Whiskeytown Environmental School Rebuild

Whiskeytown National Recreation Area

Floodplain Statement of Findings

PEPC # 116125

Recommended:

JOSH HOINES Digitally signed by JOSH HOINES
Date: 2026.03.16 16:49:25 -07'00'

Josh Hoines Date
Superintendent, Whiskeytown National Recreation Area

Certified for Technical Adequacy and Servicewide Consistency:

TERRY FISK Digitally signed by TERRY FISK
Date: 2026.03.20 09:37:39 -06'00'

Terry Fisk Date
Acting Chief, Water Resources Division

Approved:

KATARIINA TUOVINEN Digitally signed by KATARIINA TUOVINEN
Date: 2026.04.21 10:13:54 -07'00'

Randy Lavasseur Date
Acting Regional Director, NPS Regions 8, 9, 10, 12

Table of Contents

Whiskeytown Environmental School Rebuild

Whiskeytown National Recreation Area

FLOODPLAINS STATEMENT OF FINDINGS

1 INTRODUCTION

Executive Order (EO) 11988, *Floodplain Management,* requires the National Park Service (NPS) and other federal agencies to evaluate the likely impacts of actions in floodplains. The objective of EO 11988 is to avoid, to the extent possible, the long-term and short-term adverse impacts associated with occupancy, modification, or destruction of floodplains and to avoid indirect support of development and new construction in such areas wherever there is a practicable alternative. The National Park Service administers floodplain policy through Director's Order 77-2: *Floodplain Management* (DO 77-2) and Procedural Manual 77-2 *Floodplain Management* (PM 77-2). The National Park Service also complies with departmental guidance outlined in 520 DM 1, *Floodplain Management and Wetlands Protection Policy and Responsibilities*, and 520 DM 2, *Floodplain Management and Wetlands Protection Program Requirements*.

It is NPS policy to preserve floodplain functions and values and minimize potentially hazardous conditions associated with flooding, including threats to human health and safety, risk to NPS capital investment, and impacts on natural and beneficial floodplain values. If a proposed action is found to be in, or possibly affecting a floodplain, and relocating the action to a non-floodplain site is considered not to be a viable alternative, then a formal Floodplain Statement of Findings (FSOF) must be prepared unless the action is considered excepted. The FSOF must (a) describe the rationale for selection of a floodplain site, (b) disclose the amount of risk associated with the chosen site (with respect to human life, health, and safety, resource protection, and capital investment), and (c) explain strategies for mitigation of flood risk. The FSOF will be available for public review and comment in coordination with the National Environmental Policy Act (NEPA) and other compliance procedures, as applicable. If public review is not provided through the NEPA process (e.g. environmental assessment), another opportunity for public review is required.

This FSOF provides:

1. A detailed justification for selecting a proposed action that would adversely impact the Federal Flood Risk Management Standard (FFRMS) floodplain (Section 2).
2. A detailed and comprehensive description of the flood hazard and risk associated with implementation of the proposed action (Section 3).
3. A thorough description of mitigation measures chosen to eliminate, to the extent possible, adverse floodplain impacts associated with the proposed action(s) (Section 4).

1.1 PREPARER

In accordance with DO 77-2 and PM 77-2, we, John Wooster, Hannah Karlsson, Sarah Aguiar and Daniel Sedgwick, the authors of this FSOF, affirm we are hydrologists and environmental protection specialists and are technically qualified to prepare this document.

1.2 LOCATION

The Whiskeytown Environmental School (WES) Rebuild is located at 10106 Paige Bar Road in Shasta County, California. It is located within the Whiskeytown National Recreation Area (WHIS), in the Southern section of the park (Figure 1).

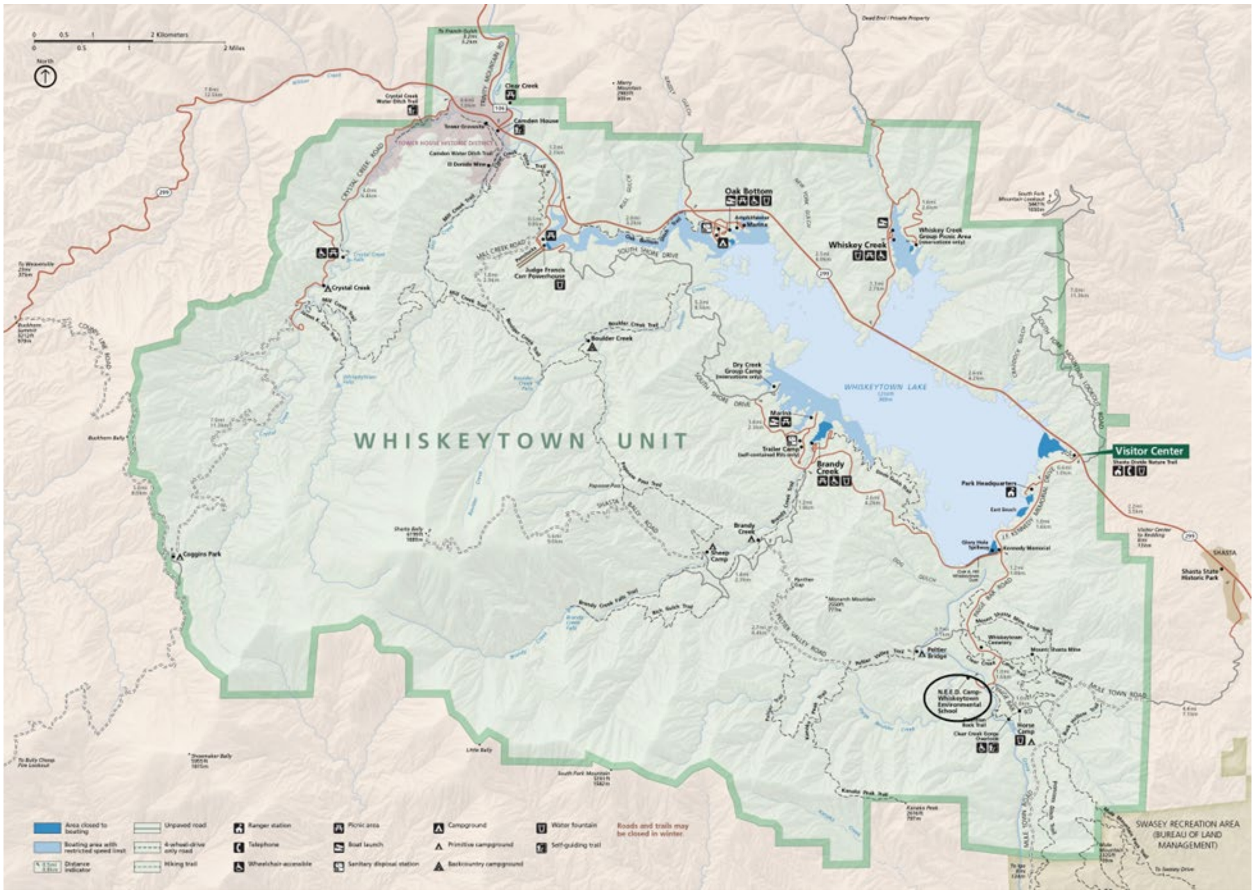


Figure 1. Location of WES at the Whiskeytown National Recreation Area. WES is represented by a hollowed out black circle.

WES is located on a terrace / historic floodplain of Clear Creek immediately downstream of the confluence with tributary Paige-Boulder Creek (PBC). Clear Creek is primarily regulated by Whiskeytown Dam, an earthen dam located approximately 2 miles upstream of WES. Whiskeytown Dam significantly regulates the flow in Clear Creek, with average daily discharge rates varying seasonally, and a typical maximum daily flow rate of 600 cubic feet per second (cfs) (Anderson, 2022). Whiskeytown Dam, completed by the Bureau of Reclamation (BOR) in 1963, alters the timing, frequency, and magnitude of flood flows in Clear Creek through infrequent spill events. Based on an analysis with other nearby stream gages on unregulated streams, Whiskeytown spills and annual Clear Creek high flows coincide about 50% of the time with regional flood flows. The differences are likely attributable to BOR operations at Whiskeytown and the large Central Valley Water Project. Spill events occur through the glory hole spillway and are typically known well in advance by BOR as part of their operations and forecasting for the Central Valley Project (federal water project in California).

The PBC watershed is a 4.8 mi^2 drainage that extensively burned in the 2018 Carr fire. Shortly after the fire, a U.S Forest Service Burned Area Emergency Response team identified an increased risk to the camp, and in particular Hatcher Hall, from flooding and debris flow because of the altered watershed conditions. Anderson (2022) focused on modeling flood and debris flow scenarios for PBC using multiple burn severity and bulking factor adjustments to characterize post-fire impacts to the watershed. However, Gusman et al. (2011) found the burn severity factor typically declines to zero within 7.5 years post-fire; thus, given the timeline for implementation of this project, the PBC hydrology was not adjusted for fire impacts in the modeling presented in the FSOF. Annual high flows on Clear Creek appear to coincide about 50% of the time with nearby Cow Creek (unregulated basin directly to the south); a similar relationship is assumed with PBC and Clear Creek/Whiskeytown spills but unconfirmed due to no available gage data on PBC. For modeling scenarios presented in this FSOF, peak flows in PBC and Clear Creek were assumed to occur simultaneously to provide conservative estimates of flood inundation and backwater extents.

1.3 PROPOSED ACTION

The WES was greatly damaged by the Carr Fire in 2018. The proposed rebuild is needed to restore functionality and capacity to WES. WES is operated by the Shasta County Office of Education (SCOE) in cooperation with the NPS and the non-profit Whiskeytown Environmental School Community (WESC). The school provides environmental education programs for K-8 students in Shasta County and the neighboring counties, and it is a cornerstone of multiple communities, providing a multi-generational impact for Shasta County residents and beyond. Currently, the school is only open for day-use. There are no residential and overnight opportunities due to the damage sustained by the Carr Fire.

- The purpose for the project is to preserve and restore programs at WES and create a new campus that would serve the community through interpretation, research, and partnerships. In addition to the projects associated with the proposed action, the WES Rebuild project seeks to provide a school facility that is a model of sustainability and ecological sensitivity that protects park resources, encourages responsible interaction with the environment, and exemplifies WES vision and goals.
- Provide a safe and universally accessible place to learn and work by integrating accessibility throughout the project. Implement safety plans to address flooding and enhance structural resilience to wildfire through modern building materials and current building codes, making the site safer and more resilient.

Project funding is expected in phases from several funding sources, including Repair/Rehabilitation, Cyclic Maintenance, Centennial Challenge, Federal Lands Recreation Enhancement Act, and external donations.

The need for the project is to restore and rebuild the fire damaged WES campus where structures were lost, or restore buildings that were severely damaged and are not safe for use by the public. There are currently no habitable cabins for overnight use by students. Along with rebuilding the cabins, an overall rehabilitation of the campus would bring other facilities up to code and improve functionality. Under the Action Alternative, the campus would be rebuilt in the same area as the current WES site (Figure 2). The Action Alternative encompasses:

1. Removal of PBC bridge
2. Renovation of Hatcher Hall
3. Construction of double/quad residential cabin buildings
4. Conversion of existing administration building into field instructor housing
5. Construction of new administrative building, teacher housing, and pavilions
6. Construction of new arbor
7. Expansion of parking
8. Upgrades to utilities
9. Construction of fire access road
10. Renovation of educational pond
11. Regrading roads and outsloping banks on roads and near new buildings
12. Rebuilding an amphitheater in the footprint of the old amphitheater

The final locations of some of the proposed cabins and buildings are still pending, primarily due to additional planning needed related to the sewer lines and leach fields. However, all buildings would be located within the "proposed buildable zone" polygon depicted in Figure 2 (see also: Appendix A). This plan could support up to 192 occupants. The project is also needed to bring the facilities up to modern code and standards including updating the dining hall (Hatcher Hall) and commercial kitchen, making facilities universally accessible and Architectural Barriers Act compliant, expanding parking, regrading land surface contours, upgrading utilities, and removing an old vehicle bridge over PBC (Figures 2, 3, and 4). The old bridge over PBC will be replaced with a modern footbridge as part of a future project. The hydraulic effects of removing the old vehicular bridge are included in the modeling results presented herein, but the proposed footbridge is not evaluated as part of this FSOF. After engineering designs are complete, if the replacement footbridge is determined within the regulatory floodplain a separate FSOF will be developed (see also: Appendix A).

