PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM (PRRIP -or- Program)

TO: PRRIP Technical Advisory Committee (TAC)
FROM: Quinn Lewis, PhD, River Scientist - Executive Director's Office (EDO)
SUBJECT: No Sediment Augmentation Annual Report, 2025
DATE: June 30 2025

PURPOSE

The purpose of this document is to report on the status of the "No Sediment Augmentation" (NSA) experiment within and downstream of the J2 return channel (J2) on the upstream portion of the Platte River Recovery Implementation Program's Associated Habitat Reach (AHR). The content of this report is based on the No Sediment Augmentation Monitoring Plan, and the goal is to provide quantitative and spatial information on geomorphic changes that allows the Technical Advisory Committee (TAC) to evaluate channel condition and make recommendations to the GC about whether or not the current experiment should be allowed to continue.

This document provides maps and quantitative results to summarize the magnitude, rates, patterns, and locations of channel change in and just downstream of J2 as specified in Section 5.3 of the Monitoring Plan. These analyses are based most critically on the assessment of digital elevation models (DEM) and relative elevation models (REM) produced from November 2024 lidar data. In this year's report, we include details on new data collection, highlighting results from supplementary field work designed to provide higher spatial and temporal resolution monitoring. We finish with a brief qualitative assessment of the past year's monitoring efforts, highlighting lessons learned and discussing any potential future changes or additions to the Monitoring Plan.

Table of Contents

List of Abbreviations

70K – Station 70,000
AHR – Associated Habitat Reach
AOI – Area of Interest
AP – Anchor Point
CFS – Cubic Feet per Second
CY – Cubic Yard
D_{50} – Median Sediment Grain Size
DEM – Digital Elevation Model
DSM - Digital Surface Model
EDO – Executive Director's Office
GC – Governance Committee
GGL – geomorphic Grade Line
J2 – J2 Reservoir Return/Outflow Channel
KCD – Kearney Canal Diversion
NSA – No Sediment Augmentation
REM – Relative Elevation Model
TAC – Technical Advisory Committee
USGS – United States Geological Survey

1. Background and Methods

The NSA Monitoring Plan approved by the Governance Committee (GC) in winter 2024 explains that the yearly topo-bathymetric lidar data acquired by the Program should be the main source of information provided in the yearly report to the TAC because of its high accuracy and detailed spatial coverage. Additional field data are acquired three times over the course of each year to provide sub-annual measurement of J2 changes and improve understanding of mechanisms and timing of changes in channel morphology. Table 2.1of the NSA Monitoring Plan summarizes the long-term timeline of data collection and deliverables and Table 2.2 details the annual task breakdown that provides information for this annual report.

Changes to the channel form are determined from a comparison of DEMs of the current and previous year (Figure 1). The current DEM is also compared to an established geomorphic grade line (GGL) to produce a REM capable of quantifying incision below or aggradation above a standard datum representative of the overall river valley slope (Figure 2). DEM and REM analysis are focused on two areas of interest (AOI) – from River Station 70,000 (70K) to Overton Bridge (AOI1) and from Overton Bridge three miles downstream to Cottonwood Ranch (AOI2) (Figure 1). AOI1 is the location of substantial channel incision downstream of the J2 spillway, is directly downstream of the region mechanically augmented with sediment, is the reach where meandering transitions to braiding, and has not traditionally been considered critical habitat. AOI2 is the first reach downstream of the J2 channel. It includes the Cottonwood Ranch habitat complex where management actions have improved channel conditions to increase suitability for whooping crane roosting, and as such represents a critical location to look for channel changes that could degrade habitat within the AHR.

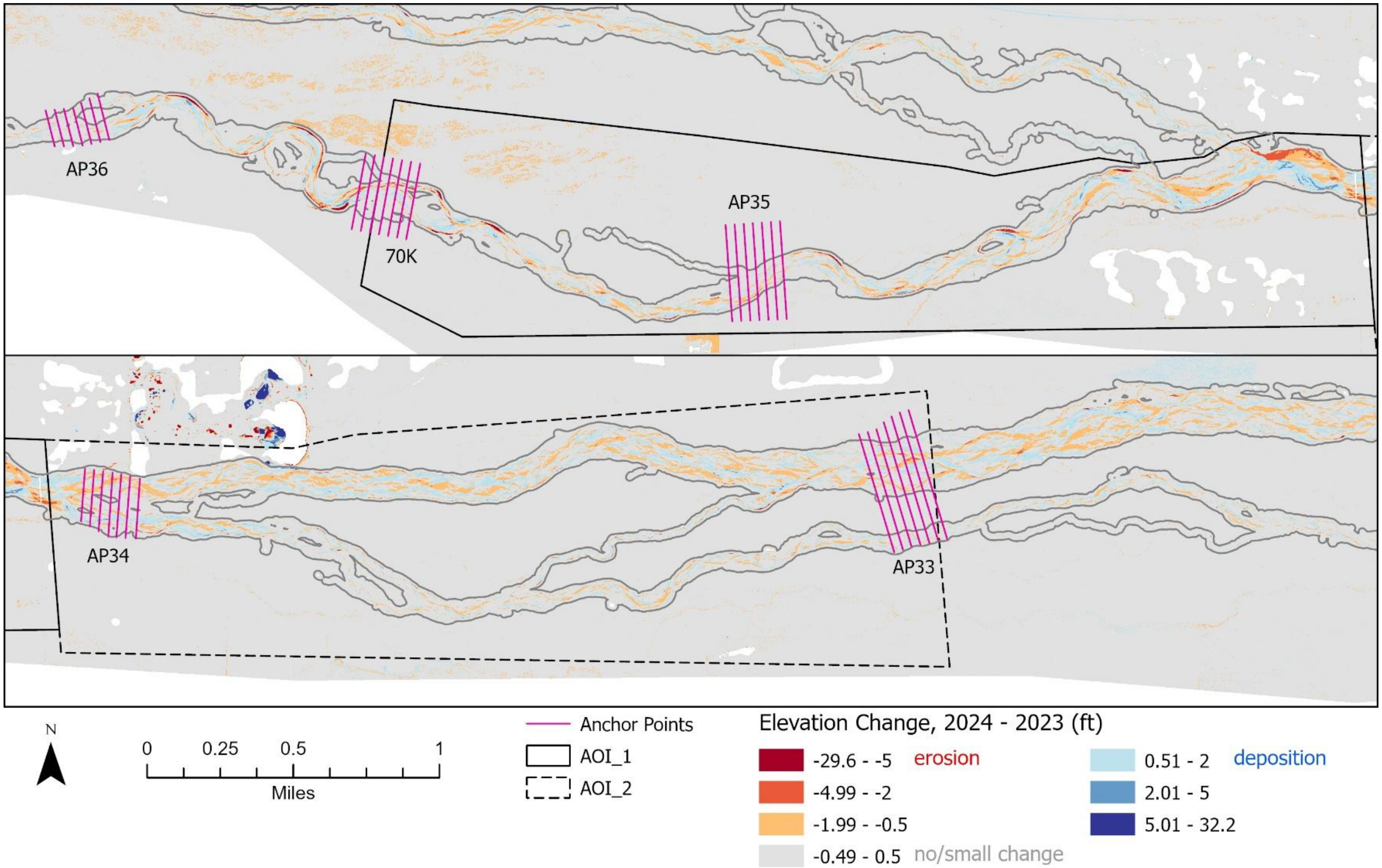

Figure 1. Difference in elevation between the 2024 and 2023 lidar DEM within the study site. Also shown are the two areas of interest (AOIs) for incisional and volumetric change analysis and five Anchor Points (AP) for field measurements within and downstream of the J2 channel. The Overton Bridge is located where the two AOIs meet.

The lidar DEM analysis follows the same methods used previously to develop the Sediment Augmentation Synthesis Report and NSA Monitoring Plan itself. In addition to the annual lidar DEM and aerial photography (Section 2), we are continuing to obtain updated stream gage records and produce annual 2D hydraulic models. Data collection new to the NSA Monitoring plan (Section 3) are aimed at increasing temporal and spatial resolution of monitoring data with surveying at specified Anchor Points (AP – Figure 1), supplemented with low-altitude remote sensing using drones.

