Reference: Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement

To:	Steve Wilson, PE, PS Maumee Watershed Conservancy District	From:	David Hayson, PE, SI Stantec Consulting Services Inc.
File:	174316204	Date:	October 31, 2019

Reference: Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement

AURAND RUN CONCEPT REFINEMENT OVERVIEW

Previously, Stantec assumed for the draft *Proof of Concept Update* Report that modifications could feasibly be made to Aurand Run to convey an additional 500 cfs of flow from the Eagle Creek dry-storage basin via a secondary spillway. Previous analyses assumed a certain price per linear foot of modification and that the modification would occur for an assumed distance. As part of this study, Stantec refined the concept and confirmed the feasibility of discharging flow from the Eagle Creek Dry-Storage Basin to Aurand Run. Figure 1 shows an overview of the study area.

Stantec used the existing HEC-HMS and unsteady HEC-RAS models developed and revised as part of the Hancock County Flood-Risk Reduction (HCFRR) Program to perform analysis of existing and proposed conditions within Aurand Run. Three (3) possible scenarios were analyzed for the Aurand Run concept refinement. Each of the three (3) Aurand Run scenarios consider the following:

- Up to 500 cfs is discharged to Aurand Run via the proposed Eagle Creek Dry-Storage Basin secondary spillway assuming a 1% annual chance exceedance (ACE) storm event occurs concurrently in the Aurand Run watershed.
- Stantec used the “Typical Storm” developed as described in the *Hydrologic Evaluation of the Blanchard River* (Stantec, 2017) for the 1% ACE event;
- A discharge channel between the Eagle Creek Dry-Storage Basin’s west embankment and Aurand Run, to a location just north (downstream) of Township Road 48 is sized to accept the 500 cfs; and
- New bridges will be required over this discharge channel where it intersects existing roads. New bridges will be required at Township Road 67 and County Road 76 for base layouts Alternatives 1, 2, 3 and 4, and also at Township Road 77 for base layout Alternative 4.

The three (3) scenarios considered as part of the Aurand Run concept refinement are:

1. Discharge the additional flow to Aurand Run without incorporating channel or structure modifications to increase capacity;
2. Modify Aurand Run with an increased trapezoidal channel geometry to accept the additional flow; and
3. Modify Aurand Run with a benched channel geometry to accept the additional flow.

Reference: **Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement**

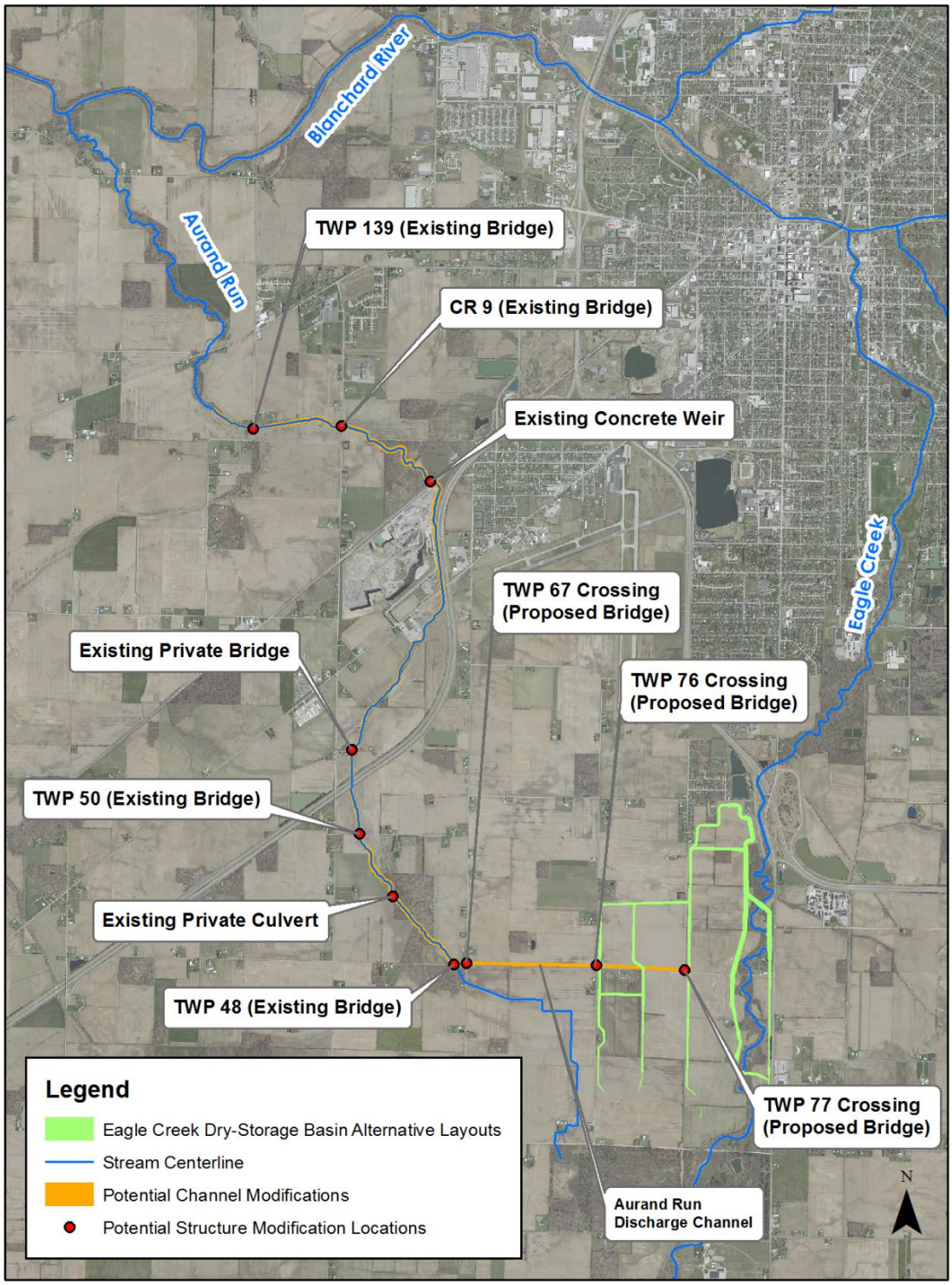

Figure 1 - Aurand Run Concept Refinement Overview

Reference: **Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement**

AURAND RUN SCENARIO 1 – ADDITIONAL FLOW, NO CHANNEL MODIFICATIONS

Stantec compared the hydraulic performance of Aurand Run with the additional flow from the storage basin to existing conditions. Even though up to 500 cfs is proposed to be discharged through the secondary spillway of the storage basin, Aurand Run would not experience the additional 500 cfs at the same time as its existing conditions peak flow due to the timing of the runoff hydrographs and attenuation of the discharge due to storage. Figure 2 shows that the location where the proposed discharge channel intersects Aurand Run would experience a peak flow increase of about 400 cfs due to the delay of the routing for the discharge channel hydrograph. Figure 3 shows further attenuation downstream at County Road 9 where the peak flow increase is approximately 275 cfs.

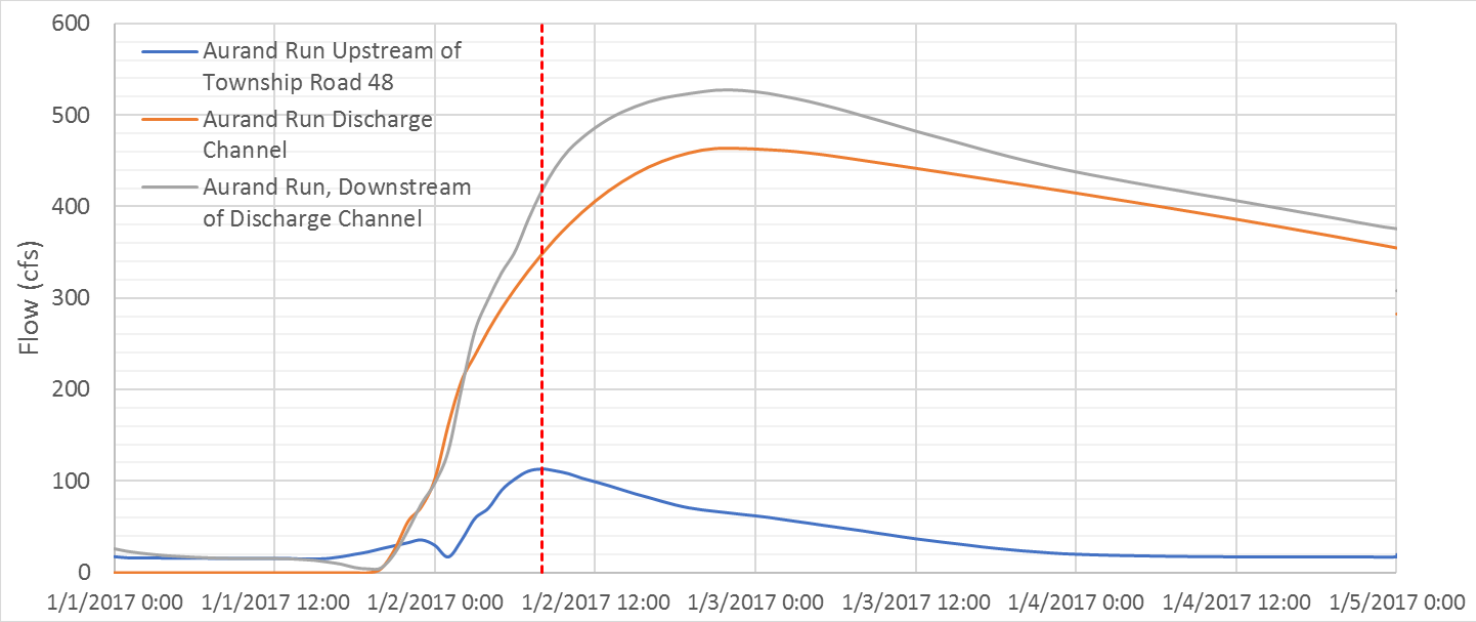

Figure 2 – Aurand Run Discharge Channel at Township Road 48 – 1% ACE Hydrograph

Reference: **Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement**

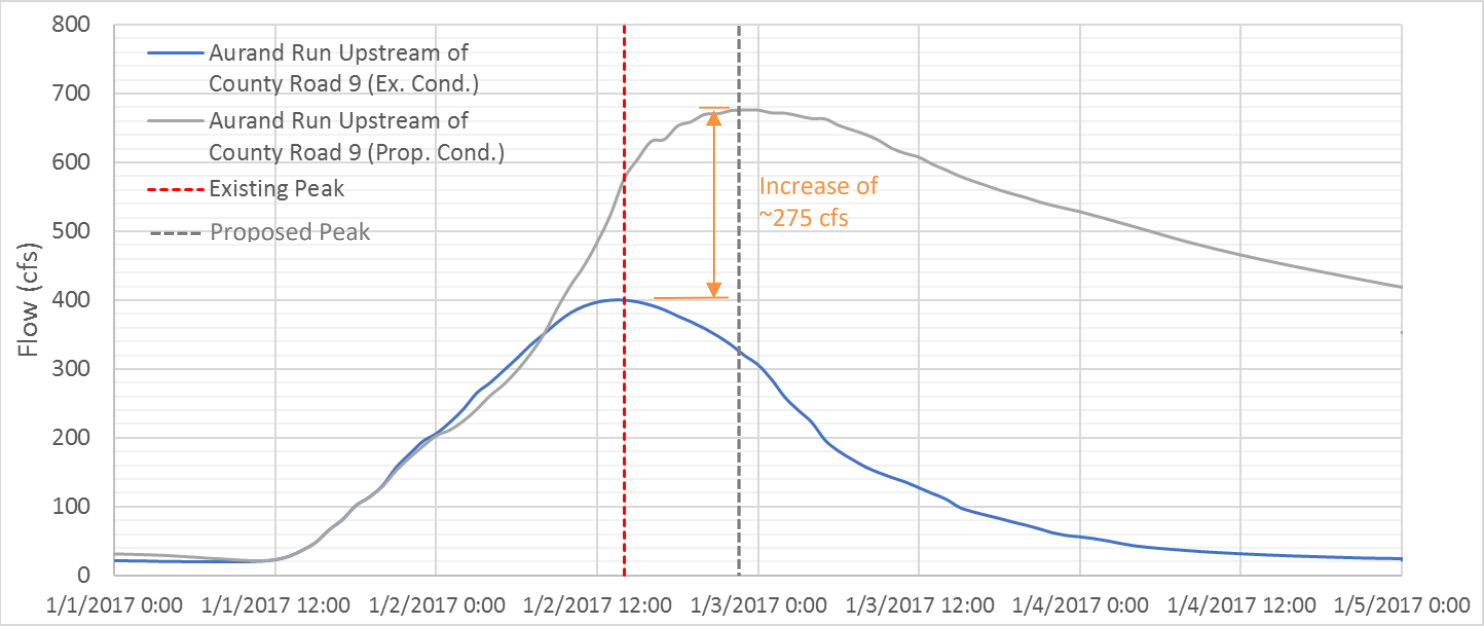

Figure 3 – Aurand Run Discharge Channel at County Road 9 – 1% ACE Hydrograph

Stantec performed hydraulic modelling to compare the 1% ACE storm event peak flow rates and floodplain extents for existing and proposed conditions for the length of Aurand Run. Figure 4 through Figure 8 show the 1% ACE floodplain extents for both existing conditions and proposed conditions. The yellow floodplain represents existing conditions (no channel modifications) while the blue floodplain represents the proposed conditions with no channel or structure modifications. Differences in peak flow rates along Aurand Run are noted.