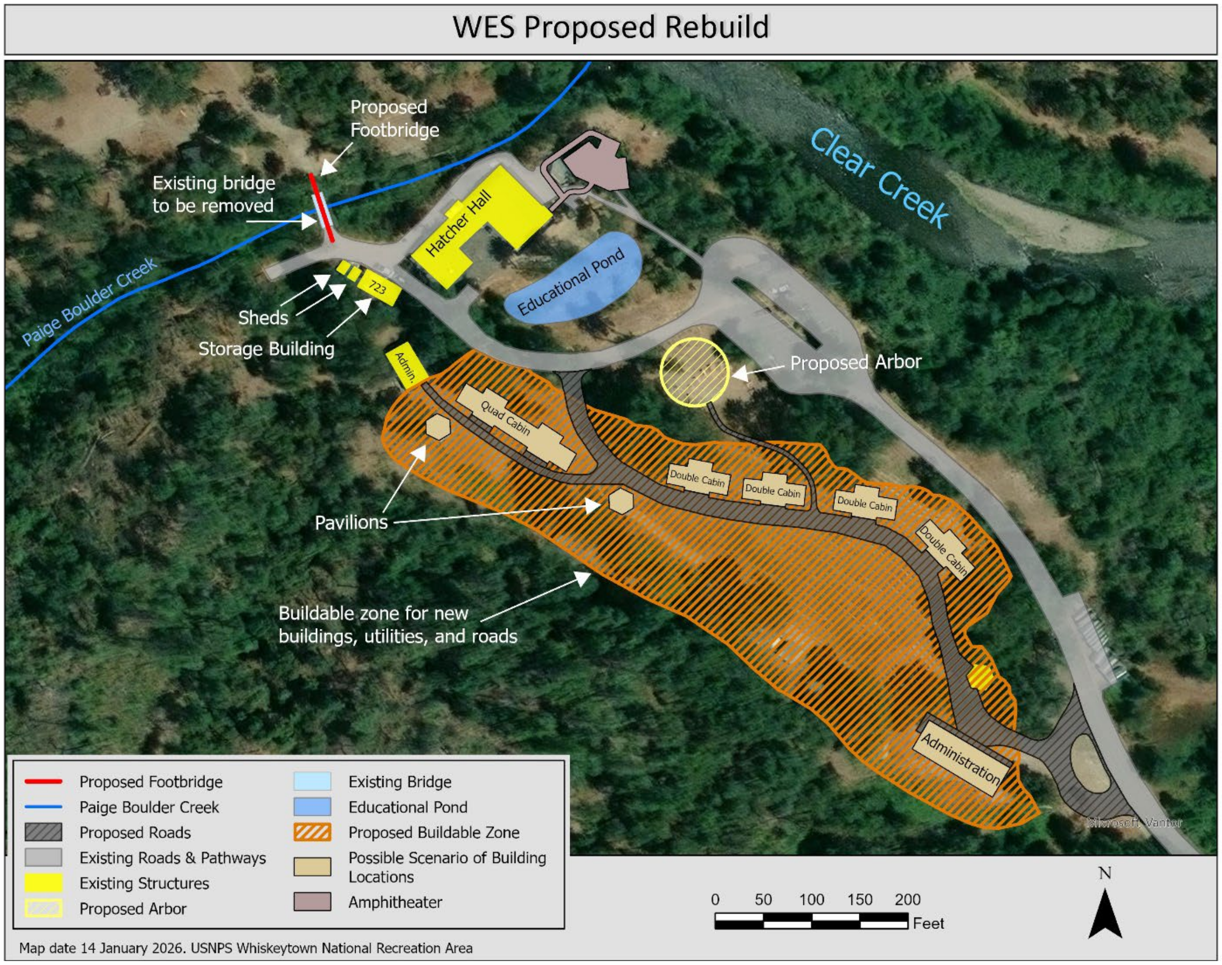


Figure 2. A visual representation of the proposed WES Rebuild, with the existing structures shown in yellow and a possible configuration for most of the new structures shown in tan. Exact locations of buildings, utilities, and roads may vary within the buildable zone shown in hashed orange. The proposed bridge over Paige Boulder Creek is not evaluated as part of this FSOF.

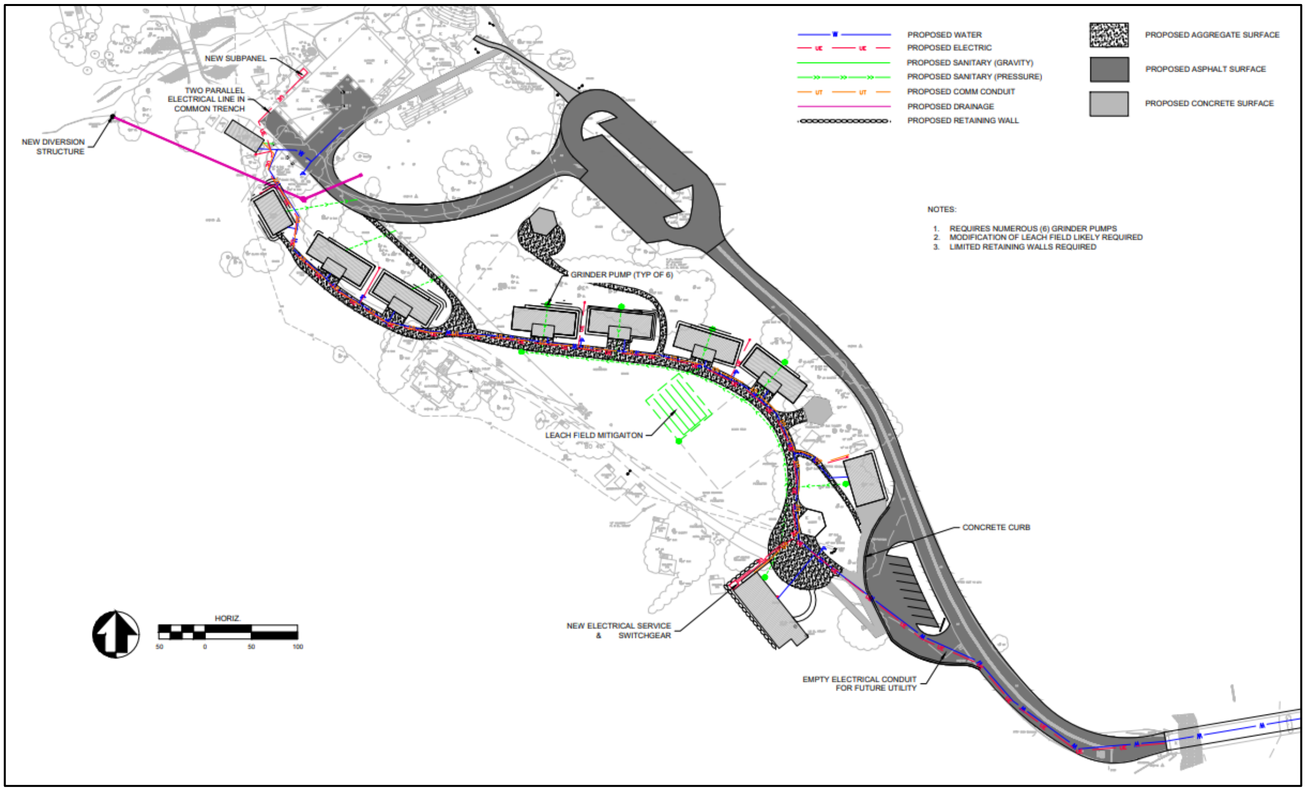
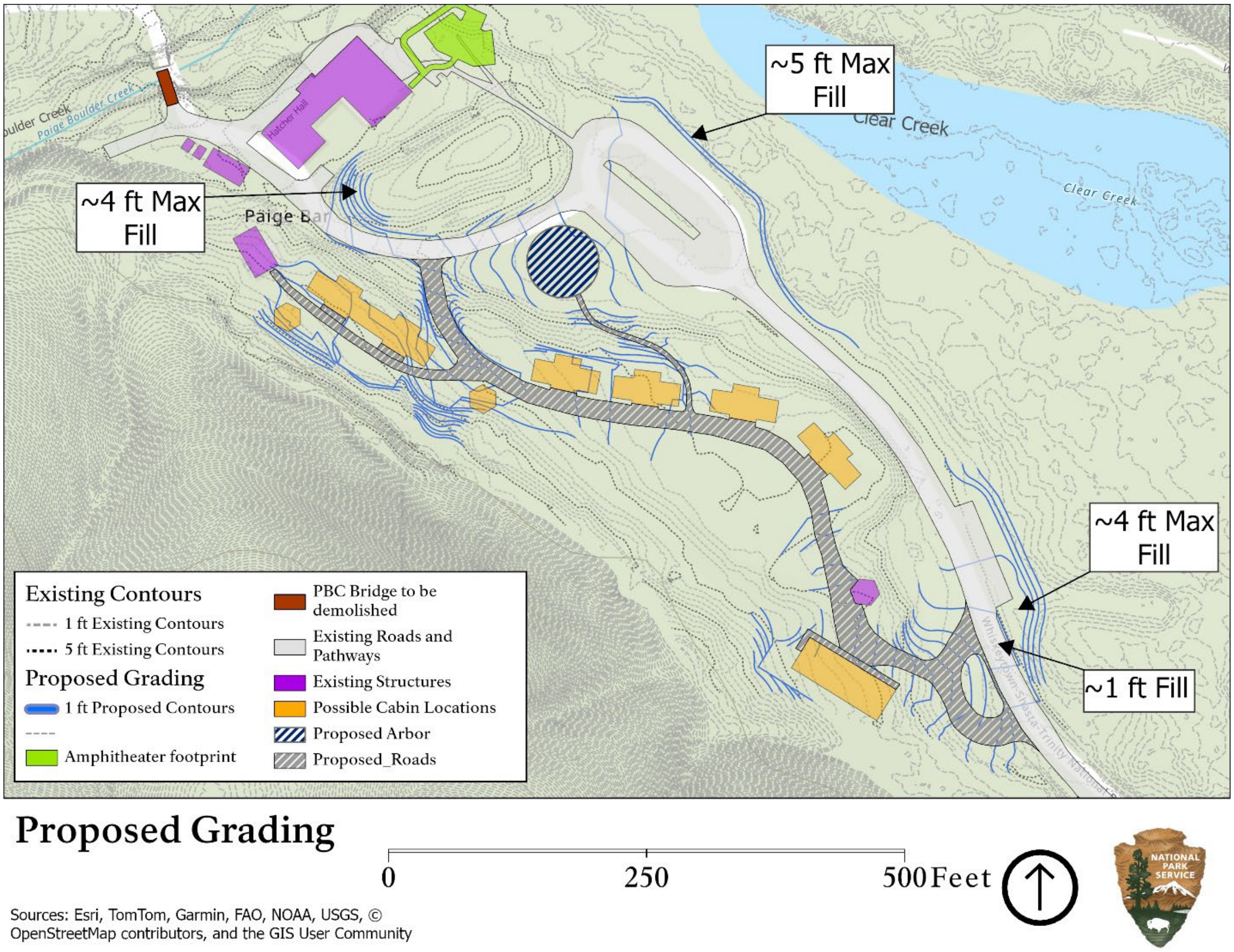


Figure 3. Conceptual schematic of proposed utility and road development site plan for WES.



Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Figure 4. Proposed Contours for regrading roads and outsloping banks on roads and near new buildings.

1.4 DETERMINATION OF ACTION CLASS AND REGULATORY FLOODPLAIN

Following PM 77-2, three action classes were considered when establishing the regulatory floodplain:

1. Class I Actions (i.e., non-critical actions) include location or construction of administrative, residential, warehouse, and maintenance buildings; non-excepted parking lots; or other man-made features, which by their nature entice or require individuals to occupy the site, are prone to flood damage, or result in impacts to natural floodplain values.
2. Class II Actions (i.e., critical actions) include any activity for which even a slight chance of flooding is too great, such as construction of schools, medical facilities, emergency services, hazardous material storage, and records/collections storage.
3. Class III Actions include any action that involves human occupation or substantial human exposure in high hazard areas, such as drainages subject to flash flooding.

The majority of proposed project activities, and overall intent of the project meets the definition of a Class II Action, the construction of an environmental school that includes overnight facilities for students and facilitators. However, some project components, including road / bank regrades, pavilions, arbor, parking lots, roads, pond rehabilitation, and bridge removal (non-essential location for emergency egress) would meet the definition of a Class I non-critical action.

Proposed actions that involve federal capital investment must comply with FFRMS for new construction, substantial improvement, or repairing substantial damage. Per departmental guidance, agencies may select one of three approaches to implement flood resiliency measures:

- **Climate-Informed Science Approach (CISA) –** The elevation and flood hazard area that result from using the best-available, actionable hydrologic and hydraulic data and methods that integrate current and future changes in flooding, including climate change and other physical processes (e.g. land-use change).
- **Freeboard Value Approach (FVA) –** The elevation and flood hazard area that result from adding an additional 2 feet to the base flood elevation (BFE) for non-critical actions and by adding an additional 3 feet to the BFE for critical actions.
- **0.2% Annual-Chance Flood Approach (0.2PFA) –** The area subject to flooding by the 0.2% (500-year) annual-chance flood.

A 0.2% Annual Chance Flood Approach establishing FFRMS flood elevations is employed for this proposed action. Therefore, the regulatory floodplain for the proposed action is the 0.2% annual chance (500-year) flood elevation, or approximately 927.7 feet.

The hydraulic model and flood inundation map were developed by refining a previously established U.S. Army Corps of Engineers Hydraulic Engineering Center River Analysis System (HEC-RAS) Version 6.6 two-dimensional (2D) model. Anderson (2022) developed the initial model used for the Flood Risk Evaluation Report focused on flood hazard analysis at WES, specifically evaluating flood risk from PBC, a tributary of Clear Creek. NPS' Water Resources Division (WRD) adapted the hydraulic model developed for the Flood Risk Evaluation Report (Anderson, 2022) to determine the 100- and 500-year flood inundation areas at the Project site. Specific model parameters, methods, and results for the updated model are detailed in Karlsson and Wooster (2025): available as Appendix B to this FSOF, as well as an addendum to the Anderson (2022) report.

A key component of the proposed project is the removal of PBC bridge. To assess the flood hazard improvements resulting from the bridge removal, the 100- and 500-year flood events were modeled for both pre- and post-project conditions—both with and without the PBC bridge.

A summary of the floodplain compliance condition for each of the 12 project elements (Section 1.3) is provided in Table 1. In general, the elements of WES within the FFRMS floodplain include: proposed amphitheater, portions of the access roads and parking spaces, the proposed arbor, and the pond. The majority of WES and its primary structures are outside the regulatory floodplain, including the entire potential "buildable area" polygon (Figures 5 and 6).