2. Continuing Data: Lidar and Aerial Photograph Results

Relative Elevation Models

Channel change from 2023-2024 in both AOIs was minimal, without notable increases in either incision or downstream progression of incision (Figure 1). There are few differences between the REMs produced for 2024 compared to the previous year in both AOIs (Figure2; Figure 3). In the first AOI, upstream of the Overton Bridge, the nine-foot and deeper depth class is visually similar in 2023 and 2024 (Figure 2). Small changes to the exact location and pattern of this class are noticeable in the upstream part of the AOI, and small magnitudes of local downstream translation (< 50 ft) of scour pools are evident just downstream of AP 35. However, there is no evidence for clear and consistent downstream translation within the nine-foot and deeper class in AOI1, and the area of the channel within the class increased by less than 0.1 acre between 2023 and 2024 (Figure 4).

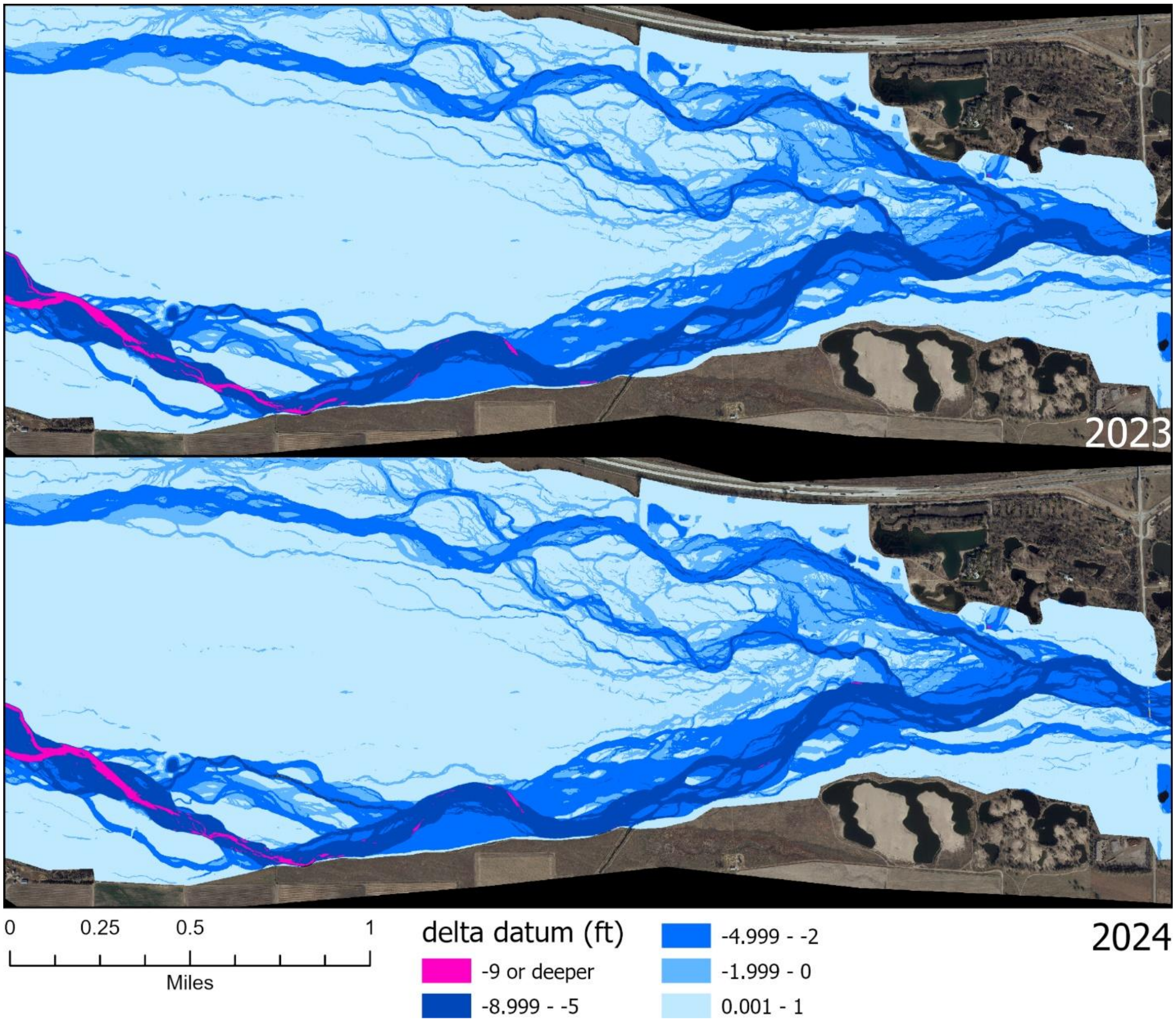

Figure 2. Change in the nine foot and deeper depth class (pink) between 2023 (top) and 2024 (bottom) upstream of the Overton Bridge.

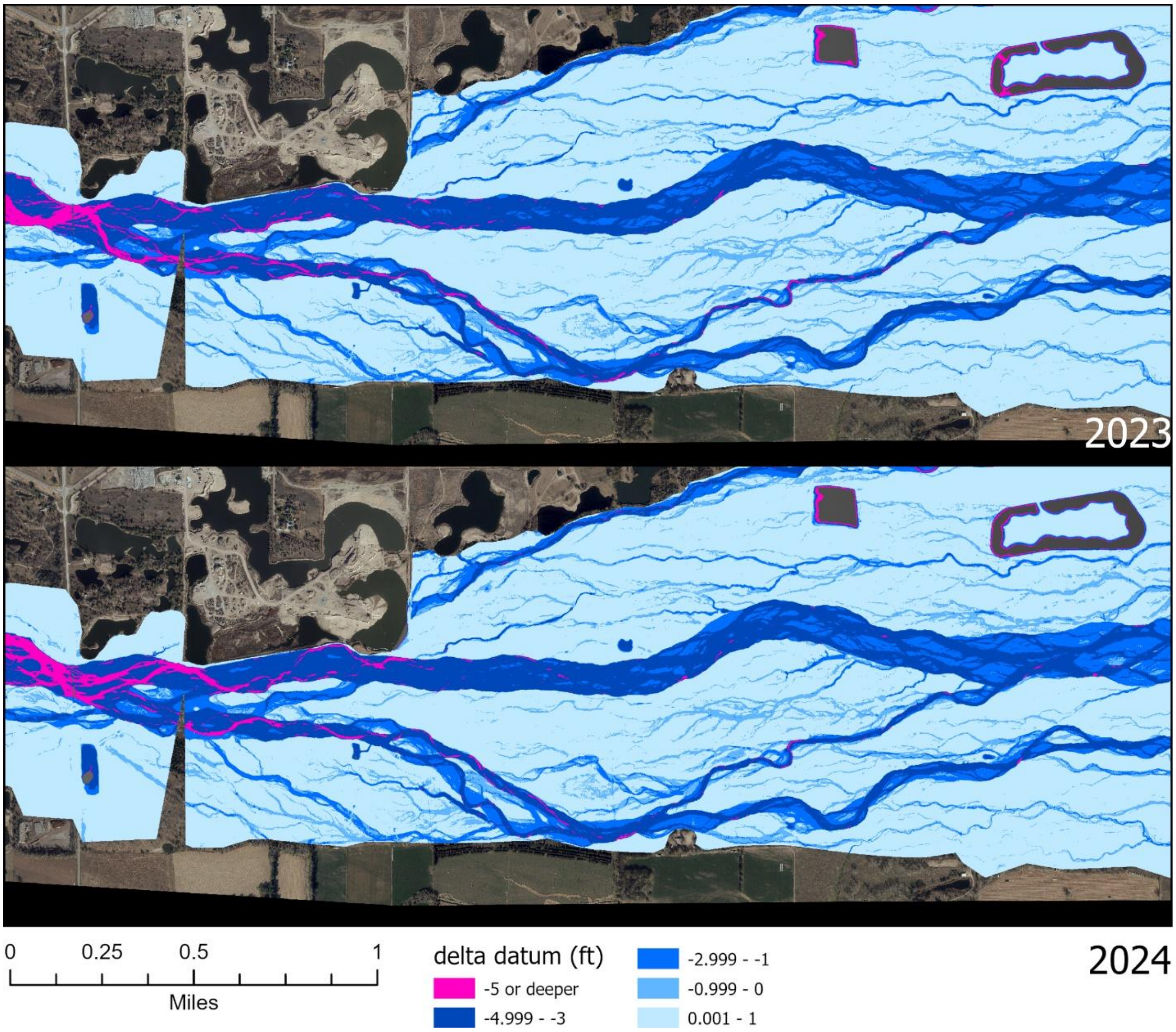

Figure 3. Change in the five foot and deeper depth class (pink) between 2023 (top) and 2024 (bottom) downstream of the Overton Bridge.