Figure 6 shows the 1% ACE floodplain extending to the east of Interstate 75, near the intersection of Lima Avenue and Township Road 67. This hydraulic connection was confirmed by the Aurand Run Single County Ditch improvements plans from 1971.

Stantec compared the total acreage of inundated area between the two floodplains and calculated the difference in the floodplain extents. The proposed Eagle Creek dry-storage basin discharging an additional 500 cfs down an unmodified Aurand Run during the 1% ACE event adds approximately 220 acres to the floodplain. Figure 9 provides a full-scale comparison of the Aurand Run existing and proposed conditions 1% ACE floodplains.

Reference: **Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement**

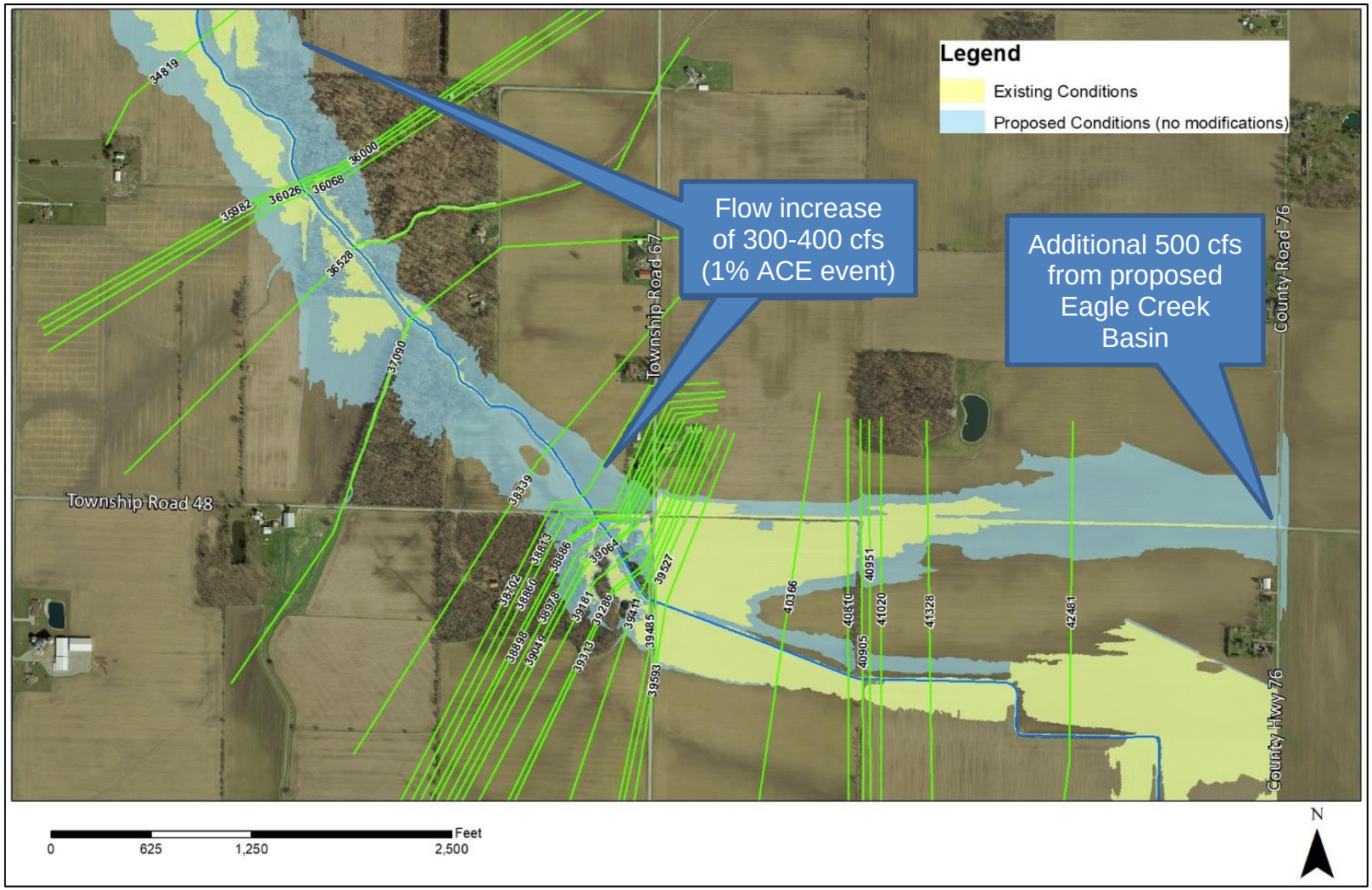

Figure 4 – Floodplain extents near the location of the proposed basin discharge to Aurand Run

Reference: **Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement**

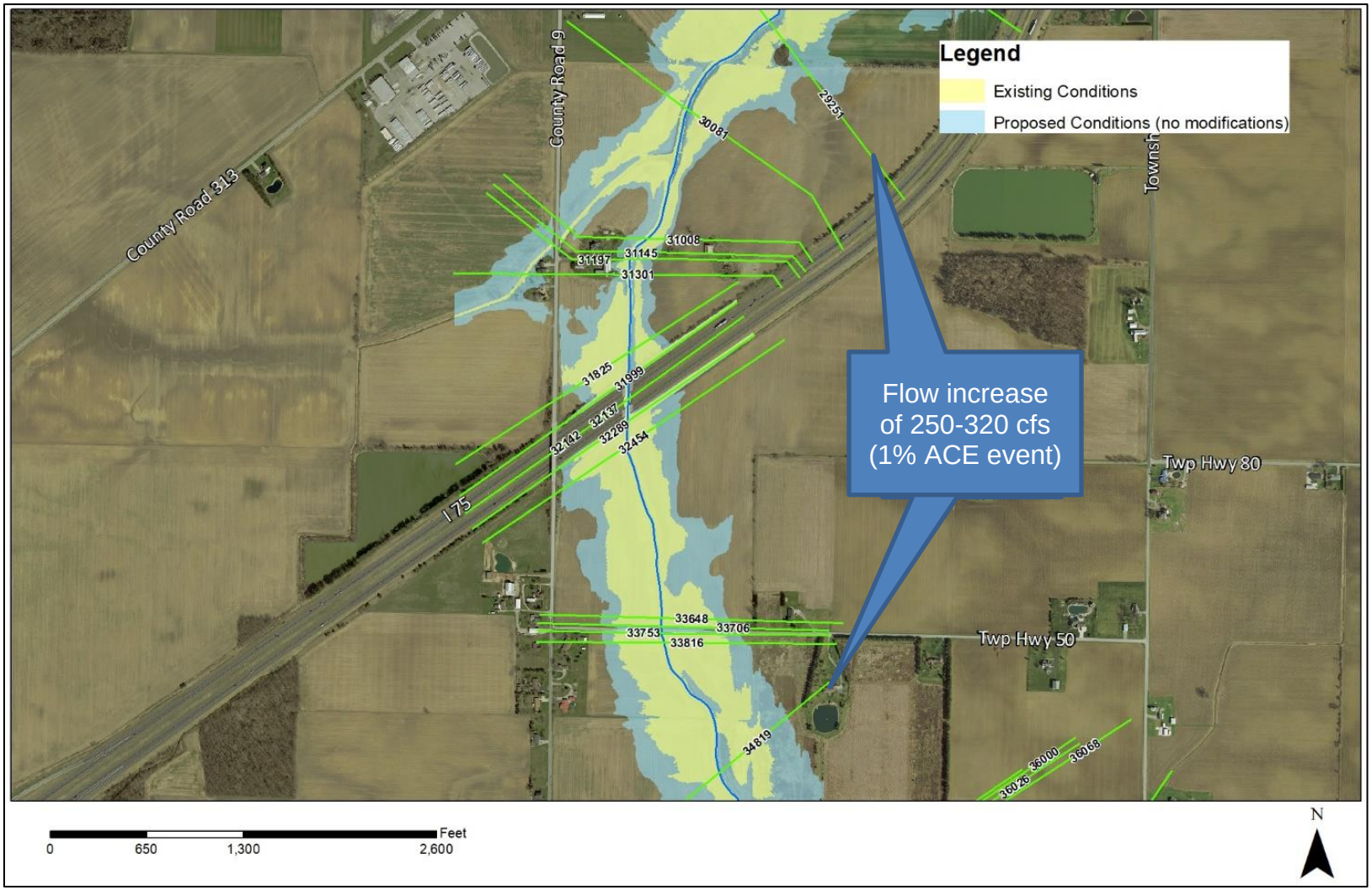

Figure 5 – Floodplain extents between Cross Sections 34819 and 29251

Reference: **Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement**

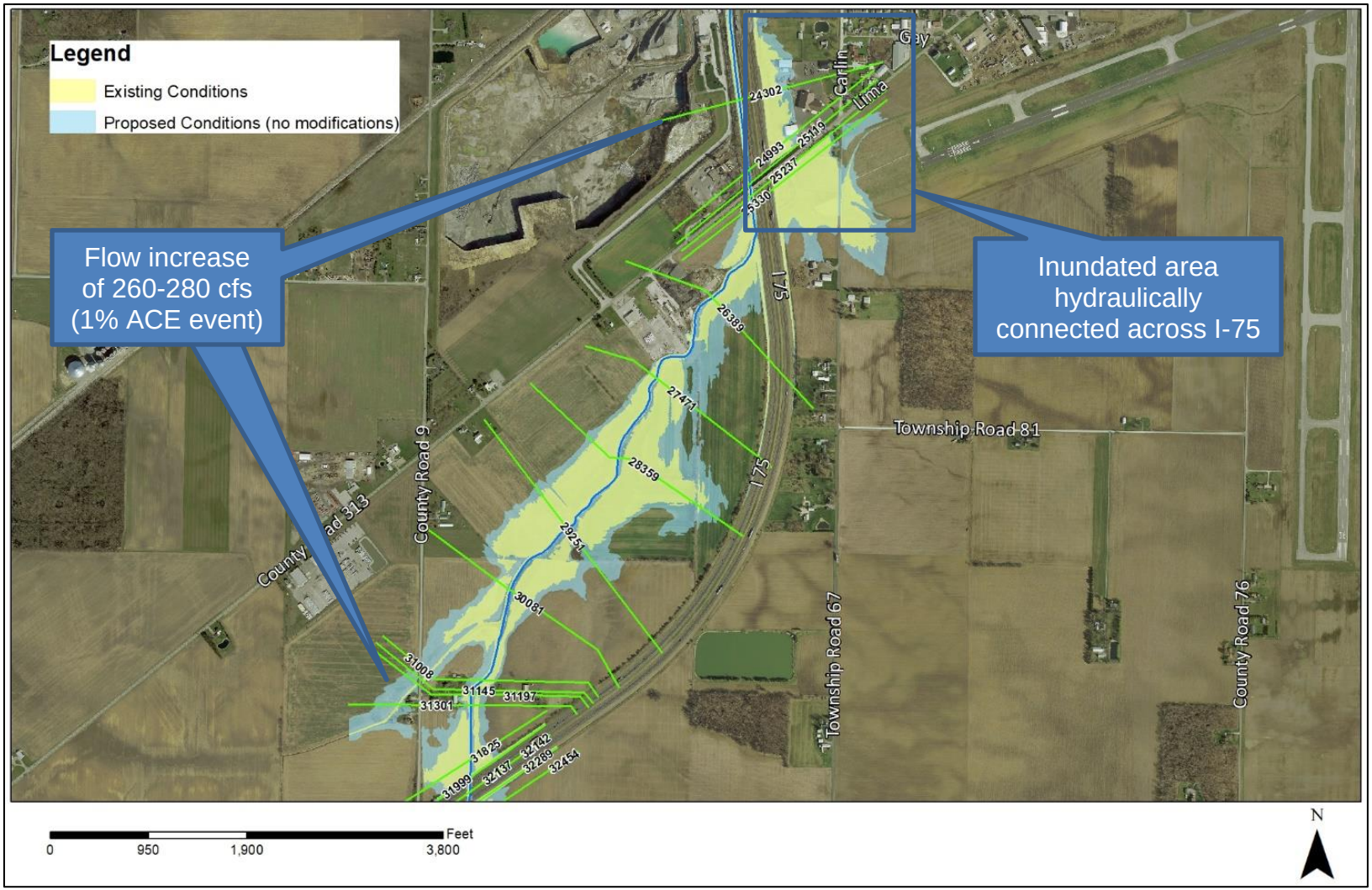

Figure 6 – Floodplain extents between Cross Sections 31825 and 24302

Reference: **Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement**

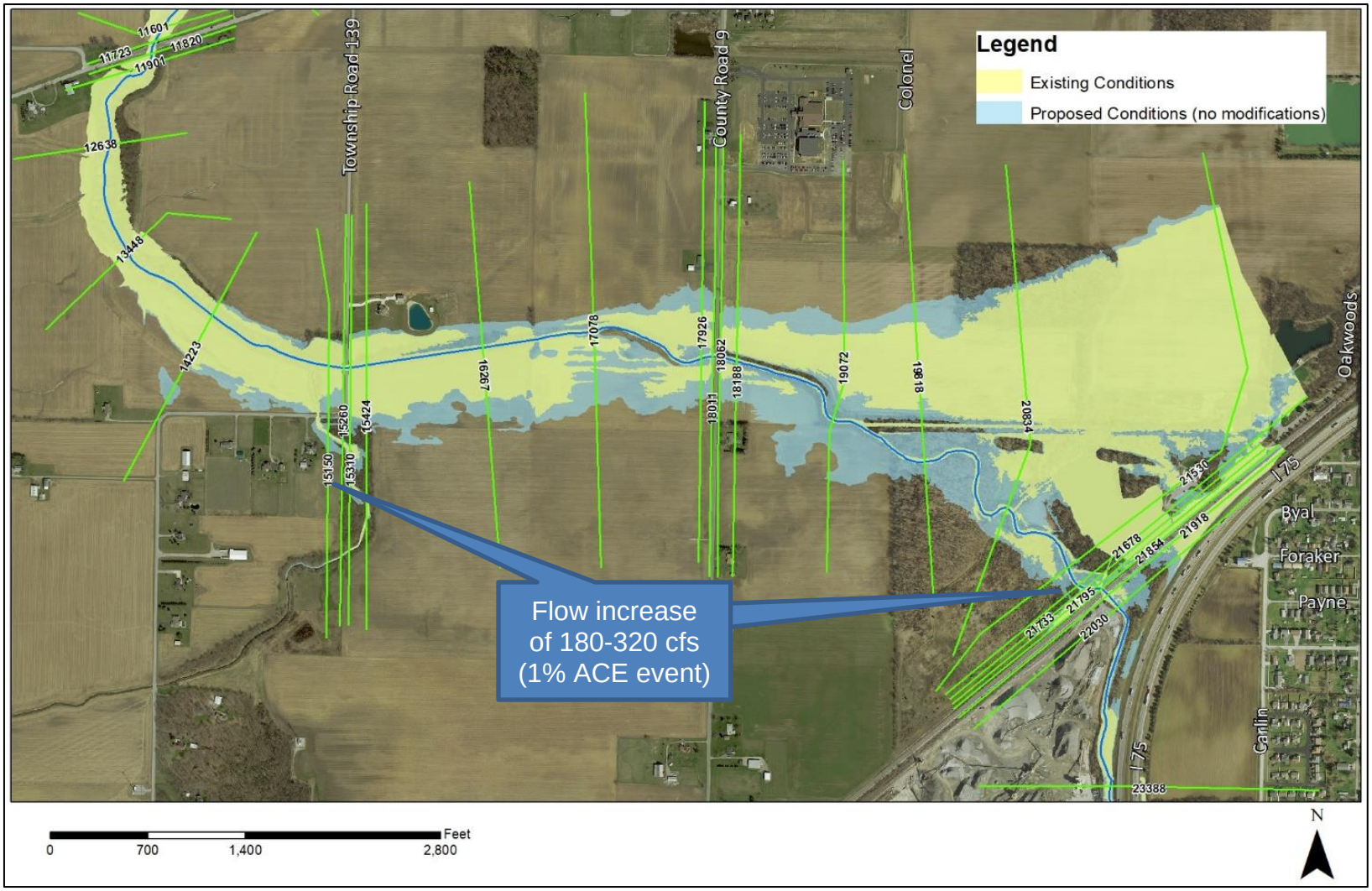

Figure 7 – Floodplain extents between Cross Sections 23388 and 11601

Reference: **Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement**

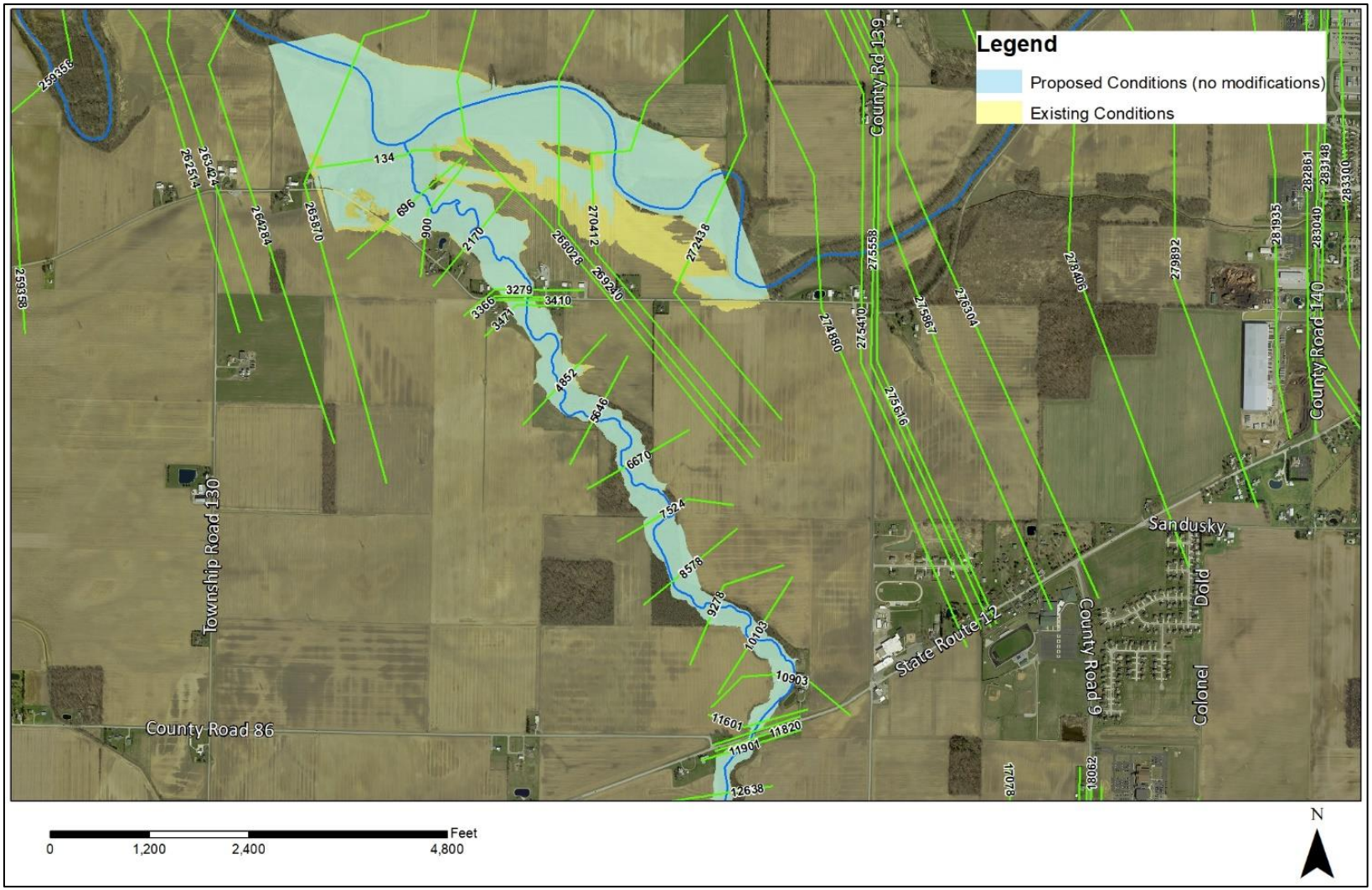

Figure 8 – Floodplain extents from Cross Section 10903 to Aurand Run confluence with the Blanchard River

Reference: **Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement**

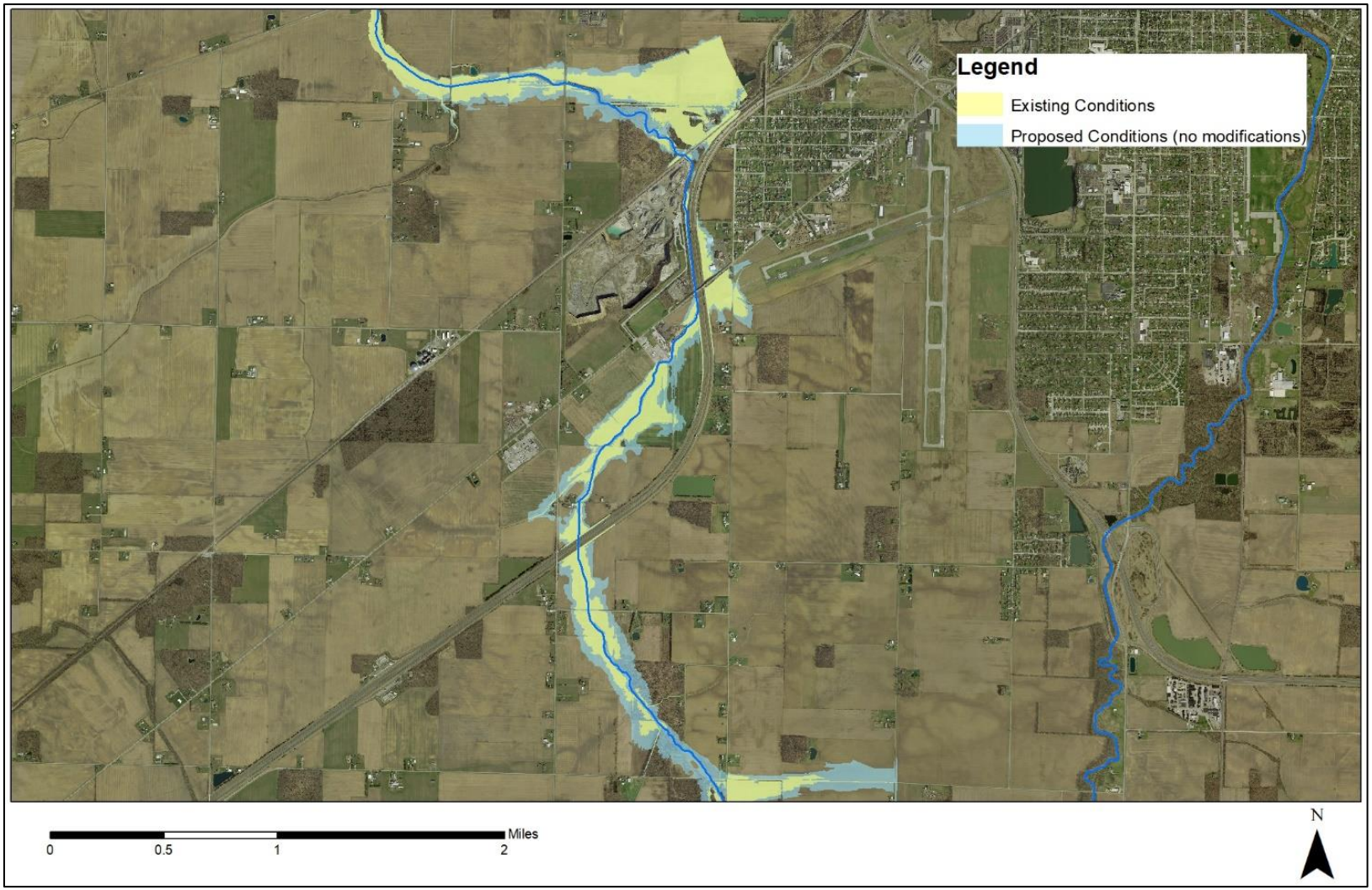

Figure 9 – Comparison of the 1% ACE floodplain extents for Existing and Proposed Conditions (no modifications) along Aurand Run

Reference: Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement

Stantec also reviewed the water surface elevations (WSEs) and floodplain extents for potential ancillary impacts to roadway crossings, structures, or agricultural areas based on results from the HEC-RAS model and Light Detection and Ranging (LiDAR). Figure 10 to Figure 13**Error! Reference source not found.** compare the existing conditions and proposed conditions (no channel modifications) 1% ACE floodplain extents along Aurand Run, showing potential roadways and structures impacted.

