Bushy Lake Draft Conceptual Restoration Plan

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Abbreviations

AA	Assessment Area
ARPP	American River Parkway Plan
Cal Expo	California Exposition and State Fair
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFGC	California Fish and Game Code
CFS	Cubic feet per second
CNDDB	CDFW's California Natural Diversity Database
CNPS	California Native Plant Society
CRAM	California Rapid Assessment Method
CRP	Conceptual Restoration Plan
CSUS	California State University, Sacramento
CWA	Clean Water Act
ESA	Federal Endangered Species Act
°F	Degrees Fahrenheit
IPaC	USFWS Information for Planning and Conservation tool
MBTA	Migratory Bird Treaty Act
MCV	Manual of California Vegetation
NNT	Non-native Turtle
NPPA	California Native Plant Protection Act
NRCS	Natural Resource Conservation Service
NRMP	Natural Resource Management Plan
NWPT	Northwestern Pond Turtle
Parkway	American River Parkway
PG&E	Pacific Gas and Electric
Project	Bushy Lake Eco-Cultural Restoration Project
RWQCB	Regional Water Quality Control Board
SAA	Streambed Alteration Agreement
SAFCA	Sacramento Area Flood Control Agency
SARA	Save the American River Association
SIRIUS	Sustainable Interdisciplinary Research to Inspire Undergraduate Success
SMUD	Sacramento Municipal Utility District
SSC	CDFW Species of Special Concern
SWRCB	State Water Resources Control Board
TEK	Traditional Ecological Knowledge
TRM	Traditional Resource Management
USACE	United States Army Corp of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WCB	California Wildlife Conservation Board

NWPT	Northwestern Pond Turtle
WSRA	Wild and Scenic River Act

Acknowledgment of Funders

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1. Introduction

1.1. Purpose

Ecological restoration provides a mechanism and process to improve ecosystem functions and services to benefit humans and to expand conservation and adaptive management actions for conservation of biodiversity and sensitive plant and animal species. The purpose of the Bushy Lake Eco-Cultural Restoration Project (Project) is to restore culturally significant plant and wildlife species within an urbanized and disturbed parkway subjected to frequent wildfires. Restoration planning efforts were based on historic ecology, Traditional Ecological Knowledge (TEK), and Traditional Resource Management (TRM) of local Nissenan, Miwok, and Maidu tribal knowledge to inform sustainability in restoration design.

We acknowledge that the land Bushy Lake is on today was and continues to be occupied by the Indigenous people of this area, the Miwok, Maidu, and Nisenan. Recognizing their culture that is rich with spiritual ties, to the land and waters that resonate with their traditions. We thank and honor those California Native people of the Sacramento Valley and respect their sovereignty.

1.2. Goals and Objectives

The goal and objectives of the Bushy Lake Conceptual Restoration Plan (CRP) are:

1. Protect, enhance, and restore a sustainable habitat refuge for northwestern pond turtles, a California Department of Fish and Wildlife species of special concern and proposed listing as Threatened under the Federal Endangered Species Act;
    a. Revision to Goal 1: Protect, enhance, and restore habitat for biodiverse native plants and wildlife;
2. Enhance/restore the habitat function and fire resiliency by including culturally significant and fire-resilient native plants; and
3. Enhance education outreach regarding natural resources in the Parkway, specifically showcasing tribal cultural use of the Parkway.

While the focus is on restoration of the site, restoration to a historic condition is not possible due to modifications of hydrologic input flows and by the construction of levees. The desired condition is a biodiverse riparian habitat and ecosystem. This focus will, in part, rely on artificial hydrologic inputs by means of pumped water.

1.3. Eco-cultural and Riparian Restoration

Approximately 2 to 7 percent of riparian habitat remains in the Central Valley of California due to urban development, agricultural alterations to the land, and other anthropogenic activities (Vaghti and Greco, 2007; Moore et al., 2011). Consequently, restoration of riparian areas has become increasingly important as riparian loss has adversely impacted the environment and wildlife while significantly reducing cultural resources for indigenous groups (Stevens and Zaloza 2015, Hankins 2013, Seavy et al. 2009, Stevens 2004a, Smith 1977).

Riparian vegetation plays a major role in influencing biodiversity and ecosystem functions in a riparian ecosystem (Alpert et al. 1999). Resident and migratory bird species, native plants, and wildlife depend on healthy ecosystems where suitable habitats and natural resources are available (Gaines 1977). European settlements in California resulted in major environmental changes and catastrophic changes for First Nation peoples. The rich, fertile floodplains and surrounding riparian forests in the Central Valley were converted to agricultural land and urban areas (Cunningham 2010, Thompson 1977).

California is a culturalized landscape. The indigenous peoples descended from Nissenan, Miwok, Maidu, and other tribal traditions practice Traditional Fire Management through burning and other tending practices of culturally significant resources. The Project began in 2016 with planting Santa Barbara sedge or white root (*Carex barbarae*), creeping wild rye (*Elymus triticoides*), and mugwort or Kachinu (*Artemisia douglasiana*) because they are dominant understory native riparian species that are adapted to centuries of Traditional Fire Management. Restoring culturally significant understory species will support fire resiliency, habitat for native Parkway flora and fauna, and minimize the spread of invasive species.

Traditionally, