (ft. NAVD88)		Difference (ft.)
	Existing Conditions	Alternatives 1, 2, and 3	
Cache Slough	11.83	11.83	0
Rio Vista	11.54	11.54	0
3 Mile Slough	9.82	9.82	0
Collinsville gage	8.3	8.3	0

Source:

HEC-RAS = Hydrologic Engineering Center River Analysis System hydraulic model (HEC-RAS model) 1997 storm pattern scaled to 85 percent, routed through Central Valley Hydrology Study's (CVHS)

WSE = water surface elevation; ft. = feet; NAVD88 = North American Vertical Datum of 1988

Table 4-4. Maximum WSE Changes between the Existing Conditions and Alternatives 1, 2, and 3 along the Yolo Bypass at Key Locations

Locations along the Yolo Bypass	Maximum WSE (ft. NAVD88)		Difference (ft.)
	Existing Conditions	Alternatives 1, 2, and 3	
Fremont Weir	40.16	40.15	-0.01
Agricultural Road Crossing 1	37.27	37.27	0
Agricultural Road Crossing 2	36.96	36.97	0.01
Knights Landing Ridge Cut	36.52	36.52	0
Interstate 5	33.47	33.47	0
Road 25 at West Levee	32.04	32.04	0
Sacramento Bypass	29.91	29.91	0
Agricultural Road Crossing 4	29.83	29.84	0
Interstate 80	29.07	29.07	0
Putah Creek	27.60	27.60	0
Lisbon Gage	26.29	26.29	0
North end of Holland Tract	21.43	21.43	0
South end of Holland Tract	19.06	19.06	0
DWSC at Miner Slough	15.81	15.81	0

Source:

DSWC = Deep Water Ship Canal

HEC-RAS = Hydrologic Engineering Center River Analysis System hydraulic model (HEC-RAS model) 1997 storm pattern scaled to 85 percent, routed through Central Valley Hydrology Study's (CVHS)

WSE = water surface elevation; ft. = feet; NAVD88 = North American Vertical Datum of 1988

When Fremont Weir flows at its design capacity of 343,000 cfs (85 percent of the 1997 CVHS hydrograph), the analysis conducted in HEC-RAS indicates that peak WSE within the bypass would increase up to 0.01 feet under Alternative 1 in one location relative to existing conditions. WSE would decrease up to 0.04 feet on the Sacramento River relative to existing conditions.

For the highest historic flood flow routed in TUFLOW, which occurred during the 1997 event, TUFLOW indicated that some portions of the bypass would experience increases in maximum

WSE between 0.02 and 0.05 feet under Alternative 1 relative to the existing conditions hydrodynamic model. TUFLOW results indicated that flows up to the weir capacity would remain within the leveed portion of the Yolo Bypass. Therefore, Alternative 1 would not impede or redirect flood flows within the existing flood hazard area.

Alternative 1 compared to the No Action Alternative

Alternative 1 and the No Action Alternative would be affected by sea level rise. The absolute WSE of Alternative 1 with sea level rise and the absolute WSE of the No Action Alternative would be higher than the absolute WSE of Alternative 1 with current sea levels and the absolute WSE of existing conditions. However, as discussed in Section 4.3.3.1.3, the changes in WSE at higher flows caused by sea level rise are smaller than the differences in WSE at lower flows. Peak WSE is relatively less sensitive to changes due to sea level rise compared to WSE at lower flows.

Because the changes in peak WSE due to sea level rise would be small compared to changes in WSE at low flows due to sea level rise, it is assumed that sea level rise would increase the peak WSE of all alternatives similarly, relative to the alternatives under current sea level conditions. This means that the peak WSE for all alternatives, including Alternative 1 and the No Action Alternative, would be assumed to be increased upward by the same amount.

Therefore, although absolute WSE would change for both the No Action Alternative and Alternative 1, it is assumed that the relative difference in the peak WSE for Alternative 1 compared to the No Action Alternative would remain similar to what is shown in Table 4-4 for Alternative 1 compared to the existing conditions. Similar to the differences presented in Table 4-4, increases in peak WSE in the Yolo Bypass under Alternative 1 with sea level rise compared to the No Action Alternative are expected to be less than one foot. WSE would decrease on the Sacramento River under Alternative 1 with sea level rise compared to the No Action Alternative.

CEQA Conclusion

Impacts to the 100-year flood hazard area would be **less than significant** because the changes to bypass channel geometry under Alternative 1 would not impede or redirect peak flood flows. Increased peak flows from changes to Fremont Weir geometry would remain within the Yolo Bypass. The changes to channel geometry within the Yolo Bypass would increase peak WSE less than one foot. Peak WSE would remain the same or decrease on the Sacramento River.

4.3.3.3 Alternative 2: Central Gated Notch

Alternative 2, Central Gated Notch, would provide a similar new gated notch through Fremont Weir as described for Alternative 1. The primary difference between Alternatives 1 and 2 is the location of the notch; Alternative 2 would site the notch near the center of Fremont Weir. This gate would be a similar size but would have an invert elevation that is higher (14.8 feet) because the river is higher at this upstream location, and the gate would allow up to 6,000 cfs through to provide open channel flow for adult fish passage. See Section 2.5 for more details on the alternative features.

Under Alternative 2, larger areas within the bypass would be inundated at low flows; flood flows would remain limited to the leveed portion of the bypass. Alternative 2 would not locate any new facilities within the 100-year flood hazard area.

4.3.3.3.1 Impact HYD-1: Change in occurrence of flows exceeding the maximum existing conditions monthly flow from the Sacramento River into the Yolo Bypass

Flows at Fremont Weir under Alternative 2 would be identical to flows under Alternative 1, and effects would be identical.

CEQA Conclusion

The effect of Alternative 2 on flows from the Sacramento River into the Yolo Bypass would be **less than significant** relative to existing conditions and the future no action scenarios because Alternative 2 would not increase or decrease the number of occurrences of flows exceeding the maximum existing conditions monthly average flow from the Sacramento River into the Yolo Bypass.

4.3.3.3.2 Impact HYD-2: Change in occurrence of flows exceeding the maximum existing conditions monthly flow in the Sacramento River at Freeport

Sacramento River flow at Freeport under Alternative 2 would be identical to flows under Alternative 1, and effects would be identical.

CEQA Conclusion

The effect of Alternative 2 on flows in the Sacramento River at Freeport would be **less than significant** relative to existing conditions and the No Action Scenarios because Alternative 2 would not increase or decrease the number of occurrences of flows exceeding the maximum existing conditions monthly average flow at Freeport.

4.3.3.3.3 Impact HYD-3: Change in 100-year flood hazard area

Tables 4-3 and 4-4 show maximum WSE along the Sacramento River and Yolo Bypass for Alternatives 1, 2, and 3 in comparison to existing conditions. Effects under Alternative 2 relative to existing conditions and the No Action Alternative are expected to be identical to effects under Alternative 1, shown in Table 4-4.

CEQA Conclusion

Impacts to the 100-year flood hazard area would be **less than significant** because the changes to bypass channel geometry under Alternative 2 would not impede or redirect peak flood flows. Increased peak flows from changes to Fremont Weir geometry would remain within the Yolo Bypass. The changes to channel geometry within the Yolo Bypass would increase peak WSE less than one foot. Peak WSE would remain the same or decrease on the Sacramento River.

4.3.3.4 Alternative 3: West Side Gated Notch

Alternative 3, West Side Gated Notch, would provide a similar new gated notch through Fremont Weir as described for Alternative 1. The primary difference between Alternatives 1 and 3 is the location of the notch; Alternative 3 would site the notch on the western side of Fremont Weir. This gate would be a similar size but would have an invert elevation that is higher (16.1 feet) because the river is higher at this upstream location. Alternative 3 would allow up to 6,000 cfs through the gated notch to provide open channel flow for adult fish passage. See Section 2.6 for more details on the alternative features.

Under Alternative 3, larger areas within the bypass would be inundated at low flows. Flood flows would remain limited to the leveed portion of the bypass. Alternative 3 would not locate any new facilities within the 100-year flood hazard area.

4.3.3.4.1 Impact HYD-1: Change in occurrence of flows exceeding the maximum existing conditions monthly flow from the Sacramento River into the Yolo Bypass

Flows at Fremont Weir under Alternative 3 would be identical to flows under Alternative 1, and effects would be identical.

CEQA Conclusion

The effect of Alternative 3 on flows from the Sacramento River into the Yolo Bypass would be **less than significant** relative to existing conditions because Alternative 3 would not increase or decrease the number of occurrences of flows exceeding the maximum existing conditions monthly average flow from the Sacramento River into the Yolo Bypass.

4.3.3.4.2 Impact HYD-2: Change in occurrence of flows exceeding the maximum existing conditions monthly flow in the Sacramento River at Freeport

Sacramento River flow at Freeport under Alternative 3 would be identical to flows under Alternative 1, and effects would be identical.

CEQA Conclusion

The effect of Alternative 3 on flows in the Sacramento River at Freeport would be **less than significant** relative to existing conditions because Alternative 3 would not increase or decrease the number of occurrences of flows exceeding the maximum existing conditions monthly average flow at Freeport.

4.3.3.4.3 Impact HYD-3: Change in 100-year flood hazard area

Tables 4-3 and 4-4 show maximum WSE along the Sacramento River and Yolo Bypass for Alternatives 1, 2, and 3 in comparison to existing conditions. Effects under Alternative 3 relative to existing conditions and the No Action Alternative are expected to be identical to effects under Alternative 1.

CEQA Conclusion

Impacts to the 100-year flood hazard area would be **less than significant** because the changes to bypass channel geometry under Alternative 3 would not impede or redirect peak flood flows. Increased peak flows from changes to Fremont Weir geometry would remain within the Yolo Bypass. The changes to channel geometry within the Yolo Bypass would increase peak WSE less than one foot. Peak WSE would remain the same or decrease on the Sacramento River.

4.3.3.5 Alternative 4: West Side Gated Notch – Managed Flow

Alternative 4, West Side Gated Notch – Managed Flow, would have a smaller amount of flow entering the Yolo Bypass through the gated notch in Fremont Weir than some other alternatives, but it would incorporate water control structures to maintain inundation for longer periods of time within the northern portion of the Yolo Bypass. Alternative 4 would include the same gated notch and associated facilities as described for Alternative 3; however, it would be operated to limit the maximum inflow to 3,000 cfs. See Section 2.7 for more details on the alternative features.

Alternative 4 would not locate any new housing or new structures within the 100-year floodplain. In addition, Alternative 4 would not impede or redirect flood flows within the existing flood hazard area.

4.3.3.5.1 Impact HYD-1: Change in occurrence of flows exceeding the maximum existing conditions monthly flow from the Sacramento River into the Yolo Bypass

Alternative 4 compared to Existing Conditions

The CalSim II modeling uses a monthly time step, which is inappropriate for flood control analysis; however, flood management operations at upstream reservoirs would not change for Alternative 4 relative to existing conditions. Although a slight increase in the frequency of high flows in the bypass under Alternative 4 would be possible because of the increased weir capacity at Fremont Weir, Alternative 4 would not increase the occurrence of monthly flows above 136,869 cfs (the maximum existing conditions monthly flow). Based on the CalSim II model results at Fremont Weir with 2030 hydrology and infrastructure, monthly flows at Fremont Weir greater than 136,869 cfs would not occur under either Alternative 4 or existing conditions.

Alternative 4 compared to the No Action Alternative

Based on the CalSim II results at Fremont Weir with 2070 hydrology, infrastructure, and sea level rise, the number of occurrences of flow above 136,869 cfs would remain the same under Alternative 4 relative to the No Action Alternative. Although there would be differences in month-to-month flow in the bypass under Alternative 4 compared to the No Action Alternative, monthly flows at Fremont Weir greater than 136,869 cfs would occur in two months under both Alternative 4 and the No Action Alternative.

CEQA Conclusion

The effect of Alternative 4 on flows from the Sacramento River into the Yolo Bypass would be **less than significant** because Alternative 4 would not increase or decrease the number of occurrences of flows exceeding the maximum existing conditions monthly average flow from the Sacramento River into the Yolo Bypass.

4.3.3.5.2 Impact HYD-2: Change in occurrence of flows exceeding the maximum existing conditions monthly flow in the Sacramento River at Freeport

Alternative 4 compared to Existing Conditions

The CalSim II modeling uses a monthly time step, which is inappropriate for flood control analysis; however, flood management operations at upstream reservoirs would not change for Alternative 4 relative to existing conditions. A slight decrease in the frequency of high flows in the Sacramento River at Freeport under Alternative 4 would be possible because of the increased weir capacity at Fremont Weir. Alternative 4 would not increase the occurrence of monthly flows above 72,231 cfs (the maximum existing conditions monthly flow). Based on the CalSim II model results at Freeport with 2030 hydrology and infrastructure, monthly flows at Freeport greater than 72,231 cfs would not occur under either Alternative 4 or existing conditions.

Alternative 4 compared to the No Action Alternative

Based on the CalSim II results at Freeport with 2070 hydrology, infrastructure, and sea level rise, the number of occurrences of flow above 72,231 cfs would remain the same under Alternative 4 relative to the No Action Alternative. Although there would be differences in month-to-month Sacramento River flow at Freeport under Alternative 4 compared to the No Action Alternative, monthly flows at Freeport greater than 72,231 cfs would occur in 2 months under both the No Action Alternative and Alternative 4.

CEQA Conclusion

The effect of Alternative 4 on flows in the Sacramento River at Freeport would be **less than significant** relative to existing because Alternative 4 would not increase or decrease the number of occurrences of flows exceeding the maximum existing conditions monthly average flow in the Sacramento River at Freeport.

4.3.3.5.3 Impact HYD-3: Change in 100-year flood hazard area

Alternative 4 compared to Existing Conditions

For a given flood or high-flow hydrograph, peak WSE is expected to remain similar to existing conditions. Tables 4-5 and 4-6 show a comparison of maximum WSE between Alternative 4 and existing conditions along the Sacramento River and the Yolo Bypass, respectively.

Table 4-5. Maximum WSE Changes between Existing Conditions and Alternative 4 along the Sacramento River at Key Locations

Locations along the Sacramento River	Maximum WSE (ft. NAVD88)		Difference (ft.)
	Existing Conditions	Alternative 4	
Upstream of Fremont Weir	40.39	40.24	-0.15
Natomas Cross Canal	40.22	40.12	-0.10
Verona gage	39.93	39.83	-0.10
Interstate 5	36.11	36.04	-0.07
Upstream of Sacramento Weir	32.23	32.15	-0.08
Interstate 80	32.2	32.16	-0.04
Bryte gage	32.2	32.16	-0.04
American River	32.19	32.17	-0.02
I Street Bridge	31.89	31.86	-0.03
Pioneer Memorial Bridge	31.24	31.21	-0.03
Freeport bridge	26.13	26.1	-0.03
Snodgrass Slough	21.41	21.39	-0.02
Sutter Slough	20.2	20.18	-0.02
Steamboat Slough	18.95	18.93	-0.02
Walnut Grove gage	16.44	16.43	-0.01
Cache Slough	11.16	11.16	0.00

Source:

TUFLOW Hydraulic Impact Analysis. 1997 storm pattern scaled to 85 percent, routed through CVHS HEC-RAS.

WSE = water surface elevation; ft. = feet; NAVD88 = North American Vertical Datum of 1988

Table 4-6. Maximum WSE Changes between Existing Conditions and Alternative 4 along the Yolo Bypass at Key Locations

Locations along the Yolo Bypass	Maximum WSE (ft. NAVD88)		Difference (ft.)
	Existing Conditions	Alternative 4	
Fremont Weir	40.39	40.24	-0.15
Knights Landing Ridge Cut	35.33	35.32	-0.01
Interstate 5	31.04	31.02	-0.02
Sacramento Bypass	29.88	29.86	-0.02
Interstate 80	28.45	28.43	-0.02
Lisbon Gage	26.49	26.47	-0.02
Thomsen Road	25.30	25.28	-0.02
Delhi Road	22.23	22.21	-0.02

Source:

TUFLOW Hydraulic Impact Analysis. 1997 storm pattern scaled to 85 percent, routed through TUFLOW.

WSE = water surface elevation; ft. = feet; NAVD88 = North American Vertical Datum of 1988

When Fremont Weir flows at its design capacity of 343,000 cfs (85 percent of the 1997 CVHS hydrograph), the analysis conducted in HEC-RAS indicates that peak WSE within the bypass would decrease up to 0.15 feet under Alternative 4 in one location relative to existing conditions. WSE would decrease up to 0.15 feet on the Sacramento River relative to existing conditions.

TUFLOW results indicate that flows up to the weir capacity would remain within the leveed portion of Yolo Bypass for all alternatives. Therefore, Alternative 4 would not impede or redirect flood flows within the existing flood hazard area.

Alternative 4 compared to the No Action Alternative

As discussed in Section 4.3.3.2.3, it is assumed that sea level rise would increase the peak WSE of all alternatives equally, relative to the alternatives under 2030 sea level conditions. Therefore, the differences in peak WSE under Alternative 4 with 2070 sea levels relative to the No Action Alternative are expected to be of a similar magnitude to the differences in peak WSE under Alternative 4 with 2030 sea levels relative to existing conditions.

Similar to the differences compared to the existing conditions presented in Table 4-6, Yolo Bypass peak WSE is expected to decrease under Alternative 4 with sea level rise compared to the No Action Alternative. Peak WSE would decrease on the Sacramento River under Alternative 4 with sea level rise compared to the No Action Alternative.

CEQA Conclusion

Impacts to the 100-year flood hazard area would be **less than significant** because the changes to bypass channel geometry under Alternative 4 would not impede or redirect peak flood flows. Increased peak flows from changes to Fremont Weir geometry would remain within the Yolo Bypass. The changes to channel geometry within the Yolo Bypass would increase peak WSE less than one foot. Peak WSE would remain the same or decrease on the Sacramento River.

4.3.3.6 Alternative 5: Central Multiple Gated Notches

Alternative 5, Central Multiple Gated Notches, would have a smaller amount of flow entering the Yolo Bypass through the gated notch in Fremont Weir than some other alternatives, but it would incorporate water control structures to maintain inundation for longer periods of time within the northern portion of the Yolo Bypass. Alternative 5 would include the same gated notch and associated facilities as described for Alternative 3; however, it would be operated to limit the maximum inflow to 3,200 cfs. See Section 2.7 for more details on the alternative features.

4.3.3.6.1 Impact HYD-1: Change in occurrence of flows exceeding the maximum existing conditions monthly flow from the Sacramento River into the Yolo Bypass

Alternative 5 compared to Existing Conditions

The CalSim II modeling uses a monthly time step, which is inappropriate for flood control analysis; however, flood management operations at upstream reservoirs would not change for Alternative 5 relative to existing conditions. Although a slight increase in the frequency of high flows in the bypass under Alternative 5 would be possible because of the increased weir capacity at Fremont Weir, Alternative 5 would not increase the occurrence of monthly flows above 136,869 cfs (the maximum existing conditions monthly flow). Based on the CalSim II model results at Fremont Weir with 2030 hydrology and infrastructure, monthly flows at Fremont Weir greater than 136,869 cfs would not occur under either Alternative 5 or existing conditions.

Alternative 5 compared to the No Action Alternative

Based on the CalSim II results at Fremont Weir with 2070 hydrology, infrastructure, and sea level rise, the number of occurrences of flow above 136,869 cfs would remain the same under Alternative 5 relative to the No Action Alternative. Although there would be differences in month-to-month flow in the bypass under Alternative 5 compared to the No Action Alternative, monthly flows at Fremont Weir greater than 136,869 cfs would occur in two months under both Alternative 5 and the No Action Alternative.

CEQA Conclusion

The effect of Alternative 5 on flows from the Sacramento River into the Yolo Bypass would be **less than significant** because Alternative 5 would not increase or decrease the number of occurrences of flows exceeding the maximum existing conditions monthly average flow from the Sacramento River into the Yolo Bypass.

4.3.3.6.2 Impact HYD-2: Change in occurrence of flows exceeding the maximum existing conditions monthly flow in the Sacramento River at Freeport

Alternative 5 compared to Existing Conditions

The CalSim II modeling uses a monthly time step, which is inappropriate for flood control analysis; however, flood management operations at upstream reservoirs would not change for Alternative 5 relative to existing conditions. A slight decrease in the frequency of high flows in the Sacramento River at Freeport under Alternative 5 would be possible because of the increased weir capacity at Fremont Weir. Alternative 5 would not increase the occurrence of monthly flows above 72,231 cfs (the maximum existing conditions monthly flow). Based on the CalSim II model results at Freeport with 2030 hydrology and infrastructure, monthly flows at Freeport greater than 72,231 cfs would not occur under either Alternative 5 or existing conditions.

Alternative 5 compared to the No Action Alternative

Based on the CalSim II results at Freeport with 2070 hydrology, infrastructure, and sea level rise, the number of occurrences of flow above 72,231 cfs would remain the same under Alternative 5 relative to the No Action Alternative. Although there would be differences in month-to-month Sacramento River flow at Freeport under Alternative 5 compared to the No Action Alternative, monthly flows at Freeport greater than 72,231 cfs would occur in 2 months under both the No Action Alternative and Alternative 5.

CEQA Conclusion

The effect of Alternative 5 on flows in the Sacramento River at Freeport would be **less than significant** relative to existing conditions because Alternative 5 would not increase or decrease the number of occurrences of flows exceeding the maximum existing conditions monthly average flow in the Sacramento River at Freeport.

4.3.3.6.3 Impact HYD-3: Change in 100-year flood hazard area

Alternative 5 would change the channel geometry within the Yolo Bypass to improve fish passage and would change the geometry of Fremont Weir to allow higher discharge into the Yolo Bypass than under the existing conditions. Under Alternative 5, larger areas within the bypass would be inundated at low flows. Flood flows would remain limited to the leveed portion of the bypass. Alternative 5 would not locate any new housing or new structures within the 100-year flood hazard area.

Alternative 5 compared to Existing Conditions

For a given flood or high-flow hydrograph, peak WSE under Alternative 5 are expected to remain similar to existing conditions. Tables 4-7 and 4-8 show a comparison of maximum WSE under Alternative 5 compared to existing conditions along the Sacramento River and the Yolo Bypass respectively.

Table 4-7. Maximum WSE Changes between Existing Conditions and Alternative 5 along the Sacramento River at Key Locations

Locations along the Sacramento River	Maximum WSE (ft. NAVD88)		Difference (ft.)
	Existing Conditions	Alternative 5	
Upstream of Fremont Weir	41.02	40.92	-0.10
Natomas Cross Canal	41.24	41.17	-0.07
Verona gage	41.15	41.09	-0.06
Interstate 5	37.79	37.74	-0.05
Upstream of Sacramento Weir	33.89	33.87	-0.02
Interstate 80	34.37	34.35	-0.02
Bryte gage	34.38	34.35	-0.03
American River	34.37	34.35	-0.02
I Street Bridge	33.85	33.83	-0.02
Pioneer Memorial Bridge	32.62	32.6	-0.02
Freeport bridge	27.72	27.7	-0.02
Snodgrass Slough	22.92	22.9	-0.02
Sutter Slough	21.35	21.33	-0.02
Steamboat Slough	20.47	20.45	-0.02
Walnut Grove gage	17.43	17.42	-0.01
Cache Slough	11.83	11.83	0

Locations along the Sacramento River	Maximum WSE (ft. NAVD88)		Difference (ft.)
	Existing Conditions	Alternative 5	
Rio Vista	11.54	11.54	0
3 Mile Slough	9.82	9.82	0
Collinsville gage	8.3	8.3	0

Source:

HEC-RAS = Hydrologic Engineering Center River Analysis System hydraulic model (HEC-RAS model) 1997 storm pattern scaled to 85 percent, routed through Central Valley Hydrology Study's (CVHS)

WSE= water surface elevation; ft. = feet; NAVD88 = North American Vertical Datum of 1988

Table 4-8. Maximum WSE Changes between Existing Conditions and Alternative 5 along Yolo Bypass at Key Locations

Locations along the Yolo Bypass	Maximum WSE (ft. NAVD88)		Difference (ft.)
	Existing Conditions	Alternative 5	
Fremont Weir	40.16	40.05	-0.11
Agricultural Road Crossing 1	37.27	37.28	0.01
Agricultural crossing 2	36.96	36.97	0.01
Knights Landing Ridge Cut	36.52	36.53	0.01
Interstate 5	33.47	33.47	0
Road 25 at West Levee	32.04	32.04	0
Sacramento Bypass	29.91	29.91	0
Agricultural crossing 4	29.83	29.84	0
Interstate 80	29.07	29.07	0
Putah Creek	27.60	27.60	0
Lisbon Gage	26.29	26.29	0
North end of Holland Tract	21.43	21.43	0
South end of Holland Tract	19.06	19.06	0
DWSC at Miner Slough	15.81	15.81	0

Source:
DSWC = Deep Water Ship Canal

HEC-RAS = Hydrologic Engineering Center River Analysis System hydraulic model (HEC-RAS model) 1997 storm pattern scaled to 85 percent, routed through Central Valley Hydrology Study's (CVHS)

WSE= water surface elevation; ft. = feet; NAVD88 = North American Vertical Datum of 1988

When Fremont Weir flows at its design capacity of 343,000 cfs (85 percent of the 1997 CVHS hydrograph), the analysis conducted in HEC-RAS indicates that peak WSE within the bypass would increase up to 0.01 feet for Alternative 5 in one location relative to existing conditions. WSE would decrease up to 0.1 feet on the Sacramento River relative to existing conditions.

For the highest historic flood flow routed in TUFLOW, which occurred during the 1997 event, TUFLOW indicates that some portions of the bypass would experience increases in maximum WSE between 0.02 and 0.05 feet in Alternative 5 relative to the existing conditions hydrodynamic model. TUFLOW results indicate that flows up to the weir capacity would remain within the leveed portion of the Yolo Bypass for all alternatives. Therefore, Alternative 5 would not impede or redirect flood flows within the existing flood hazard area.

Alternative 5 compared to the No Action Alternative

As discussed in Section 4.3.3.2.3, it is assumed that sea level rise would increase the peak WSE of all alternatives equally, relative to the alternatives under 2030 sea level conditions. Therefore, the differences in peak WSE under Alternative 5 with 2070 sea levels relative to the No Action Alternative are expected to be of a similar magnitude to the differences in peak WSE under Alternative 5 with 2030 sea levels relative to existing conditions.

Similar to the differences presented in Table 4-8 for Alternative 5 compared to existing conditions, Yolo Bypass peak WSE is expected to decrease under Alternative 5 with sea level rise compared to the No Action Alternative. Peak WSE would decrease on the Sacramento River under Alternative 5 with sea level rise compared to the No Action Alternative.

CEQA Conclusion

Impacts to the 100-year flood hazard area would be **less than significant** because the changes to bypass channel geometry under Alternative 5 would not impede or redirect peak flood flows. Increased peak flows from changes to Fremont Weir geometry would remain within the Yolo Bypass. The changes to channel geometry within the Yolo Bypass would increase peak WSE less than one foot. Peak WSE would remain the same or decrease on the Sacramento River.

4.3.3.6.4 Tule Canal Floodplain Improvements (Program Level)

As described in Section 2.8.1.7, Alternative 5 would include floodplain improvements along Tule Canal, just north of Interstate 80. These improvements would not be constructed at the same time as the remaining facilities. Floodplain improvements are included at a program level of detail to consider all the potential impacts and benefits of Alternative 5. Subsequent consideration of environmental impacts would be necessary before construction could begin.

The Tule Canal Floodplain Improvements would not change the occurrence of flows above the maximum existing conditions monthly flow within the Yolo Bypass or the Sacramento River relative to existing conditions and the No Action Alternative. The improvements would result in changes to WSE within the bypass relative to existing conditions and the No Action Alternative. Weir operations would increase the WSE upstream of Tule Canal for more frequent, lower flows to improve habitat for fish and waterfowl. However, for less frequent, higher flows, such as a one percent AEP monthly flow, the weir would not be operated to increase WSE upstream of Tule Canal. Further, although the floodplain grading would impede flows and redirect flows at lower flows in some areas within the bypass to increase Tule Canal depth, flows through the weir structure would not be allowed to exceed 1,000 cfs (the capacity of Tule Canal).

CEQA Conclusion

The overall capacity of the Yolo Bypass would not be reduced by the Tule Canal Floodplain Improvements relative to existing conditions, and all flows would remain within the existing

Yolo Bypass. Therefore, these improvements would have a **less than significant** impact on flood control, hydrology, and hydraulics.

4.3.3.7 Alternative 6: West Side Large Gated Notch

Alternative 6, West Side Large Gated Notch, is a large notch in the western location that would allow flows up to 12,000 cfs. It was designed with the goal of entraining more fish by allowing more flow into the bypass when the Sacramento River is at lower elevations. See Section 2.9 for more details on the alternative features.

4.3.3.7.1 Impact HYD-1: Change in occurrence of flows exceeding the maximum existing conditions monthly flow from the Sacramento River into the Yolo Bypass

Alternative 6 compared to Existing Conditions

The CalSim II modeling uses a monthly time step, which is inappropriate for flood control analysis; however, flood management operations at upstream reservoirs would not change for Alternative 6 relative to existing conditions. Although a slight increase in the frequency of high flows in the bypass under Alternative 6 would be possible because of the increased weir capacity at Fremont Weir, Alternative 6 would not increase the occurrence of monthly flows above 136,869 cfs (the maximum existing conditions monthly flow). Based on the CalSim II model results at Fremont Weir with 2030 hydrology and infrastructure, monthly flows at Fremont Weir greater than 136,869 cfs would not occur under either Alternative 6 or existing conditions.

Alternative 6 compared to the No Action Alternative

Based on the CalSim II results at Fremont Weir with 2070 hydrology, infrastructure, and sea level rise, the number of occurrences of flow above 136,869 cfs would remain the same under Alternative 6 relative to the No Action Alternative. Although there would be differences in month-to-month flow in the bypass under Alternative 6 compared to the No Action Alternative, monthly flows at Fremont Weir greater than 136,869 cfs would occur in two months under both Alternative 6 and the No Action Alternative.

CEQA Conclusion

The effect of Alternative 6 on flows from the Sacramento River into the Yolo Bypass would be **less than significant** because Alternative 6 would not increase or decrease the number of occurrences of flows exceeding the maximum existing conditions monthly average flow from the Sacramento River into the Yolo Bypass.