- Figure 10 shows that the proposed floodplain (with no channel modifications) results in flooding of the roads and two structures at the intersection of Township Road 48 and Township Road 67.
- Figure 11 shows that the proposed floodplain results in inundation of Twp Hwy 50 for the 1% ACE event.
- Figure 12 shows that additional flooding resulting from the proposed conditions may impact two properties and a driveway.
- Figure 13 shows the proposed conditions floodplain may inundate a portion of Township Road 67 and two outbuildings off of Carlin Street.

Reference: **Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement**

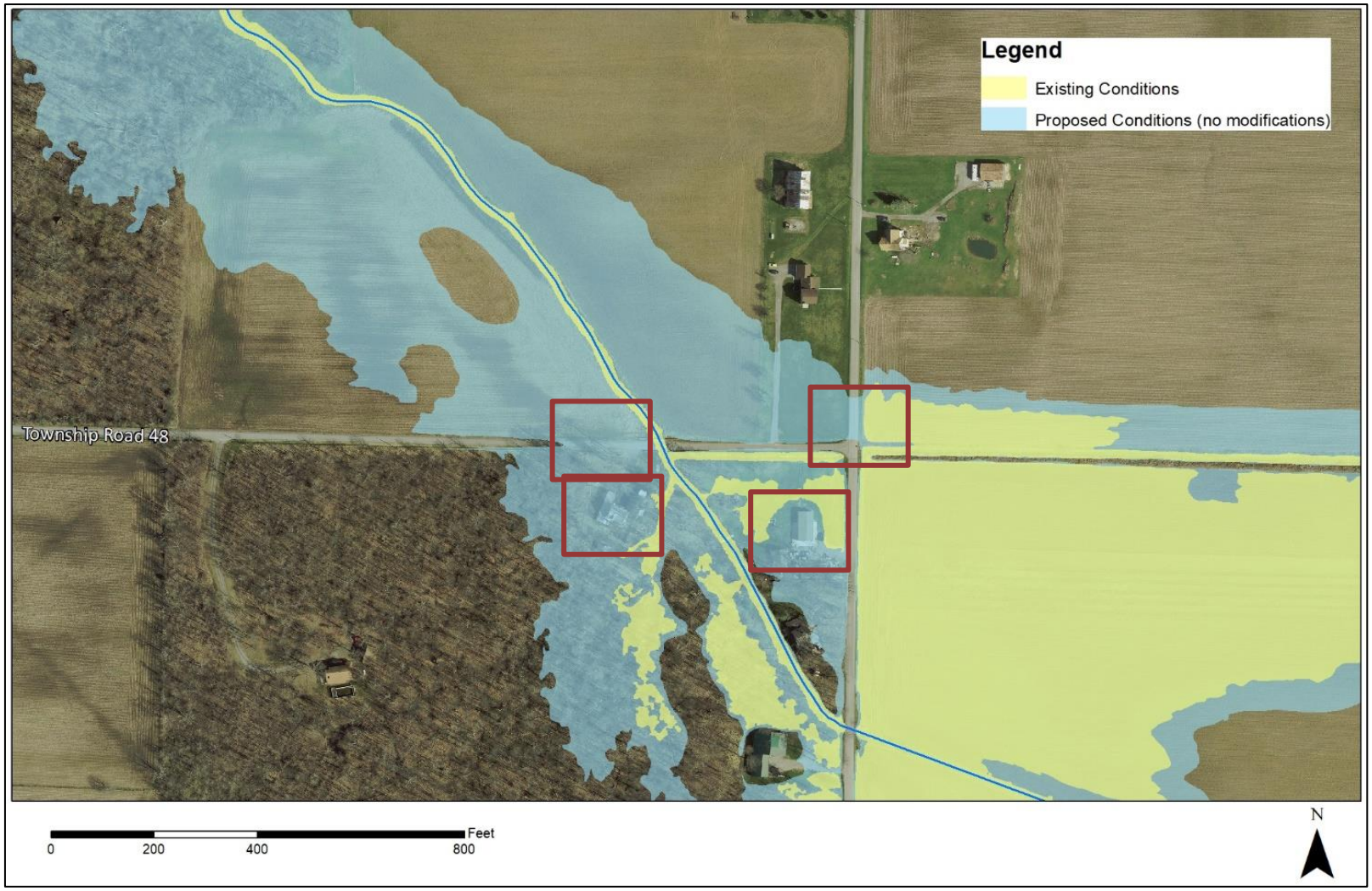

Figure 10 – Flooding observed along Township Road 48 and Township Road 67

Reference: **Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement**

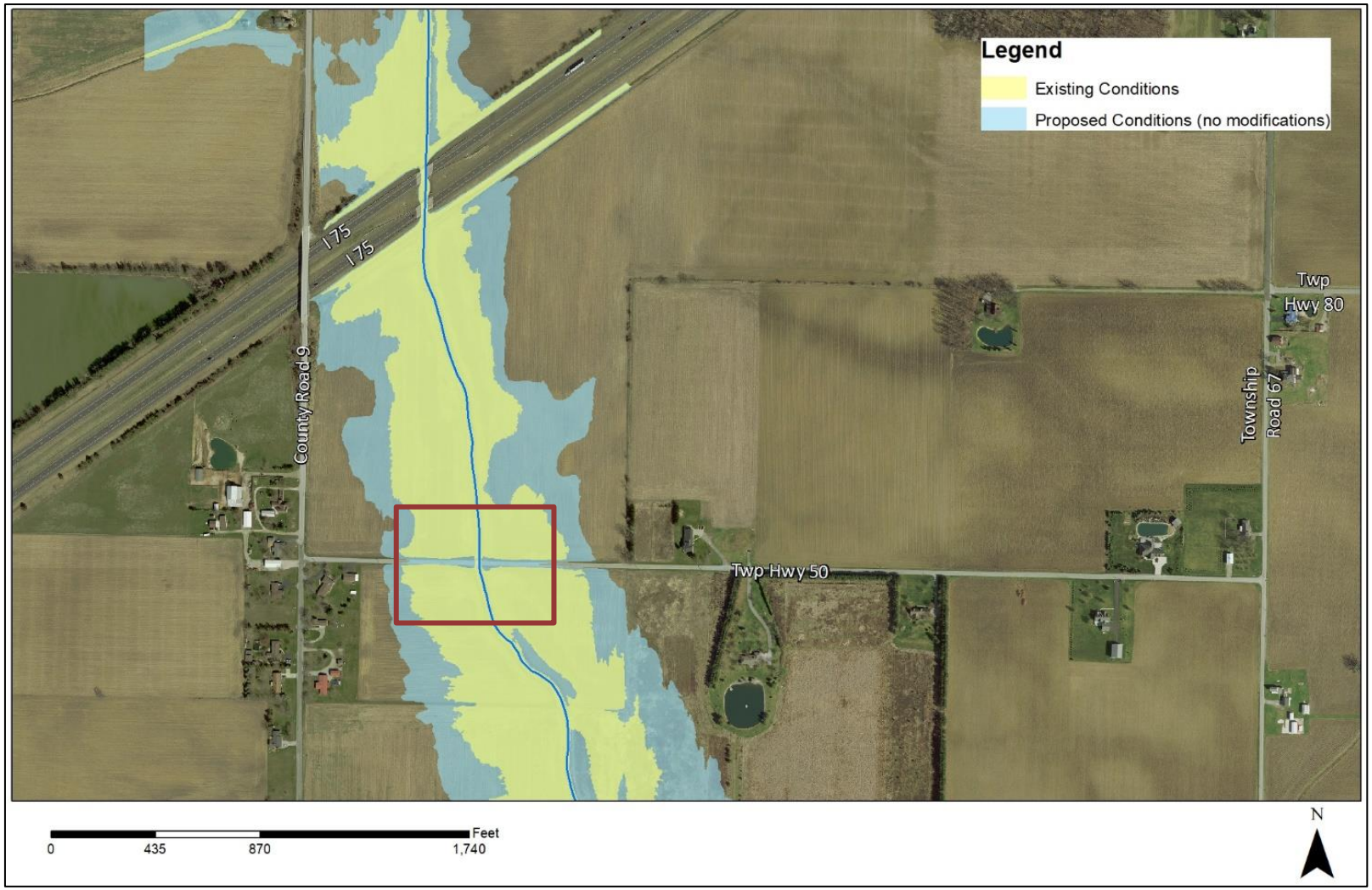

Figure 11 – Flooding observed along Twp Hwy 50

Reference: **Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement**

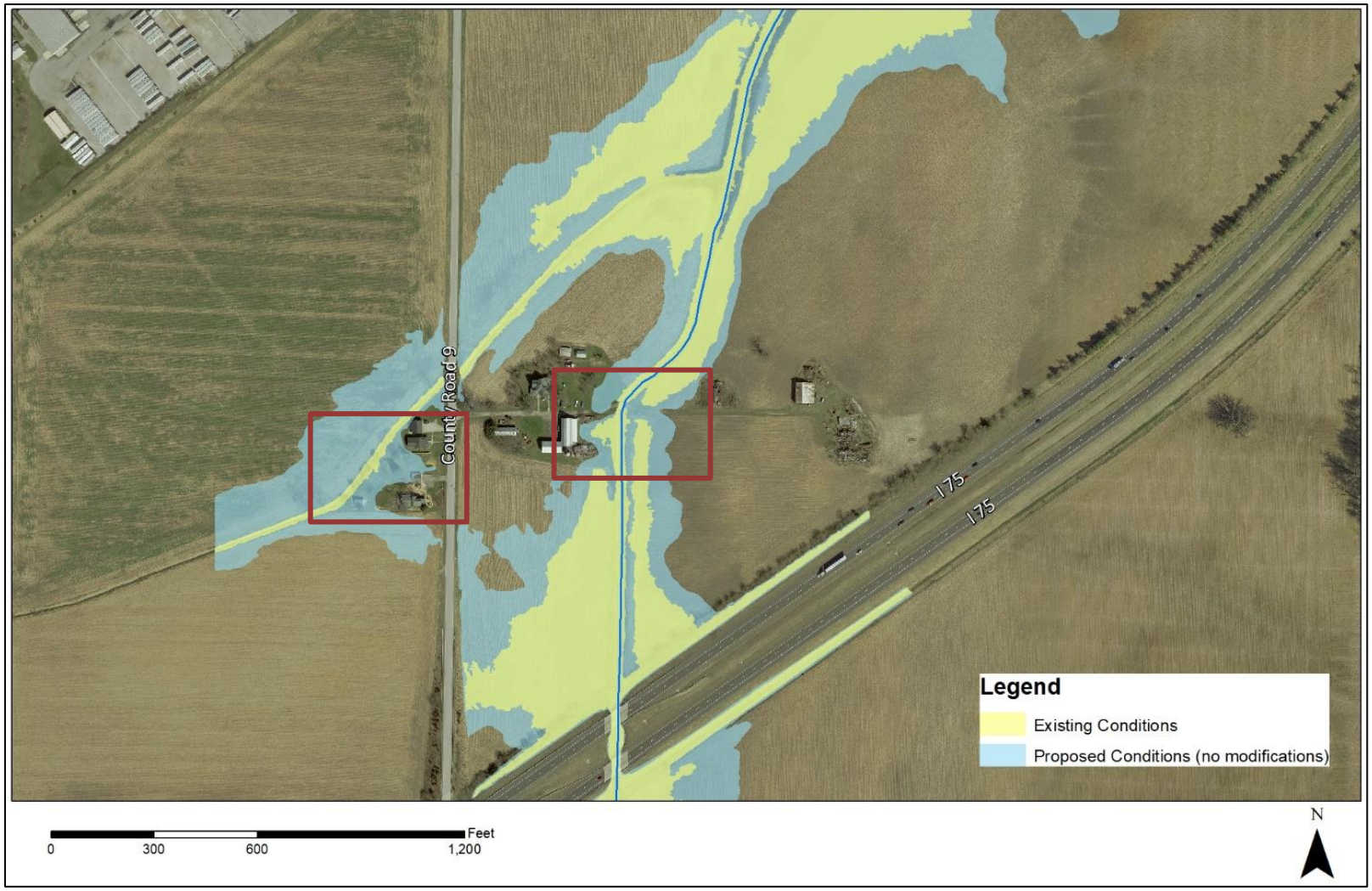

Figure 12 – Flooding observed at structures north of I-75, off of County Road 9

Reference: **Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement**

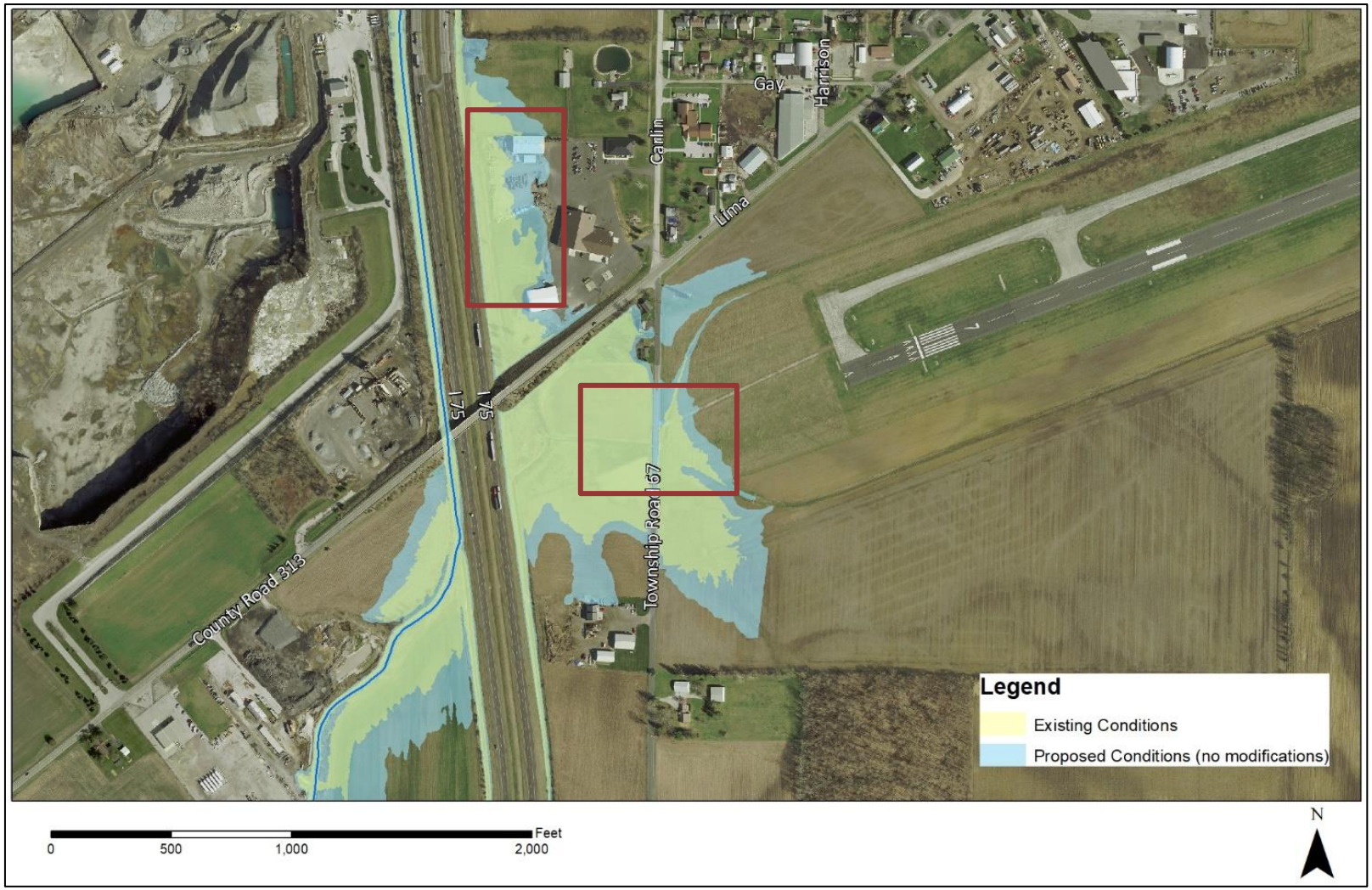

Figure 13 – Flooding observed next to I-75, along Township Road 67

Reference: **Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement**

AURAND RUN SCENARIO 2 – ADDITIONAL FLOW, TRAPEZOIDAL CHANNEL MODIFICATIONS

Aurand Run – Channel Modifications

Stantec determined the extents of possible Aurand Run modifications by analyzing increased floodplain extents from the additional flow scenario. To confirm the feasibility of accepting the additional flow and to estimate the potential impacts to land and structures, Stantec developed typical cross sections along Aurand Run that allowed the additional discharge of flow from the storage basin to be conveyed downstream while maintaining or reducing the existing conditions 1% ACE floodplain extents.

Two versions of a modified Aurand Run channel were considered in order to reduce the 1% ACE floodplain extents with additional flow to be equal to or less than the existing conditions floodplain extents. One modified scenario includes the implementation of a trapezoidal channel (expanding the current geometry), while the other scenario implements a benched channel, above the ordinary high-water mark (OHWM).

Modified Structures

Both the trapezoidal channel and benched channel scenarios require roadway and other in-line structures to be modified to allow for additional conveyance. The modified structures are the same for both scenarios. **Error! Reference source not found.** summarizes the structure modifications.