In AOI2 the thalweg shifted from the south to north side of the channel just upstream of the Overton Bridge and much of the five-foot and deeper depth class concurrently shifted from the south to the north channel split just downstream of the Overton Bridge (Figure 3). The total amount of channel area within this class increased by only 0.4 acres from 2023 to 2024, indicating that the locational shift of the thalweg represents reorganization of the channel bed rather than increased incision or downstream translation (Figure 4). Most of the change in the five-foot and deeper class in AOI2 occurs within half a mile downstream of the Overton Bridge and appears to be related to potential flow splits between the two main channels in this location. Past one-half mile downstream of the

Overton Bridge, very few and only spatially sporadic locations that are deeper than five feet are present.

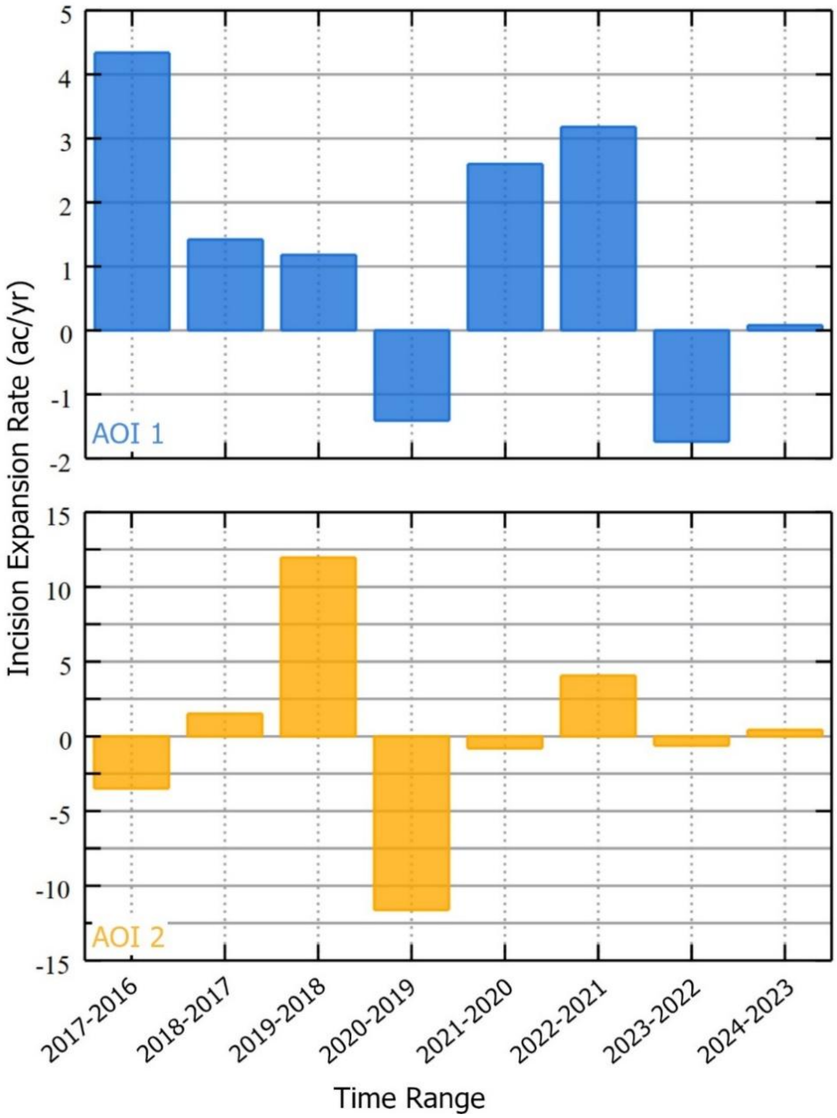

Figure 4. Incision expansion rate over time measured as change in acres of the area of deeper than nine feet in AOI1 and deeper than five feet in AOI2. Note that positive values mean increased incision.

It is also important to note that the United States Geological Survey (USGS) has not observed notable change at Overton Bridge over the past year. The rating curve at the Overton gage was created in August 2022 and received a shift of -0.01 ft in May, 2025 on low flows. This minor change on a curve that is nearly three years old indicates that bathymetry at the bridge has been experiencing a period of stability. For reference, shifts as large as 1.58 ft have been applied over the gage history. In practical terms, the -0.01 ft shift means that for a given discharge the stage has increased by .01 feet compared to the last time the stage-discharge relationship was updated. This indicates that although some minor changes to channel dimensions may have occurred at the bridge site, the change is so small it impacts stage by only a tenth of an inch. In sum, the consistency in the stage-discharge relationship at the bridge is another indication that no substantial changes to the channel have occurred over the past year.

Volume Change

Changes in sediment volume are generally comparable to previous years and small in magnitude (Figure 5). Between the upstream extent of direct mechanical augmentation to Overton Bridge (most of the J2 channel), the total volume of sediment change between 2023 and 2024 was -70,700 cubic yards (CY). This means that the reach was net erosional with a loss of about 70,000 CY of sediment. This is the greatest loss of sediment since the 2020-2019 period, when 77,500 CY were eroded. However, only 8,600 CY were eroded from the bed with the remaining 62,100 CY due to lateral erosion (see the Sediment Augmentation Synthesis Report for details on this methodology) – a process that is generally not of concern for habitat and could help reduce sediment deficits downstream.

In the downstream reach, between Overton Bridge and the Kearney Canal Diversion (KCD), the rate of erosion decreased in the 2024-2023 period compared to previous years (Figure 5). The total erosion of 58,100 CY is near the middle of the range in past volume changes. While this reach is still net erosional, the rate of change of this erosion is small. There was slightly more bed erosion (37,600 CY) compared to lateral erosion (20,500 CY) in this reach. A detailed analysis of the volume changes within and downstream of the J2 channel is beyond the scope of the yearly report, but we can conclude that sediment volume changes appear to be within the normal ranges compared to data gathered since 2016.