4.3.3.7.2 Impact HYD-2: Change in occurrence of flows exceeding the maximum existing conditions monthly flow in the Sacramento River at Freeport

Alternative 6 compared to Existing Conditions

The CalSim II modeling uses a monthly time step, which is inappropriate for flood control analysis; however, flood management operations at upstream reservoirs would not change for

Alternative 6 relative to existing conditions. A slight decrease in the frequency of high flows in the Sacramento River at Freeport under Alternative 6 would be possible because of the increased weir capacity at Fremont Weir. Alternative 6 would not increase the occurrence of monthly flows above 72,231 cfs (the maximum existing conditions monthly flow). Based on the CalSim II model results at Freeport with 2030 hydrology and infrastructure, monthly flows at Freeport greater than 72,231 cfs would not occur under either Alternative 6 or existing conditions.

Alternative 6 compared to the No Action Alternative

Based on the CalSim II results at Freeport with 2070 hydrology, infrastructure, and sea level rise, the number of occurrences of flow above 72,231 cfs would remain the same under Alternative 6 relative to the No Action Alternative. Although there would be differences in month-to-month Sacramento River flow at Freeport under Alternative 6 compared to the No Action Alternative, monthly flows at Freeport greater than 72,231 cfs would occur in 2 months under both the No Action Alternative and Alternative 6.

CEQA Conclusion

The effect of Alternative 6 on flows from the Sacramento River into the Yolo Bypass would be **less than significant** because Alternative 6 would not increase or decrease the number of occurrences of flows exceeding the maximum existing conditions monthly average flow in the Sacramento River at Freeport

4.3.3.7.3 Impact HYD-3: Change in 100-year flood hazard area

Alternative 6 would change the channel geometry within the Yolo Bypass to improve fish passage and would change the geometry of Fremont Weir to allow higher discharge into the Yolo Bypass than under the existing conditions. Under Alternative 6, larger areas within the bypass would be inundated at low flows. Flood flows would remain limited to the leveed portion of the bypass. Alternative 6 would not locate any new housing or new structures within the 100-year flood hazard area.

Alternative 6 compared to Existing Conditions

For a given flood or high-flow hydrograph, peak WSE is expected to remain similar to existing conditions. Tables 4-9 and 4-10 show a comparison of maximum WSE along the Sacramento River and the Yolo Bypass, respectively.

Table 4-9. Maximum WSE Changes between Existing Conditions and Alternative 6 along the Sacramento River at Key Locations

Locations along the Sacramento River	Maximum WSE (ft. NAVD88)		Difference (ft.)
	Existing Conditions	Alternative 6	
Upstream of Fremont Weir	41.02	40.86	-0.16
Natomas Cross Canal	41.24	41.14	-0.10
Verona gage	41.15	41.05	-0.10
Interstate 5	37.79	37.72	-0.07
Upstream of Sacramento Weir	33.89	33.86	-0.03
Interstate 80	34.37	34.34	-0.03
Bryte gage	34.38	34.34	-0.04
American River	34.37	34.34	-0.03
I Street Bridge	33.85	33.82	-0.03
Pioneer Memorial Bridge	32.62	32.58	-0.04
Freeport bridge	27.72	27.69	-0.03
Snodgrass Slough	22.92	22.89	-0.03
Sutter Slough	21.35	21.33	-0.02
Steamboat Slough	20.47	20.45	-0.02
Walnut Grove gage	17.43	17.42	-0.01
Cache Slough	11.83	11.83	0.00
Rio Vista	11.54	11.54	0.00
3 Mile Slough	9.82	9.82	0.00
Collinsville gage	8.3	8.3	0.00

Source:

HEC-RAS = Hydrologic Engineering Center River Analysis System hydraulic model (HEC-RAS model) 1997 storm pattern scaled to 85 percent, routed through Central Valley Hydrology Study's (CVHS)

WSE= water surface elevation; ft. = feet; NAVD88 = North American Vertical Datum of 1988

Table 4-10. Maximum WSE Changes between Existing Conditions and Alternative 6 along Yolo Bypass at Key Locations

Locations along the Yolo Bypass	Maximum WSE (ft. NAVD88)		Difference (ft.)
	Existing Conditions	Alternative 6	
Fremont Weir	40.16	40.03	-0.13
Agricultural Road Crossing 1	37.27	37.29	0.02
Agricultural crossing 2	36.96	36.98	0.02
Knights Landing Ridge Cut	36.52	36.54	0.02
Interstate 5	33.47	33.48	0.01
Road 25 at West Levee	32.04	32.05	0.01
Sacramento Bypass	29.91	29.91	0.00

Locations along the Yolo Bypass	Maximum WSE (ft. NAVD88)		Difference (ft.)
	Existing Conditions	Alternative 6	
Agricultural crossing 4	29.83	29.84	0.01
Interstate 80	29.07	29.07	0.00
Putah Creek	27.60	27.60	0.00
Lisbon Gage	26.29	26.29	0.00
North end of Holland Tract	21.43	21.44	0.01
South end of Holland Tract	19.06	19.06	0.00
DWSC at Miner Slough	15.81	15.81	0.00

Source:

DSWC = Deep Water Ship Canal

HEC-RAS = Hydrologic Engineering Center River Analysis System hydraulic model (HEC-RAS model) 1997 storm pattern scaled to 85 percent, routed through Central Valley Hydrology Study's (CVHS)

WSE= water surface elevation; ft. = feet; NAVD88 = North American Vertical Datum of 1988

When Fremont Weir flows at its design capacity of 343,000 cfs (85 percent of the 1997 CVHS hydrograph), the analysis conducted in HEC-RAS indicates that peak WSE within the bypass would increase up to 0.02 feet for Alternative 6 relative to existing conditions. WSE would decrease up to 0.16 feet on the Sacramento River relative to existing conditions.

For the highest historic flood flow routed in TUFLOW, which occurred during the 1997 event, TUFLOW indicates that some portions of the bypass would experience increases in maximum WSE between 0.02 and 0.05 feet in Alternative 6 relative to the existing conditions hydrodynamic model. TUFLOW results indicate that flows up to the weir capacity would remain within the leveed portion of the Yolo Bypass for all alternatives. Therefore, Alterative 6 would not impede or redirect flood flows within the existing flood hazard area.

Alternative 6 compared to the No Action Alternative

As discussed in Section 4.3.3.2.3, it is assumed that sea level rise would increase the peak WSE of all alternatives equally, relative to the alternatives under 2030 sea level conditions. Therefore, the differences in peak WSE under Alternative 6 with 2070 sea levels relative to the No Action Alternative are expected to be of a similar magnitude to the differences in peak WSE under Alternative 6 with 2030 sea levels relative to existing conditions.

Similar to the differences presented in Table 4-10 for Alternative 6 compared to existing conditions, increases in Yolo Bypass WSE at peak flows under Alternative 6 with sea level rise compared to the No Action Alternative are expected to be less than one foot. WSE at peak flows would decrease on the Sacramento River under Alternative 6 with sea level rise compared to the No Action Alternative.

CEQA Conclusion

Impacts to the 100-year flood hazard area would be **less than significant** because the changes to bypass channel geometry under Alternative 6 would not impede or redirect peak flood flows. Increased peak flows from changes to Fremont Weir geometry would remain within the Yolo

Bypass. The changes to channel geometry within the Yolo Bypass would increase peak WSE of the bypass by less than one foot. Peak WSE would remain the same or decrease on the Sacramento River.

4.3.4 Summary of Impacts

Table 4-11 provides a summary of the identified impacts to flood control, hydraulics, and hydrology within the Project area.

Table 4-11. Summary of Impacts and Mitigation Measures – Flood Control, Hydraulics, and Hydrology

Impact	Alternative	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance after Mitigation
Impact HYD-1: Change in occurrence of flows exceeding the maximum existing conditions monthly flow from the Sacramento River into the Yolo Bypass	No Action	S	--	S
	All Action Alternatives	LTS	--	LTS
Impact HYD-2 Change in occurrence of flows exceeding the maximum existing conditions monthly flow in the Sacramento River at Freeport	No Action	S	--	S
	All Action Alternatives	LTS	--	LTS
Impact HYD-3 Change in 100-year flood hazard area	No Action	LTS	--	LTS
	All Action Alternatives	LTS	--	LTS

Key:
LTS = less than significant
NI = no impact
S = significant
SU = significant and unavoidable
B = beneficial

4.4 Cumulative Impacts Analysis

This section describes the cumulative impacts analysis for flood control, hydrology, and hydraulics. Section 3.3, *Cumulative Impacts*, presents an overview of the cumulative impacts analysis, including the methodology and the projects, plans, and programs included in the cumulative impacts analysis.

4.4.1 Methodology

This evaluation of cumulative impacts considers the effects of the Project and how they might combine with the effects of other past, present, and future projects or actions to create significant impacts on flood control, hydrology, and hydraulics. The area of analysis for these cumulative impacts includes the Yolo Bypass, the Delta, and the larger Sacramento River system. The timeframe for this cumulative impacts analysis includes the past, present, and probable future projects producing related or cumulative impacts that have been identified in the area of analysis.

This cumulative impacts analysis uses the project analysis approach described in detail in Section 3.3, *Cumulative Impacts*.

4.4.2 Cumulative Impacts

Several related and reasonably foreseeable projects and actions could result in impacts to the occurrence of flows exceeding the maximum existing conditions monthly flow in the Yolo Bypass at Fremont Weir and the maximum existing conditions monthly Sacramento River flow at Freeport. In particular, there may be reduced flows in the Sacramento River and increased flows in the Yolo Bypass due to implementation of the Lower Elkhorn Basin Levee Setback Project (LEBLS). LEBLS would remove all or portions of seven miles of existing levees along the east side of the Yolo Bypass and the north side of the Sacramento Bypass. These levees would be set back, portions of local reclamation district cross levees would be removed, and related infrastructure would be improved or relocated. The project would reduce river levels in the Sacramento River and increase the capacity of the Yolo Bypass near Sacramento and West Sacramento.

Figures 4-7 through 4-11 show the change in inundated area at 1,000, 3,000, 6,000, 9,000, and 12,000 cfs due to implementation of the LEBLS as modeled in HEC-RAS under 2030 conditions. The water depth would decrease in some regions of the bypass so that some areas (shaded in pink) are no longer inundated, and the water depth would increase in other regions outside of the existing bypass (shaded in aqua) to inundate additional area.

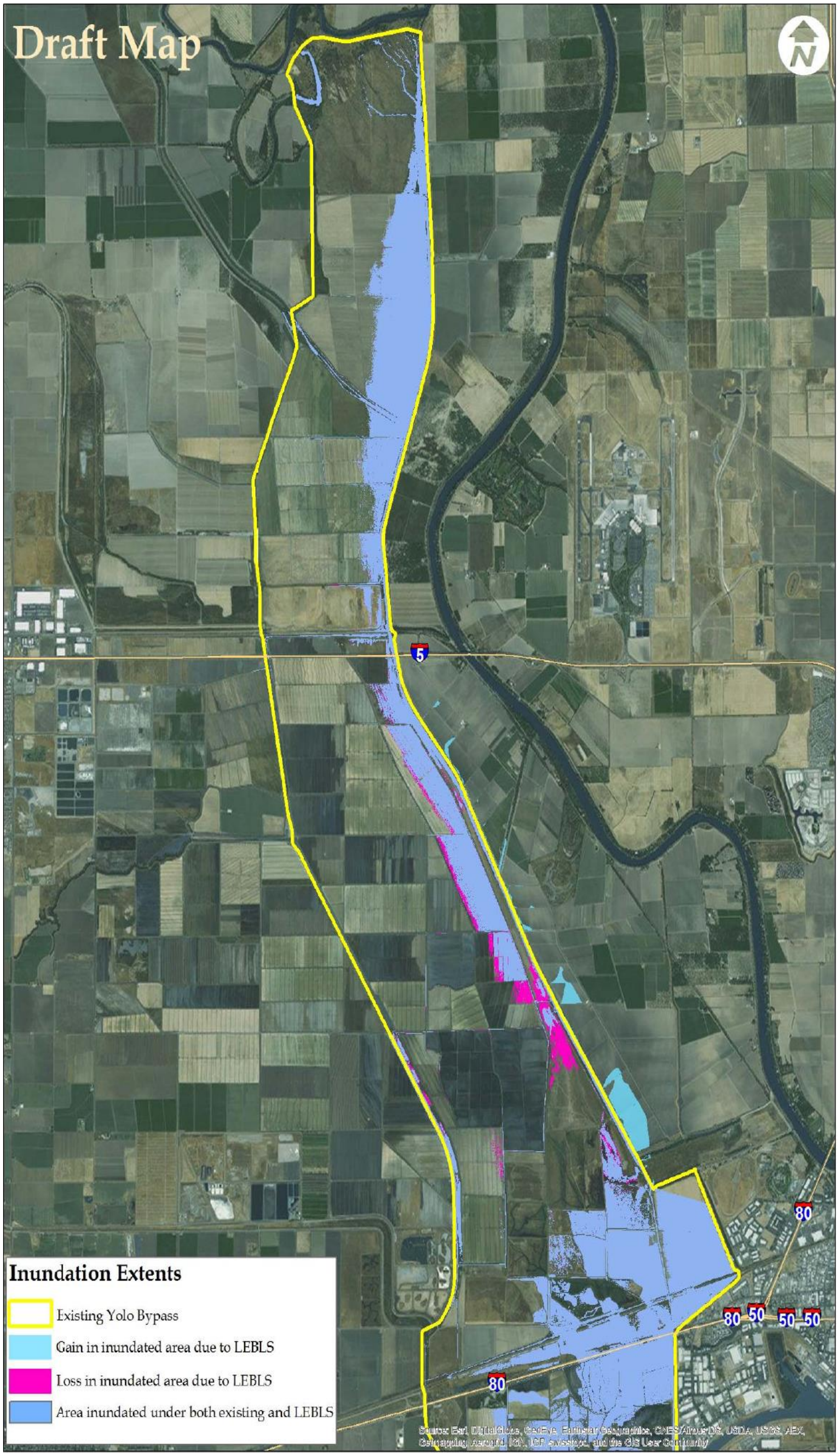

Figure 4-7. Inundation Changes at 1,000 cfs with Lower Elkhorn Basin Levee Setback (LEBLS) Cumulative Impacts versus Inundation under the Alternatives

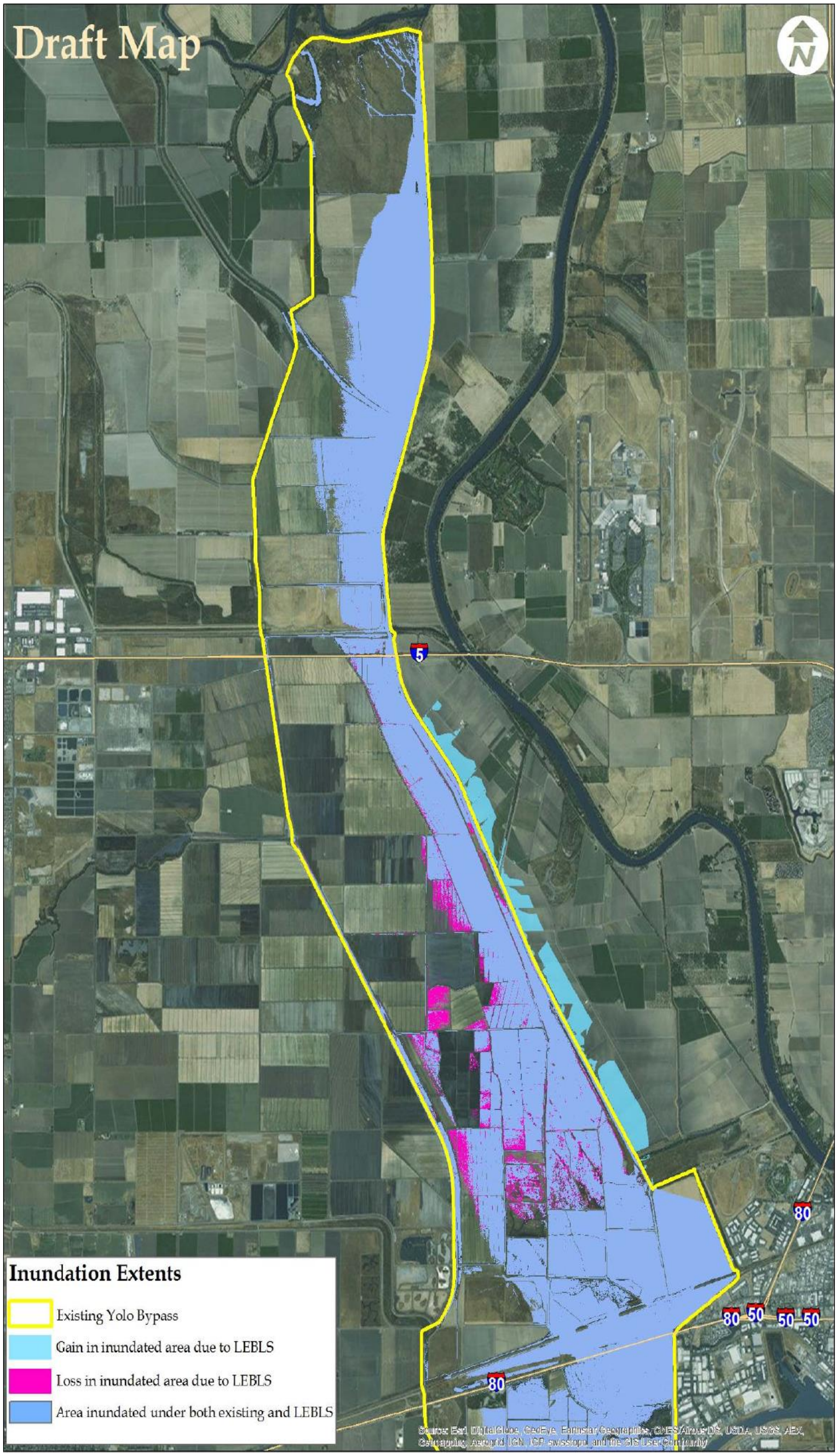

Figure 4-8. Inundation Changes at 3,000 cfs with Lower Elkhorn Basin Levee Setback (LEBLS) Cumulative Impacts versus Inundation under the Alternatives

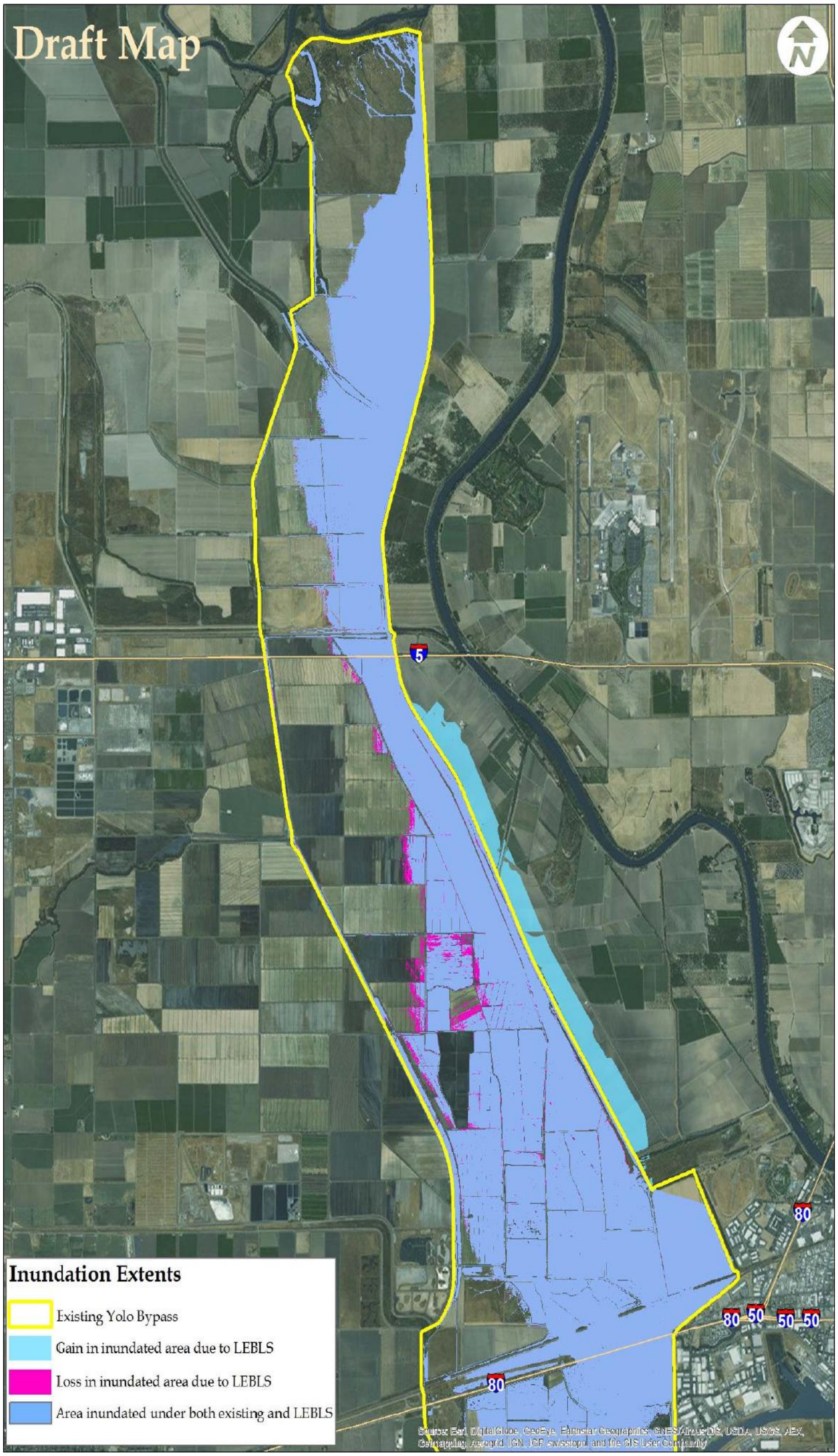

Figure 4-9. Inundation Changes at 6,000 cfs with Lower Elkhorn Basin Levee Setback (LEBLS) Cumulative Impacts versus Inundation under the Alternatives

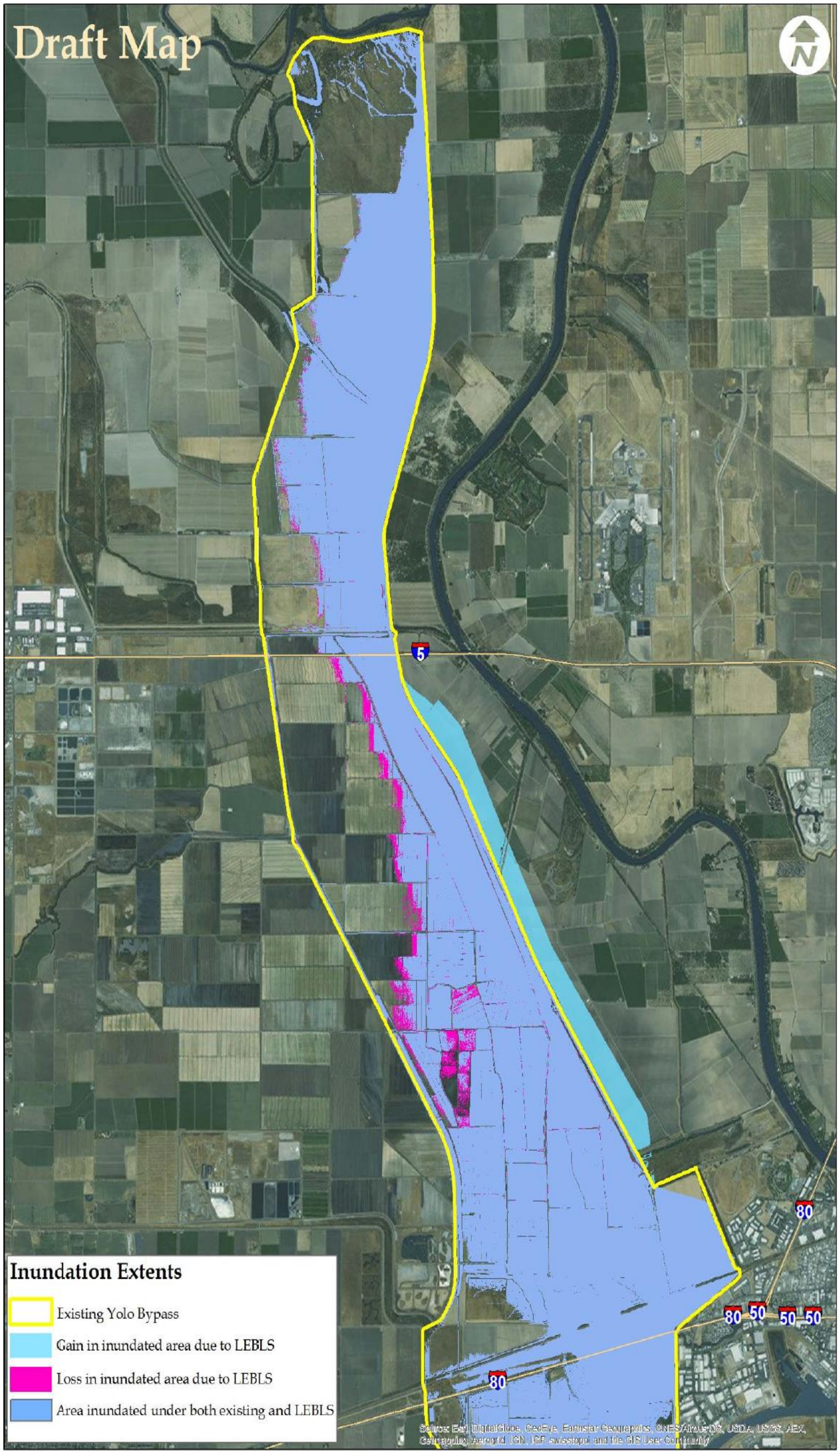

Figure 4-10. Inundation Changes at 9,000 cfs with Lower Elkhorn Basin Levee Setback (LEBLS) Cumulative Impacts versus Inundation under the Alternatives

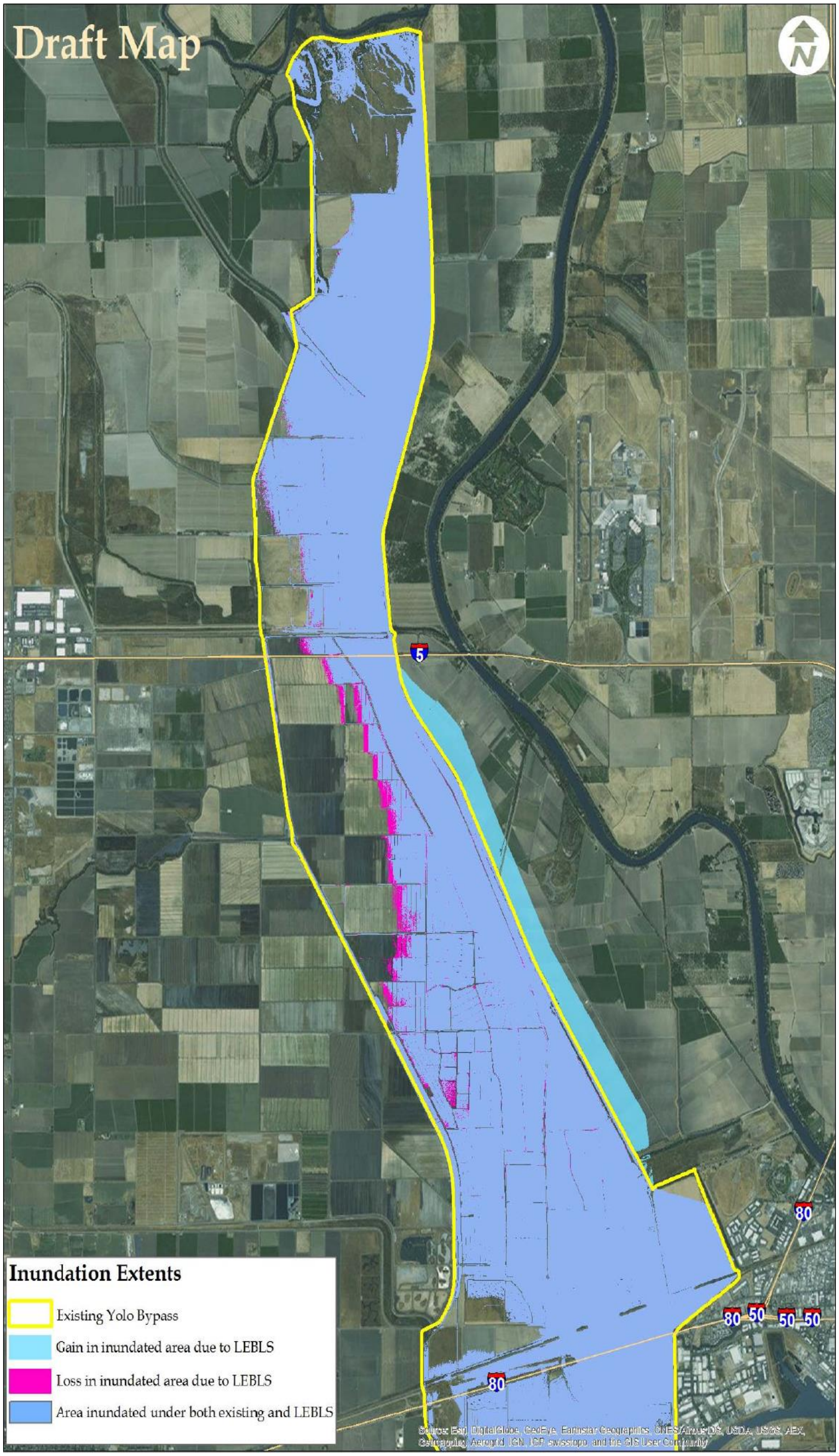

Figure 4-11. Inundation Changes at 12,000 cfs with Lower Elkhorn Basin Levee Setback (LEBLS) Cumulative Impacts versus Inundation under the Alternatives

Figures 4-12 through 4-16 show the LEBLS as modeled in HEC-RAS under 2070 conditions and sea level rise compared to the LEBLS as modeled in HEC-RAS under 2030 conditions. With sea level rise, the inundated area would increase in selected areas, and the inundation depth would increase for 1,000, 3,000, 6,000, 9,000, and 12,000 cfs. Similar to the cumulative impacts under existing conditions, some areas of the bypass would no longer be inundated, and other areas would have increased depth and inundation.

All projects would implement their own mitigation measures to reduce impacts to less than significant levels. Therefore, the cumulative impact on flood control, hydraulics, and hydrology, in both the long term and short term, would be **less than significant**.

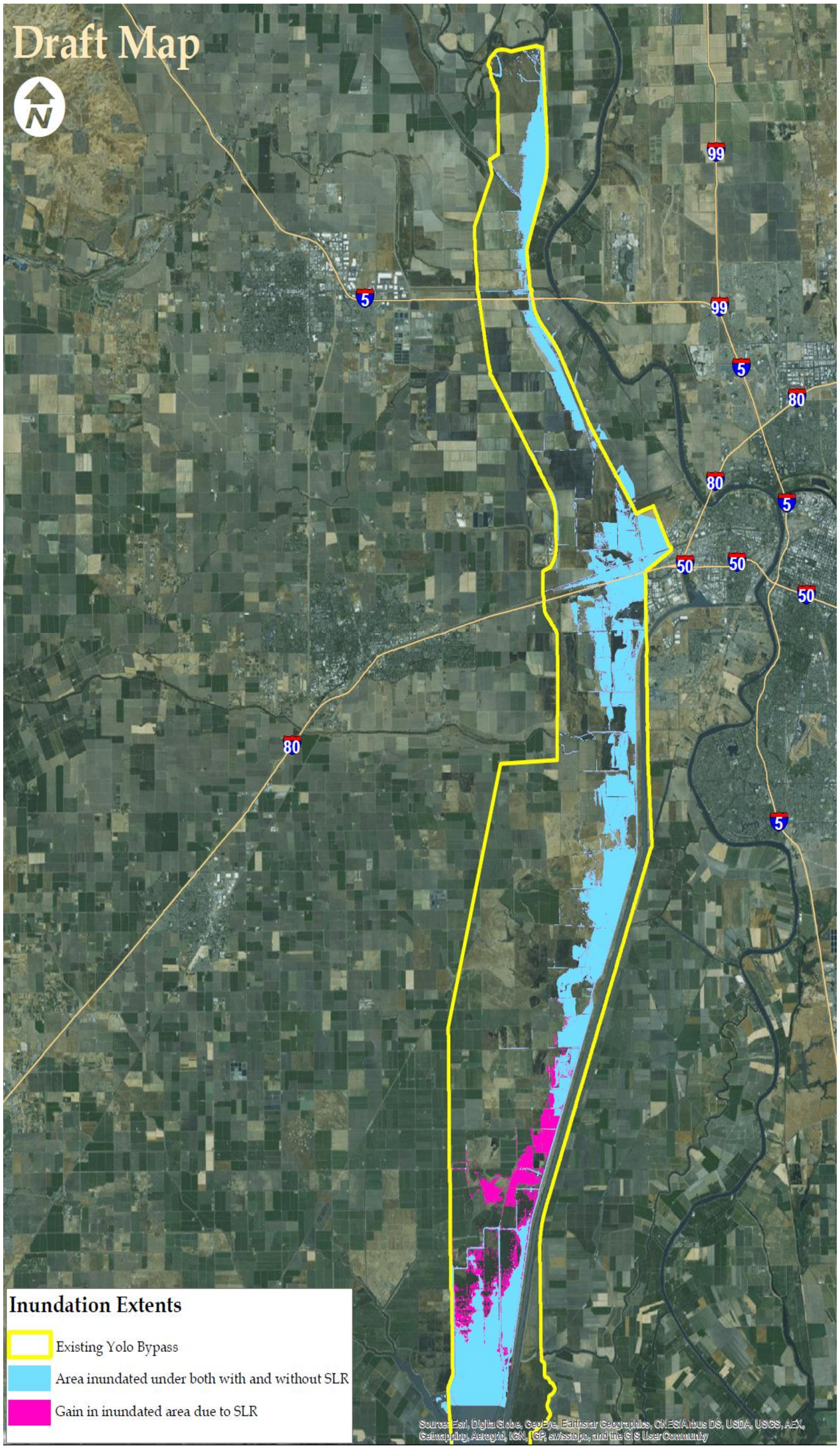

Figure 4-12. Inundation Increase for Lower Elkhorn Basin Levee Setback (LEBLS) Cumulative Impacts at 1,000 cfs with Sea Level Rise versus Inundation with LEBLS Cumulative Impacts at 1,000 cfs without Sea Level Rise

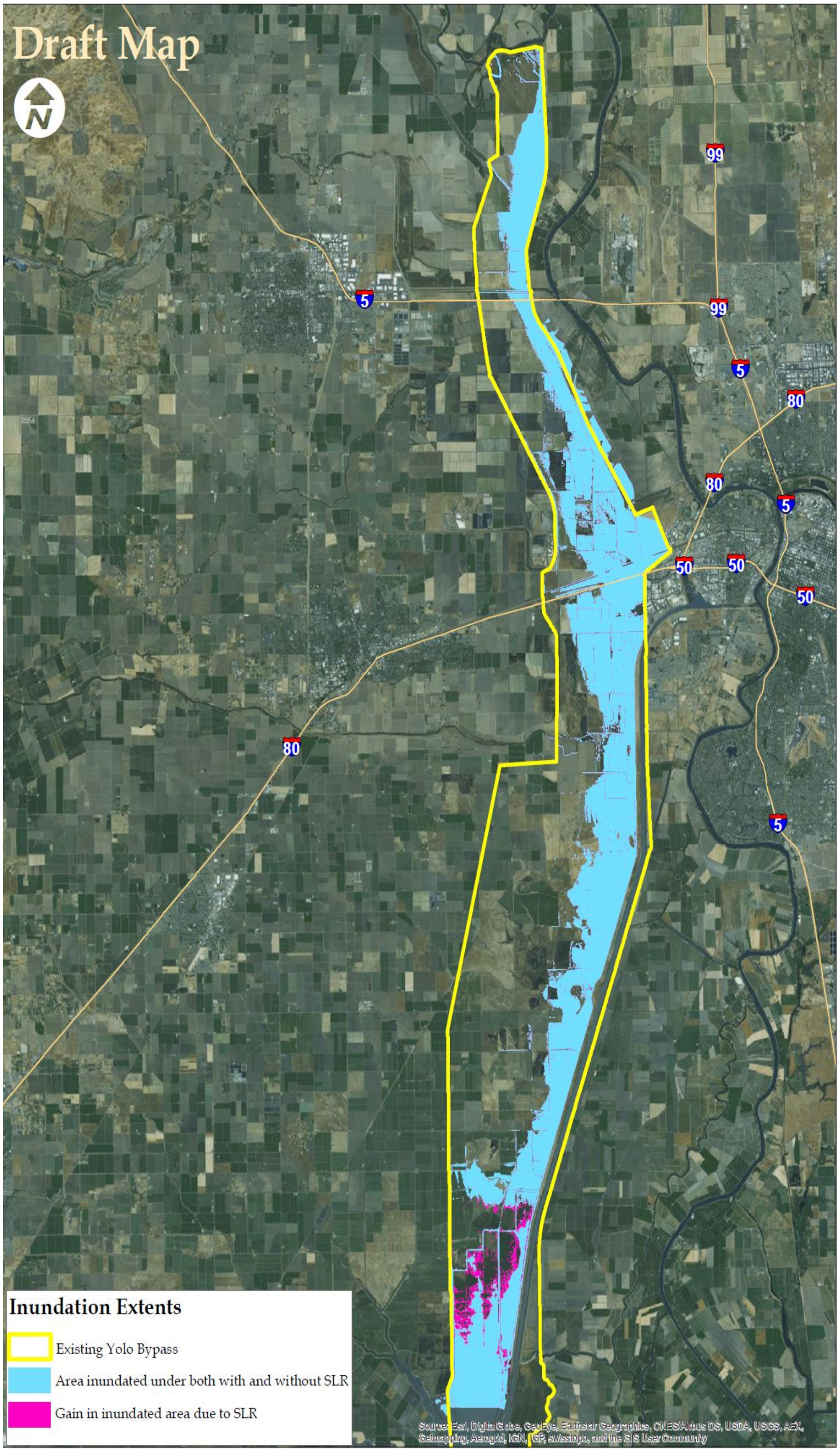

Figure 4-13. Inundation Increase for Lower Elkhorn Basin Levee Setback (LEBLS) Cumulative Impacts at 3,000 cfs with Sea Level Rise versus Inundation with LEBLS Cumulative Impacts at 3,000 cfs without Sea Level Rise