Table 1 – Modified Aurand Run Structures

Structure Cross Section	Structure Location	Structure Type	Existing Structure Dimensions (feet)		Proposed Structure Dimensions (feet)	
36015	Private Bridge	Culvert	3 Barrels	1.5 ft diameter	1 Arch	Span 20, Rise 5
33731	Township Road 50	Bridge	Height: 6.37	Width: 26	Height: 6.97	Width: 66
31166	Private Bridge	Bridge	Height: 6.23	Width: 27	Height: 7.18	Width: 72
21764	Upstream of County Road 9	Inline	Concrete Weir		Removed	
18037	County Road 9	Bridge	Height: 7.1	Width: 34	Height: 7.1	Width: 76
15281	Township Road 139	Bridge	Height: 6.44	Width: 35	Height: 7.1	Width: 75

Trapezoidal Channel

An expanded trapezoidal channel was implemented from cross section 38702 at the upstream end of Aurand Run where the discharge channel enters, to cross section 14223 at the downstream end near Township Road 139. Figure 14 provides a typical example of how the cross sections were modified. The existing channel cross section is shown in blue and the proposed cross section is red. The cross sections were modified for hydraulic efficiency based on the proposed flow rate and existing channel slope. The proposed, expanded bottom width typically varies between 30 and 50 feet with a typical side slope of 3 horizontal to 1 vertical.

Figure 15 through Figure 19 show the 1% ACE floodplain extents for both existing conditions and proposed conditions. The yellow floodplain represents existing conditions while the blue floodplain represents the

proposed conditions with trapezoidal channel and structure modifications. The goal of this exercise was to reduce the proposed conditions floodplain to equal to or less than the extents of the existing conditions floodplain. Locations where the proposed floodplain slightly exceeds the existing floodplain would be addressed in detailed design should this concept proceed.

The volume of excavation required to implement the trapezoidal modifications was calculated by comparing the existing conditions cross sections to the proposed cross sections. The trapezoidal channel modification scenario requires approximately 121,300 cubic yards of excavation. Since excavation would be required below the OHWM, additional mitigation measures are necessary for this option as compared to the benched channel option, with increased costs and permitting considerations.

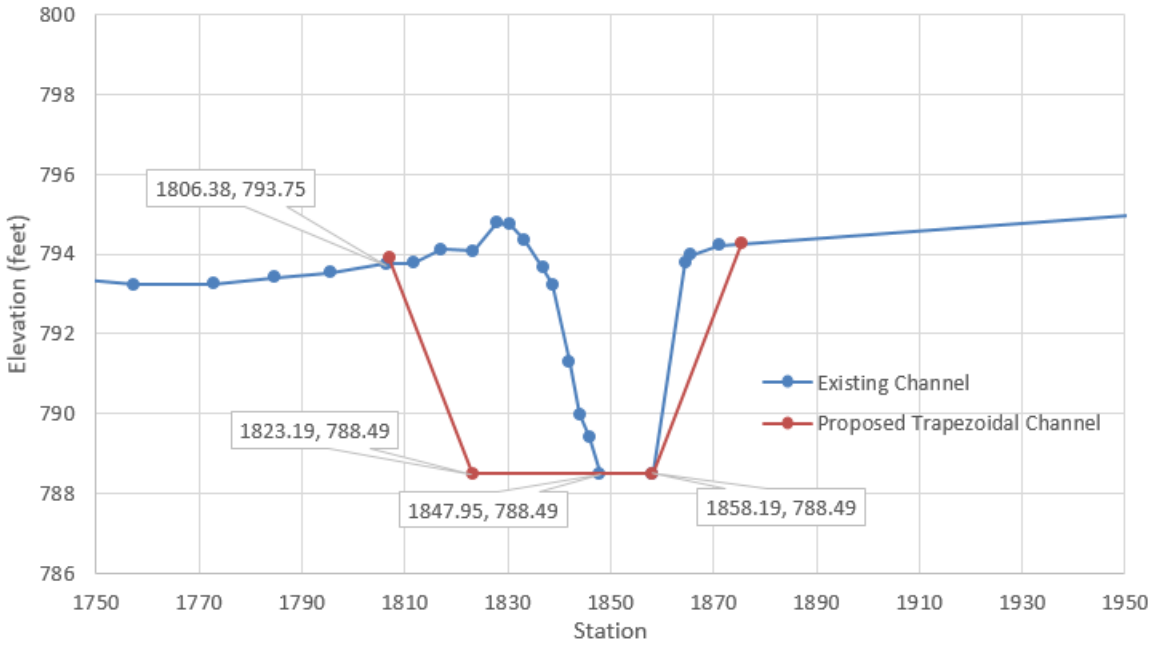

Figure 14 – Typical Section of a Trapezoidal Channel Modification

Reference: **Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement**

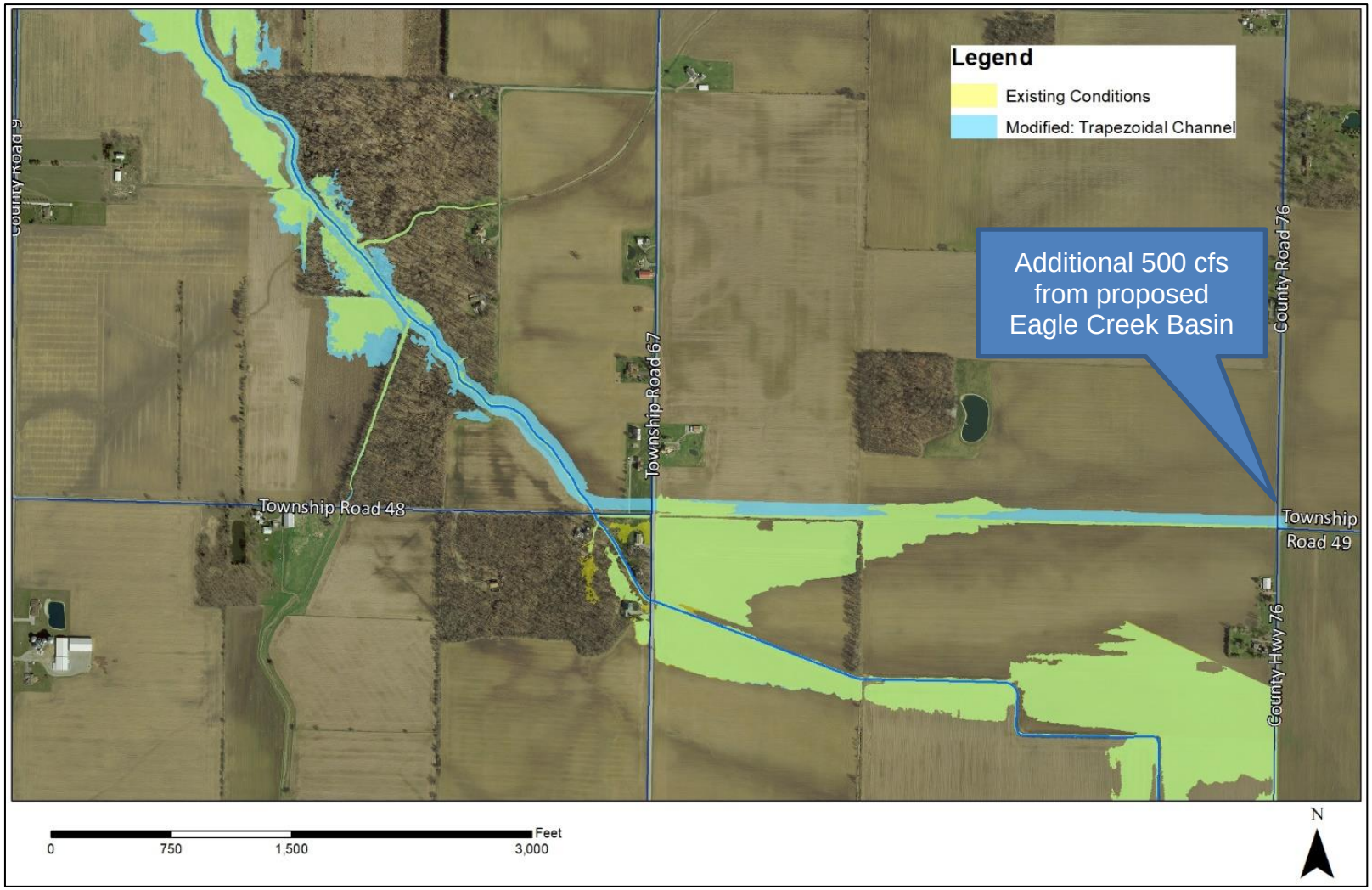

Figure 15 – Floodplain extents (existing vs trapezoidal channel) near the location of the proposed basin discharge to Aurand Run