The portion of the "buildable area" polygon proximal to Clear Creek and flood inundation limit was delineated using hydraulic model results and followed contours such that the polygon is about 2 feet higher (freeboard) than the 500-year flood stage.

Table 1. Floodplain Compliance Condition for Elements of Proposed Action.

Proposed Action*	Regulatory Status
1 - Removal of Paige Boulder Creek bridge	PM 77-2 **not applicable:** no change to or reduced flood risk
10 - Renovation of educational pond	
8 - Upgrades to utilities	**Excepted** under PM 77-2
2 - Renovation of Hatcher Hall	**Outside regulatory floodplain**: no compliance required
3 - Construction of double/quad residential cabin buildings	
4 - Convert existing administration building into field instructor housing	
5 - Construction of new administrative building, teacher housing, and pavilions	
6 - Construction of new arbor (Figure 2)	**Inside regulatory floodplain**: floodplain compliance required
7 - Expansion of parking (Figure 2)	
9 - Construction of fire road – stubs/connectors in regulatory floodplain (Figure 5)	
11 - Regrading roads and outsloping banks on roads and near new buildings (Figure 4)	
12 - Construction of new amphitheater (Figure 2)	

*Items numbered as shown in Section 1.3

Proposed action elements listed in Table 1 as not applicable, excepted, or outside the regulatory floodplain are not required to be discussed further in this document; however, in cases where implementation of an element may change (reduce) flood risk, discussion is included (e.g., Removal of Page Boulder Creek bridge).

2 JUSTIFICATION FOR USE OF THE FLOODPLAIN

2.1 INVESTIGATION OF ALTERNATIVE SITES

Following significant impacts from the 2018 Carr Fire, SCOE investigated 32 potential sites within Shasta County and beyond for rebuilding the school, including alternate, non-floodplain sites. The 32 sites included state and national parks, existing retreat centers, decommissioned schools, retired and current camps, retired and current campgrounds, and many locations on public land.

The following criteria were used to select possible locations:

- Distance from Redding. Redding-district schools are accustomed to traveling no more than 90 minutes, though students come from all over
- Emergency service availability. Fast access to emergency services is critical.

- Access. Paved access to support bus transit.
- Potential for snow in the winter. According to SCOE, there were other sites that may have been acceptable, but were located along transportation corridors that close frequently due to snow.
- Elevation. Sites at elevations with moderate temperatures during the school year were preferred.
- Size (acres). 10+ miles of hiking trails permit six trail groups of 20 kids to spread out.
- Power and water access. Existing power and water systems was also of high importance, as the cost of developing new utilities would be too great.
- Cost and ownership. Support from NPS for maintenance keeps costs low.
- Water access. Proximity to water was of great concern, as access to streams/ponds/lakes is a cornerstone of the educational programs and is extremely valuable for students' experience.

2.2 JUSTIFICATION FOR FLOODPLAIN LOCATION

Based on the factors listed above, the existing WES site was identified as the ideal location for rebuilding the school, despite its location within and adjacent to a floodplain. These factors highlight the distinctive location, diverse mix of habitats, and rich history of the WES site creating an overall unique experience for students, teachers, researchers, and visitors. The NPS also evaluated other sites within WHIS and found that there is no other comparable site within the park that could serve as a residential outdoor education campus. Therefore, no practicable non-floodplain sites for the WES campus were identified.

3 DETAILED FLOOD HAZARD AND FLOOD RISK ANALYSIS

3.1 DESCRIPTION OF SITE-SPECIFIC FLOOD HAZARD

Clear Creek is primarily regulated by Whiskeytown Dam, which was constructed by the Bureau of Reclamation between 1960 and 1963. The nearest historic gage to the project site was USGS Gage 11372000, located on Clear Creek near Igo, CA. This gage collected discharge and peak streamflow records for 84 years from 1941 through 2024. The gage is located approximately five river miles downstream from the Project site. The project site on Clear Creek is approximately two miles downstream of Whiskeytown Dam. Data from the regulated flow record (1963 to 2024) was used to calculate the 100- and 500-year return periods flows, employing the Log Pearson III distribution.

The highest recorded instantaneous peak flow at this gage, post-dam construction, occurred on March 3, 1983, with a flow of 18,400 cfs. The 100- and 500-year flows calculated at this site were 18,100 and 26,600 cfs, respectively. Tributary contributions between the project site and the gage location are small and often do not sync with the primary floods released from Whiskeytown Dam. Therefore, the peak flows recorded at the gage are considered a conservative representation of the potential flood flows at the project site. Peak flow statistics for the PBC tributary were estimated using the USGS StreamStats tool, which applies regional regression estimate methods (Gotvald et al., 2012) to provide streamflow estimates at ungaged sites in California. The 100- and 500-year flood flows for Clear Creek and PBC are summarized in Table 2. The maximum design discharge at Whiskeytown Dam is 28,650 cfs (BOR 2008), which is slightly more than the estimated 500-year flood flow in Clear Creek.

Table 2. Flood Flow Magnitudes used for FSOF and Hydraulic Modeling.

Annual Exceedance Probability	Return Periods (years)	Clear Creek at Project Site (cfs)	Paige-Boulder Creek at Project Site (cfs)
1.0%	100	18,100	1,990
0.2%	500	26,600	2,570

Modeled inundation extents for the 100 and 500-year flood flows are presented below in Figure 5 with PBC bridge in place and in Figure 6 with PBC bridge removed. Flow depths for the Regulatory Flood (500-year flow) with PBC bridge removed are shown in Figure 7 and Table 3 along with Regulatory Flood velocity. Additional model results including 100-year flow depths (with and without PBC bridge), 100-year flow velocities (with and without PBC bridge), and 500-year flow velocities (with and without PBC bridge) are available in the addendum to this FSOF.

As described in Table 1, modeling results indicate that the majority of the new proposed buildings are outside of the NPS regulatory floodplain (i.e., 500-year flood extent), including all the double cabins, the quad cabin, and the new administrative building. The two exceptions would be the proposed arbor near the primary parking lot and the proposed amphitheater rebuild. Hatcher Hall, an existing building proposed for renovation, is outside the 500-year inundation extent; but the scenario with PBC bridge in place shows flow immediately along the building's footprint (Figure 5). By removing the PBC bridge, the inundation in the immediate vicinity of Hatcher Hall is largely eliminated (Figure 6). Similarly, existing building 723 and two nearby sheds are inundated at the 500-year flow with PBC bridge in place but are not inundated when the PBC bridge is removed. The proposed new footbridge (to be constructed as part of a future project) is intended to have a soffit above the 500-year flood stage and should influence PBC hydraulics similar to the "without bridge" scenarios modeled in the addendum and shown in Figures 6 and 7.

The existing road and primary parking area are mostly inundated at a 100 and 500-year flow level, with the exception being a stretch of road near the southern end that connects to the bridge over Clear Creek. The Fire Road, located behind (upslope) the new cabins and buildings, is not inundated, and should provide egress from Hatcher Hall and the cabins to the Clear Creek bridge during extreme flood flows.

Flow depths along the inundated portion of the existing road at a 500-year flow are generally over 3 ft and peak at 5 ft. Flood flow velocities along one stretch of the existing road appear to be anomalously high (> 12 ft/s, Appendix B). Interpreting model output with the existing topography indicates that flow entering the WES pond and primary parking area subsequently flows out of this area in a concentrated manner along the existing road with elevated depths and velocities; regrading to slopes required for accessibility and fire apparatus, widening and paving this area with proper outsloping should allow the flow to mix with the other overbank flow from Clear Creek and approach depths and velocities similar to the adjacent overbank areas (Figure 4 and Appendix B). A summary of modeled water depths and velocities anticipated for the Proposed Action elements within the Regulatory Floodplain is provided in Table 3.

Table 3. Anticipated Water Depth and Velocity at the Regulatory Flood for the Proposed Action

Proposed Action Element	Modeled Water Depth (feet)	Modeled Water Velocity (ft/s)
6 - Construction of new arbor	Up to 5	< 1
7 - Expansion of parking	Up to 5	Up to 5
9 - Construction of fire road – stubs / connectors in regulatory floodplain	Up to 5	Up to 5
11 - Regrading roads and outsloping banks on roads and near new buildings	Up to 10	Up to 5
12 - Construction of new amphitheater	Up to 4	Up to 3

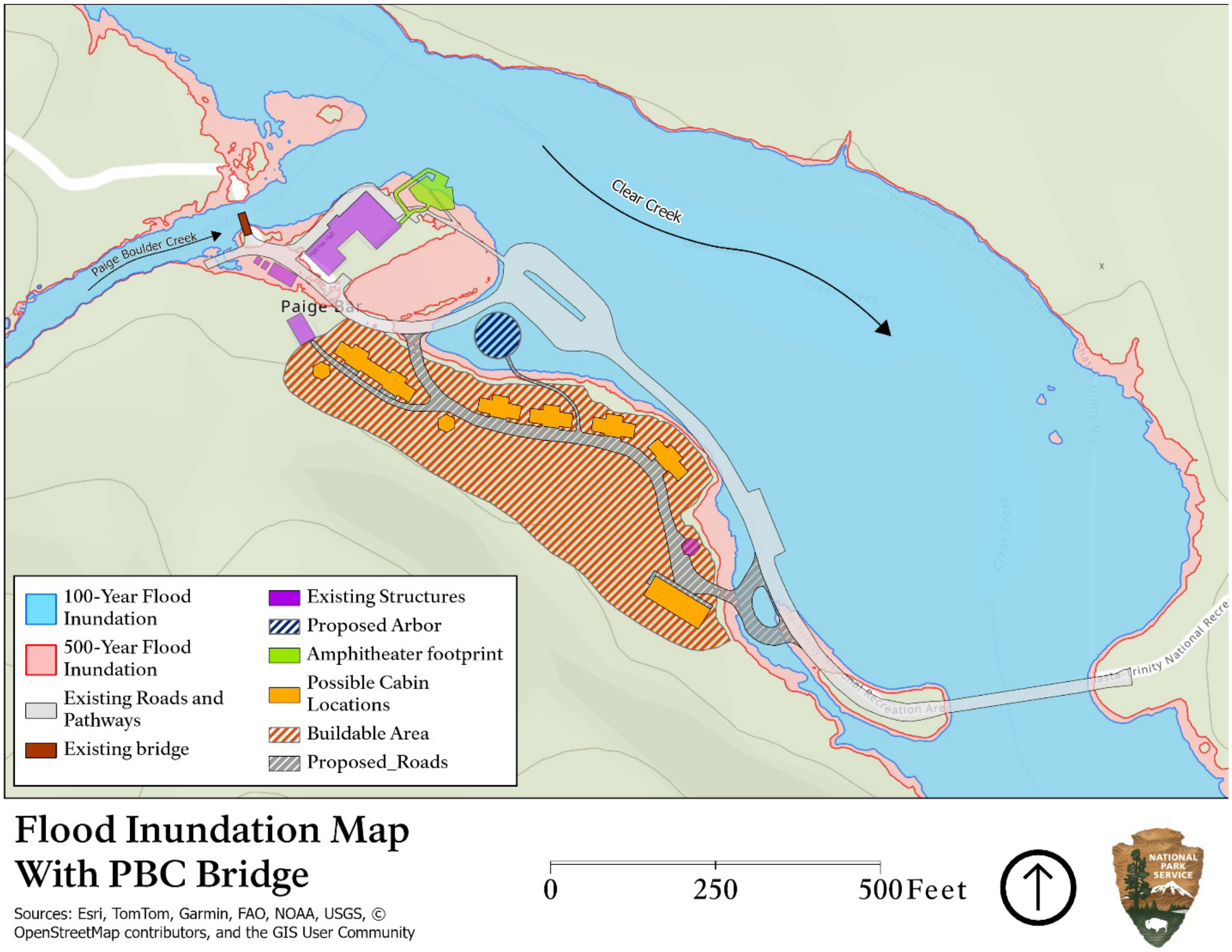


Figure 5. 100- and 500-Year Flood Inundation Areas with PBC Bridge in Place.

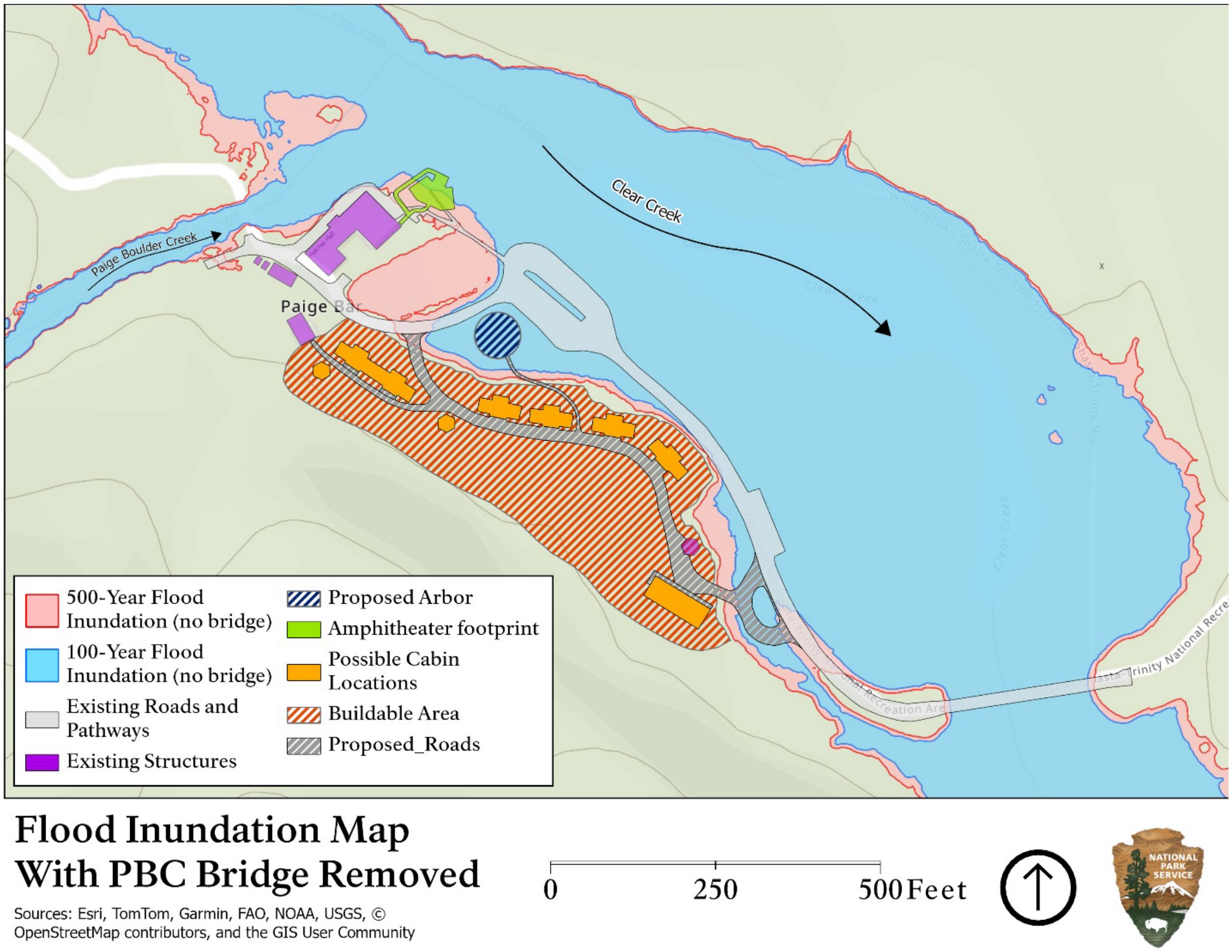
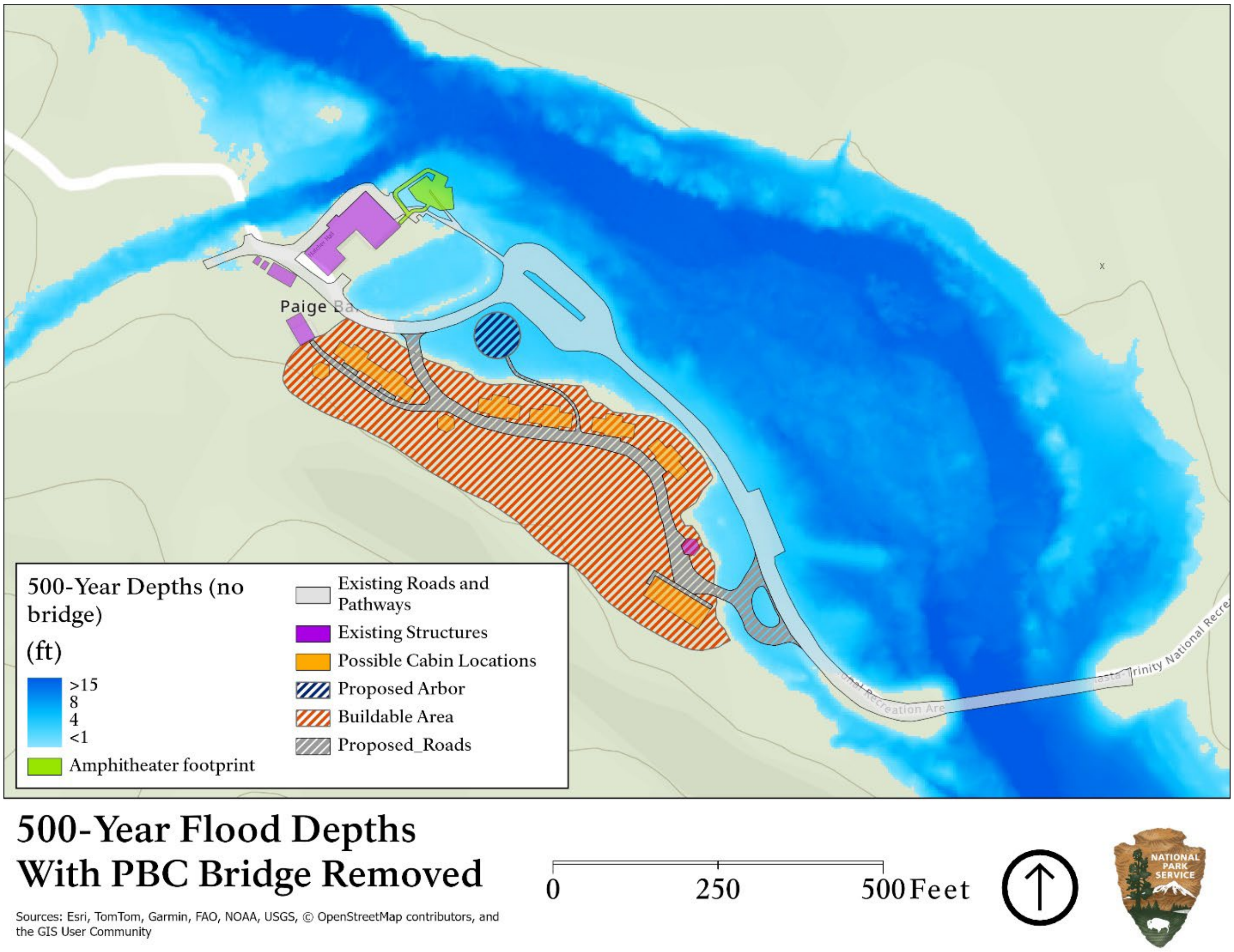


Figure 6. 100- and 500-Year Flood Inundation Areas with PBC Bridge Removed.



Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Figure 7. 500-Year Flow Depths with PBC Bridge Removed.

3.2 DESCRIPTION OF SITE-SPECIFIC FLOOD RISK

The majority of the WES footprint is outside the 500-year inundation extent and thus the impact to floodplain, geomorphic, and hydrologic processes is generally considered minimal. The preponderance of proposed, new construction is outside the 500-year footprint and would not impact physical processes beyond the existing, baseline conditions. At extreme flows the existing road and parking lot have the potential to capture and channelize flow into a narrower flowpath, which could potentially exacerbate erosion along the road and nearby banks. Flow depths and velocities along the road are expected to decrease relative to model results after the proposed regrade and widening of the road and outslope banks (Figure 4). The existing and new proposed roads are being widened/constructed to a minimum of 20-feet to accommodate fire apparatus, and the regrade will meet slope requirements for accessibility and fire. Proposed regrade contours were not incorporated into the hydraulic model and a quantitative assessment of changes in flow depth and velocity post-regrade is not available. However, road improvements are expected to decrease flow concentration along the road as illustrated in model output and allow for increased mixing with other Clear Creek overbank flood areas. This should lead to decreased flow depths and velocities along the road and have minimal change to hydraulics within Clear Creek and adjacent overbank areas.

The risk to property, infrastructure, and buildings is minimal as the majority are outside the 500-year floodplain, particularly with the removal of the PBC bridge and reducing overbank flow near building 723 and Hatcher Hall. There may be risk to Hatcher Hall from stream bank erosion along PBC. Bank armor and stream bank stabilization are currently being evaluated as an option for additional protection.

The infrastructure most at risk during an extreme flood are the existing road, proposed amphitheater and proposed arbor – class I actions. Regrading the road and outsloping the banks should help minimize flood damage, but it is reasonable to expect some erosion and damage to the existing road at a 500-year flow event. The arbor is expected to withstand mild flood pressure due to its open-air construction without walls or other building elements readily damaged by water. Furthermore, the arbor would be a relatively low-cost element to repair or replace if damaged in a large flood. The pond, which is proposed for some renovation and recontour (including steepening the bank and increasing the overflow elevation near the west edge towards the buildings), is predicted to connect to flood flows in Clear Creek at a 500-year event (but not at a 100-year flow). Depths and velocities of flows connecting to the pond are low, and potential impacts to the pond other than egress of aquatic organisms and nutrients with Clear Creek are deemed minimal.

The proposed amphitheater and approach paths are in the footprint of an old concrete amphitheater that was significantly deteriorated and demolished in 2024. This footprint is located entirely in the 500-year floodplain and partially in the 100-year floodplain (Figures 5 and 6). A suitable alternative location for the amphitheater is not available on the WES grounds. The entire amphitheater structure and pathways are proposed to be constructed with concrete, with metal railings along the paths and stairs. The concrete structure is expected to largely withstand the predicted flow depths (<1 to 4 ft) and velocities (<1 to 3 ft/s) of a 500-year flow event and present minimal risk of requiring repair beyond cleaning up debris and sediment deposited from flood flows. The proposed amphitheater more or less follows grade of the terrace bank extending from Clear Creek, thus it does not protrude excessively above ground as the higher elevation seats move further up the bank. The existence of a concrete structure within the floodplain would impose a similar geomorphic impact to the river bank as hardening or armoring with rock, at a bank elevation between the 100-year and 500-year inundation stages. The proposed amphitheater has shape similar to a trapezoid like footprint, increasing in width with distance away from the river channel and stage. At its narrowest point and closest proximity to the river channel, the proposed amphitheater would armor about 40 feet of bankline and at its widest point (furthest away from the channel) about 100 feet of bank would be hardened. The impacts of this bank hardening are expected to influence localized scour and erosion in the immediate vicinity of the amphitheater, but are not expected to influence rates of migration or scour along the broader 1,400 ft long meander bend on clear Creek that forms the terrace and floodplain where WES is located.

Primary buildings serving WES, including Hatcher Hall, kitchen facilities, sleeping cabins, and administration buildings are outside both the 100 and 500-year floodplains. Thus, the immediate human health and safety risk is minimal. Since the majority of structures at WES are above the 500-year flood level, people would generally not be forced to evacuate during a flood; although, they likely would have evacuated long before Whiskeytown Dam spilled due to early warnings whenever a spill event does occur. The primary egress into and out of WES is the bridge over Clear Creek which is above the 500-year flow. Vehicles would primarily maintain access to this bridge via the new proposed road southwest of the new cabins. Vehicles would have to cross one stretch of inundated road near the south end of WES. Regrading of the road in this area will decrease flood depths and potentially eliminate some inundated areas. Using the existing topography flow depths at a 100-year flow are about 1 foot or less and velocities less than 0.5 ft/s. However, at a 500-year flow with existing topography, flow depths are 3 to 4 feet and peak velocities approach 6 ft/s. Under this scenario, vehicles would likely not cross, and people would need to walk around the inundated portion of the road and cross the Clear Creek bridge on foot.

A flood risk analysis associated with Whiskeytown Dam failure was not performed as part of this FSOF. However, BOR assessed the failure modes, including static, seismic, and hydrologic and their exceedance probability in a 2006 Whiskeytown Dam Issue Evaluation Study. The failure modes, exceedance probabilities, and return intervals are summarized in Table 4, as cited in BOR 2008. The potential hydrologic failure modes are overtopping and breach of the dam or dike during a large flood event, which causes the dam or dike to overtop and piping of the embankment due to the higher reservoir water surface elevation. The dam is overtopped during a Probable Maximum Flood and is expected to lead to breach and dam failure (BOR, 2008).

Table 4. Summary of expected Whiskeytown Dam failure risks from 2006 Issue Evaluation Study (as cited in BOR 2008).

Failure Mode	Expected Annual Probability of Failure	Return Interval (yrs)
Static	0.0000018	555,556
Seismic	0.0000002	5,000,000
Hydrologic	0.00012	8,333

4 FLOODPLAIN IMPACT MITIGATION MEASURES

Selected proposed activities within the 500-year floodplain should positively impact physical processes, including: 1) removing the PBC bridge; 2) constructing a new footbridge with abutments outside the PBC bankfull channel and a bridge soffit that is above the 500-year water elevation; and 3) regrading the existing road and outsloping the road bank so that flow concentration is reduced. Removing the PBC bridge and its abutments that are currently within the channel would reduce the potential for debris flow plugging, decrease the scouring within PBC, and in general improve geomorphic processes within PBC.

Extreme flood flows on Clear Creek can occur when Whiskeytown Dam spills through the glory hole. These events are generally known by the BOR well in advance and should provide significant advance warning to evacuate WES anytime a spill is going to occur. Primary WES buildings (i.e., sleeping quarters, gathering halls, administrative buildings) are located above the 500-year flood level, and substantial ground exists at higher elevations to further retreat beyond 500-year flood levels should that be necessary.

5 SUMMARY

The National Park Service has determined that implementing the proposed action at WES does not significantly impact floodplain processes and there is minimal risk to infrastructure or human health and safety. Implementing the proposed action to rebuild the WES campus, including rebuilding cabins and an amphitheater, renovating Hatcher Hall, and other campus improvements is needed to continue one of the longest running outdoor education programs in the National Park System. This outdoor education program is of high importance to multiple organizations, such as NPS, SCOE, and WESC. An Environmental Assessment is in process to ensure that all actions associated with this project are in compliance with federal laws and DOI and NPS policies.

6 REFERENCES

Anderson. 2022. Paige-Boulder Creek and WES Camp Flood Risk Evaluation Report. NPS, August 2022.

Bureau of Reclamation. 2006. Whiskeytown Dam Issue Evaluation – Risk Analysis, Technical Memorandum No. WHI-8130-IE-TM-2006-1, US Department of the Interior, Bureau of Reclamation, April 2006.

Bureau of Reclamation. 2008. Pilot Re-operation of Whiskeytown Dam, Technical Memorandum No. WHI-8130-IE-2008-1, US Department of the Interior, Bureau of Reclamation, January 2008.

Department of Interior Office of Environmental Policy and Compliance. 2022. Departmental Manual Part 520: Protection of the Natural Environment; Chapter 1: Floodplain Management and Wetlands Protection Policy and Responsibilities (520 DM 1).

Department of Interior Office of Environmental Policy and Compliance. 2022. Departmental Manual Part 520: Protection of the Natural Environment; Chapter 2: Floodplain Management and Wetlands Protection Program Requirements (520 DM 2).

Executive Order 11988, “Floodplain Management.” 1980. Executive Order of the President of the United States. May 28.

Gotvald, A.J., Barth, N.A., Veilleux, A.G., and Parrett, Charles (2012). Methods for determining magnitude and frequency of floods in California, based on data through water year 2006: U.S. Geological Survey Scientific Investigations Report 2012–5113, 38 p., 1 pl., available online only at http://pubs.usgs.gov/sir/2012/5113/

Hydrologic Engineering Center (HEC). (2024, March). River Analysis System (HEC-RAS), Version 6.6. US Army Corps of Engineers (USACE).

National Park Service (NPS). 2003. Director’s Order 77-2: *Floodplain Management*. Washington Office, Washington, D.C.

National Park Service (NPS). 2025. Procedural Manual 77-2: *Floodplain Management*. Washington Office, Washington, D.C.

APPENDIX A

RESPONSE TO PUBLIC COMMENTS

Comment #1:

"*Whiskeytown NRA and the NEED Camp experienced a huge debris torrent in 1997. Climate change will probably impact the area again with extreme flooding. Given the tragic loss of life caused by flooding in Texas during the summer of 2026 including twenty-seven children and counselors in the disaster in Kerr County, which was caused by slow-moving thunderstorms perhaps locate student cabins back to the original sites which is in higher ground. Safety above all else."* – provided by Clinton Kane on January 23, 2026

Reply to comment #1:

Thank you for the comment and attention to safety! The elevation of the proposed buildable area for the cabins is at a minimum of 2 feet above the inundation extent for a 500-yr flood event. This elevation, greater than a 500-year flood, represents the edge of where the cabins could first become wet. Flows and water depths would need to be several feet higher than that to present depths and velocities that would present a direct risk to students and staff within or near the cabins in the proposed buildable area. In order to produce a flood flow far greater than a 500-year flood, a phenomenal confluence of meteorological events would need to occur; a convergence that would be apparent in ongoing and forecasted conditions that would provide ample time to initiate and complete an evacuation of WES. In addition, moving the cabins to the back (west) edge of the same terrace where they are proposed would increase the fire risk to the cabins because of the decreased defensible space amongst the trees that line the west edge of the terrace.

Comment #2:

"Thank you for preparing the Environmental Assessment and for inviting public feedback. I appreciate the depth of detail and the thoughtful consideration given to wildlife, water resources, and cultural resources throughout the document.

During a recent tour of the property, I noted several large oak trees on or near the proposed development areas. While I understand it is the intent of the National Park Service to preserve these trees, I did not find many specific references to them in the EA beyond page 14 ("Cabins would be located out of the drip line of oaks"). Because oaks are a keystone species that provide shelter, food, and shade for more than 100 other species, it may be helpful for the final document to more explicitly describe how these mature oaks will be protected during grading, construction, and site layout. Even a brief clarification would strengthen the reader's understanding of how these important trees are being considered.

I also had a few suggestions for improving clarity in Appendix F. On page 113, the statement "The old bridge over PBC will be replaced with a modern footbridge as part of a separate project and is not evaluated as part of this FSOF" was somewhat confusing. Because the EA elsewhere describes the *removal of the old bridge as a key step in reducing flood risk, mentioning a future replacement project that is outside the scope of this EA may introduce unnecessary ambiguity. It may be worth clarifying whether this reference is needed in the appendix.*

Thank you again for the opportunity to comment and for the careful work that has gone into this plan. The Whiskeytown Environmental School is an important educational and ecological resource for our region, and I appreciate the thoughtful approach reflected in the EA." – provided by Holly J. White-Wolfe on February 7, 2026

Reply to comment #2:

Thank you for your comment! This response focuses on the portion of the comment pertaining to the removal of the old bridge on PBC and construction of a future footbridge. The preferred alternative in the EA includes both the removal of the old vehicle bridge and future construction of a new footbridge. The modeling in the FSOF assesses the hydraulic and flooding impacts of removing the existing bridge, in part because the existing bridge does constrict the channel and increases flood extent at high flows in the vicinity of PBC. However, the FSOF does not assess the proposed footbridge because engineering designs have not been developed. Thus, it is not possible to determine if the proposed footbridge is within the regulatory floodplain, nor can the hydraulic impacts of the proposed footbridge be assessed. Once designs are developed, if the footbridge is within the regulatory floodplain, we will develop a separate FSOF for that project. We have developed additional language within the FSOF (pg 6) to help clarify the points you raise:

The old bridge over PBC will be replaced with a modern footbridge as part of a future project. The hydraulic effects of removing the old vehicular bridge are included in the modeling results presented herein, but the proposed footbridge is not evaluated as part of this FSOF. After engineering designs are complete, if the replacement footbridge is determined within the regulatory floodplain a separate FSOF will be developed.

APPENDIX B

Addendum to Paige-Boulder Creek and WES Camp Flood Risk Evaluation Report

Addendum to Flood Risk Evaluation
Whiskeytown Environmental School Rebuild

Prepared for: Whiskeytown National Recreation Area
Prepared by: Hannah Karlsson – Hydrologist
& John Wooster – Hydrologist/Geomorphologist
Water Resources Division (WRD)
National Park Service – Natural Resource Stewardship and Science

September 30, 2025

INTRODUCTION

This report serves as an addendum to the Flood Risk Evaluation Report (Anderson, 2022) to inform the Floodplain Statement of Finding (FSOF) for the Whiskeytown Environmental School (WES) Rebuild project (Project). The Water Resources Division (WDR) adapted the hydraulic model developed for the Flood Risk Evaluation Report (Anderson, 2022) to determine the 100- and 500-year flood inundation areas at the Project site.

HYDROLOGY

The model used for the Flood Risk Evaluation Report (Anderson, 2022) focused on flood hazard analysis at WES, specifically evaluating flood risk from Paige-Boulder Creek (PBC), a tributary of Clear Creek. Peak flow statistics for the PBC tributary were estimated using the USGS StreamStats tool, which applies regional regression estimate methods (Gotvald et al., 2012) to provide streamflow estimates at ungagged sites in California.

In 2018, the PBC watershed was significantly impacted by the Carr fire. Anderson (2022) assessed various scenarios for the flood flows at PBC, incorporating post-fire burn severity and bulking factors. Given that approximately seven years have passed since the fire, the burn severity and bulking effects have diminished. According to the "Sediment/Debris Bulking Factor and Post-Fire Hydrology" paper (Gusman, 2011), the burn severity factor typically declines to zero within 7.5 years. Therefore, the updated model for the 100- and 500-year flood events does not apply a burn severity or bulking factor. However, it is important to note that the Flood Risk Evaluation Report acknowledges the Project area is susceptible to frequent wildfires, and the bulking factor flows can be referenced in the *Flood Risk Evaluation* Report (Anderson, 2022) if needed.

Clear Creek is primarily regulated by Whiskeytown Dam. As such, the flows on the mainstem of Clear Creek were assumed to remain at the upper end of the average daily flow rate for all scenarios in the prior hydraulic model. To assess floodplain inundation along Clear Creek, the model's hydrology was updated to reflect the 100- and 500-year return period flows for both PBC and Clear Creek.

The nearest historic gage to the project site was USGS Gage 11372000, located on Clear Creek near Igo, CA. This gage collected discharge and peak streamflow records for 84 years from 1941 through 2024. The gage is located approximately five river miles downstream from the Project site. The project site on Clear Creek is approximately two miles downstream of Whiskeytown Dam. The dam, constructed by the Bureau of Reclamation between 1960 and 1963, regulates stream flow in the area. Data from the regulated flow record (1963 to 2024) was used to calculate the 100- and 500-year return periods flows, employing the Log Pearson III distribution.

The highest recorded instantaneous peak flow at this gage, post-dam construction, occurred on March 3, 1983, with a flow of 18,400 cubic feet per second (cfs). The 100- and 500-year flows calculated at this site were 18,100 and 26,600 cfs, respectively. Tributary contributions between the project site and the gage location are small and often do not sync with the primary floods released from Whiskeytown Dam. Therefore, the peak flows recorded at the gage are considered representative of the potential flood flows at the project site. The 100- and 500-year flood flows for Clear Creek and PBC are summarized in Table 1.

Table 1. Flood Flows

Probability (AEP)	Return Periods (years)	Clear Creek at Project Site (cfs)	Paige-Boulder Creek at Project Site (cfs)
1.0%	100	18,100	1,990
0.2%	500	26,600	2,570

HYDRAULICS

MODEL DEVELOPMENT

The hydraulic model and flood inundation map were developed by refining the previously established U.S. Army Corps of Engineers Hydraulic Engineering Center River Analysis System (HEC-RAS) Version 6.6 two-dimensional (2D) model, initially created by Anderson (2022).

Topographic Data

The Flood Risk Evaluation model (Anderson, 2022) terrain data was used in the updated hydraulic analysis for the project area. The terrain data was obtained from a 2019 Lidar from the USGS data source. The DEM used is a 0.5 meter (~1.64 ft) resolution LiDAR data set. The data was collected by flights between 10/07/19 and 08/15/20. Therefore, low flows in the river cannot be assumed for this dataset. Topobathy data was not available for this project location.

Model Refinement

The model upstream boundary condition on Clear Creek was extended approximately 500 feet to improve the representation of the flood inundation and flow patterns upstream of WES and the PBC confluence. Additionally, the downstream boundary condition was extended approximately 700 feet, which ensured that the roadway bridge crossing southeast of WES did not influence the hydraulic calculations at the boundary. The bridge deck and pier on Clear Creek was incorporated into the model, using Lidar return point from the bridge deck, with an assumed deck depth of 6.67 feet and a pier width of 6.25 feet based on information from the Bridge inspection reports (FHWA, 2011). Further model refinement included adding more breaklines to capture shallow overbank flows, and the 2D flow area was expanded to encompass the full extent of the 500-year flood inundation.

Roughness Coefficients

The roughness coefficient along the channel was assigned a manning's n values of 0.035 and the overbank area was modeled with a manning's n value of 0.08. The roughness coefficient for the existing and proposed roadway and parking area surrounding the WES site was assigned a Manning's n value of 0.016 (Chow, 1959).

Boundary Conditions

The 100- and 500-year flood discharges, as presented in Table 1, were applied as the upstream boundary conditions. A normal depth boundary condition was used for the downstream boundary condition of the 2D flow area, with normal depth calculated from measured channel slope derived from the Digital Elevation Model (DEM) along the downstream boundary condition.

HYDRAULIC RESULTS

The objective of the hydraulic model was to evaluate potential flood impacts for the 100- and 500-year flood events at the WES site at the proposed rebuild project. Preliminary locations for the proposed construction were provided by WHIS park. A key component of the proposed project is the removal of Paige Boulder Creek (PBC) bridge. To assess the flood hazard improvements resulting from the bridge removal, the 100- and 500-year flood events were modeled for both pre- and post-project conditions—both with and without the PBC bridge.