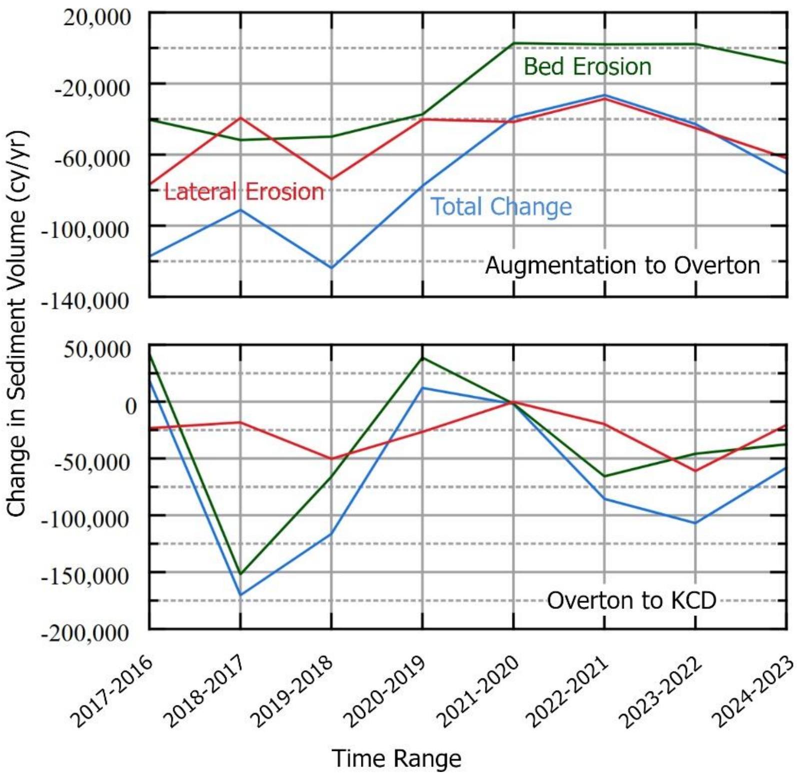

Figure 5. Sediment volume change (cubic yards per year) from the upstream part of the augmented reach within the J2 channel to the Overton Bridge (top) and the Overton Bridge to the Kearney Canal Diversion (bottom) divided into total change (blue), bed change (green), and lateral erosion (red). Note that these reaches do not correspond to AOI1 and AOI2.

Flow Context

The small changes in channel area within the nine and five foot incisional classes in AOI1 and AOI2 and the relatively low volumetric sediment flux within and downstream of J2 must be considered within the context of flows between the 2023 and 2024 lidar acquisitions (Figure 6). There were no substantial high flows between these dates. In particular, 2024 summer flows were consistently low. Mean annual discharge in 2024 was one of the lowest since 2009 and mean daily peak discharge had a return interval of only 1.2 years (Table 1). 40-day max discharge, defined as the maximum value of average discharge in any 40-day window within a given year, is representative of flows that can do substantial work and move sediment along the channel. The value of 40-day max discharge in 2024 was the second lowest since 2009 and less than half of the 1958-2024 average value (Table 1). Both the annual flow statistics (Table 1) and visual inspection of flow hydrographs (Figure 6) demonstrate the consistently low stream power and resultant low ability to move sediment between lidar acquisition dates. In sum, low flows within J2 and the downstream channel at least in part contributed to the small changes to channel form between November 2023 and November 2024.

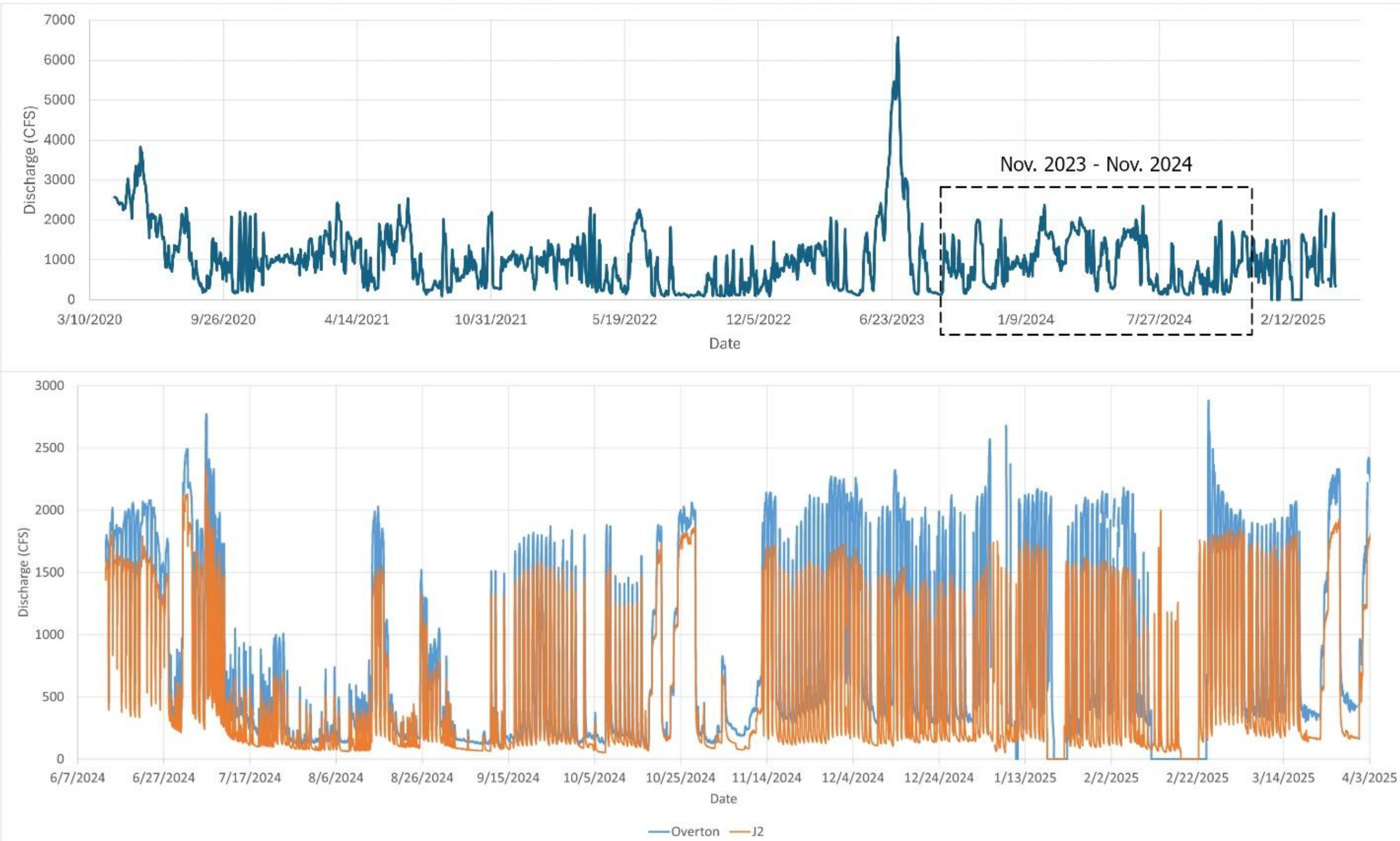

Figure 6. Discharge at Overton (USGS 06768000; 40°40'57" N, 99°32'26" W) over the last five years (top panel) with flows between November 2023 and November 2024 highlighted (top). Discharge at Overton (blue) and J2 (orange, USGS 06767970; 40°40'36.62" N, 99°34'04.64" W) at 15-minute intervals since June 13, 2024 when the J2 gage began collecting data (bottom).

Table 1: Summary of flow metrics at the USGS Overton (06768000) gage including mean annual value for period of 1958-2024 and annual values from 2009 to 2024.

Water Year	Mean Annual Discharge	Annual Volume (ac-ft)	Mean Daily Peak Discharge	Return Interval (Years)	40-Day Max Discharge	Mean June flow (germination)
1958-2024	1,660	1,202,733	6,224	2.8	3,757	2,670
2009	942	681,929	3,600	1.5	1,811	1,282
2010	2,157	1,561,636	7,370	3.6	4,108	4,536
2011	3,877	2,807,022	8,720	4.9	7,503	7,675
2012	1,114	808,918	3,430	1.4	2,796	319
2013	1,140	824,993	12,400	10.5	4,129	303
2014	1,249	904,100	7,360	3.6	3,150	3,822
2015	3,506	2,538,111	15,300	18.0	12,708	12,920
2016	2,950	2,141,887	8,600	4.8	7,364	6,433
2017	1,550	1,122,462	4,440	1.8	2,768	2,069
2018	1,415	1,024,114	2,960	1.3	1,834	1,343
2019	2,274	1,646,138	9,750	6.0	3,089	2,822
2020	1,800	1,306,550	3,820	1.6	2,977	1,966
2021	1,011	731,760	2,540	1.2	1,676	1,676
2022	646	467,461	2,300	1.2	1,383	1,533
2023	1,139	824,452	6,570	3.0	3,702	3,348
2024	975	708,151	2,370	1.2	1,591	1,553

Station 70,000

Station 70,000 (70K) in the J2 channel is a transitional location between a meandering/wandering channel upstream to a braided channel downstream and is thus an area of specific concern (Figure 7). The back-to-back meander bends upstream of 70K are good examples of classic outer-bank erosion and inner-bank deposition that occur more frequently in this reach. Erosion rates between 2023 and 2024 at these bends are in line with past annual changes and vary from about 10 to 50 feet of lateral erosion (Figure 7). Lateral bank erosion on the upstream bend, which erodes into a remnant braid bar, is more uniform compared to the downstream bend that erodes laterally into tree-lined floodplain. Though lateral erosion does occur downstream of 70K, it is localized and not associated with coherent, channel-scale curvature typical of a meandering or wandering planform. Overall, we did not see downstream progression of this transition zone, and 70K remains the transition point between more meander-like erosional patterns upstream and typical braid-bar dynamics downstream.

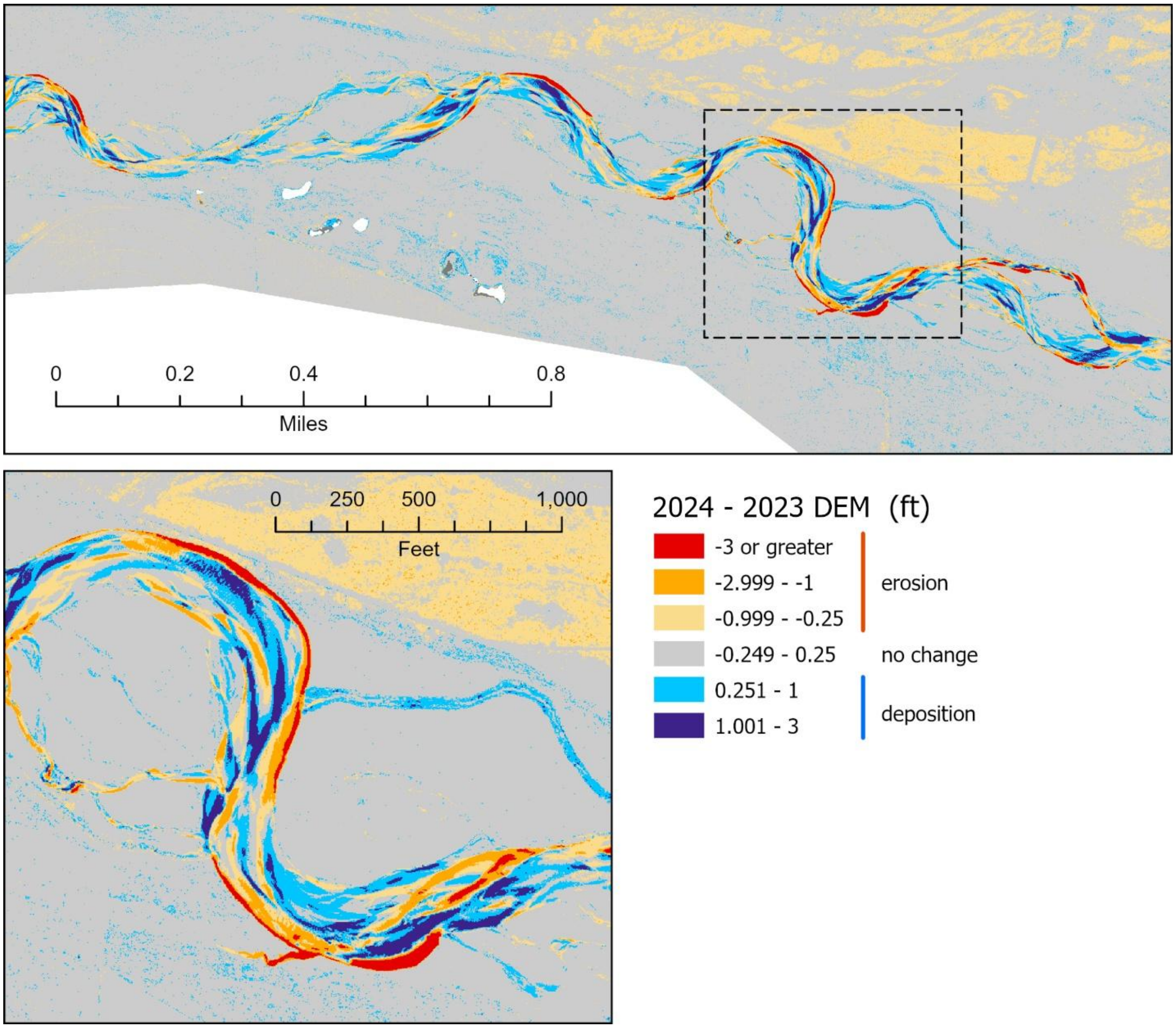

Figure 7. Highlights of lateral erosion in the upstream part of AOI1. The bottom panel inset is just upstream of station 70K and is denoted on the upper map of J2 with a dotted box. Note the meandering/wandering planform and erosional characteristics within the inset and the multi-threaded channel and braided erosional patterns downstream.

3. Supplemental Data: Field-scale Data Examples and Results

Beyond the annual remote-sensing data detailed above, the Program implemented new data collection and analyses. These data and analyses were generally in one of two categories: 1) sub-annual cross-sectional surveys to complement the annually collected lidar elevation data, and 2) leveraging emerging tools and methods to obtain opportunistic and high-resolution complementary data. These new data allow for increased confidence in results derived from annual data collection and analysis, and are key for improving interpretation of the complex relationships between flow, sediment transport, channel form, and vegetation.

Flow Data

A new stream gage operated by the USGS was installed along the J2 channel on the Cook property (40°40'36.62" N, 99°34'04.64" W). This gage began recording stage on June 13, 2024, resulting in the new ability to directly determine the contribution from both the north Platte River channel and the J2 channel to the total flow at the Overton USGS gage (Figure 6). These data are helpful for determining conditions in the field, for better constraining models, and for more completely understanding the direct relationship between flow and changes in sediment area and volume in J2. Similarly, a stage logger was installed in the breakthrough channel between the north channel and J2 channel across Jeffrey Island. This gage provides information on flow depth within the breakthrough channel that allows us to understand when and during what flow conditions the channel actively conveys flow and sediment. No flows high enough to activate the breakthrough channel occurred between the 2023 and 2024 lidar acquisition, but the gage has received regular maintenance.

Geomorphic Data

Manually surveyed elevation cross sections were obtained three times (July 2024, November 2024, and April 2025) at five AP locations within J2 and the downstream channel (Figure 8). Seven cross sections at each anchor point were obtained to measure intra-annual changes to the channel and track potential major changes at higher temporal resolution than can be obtained with lidar. The quality of this analysis is partly dependent on the flow and channel conditions during the survey, but the data so far show only small magnitude channel changes dominated by local impacts like the presence of wood or bedform/bar movement. Minimum channel elevations, averaged over the seven cross sections at each anchor point, have only changed between 0 and 0.5 feet in consecutive surveys with no clear pattern of incision or aggradation (Figure 9). It is difficult to observe patterns after just three surveys, but initial results suggest there is relative interannual stability of minimum channel elevations at each AP.