Reference: **Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement**

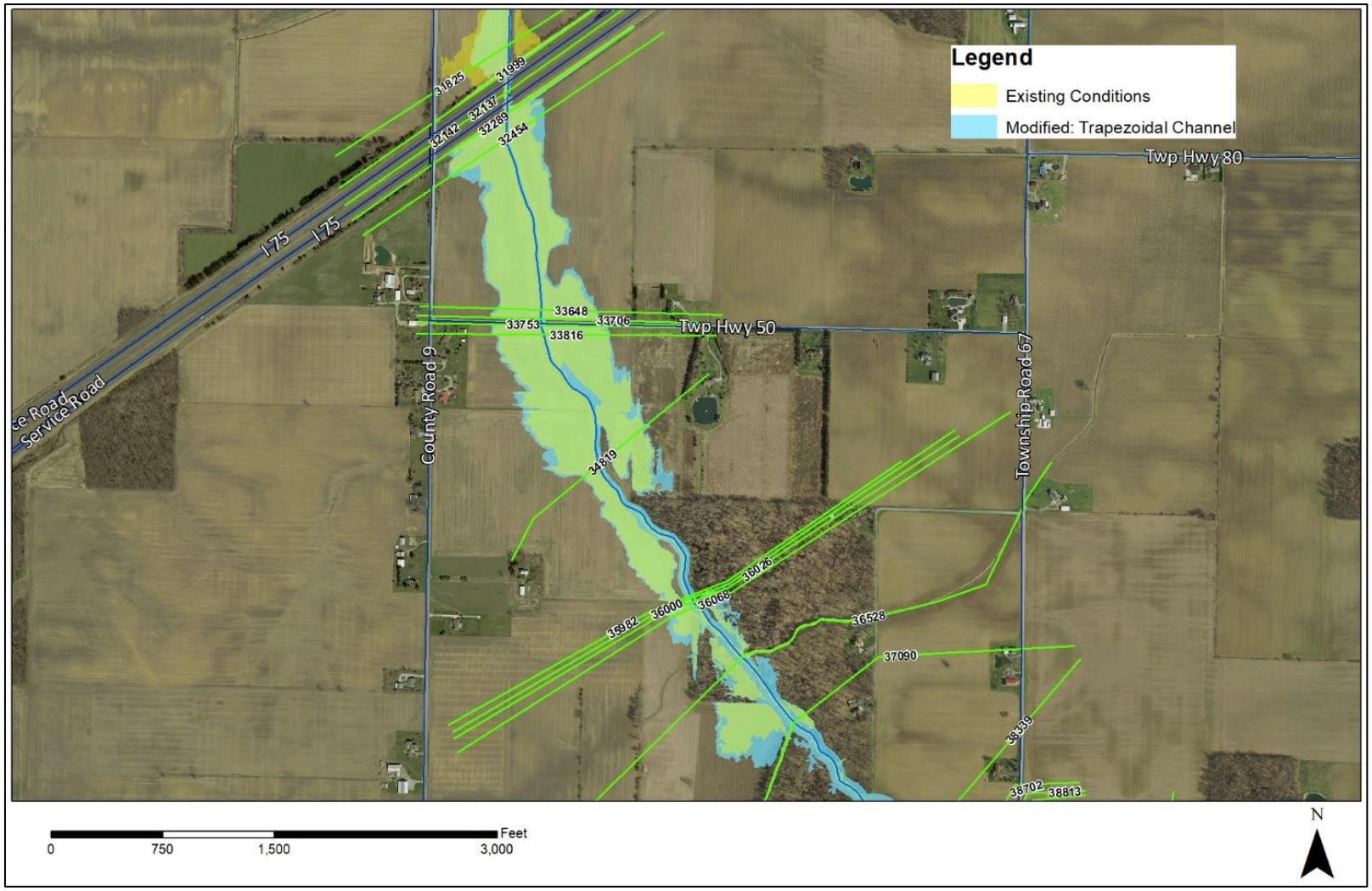

Figure 16 – Floodplain extents (existing vs trapezoidal channel) between Cross Section 37090 and Interstate-75

Reference: **Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement**

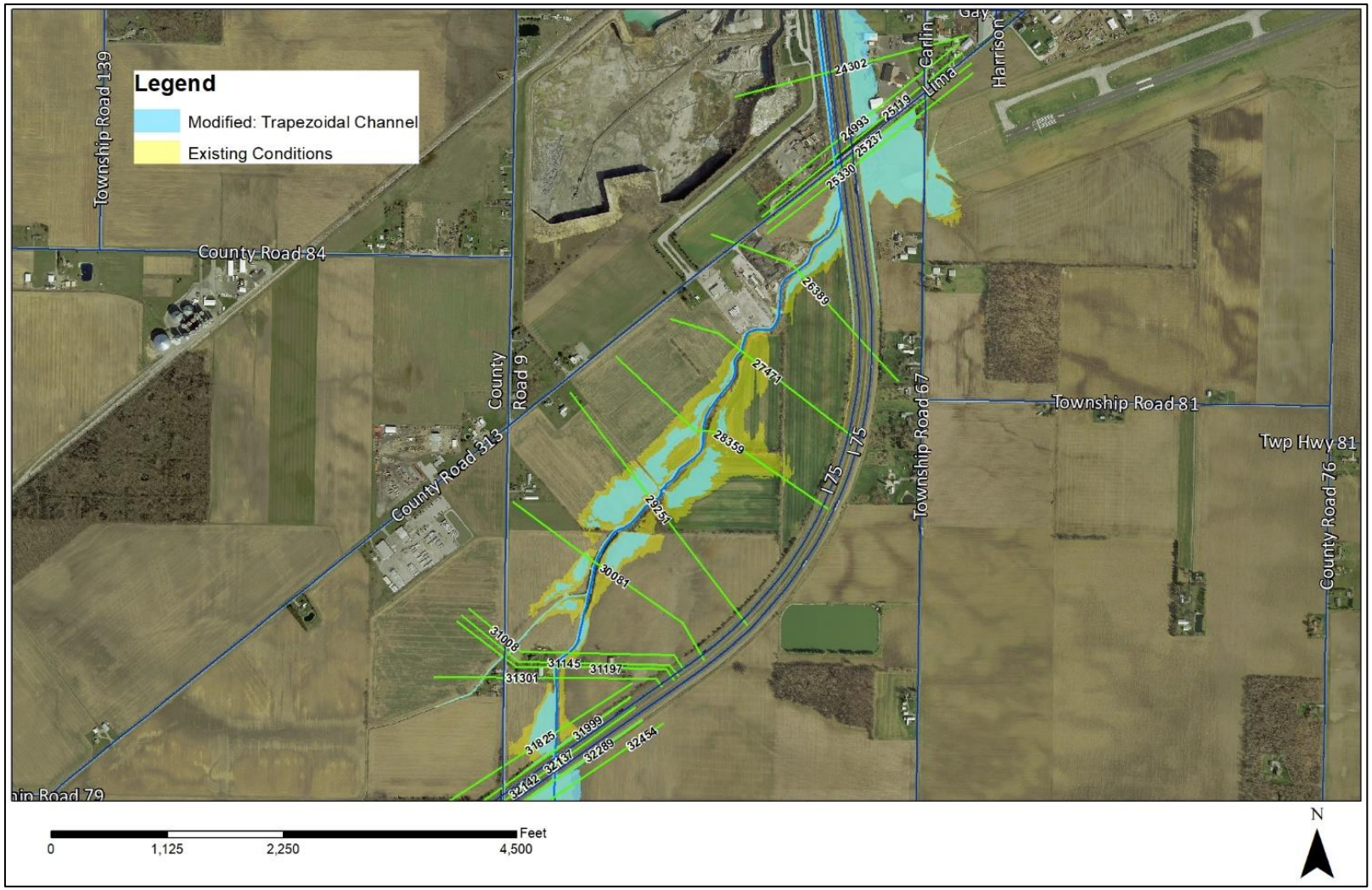

Figure 17 – Floodplain extents (existing vs trapezoidal channel) between Interstate-75 and Cross Section 24302

Reference: **Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement**

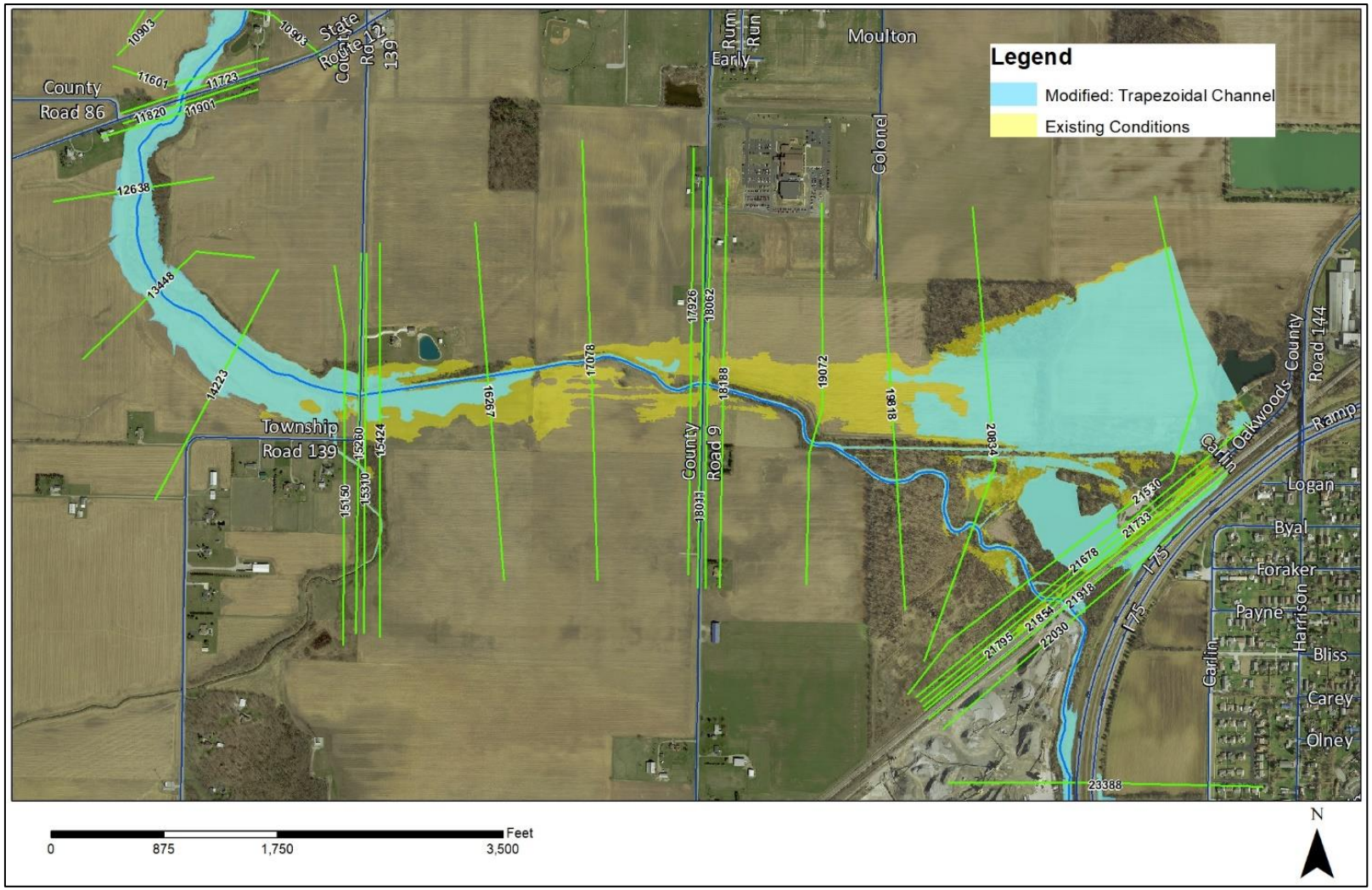

Figure 18 – Floodplain extents (existing vs trapezoidal channel) between Cross Sections 23388 and 11901

Reference: **Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement**

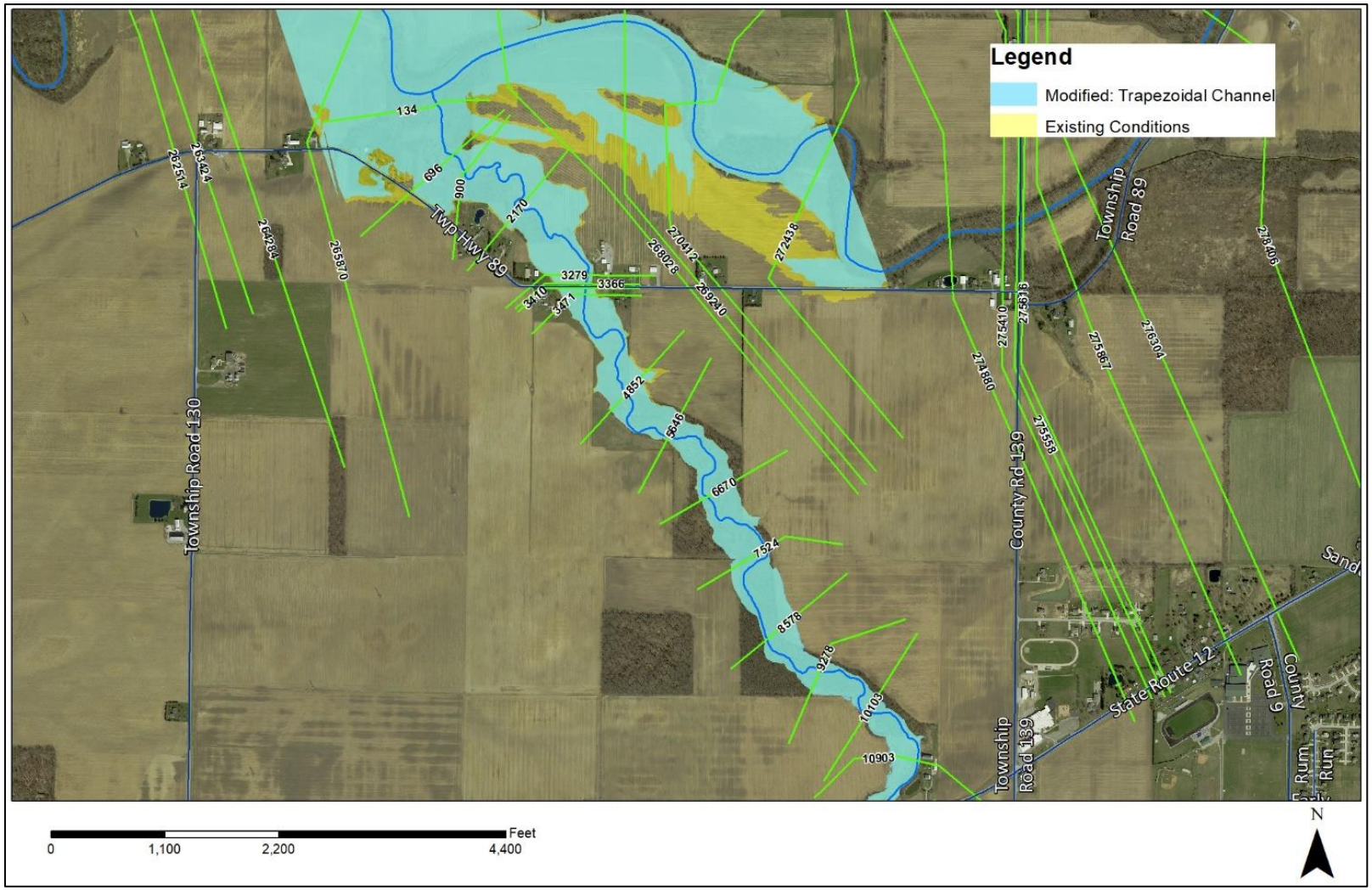

Figure 19 – Floodplain extents (existing vs trapezoidal channel) from Cross Section 10903 to Aurand Run confluence with the Blanchard River

Reference: **Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement**

AURAND RUN SCENARIO 3 – ADDITIONAL FLOW, BENCHED CHANNEL MODIFICATIONS

A benched channel was implemented from cross section 38702 at the upstream end of Aurand Run where the discharge channel enters, to cross section 14223 at the downstream end near Township Road 139. The cross sections were modified for hydraulic efficiency based on the proposed flow rate and existing channel slope. The proposed, expanded total bench width typically varies between 50 and 100 feet with a typical side slope of 3H:1V. The benching was assumed to begin above the OHWM based on field observations from the wetland and waterbody delineation survey (Attachment D), typically 18 to 24 inches from the existing channel invert. The same structure modifications listed in Table 1 were also implemented in the benched channel model.

Figure 20 through Figure 23 show the 1% ACE floodplain extents for both existing conditions and proposed conditions. The yellow floodplain represents existing conditions while the blue floodplain represents the proposed conditions with a benched channel and structure modifications. Note that the proposed floodplain is typically equal to or less than the extents of the existing conditions floodplain.

The volume of excavation required to implement the benched channel modifications was calculated by comparing the existing conditions cross sections to the proposed cross sections. The benched channel modification scenario requires approximately 198,000 cubic yards of excavation

Reference: **Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement**

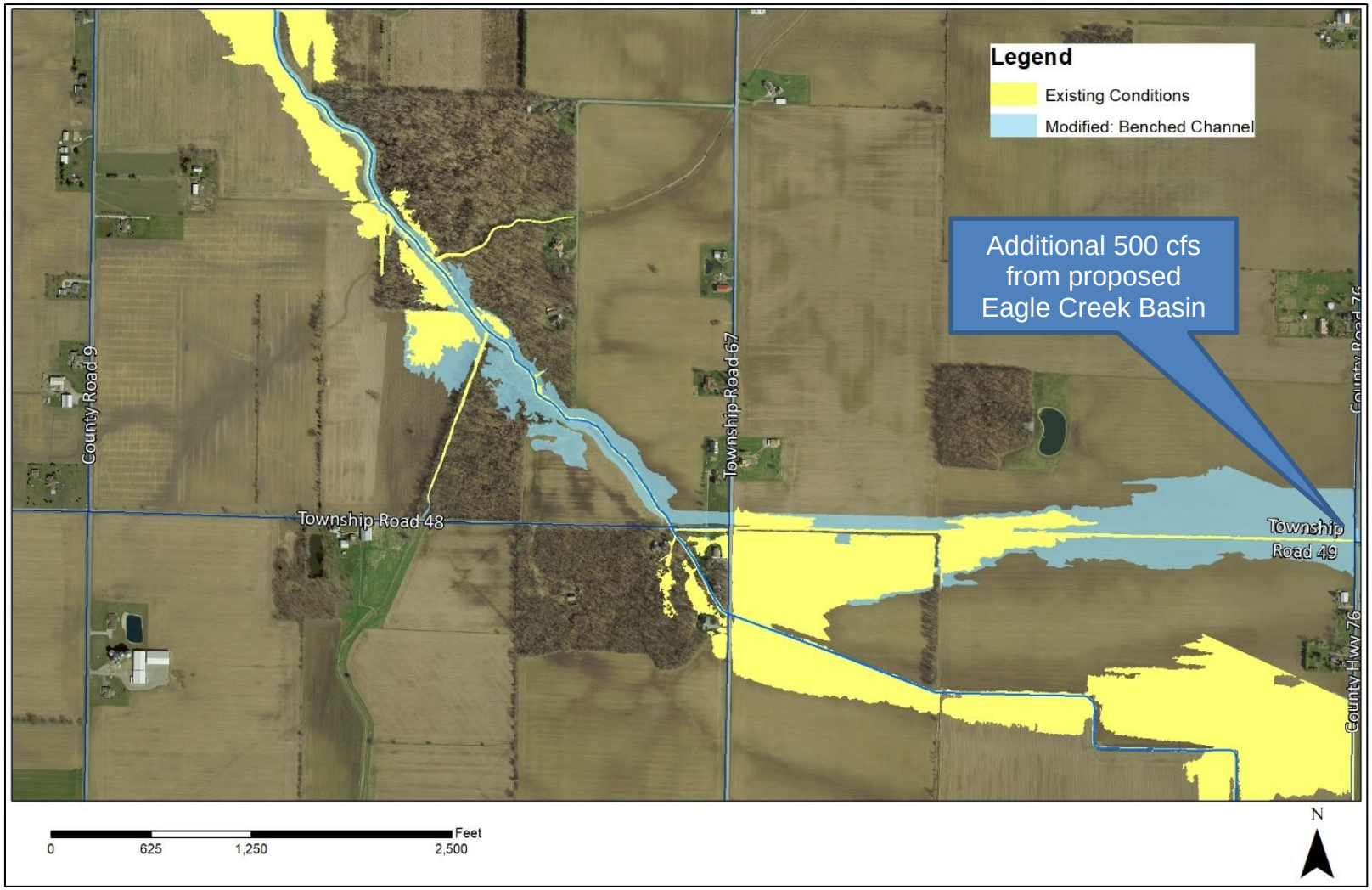

Figure 20 – Floodplain extents (existing vs benched channel) near the location of the proposed basin discharge to Aurand Run

Reference: **Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement**

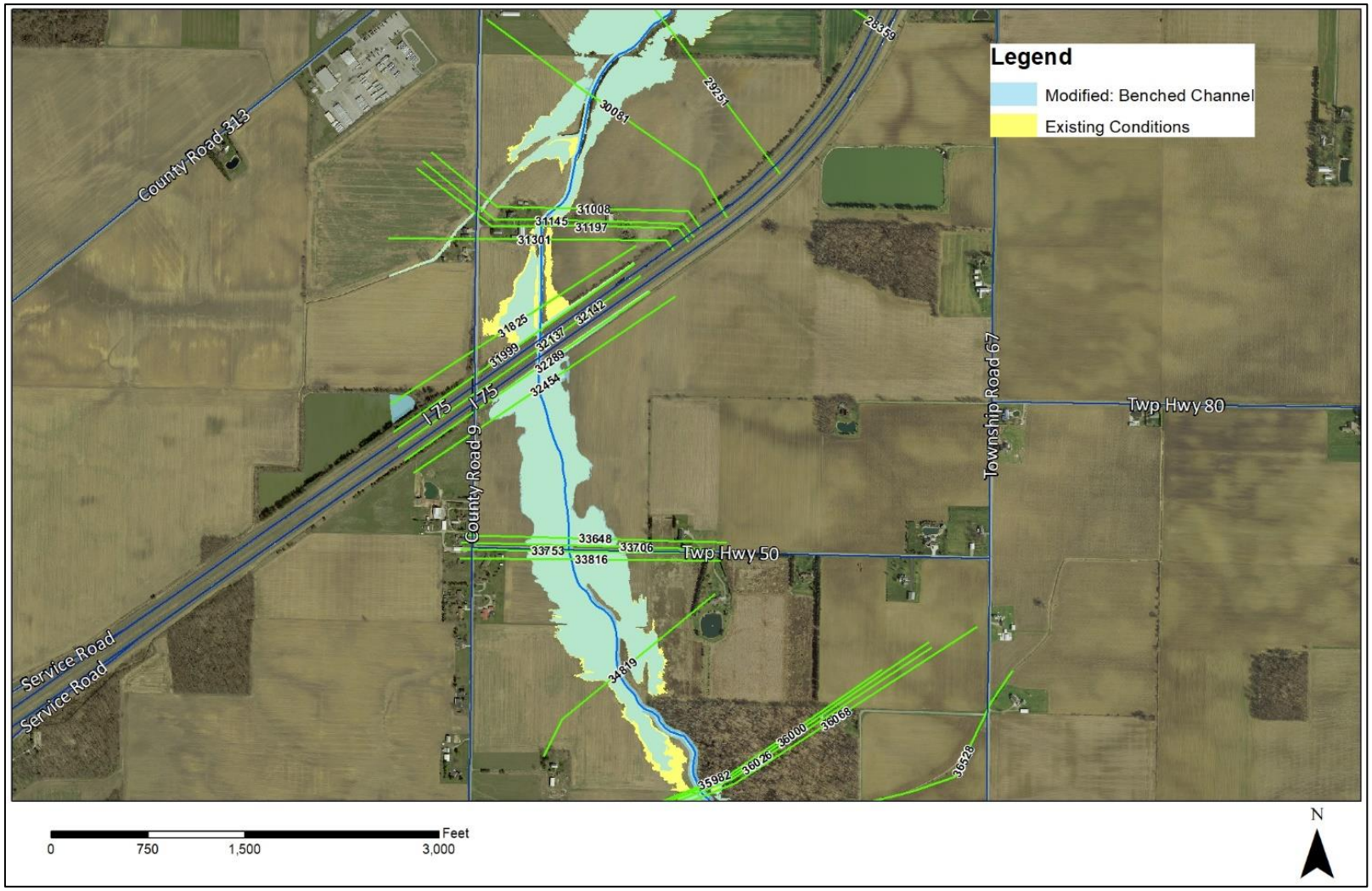

Figure 21 – Floodplain extents (existing vs benched channel) between Cross Sections 34819 and 29251

Reference: **Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement**

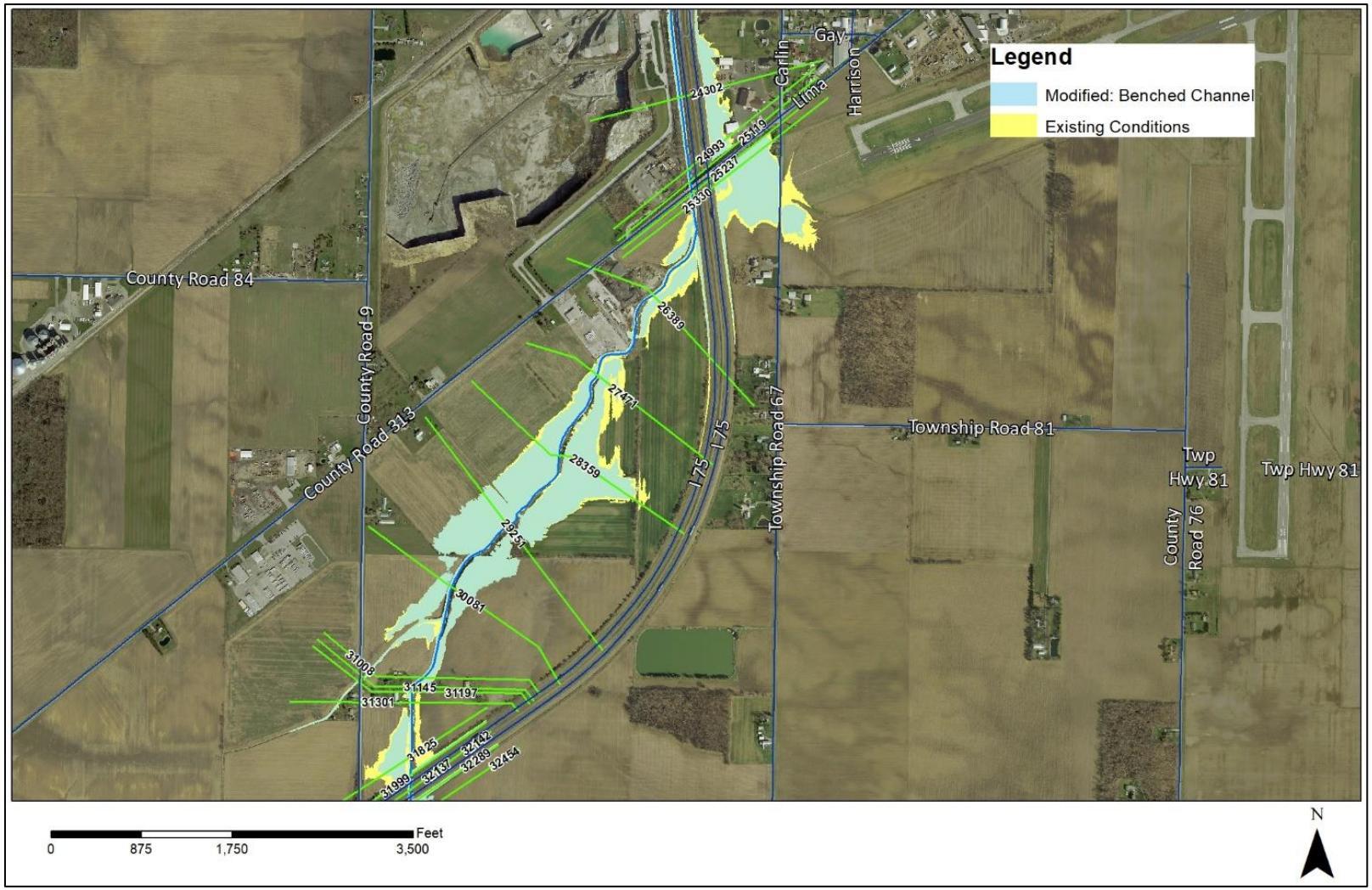

Figure 22 – Floodplain extents (existing vs benched channel) between Interstate-75 and Cross Section 24302

Reference: **Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement**

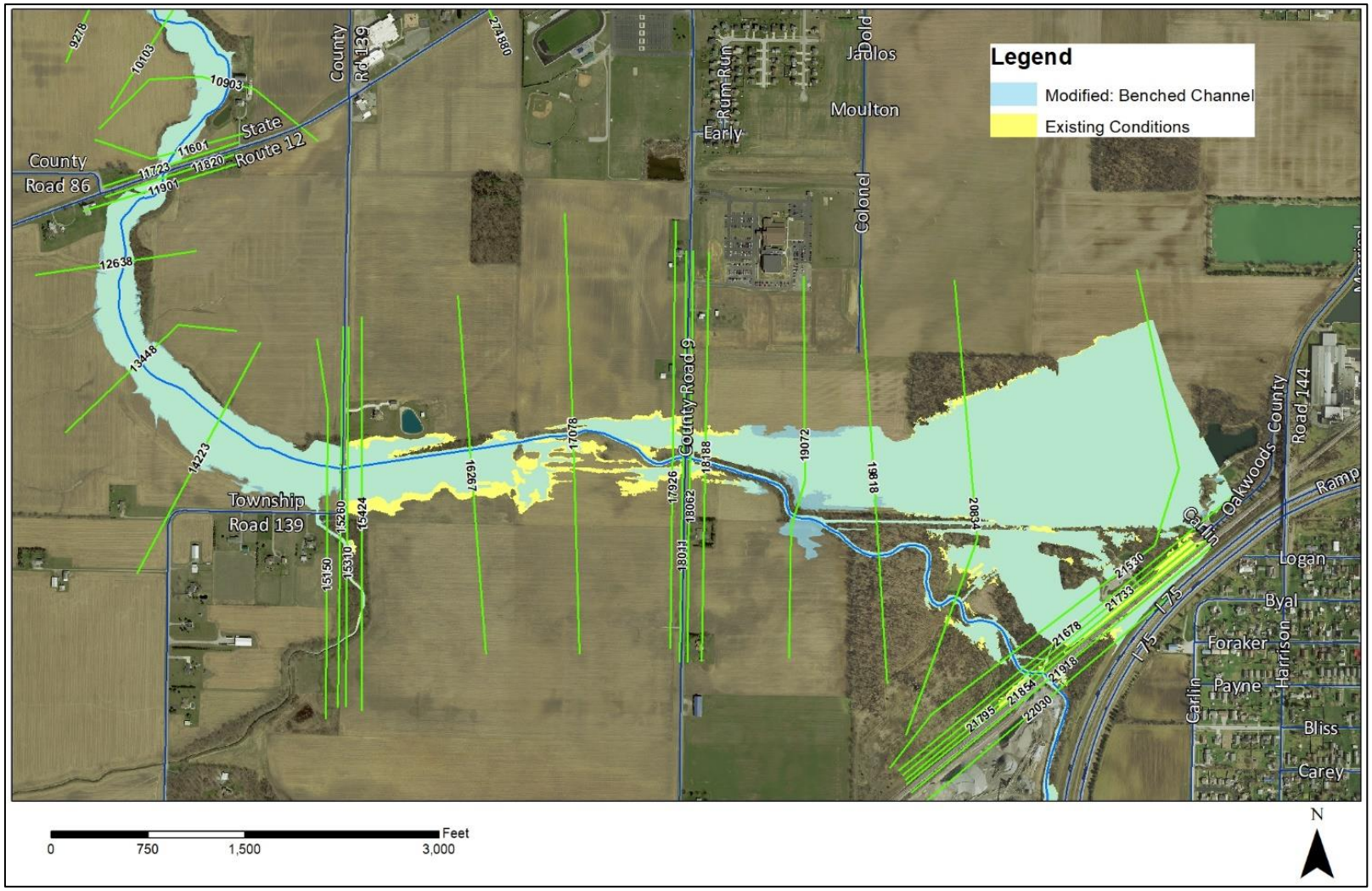

Figure 23 – Floodplain extents (existing vs benched channel) between Cross Sections 22030 and 10903

Reference: **Hancock County Flood Risk Reduction Program – Aurand Run Concept Refinement**

AURAND RUN CONCEPT REFINEMENT SUMMARY

All three scenarios presented above are likely feasible options for handling additional flow in Aurand Run from the secondary spillway of the Eagle Creek dry-storage basin; however, the options have varied costs and impacts to consider. The Aurand Run concept could likely be implemented with a combination of modified and unmodified channel sections. The modified sections would likely use the benched channel to reduce impacts to the existing stream habitat. Unmodified channel sections may require flowage easements where the 1% ACE floodplain extents increase compared to existing conditions. The lowest cost option, Scenario 3, Benched Channel, was incorporated into the Preliminary Opinion of Probable Construction Cost. Cost considerations for the three scenarios are described below, and a cost comparison chart is included as Figure 24. The costs presented do not include mobilization, demobilization, contingency, engineering, and administration.

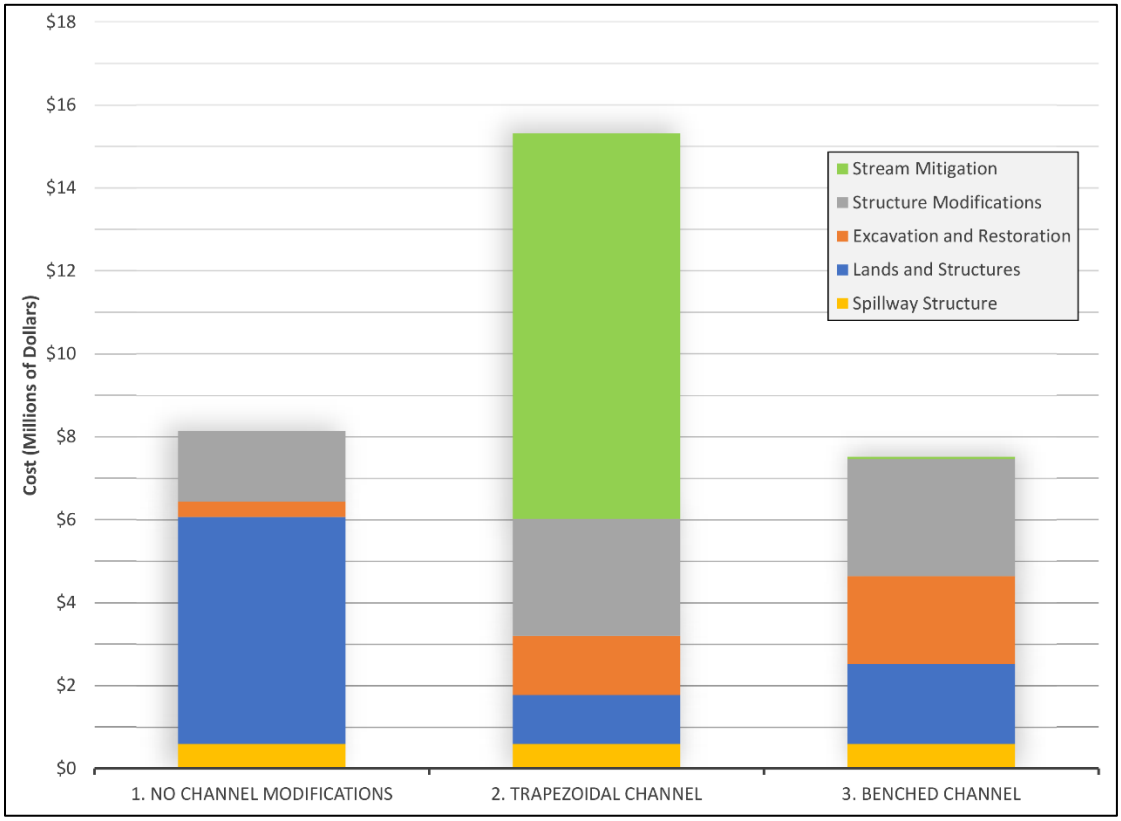

Figure 24 - Aurand Run Scenarios Cost Comparison

Scenario 1 Costs – No Channel Modifications

Without modifications to the receiving channel, the additional flow to Aurand Run causes impacts to two dwellings where the storage basin discharge channel meets Aurand Run, and the cost of these purchases were included in the estimate. Two outbuildings off of Carlin Street are also impacted by increased floodplain extents. Because properties along Aurand Run would experience greater extents of flooding due to the

additional flow, costs were included to purchase flowage easements over the full width of the floodplain. In addition to property costs, two bridges which currently do not flood would need to be raised or replaced to allow vehicle passage during a flood.

Scenario 2 Costs – Trapezoidal Channel

The bridge and other structure modifications and earthwork discussed in the above sections is included in the cost estimate for this scenario. Because the trapezoidal channel option requires excavation below the ordinary high-water mark, stream mitigation would likely be required. Costs for stream mitigation were estimated based on the anticipated in-lieu fee cost per linear feet of stream disturbed. Property costs for this scenario include the purchase of land where the stream would be modified.

Scenario 3 Costs – Benched Channel

This option includes excavation above the ordinary high water mark. Costs for this benching work include earthwork and property purchase, but the work would be designed to avoid the need for stream mitigation. The same structure modifications assumed for the trapezoidal channel were added to Scenario 3 as well. To reduce required bridge lengths, a trapezoidal channel section was assumed through these structures, which would impact the stream and may require stream mitigation.

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