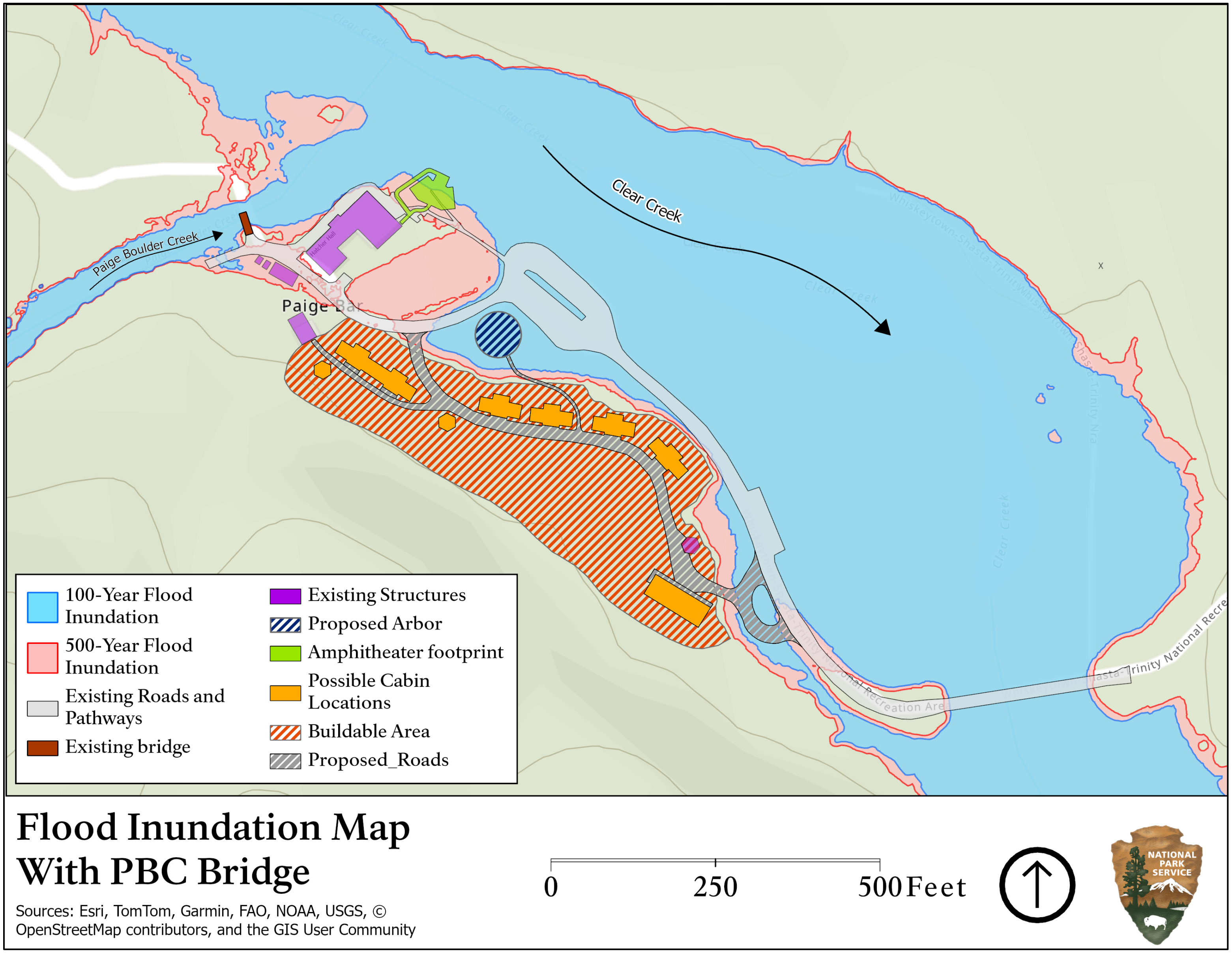
The flood inundation areas for the 100- and 500-year, with and without the bridge, are shown in Figure 1 and Figure 2, respectively. The 100-year flood depths for both pre- and post-project conditions are shown in Figure 3 and Figure 4, respectively. Similarly, the 500-year flood depths for the pre- and post-project conditions are shown in Figure 5 and Figure 6, respectively.

The results indicate that during the 500-year flood event, flows along PBC overtop the banks upstream of the bridge (see Figure 5) and inundates some administrative buildings and the southwest edge of Hatcher Hall on the right bank. However, when the bridge is removed, the hydraulic model shows that the 500-year flood flow along PBC is mostly contained within the channel (see Figure 6). Hatcher Hall, the existing building closest to the PBC bank, is also at risk of flooding. The water surface elevation for the 100- and 500-year flood events along the right bank northwest of Hatcher Hall is approximately 5 and 2.5 feet, respectively, below the base of the building. In terms of flood extent along Clear Creek, the 100-and 500-year flood inundation areas extend beyond the parking area at WES, potentially impacting the proposed site.

Flood velocities for the 100-year flood event under pre- and post-project conditions are shown in Figure 7 and Figure 8, respectively. For the 500-year flood event the velocity maps for both the pre- and post-project conditions are shown in Figure 9 and Figure 10, respectively. The results demonstrate a significant reduction in velocities on the floodplain, particularly in the overbank areas and within the vegetated zones along the creek banks and upland areas.

CONCLUSION

The hydraulic analysis confirms that the proposed removal of the Paige-Boulder Creek bridge results in a reduction in flood hazard along the creek. Specifically, the removal of the bridge improves the containment of 500-year flood flows within the channel, reducing the potential for flooding outside the defined creek banks. Additionally, flood velocities are substantially reduced in the overbank areas and vegetated zones, which may mitigate potential erosion and sediment transport. Despite these improvements, the 100-year flood still extends into the WES parking area, which could require further design considerations to mitigate flood impacts on the proposed development. Overall, the bridge removal is expected to significantly improve floodplain management in the area.



Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Figure 1. 100- and 500-Year Flood Inundation Areas with PBC Bridge in Place.

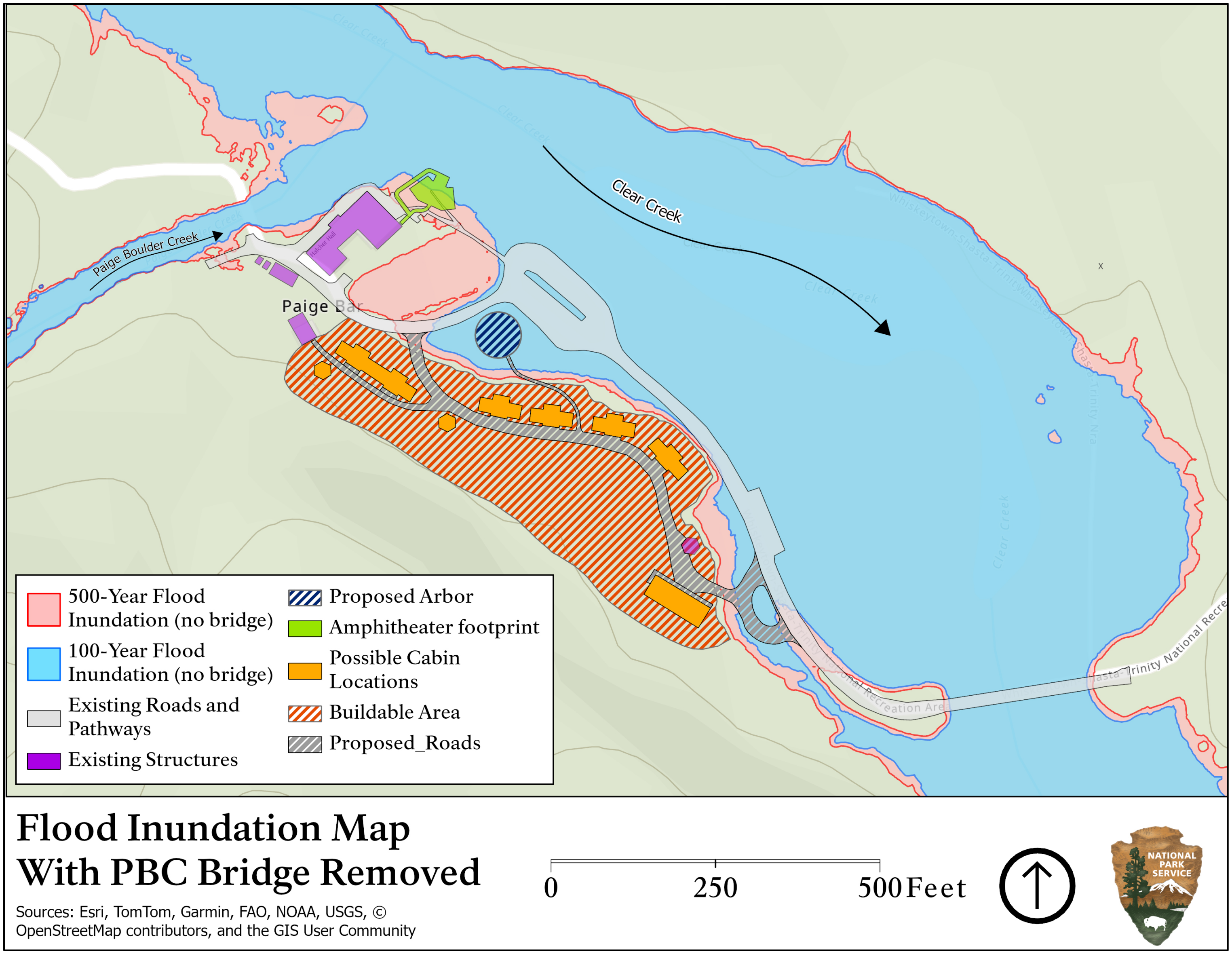
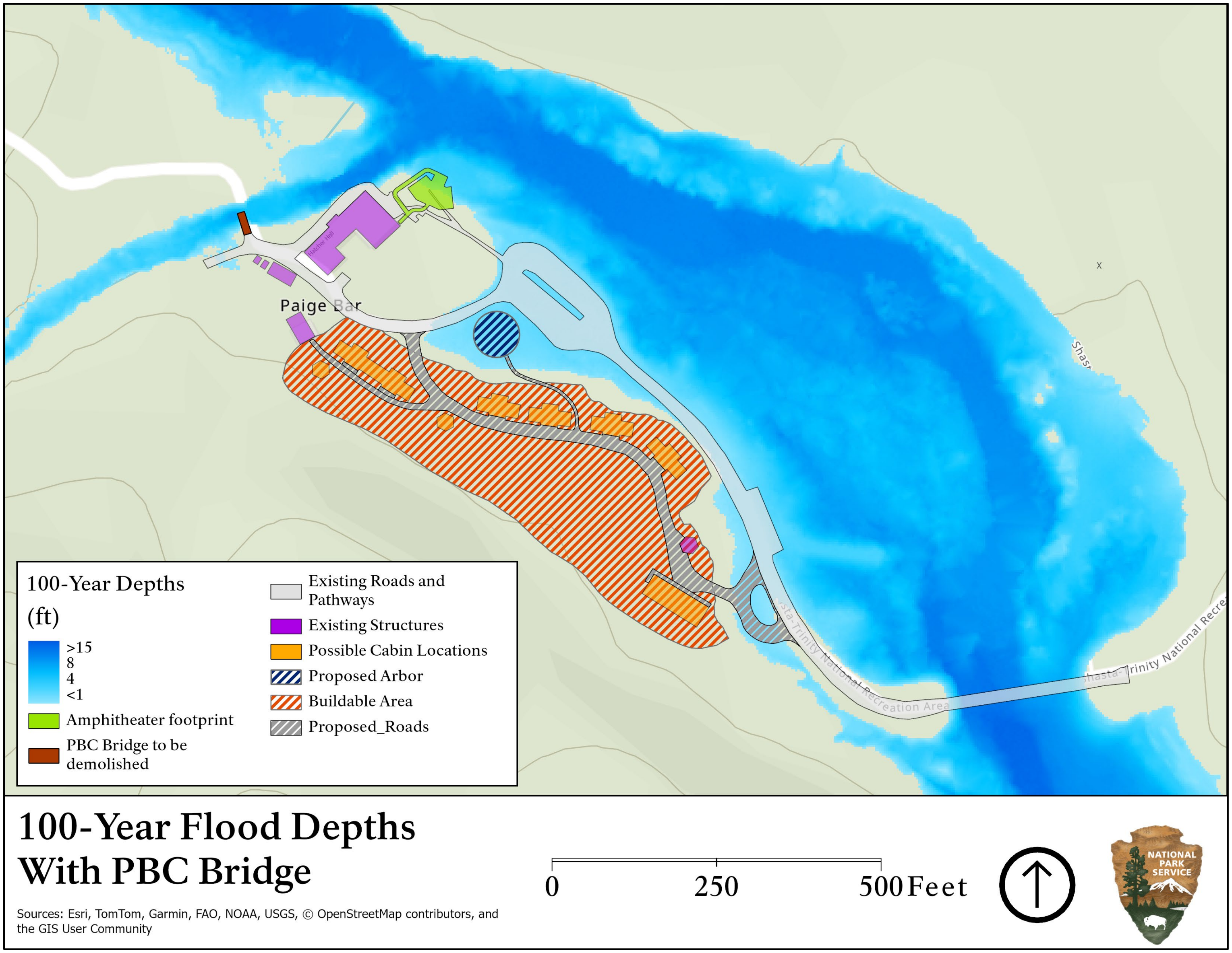


Figure 2. 100- and 500-Year Flood Inundation Areas with PBC Bridge Removed.



Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Figure 3. 100-Year Flow Depths with PBC Bridge in Place.