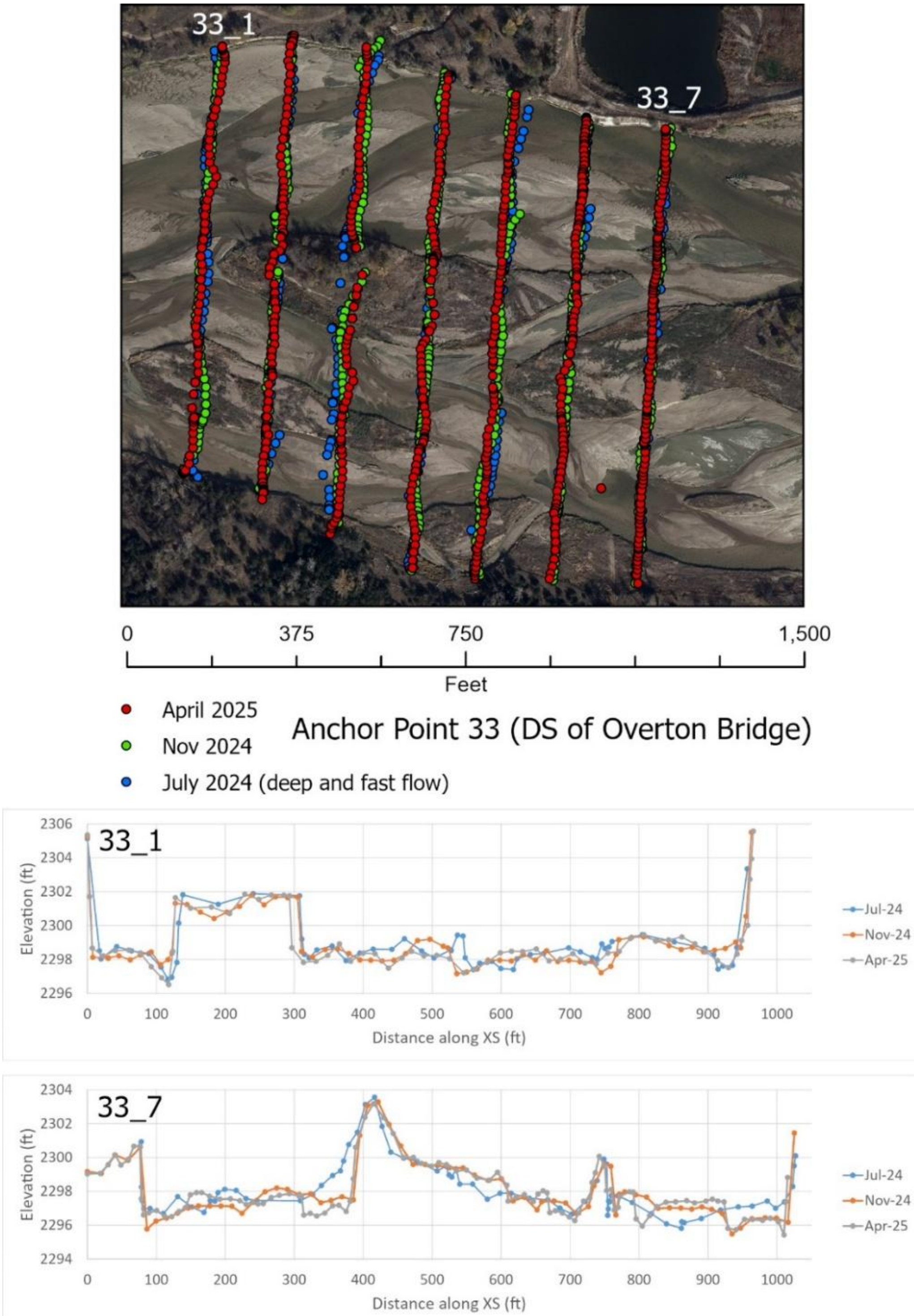

Figure 8. An example of in-channel GPS surveying at AP33. The top panel shows the location of recorded points and the bottom panels show elevations for two example cross sections.

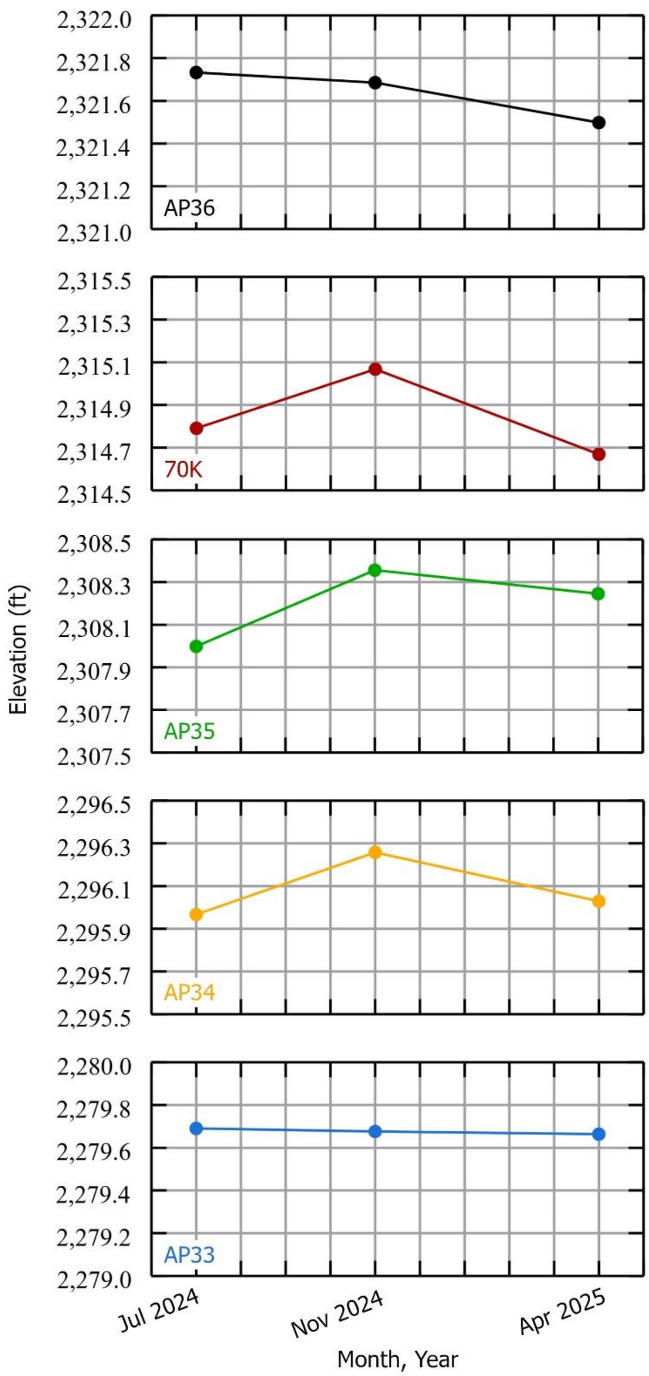

Figure 9. Average minimum elevation of the seven cross sections at each AP since July 2024. Note that the y-axis for each panel is 1 ft.

Yearly bed sediment samples at each of the five anchor point locations showed no consistent changes in sediment size compared to past data. Samples were collected in July 2024 and subsequent grain size analysis is provided in Figure 10 (Panel C). The samples represent the top layer of bed particles and are obtained by a hand sieve in the thalweg, left, and right parts of the channel at each anchor point. These data were and will continue to be compared to historical and year-over-year data to assess if sediment caliber has changed or is changing – a potential clue to changes in sediment transport and channel form. Sediment samples in July 2024 are in line with past samples at APs 33-36 from 2009 to 2016 (and sampled again in 2023). Historical median grain size or D_{50} values vary between one and four mm and current values fall within the same range. Station 70K has noticeably coarser sediment with a D_{50} around 15 mm, and the farthest downstream AP (33) has the finest sediment. A downstream-fining trend is typical in rivers absent major tributaries, and coarser sediment at 70K could be the result of the active erosion in this channel, but a detailed analysis of these results is beyond the scope of this report.