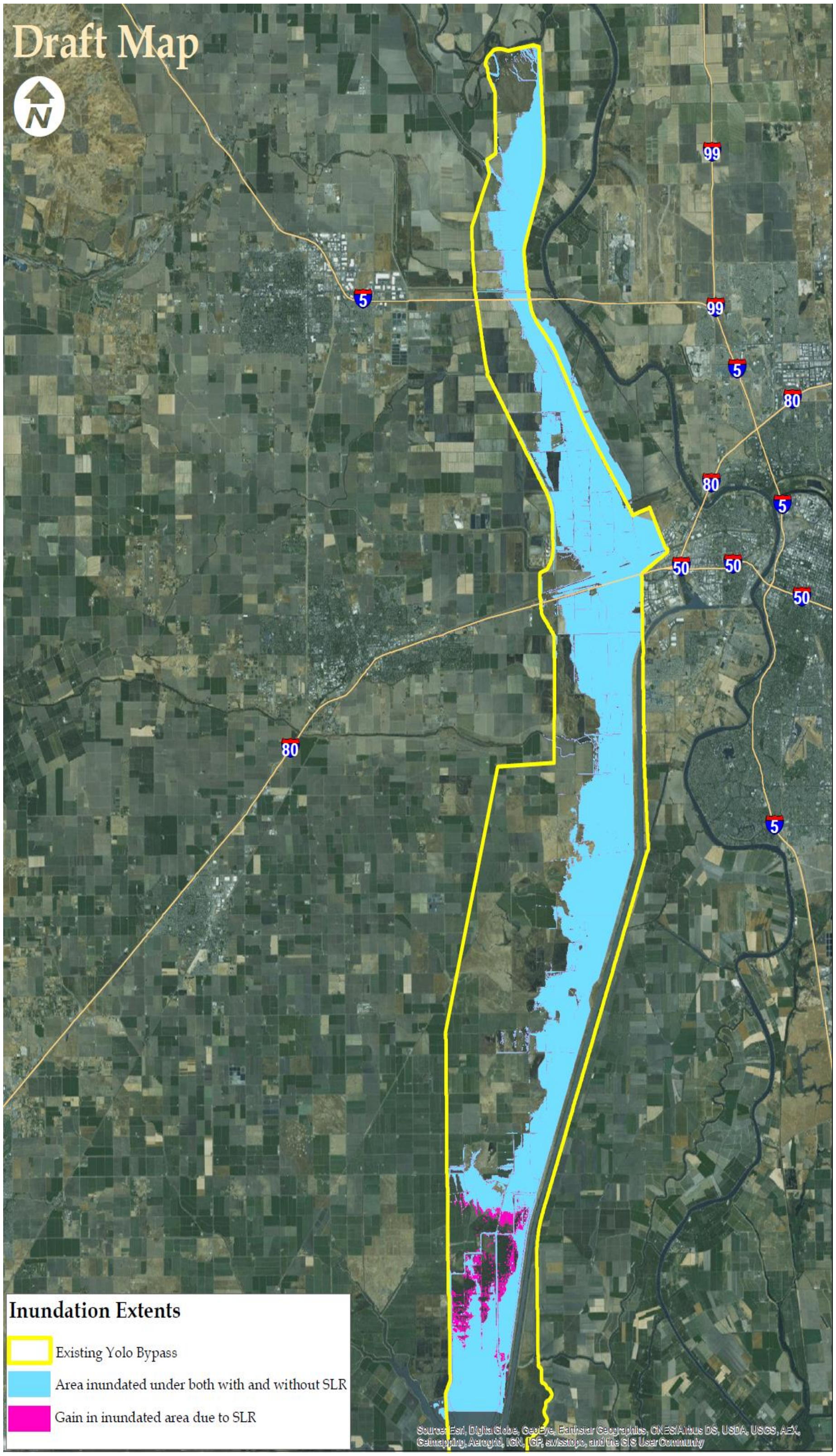

Figure 4-14. Inundation Increase for Lower Elkhorn Basin Levee Setback (LEBLS) Cumulative Impacts at 6,000 cfs with Sea Level Rise versus Inundation with LEBLS Cumulative Impacts at 6,000 cfs without Sea Level Rise

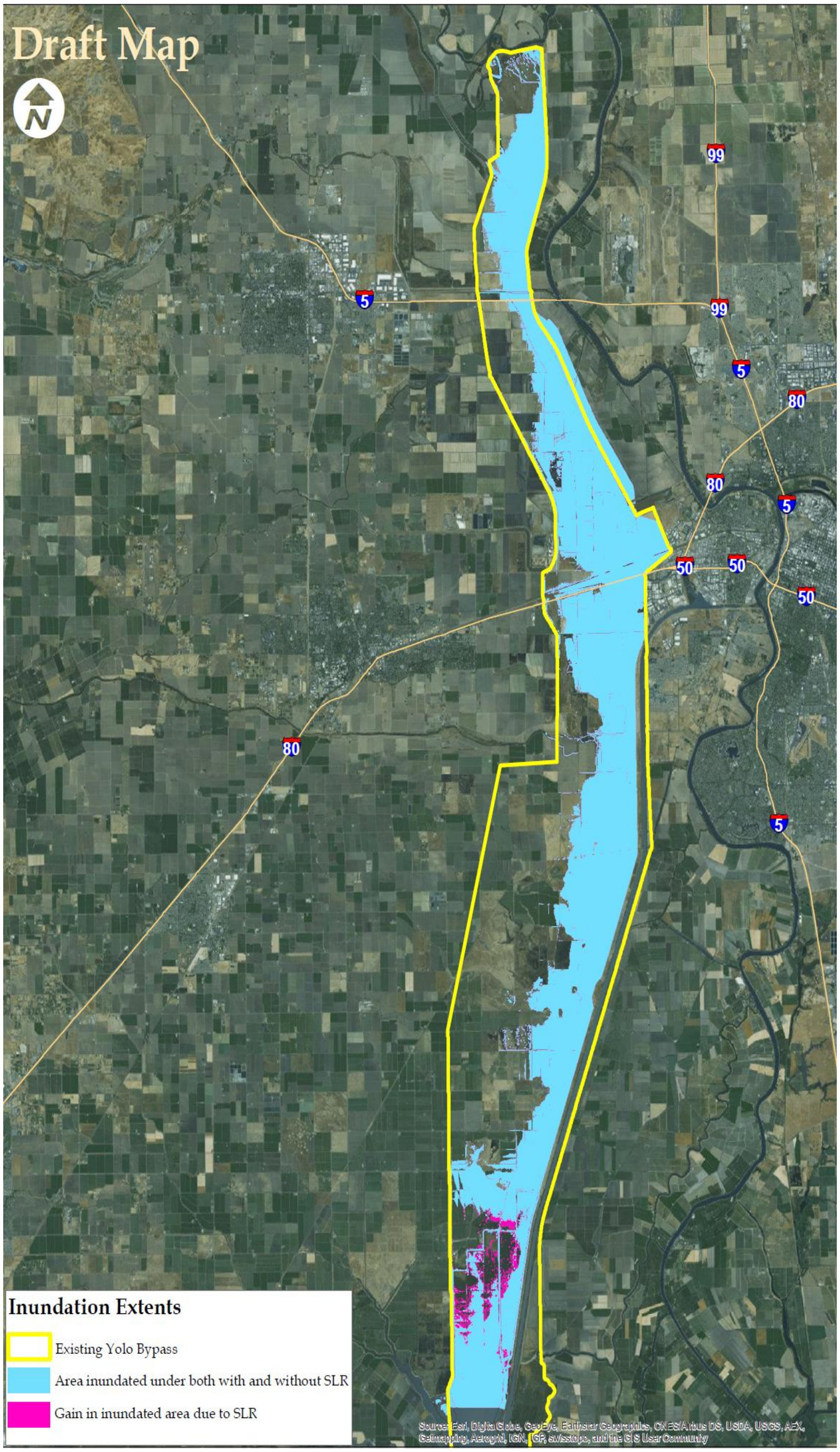

Figure 4-15. Inundation Increase for Lower Elkhorn Basin Levee Setback (LEBLS) Cumulative Impacts at 9,000 cfs with Sea Level Rise versus Inundation with LEBLS Cumulative Impacts at 9,000 cfs without Sea Level Rise

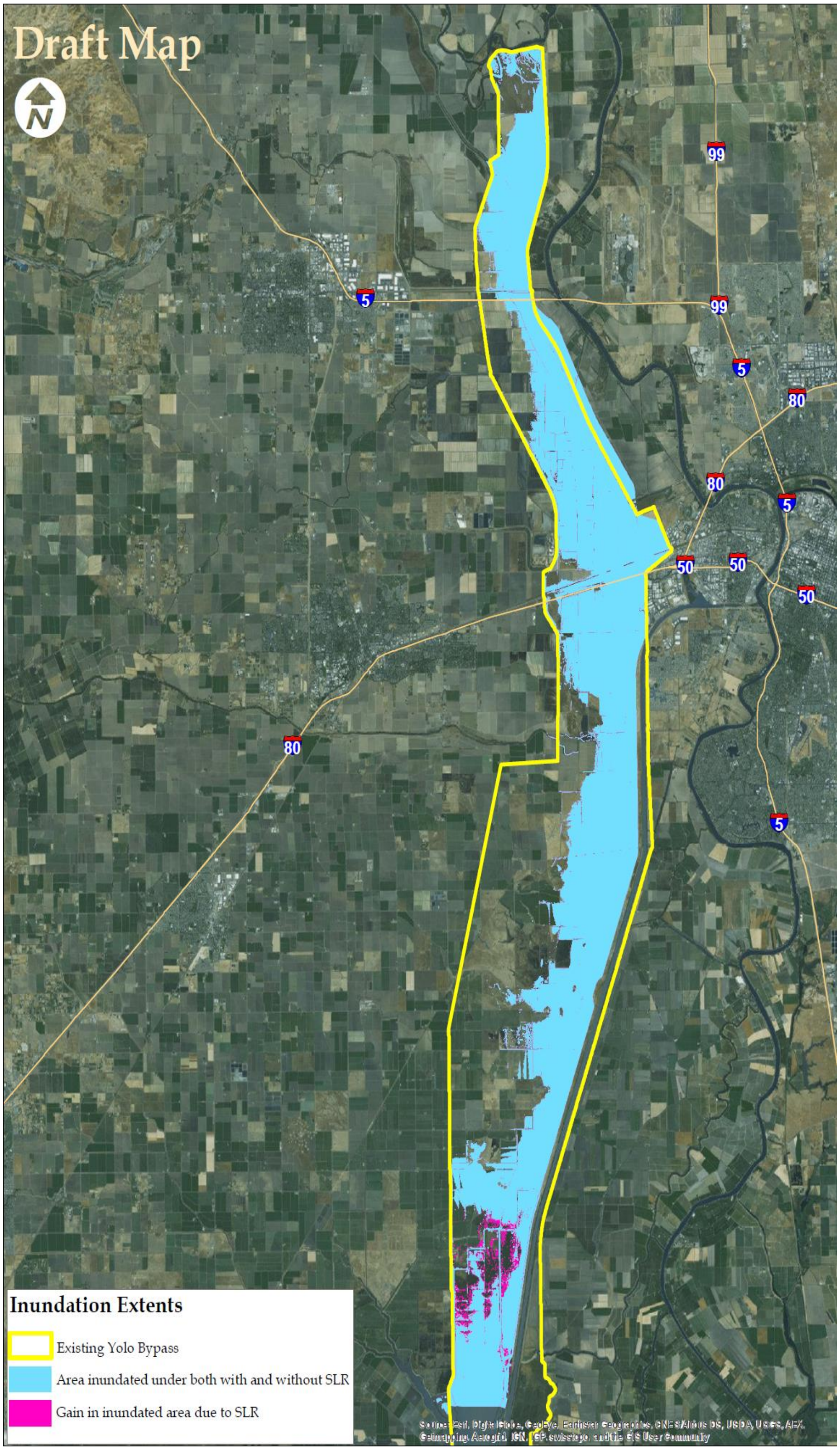

Figure 4-16. Inundation Increase for Lower Elkhorn Basin Levee Setback (LEBLS) Cumulative Impacts at 12,000 cfs with Sea Level Rise versus Inundation with LEBLS Cumulative Impacts at 12,000 cfs without Sea Level Rise

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