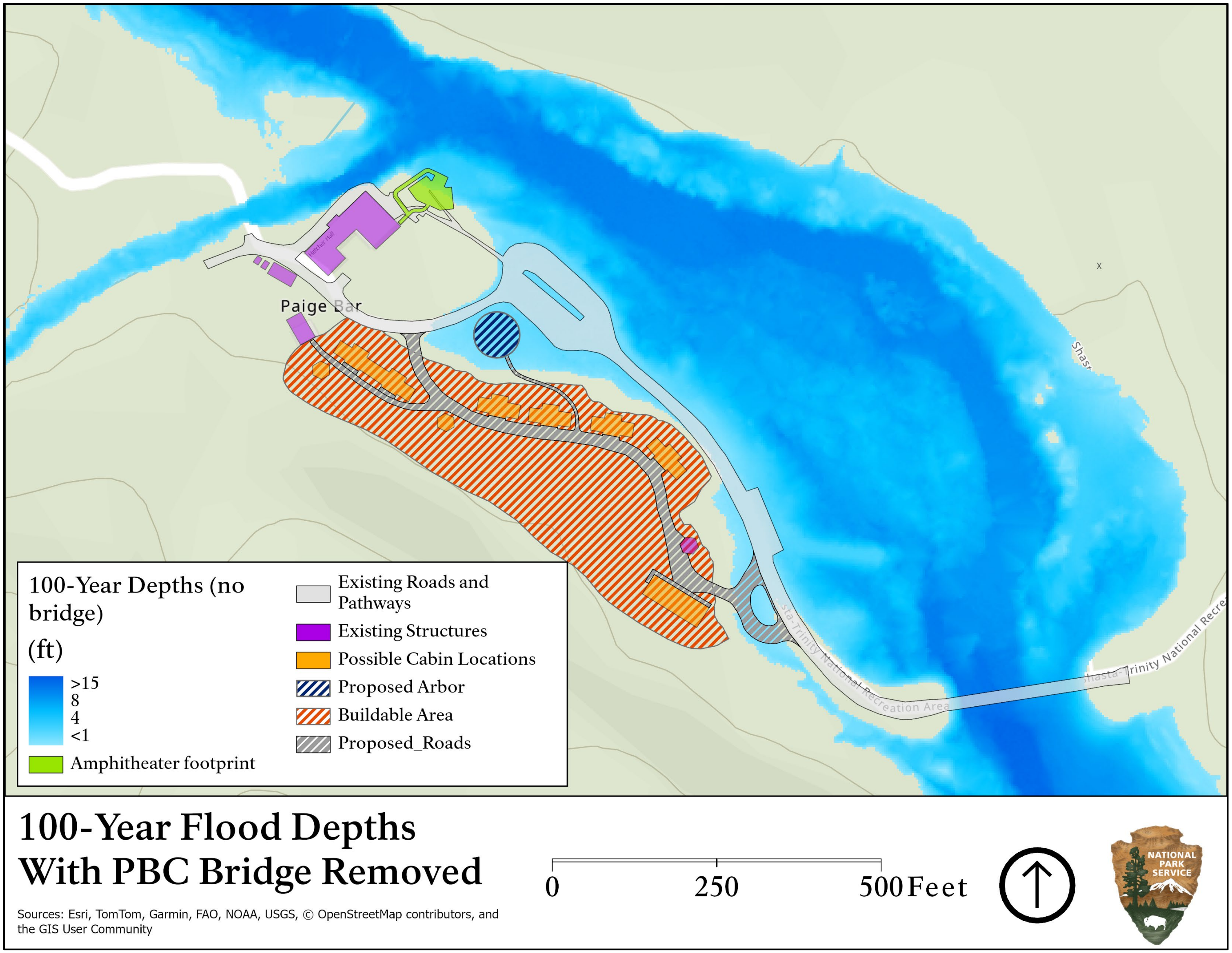


Figure 4. 100-Year Flow Depths with PBC Bridge Removed.

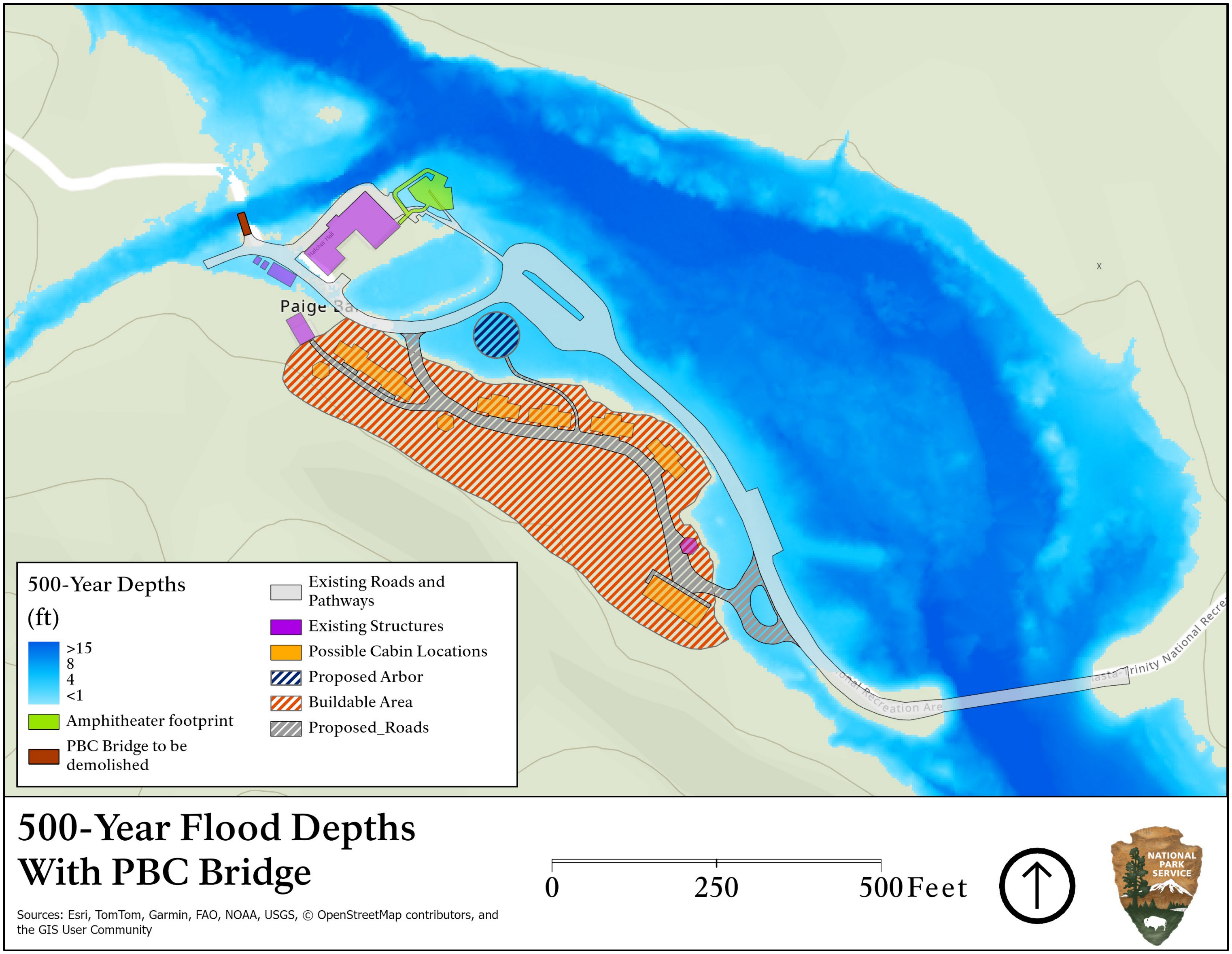


Figure 5. 500-Year Flow Depths with PBC Bridge in Place.

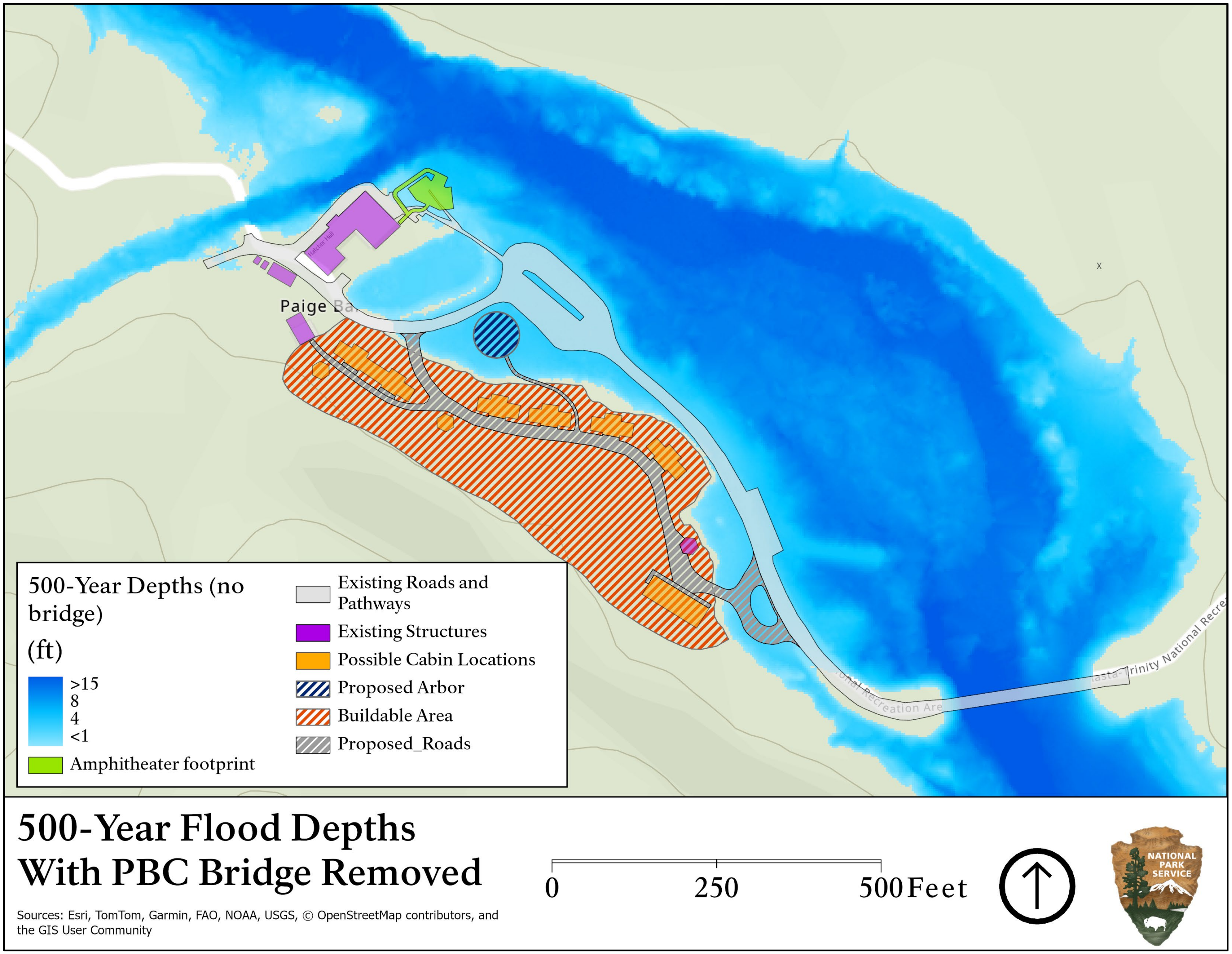
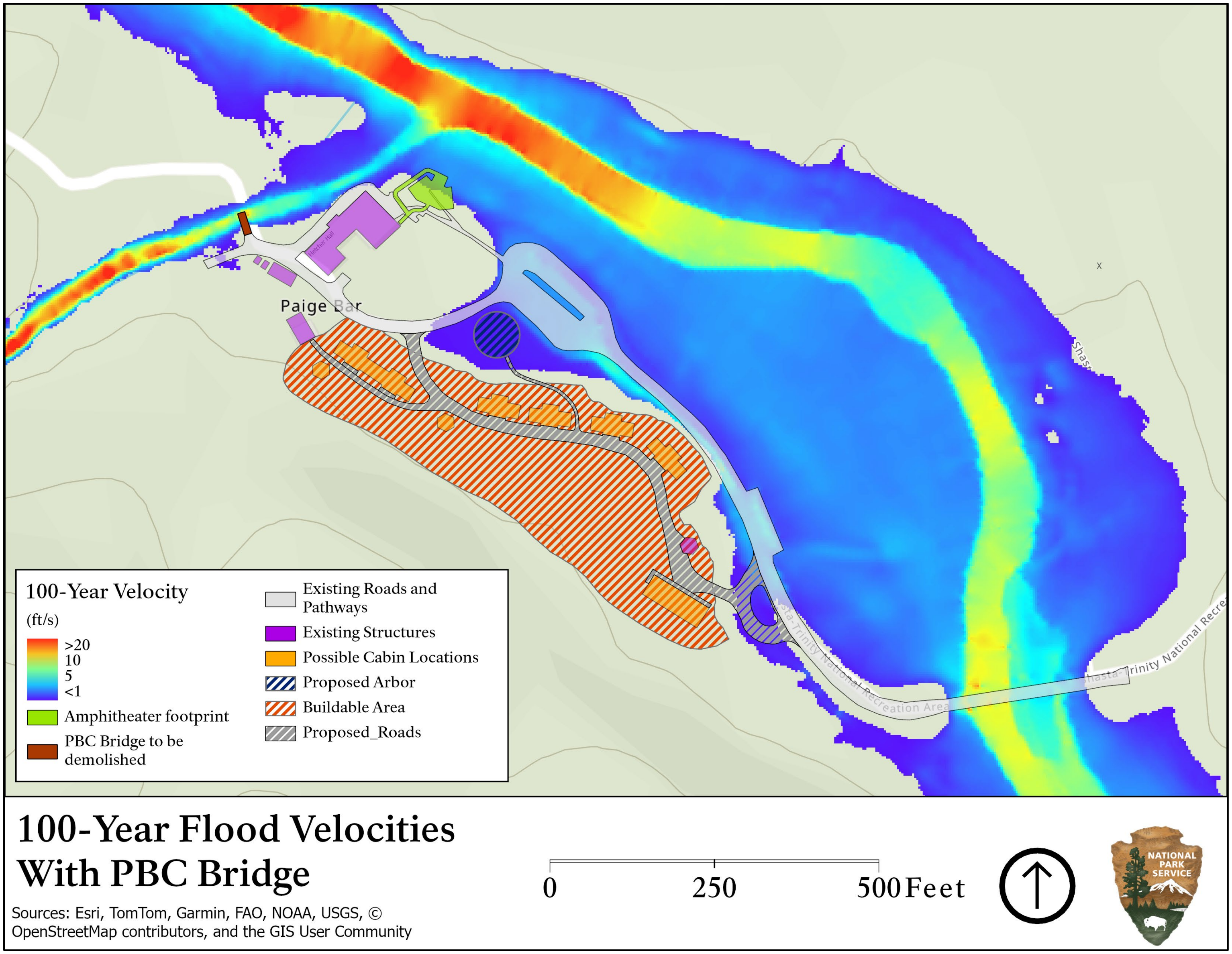


Figure 6. 500-Year Flow Depths with PBC Bridge Removed.



Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Figure 7. 100-Year Flow Velocities with PBC Bridge in Place.

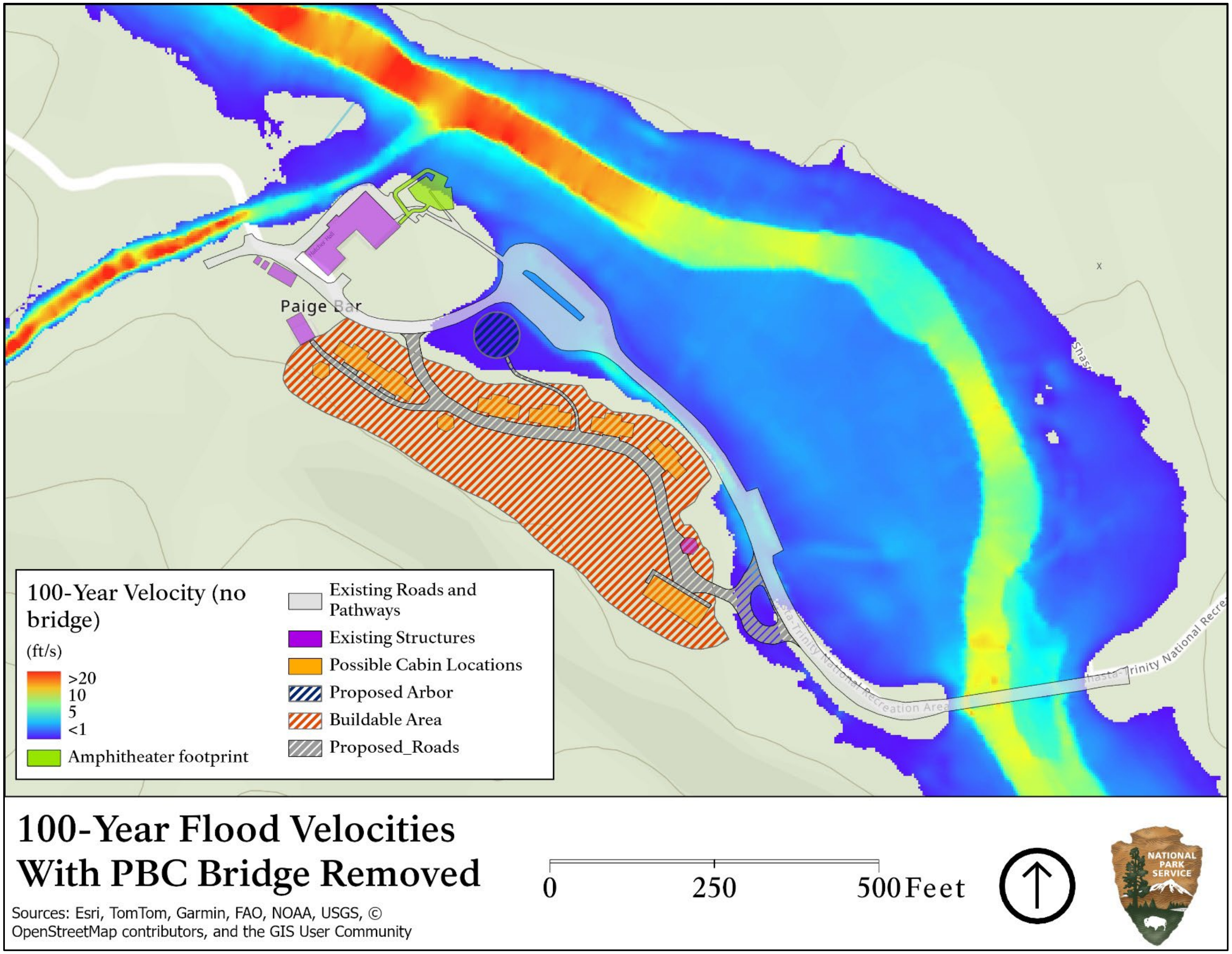


Figure 8. 100-Year Flow Velocities with PBC Bridge Removed.

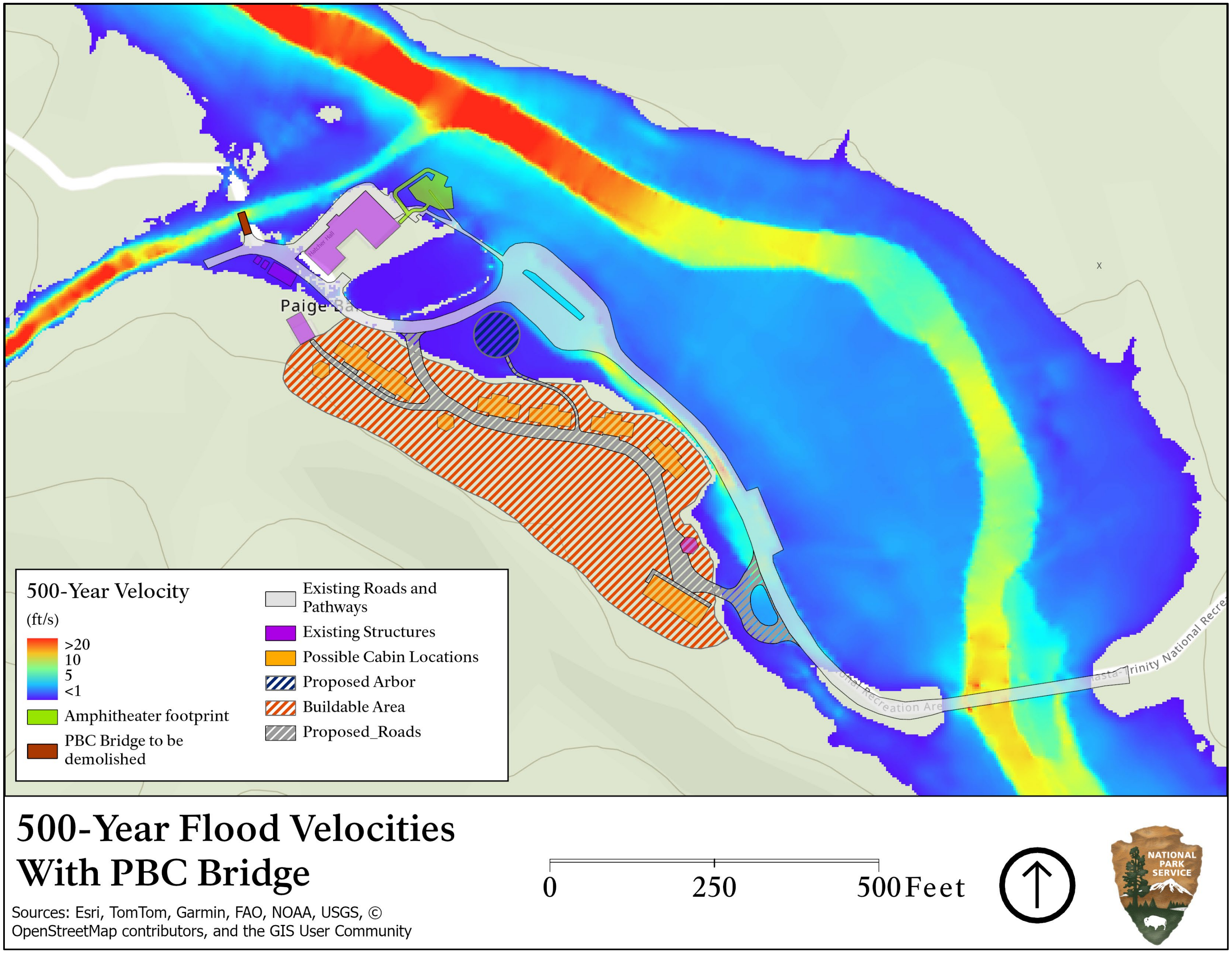
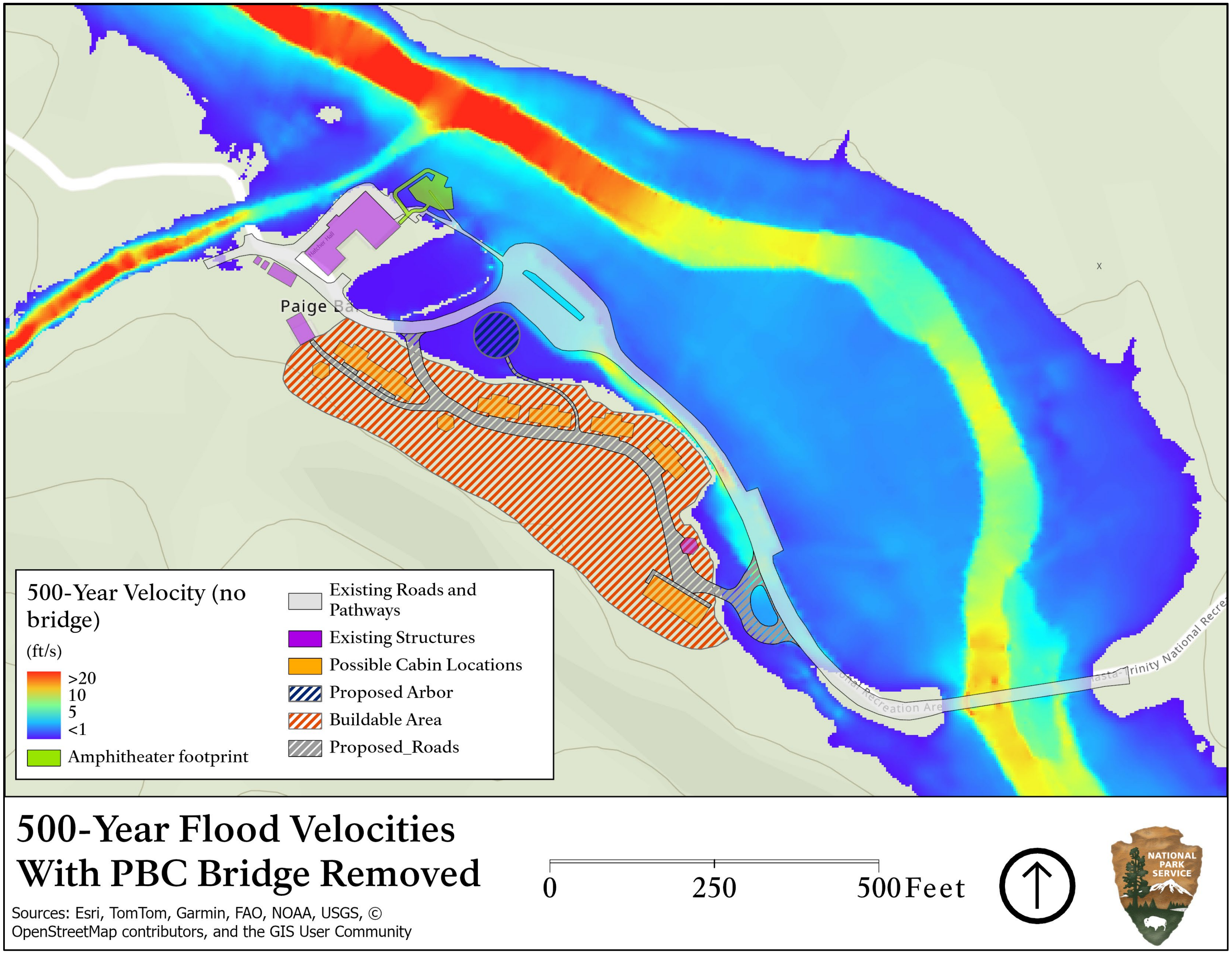


Figure 9. 500-Year Flow Velocities with PBC Bridge in Place.



Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Figure 10. 500-Year Flow Velocities with PBC Bridge Removed.

REFERENCES

Anderson. 2022. Flood Risk Evaluation Report. NPS

Federal Highway Administration. 2011. Bridge Inspection Report, Lower Clear Creek Bridge N.E.E.D Camp Road Over Clear Creek Whiskeytown National Recreation Area. Structure No. 8750-001P. Inspection Type: Routine. Inspection Date: 7/30/11.

Gotvald, A.J., Barth, N.A., Veilleux, A.G., and Parrett, Charles. 2012. Methods for determining magnitude and frequency of floods in California, based on data through water year 2006: U.S. Geological Survey Scientific Investigations Report 2012–5113, 38 p., 1 pl., available online only at http://pubs.usgs.gov/sir/2012/5113/.

Gusman, A.J., Teal, M.J., Todesco, D. and M. Bandurraga. 2011. Sediment/Debris Bulking Factors and Post-Fire Hydrology for Ventura County. Final Report, WEST Consultants Inc., San Diego, California. USGS, Gage 11372000, //waterdata.usgs.gov/nwis/inventory/?site_no=11372000&agency_cd=USGS

Chow, V.T. 1959. Open Channel Hydraulics. McGraw-Hill, New York.

Gotvald, A.J., Barth, N.A., Veilleux, A.G., and Parrett, Charles. 2012. Methods for determining magnitude and frequency of floods in California, based on data through water year 2006: U.S. Geological Survey Scientific Investigations Report 2012–5113, 38 p., 1 pl., available online only at http://pubs.usgs.gov/sir/2012/5113/.

U.S. Army Corps of Engineers. 2024. *Hydraulic Software, Version 6.6*. U.S. Army Corps of Engineers, Hydrologic Engineering Center River Analysis System (HEC-RAS).

U.S. Geological Survey. 2019. The StreamStats program, online at *https://streamstats.usgs.gov/ss/*, accessed on 3/26/2025.