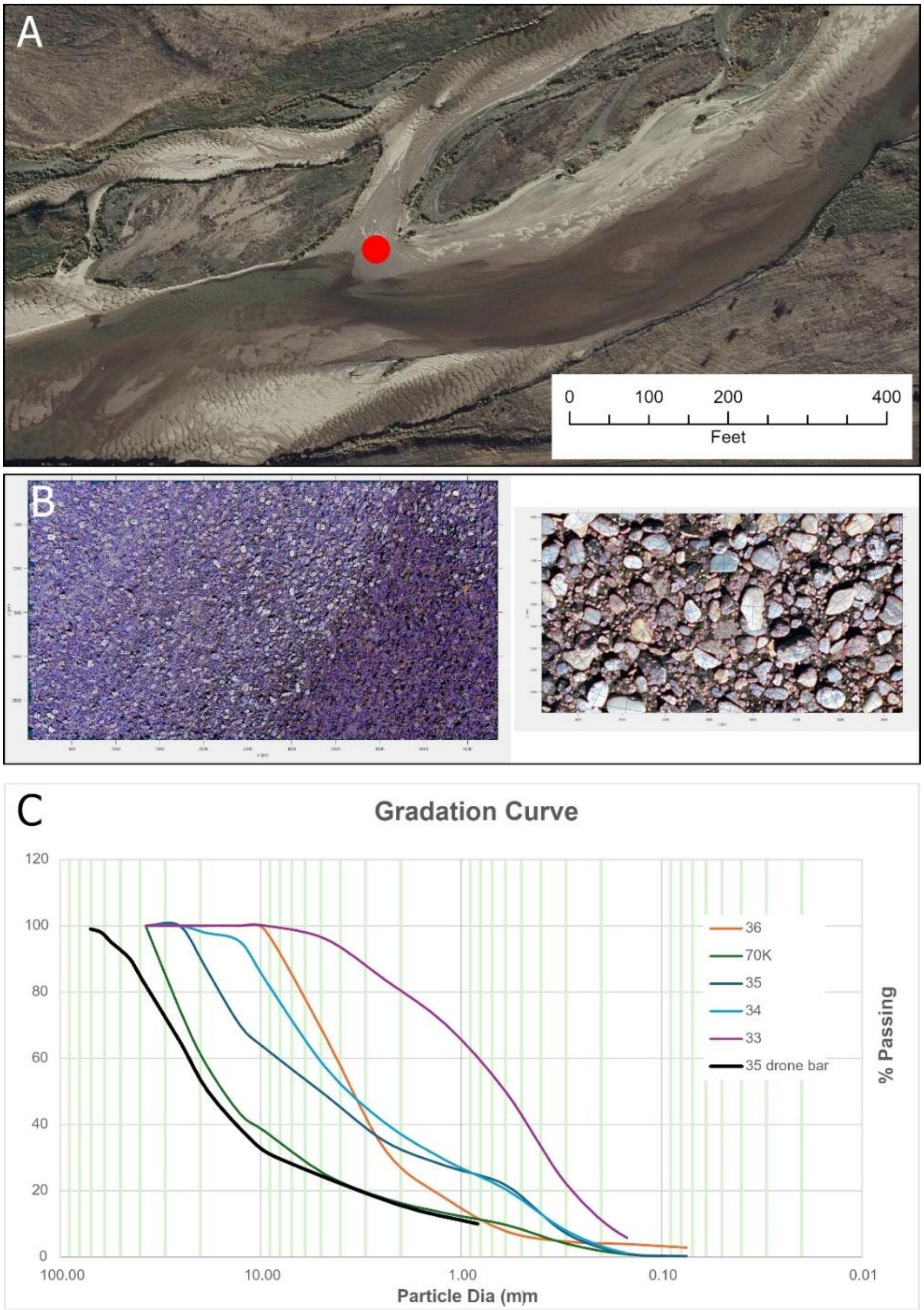

Figure 10. Location used for a drone-based sediment sample of a coarse bar at AP 35 from April 2025 (Panel A: 40.676411, -99.581277). Panel B shows segmented grains from a drone image obtained 15 feet above the bar, with an example close-up. Panel C shows the photo-sieving grain size distribution (black) with the July 2024 in-channel sample distributions from all APs.

Experimental Data

Experimental photo-sieving of bar surfaces was accomplished with a drone on various dates during the three fieldwork campaigns. Photo segmentation is most effective when the image resolution is high compared to the size of the sediment – if effective, these data could allow for rapid assessment of bar-surface sediment caliber and therefore track potential changes like bar armoring that could indicate local hydraulic or morphologic changes. Figure 10 (Panels A and B) shows an example of automatic grain size segmentation using BASEGrain (Detert and Weitbrecht, 2012) at various heights above a bar near AP 35, selected due to visually coarser grain sizes. The example in Figure 10 shows segmentation from an image taken 15 feet above the bar, and the grain size distribution from that image appears reasonably accurate - D_{50} is 21 mm, coarser than the in-channel samples at the same AP and within the pebble size classification of Wentworth (1922). Images obtained at the same location at 8, 25, and 50 feet above the bar resulted in D_{50} values of 23, 21 and 61 mm, respectively. While bar-surface grain sizes may not be directly comparable to in-channel sand samples, the first tests of photo-sieving suggest it is possible under reasonable field conditions and flight heights. The utility of this method has not yet been fully assessed and is partly related to measuring bar sediment changes through time. As a result, additional photo-sieving will be obtained to determine if a temporal change in bar grain size (armoring) is occurring and can be measured.

Drone images were used to create supplemental high-resolution orthophotos at the five AP locations. If changes are observed in the annual lidar or sub-annual cross-sectional surveys, these aerial photographs could be used to infer the specific processes that led to these changes such as changes to in-channel wood patterns, bar or lateral erosion, or flow concentration and resultant incision in a particular braid channel. An example of the utility of sub-annual drone aerial photography is a better understanding of erosion rates of the tree-lined meander bend upstream of 70K (Figure 11). A drone image shows that substantially more erosion occurred between November 2024 and April 2025 than between July 2024 and November 2024. Data such as this could help the Program determine when portions of the channel are most or least morphologically active and help decide the best timing for future natural or mechanical sediment augmentation strategies.

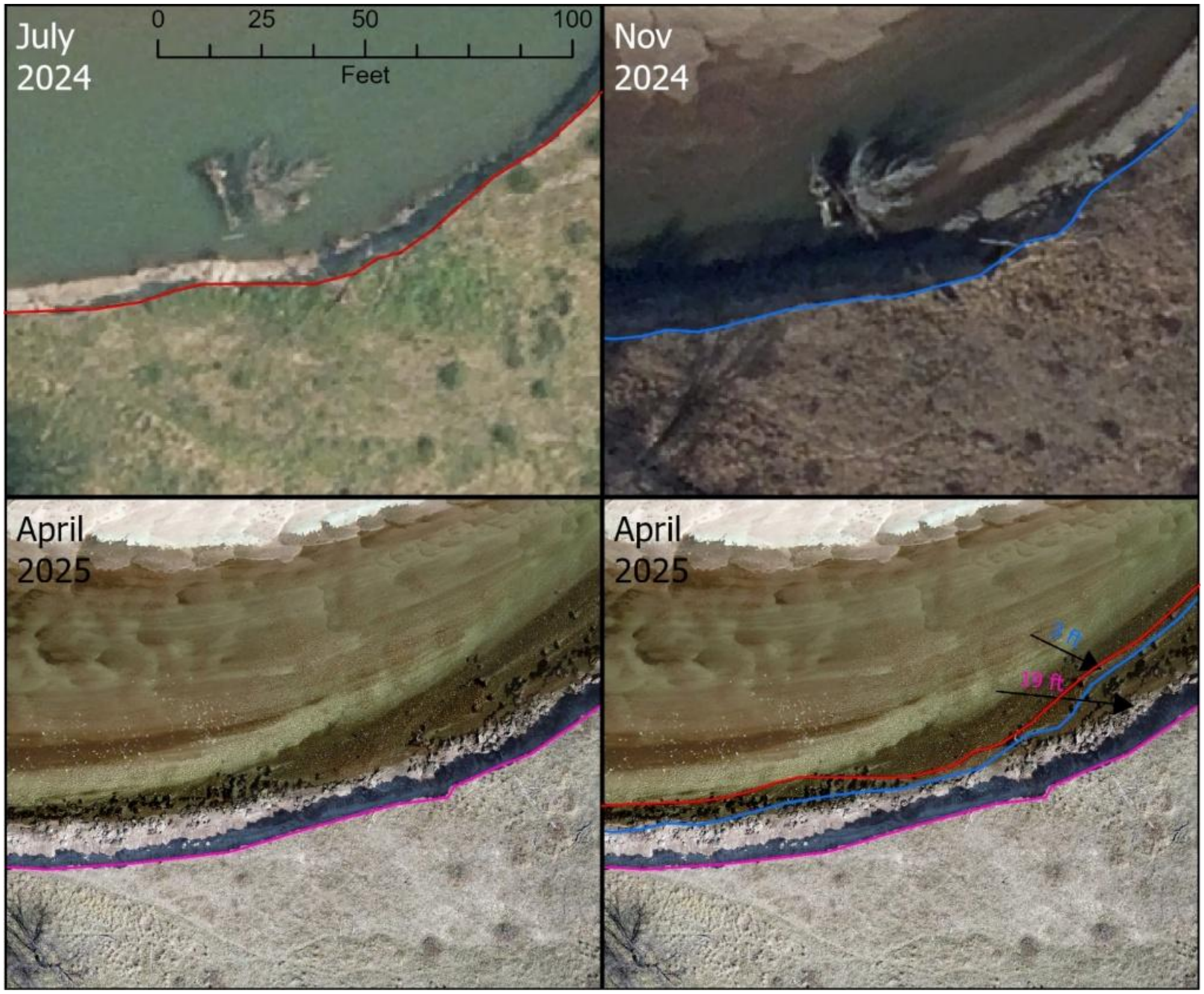

Figure 11. Comparison of the tree-lined south bank along the meander bend upstream of Station 70K (40.68090 -99.60605). The drone-based orthophoto taken in April 2025 (bottom panels) show that substantially more erosion occurred between November 2024 (blue line) and April 2025 (magenta line) than between July 2024 (red line) and November 2024. Note the increased pixel resolution in the drone photo compared to the AHR-wide orthophotos.

Three-dimensional models were also created using drone imagery. As more data are acquired, they will be used to calculate volumes and areas of change sub-annually. Drone-based DEMs at the tree-lined bank upstream of 70K provide detail on the structure of the eroding bank and reveal the presence of root structures protruding from the bank and cohesive blocks of sediment at the bank toe (Figure 12). Highly detailed local scale data such as this, especially when obtained over time, will yield important information that can be used to assess patterns and rates of lateral vs. vertical channel change, how that change varies with flow and reach characteristics, and how best to implement future natural or mechanical augmentation strategies.

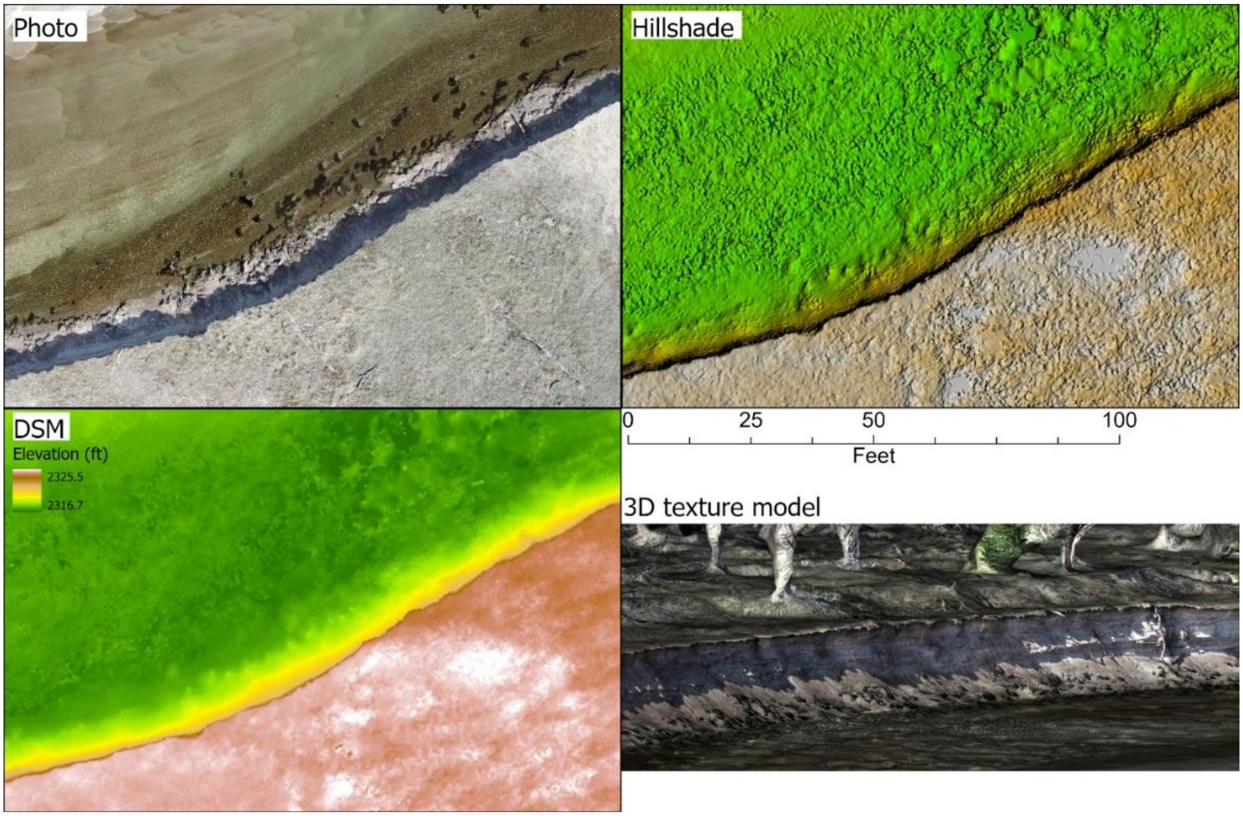

Figure 12. Example outputs of drone data along the tree-lined south bank along the meander bend upstream of Station 70K (40.68090 -99.60605). Along with aerial photos, drone imagery can produce DEMs/Digital Surface Models (DSM) (hillshade and DSM panels) and detailed 3D texture models. Note the presence of tree roots extending out from the bank in the 3D model.

4. Discussion and Conclusion

Results from analysis of the annual lidar and aerial photography data show that little incision, channel narrowing, or downstream progression of incision has occurred within or just downstream of the J2 channel from November of 2023 through November of 2024. We acknowledge that this lack of change is likely at least in part due to lower flows, which can now more accurately be captured with the J2 channel USGS gage. We will continue to monitor and report conditions within and just downstream of J2, but we see no signs of immediate concern about the morphology of the channel.

The high temporal and spatial resolution data that have been acquired since summer 2024 allow us to better understand inter-annual variability in changes to channel form and can act as an early alert should the channel begin to change anomalously or should flows increase. Drone-based imagery and DEMs are directly comparable with annual lidar and aerial photographs, so their value is clear. Photo-sieving is simple to perform and could provide important information on local sediment changes through time. As a result, we will continue these smaller-scale efforts without major changes. We have found that these data are not taxing to obtain or process, and their importance will grow with time as we obtain a longer sample of data over more varied flow and channel conditions. If sub-annual data acquisition suggests considerable changes to J2 channel form are or could be occurring, we will communicate this to the TAC as soon as possible.

Request for NSA Monitoring Plan Alteration

Cross-sectional surveys take the longest time and most effort to accomplish in the field. Early results suggest that average minimum elevations (Figure 9) change only by fractions of a foot between surveys. We therefore suggest a reduction in the number of cross sections surveyed from seven to five, removing the farthest upstream and downstream cross section at each AP. Analysis shows that removing these cross sections has a minimal impact on AP average minimum elevations, changing them at most by a few inches. It is unlikely that considerable channel changes – enough to warrant concern – would be captured with seven cross sections at each AP but would not be captured by five. This will reduce the time needed by about 30%, allowing greater flexibility in the field to work around periods of high flow, to obtain additional or more complicated drone data, or to inspect and perform maintenance on installed equipment.

5. References

Detert, M., & Weitbrecht, V. (2013). User guide to gravelometric image analysis by BASEGRAIN. Advances in River Sediment Research, 2013, 1789.

Wentworth, C. K. (1922). A scale of grade and class terms for clastic sediments. *The Journal of Geology*, *30*(5), 377-392.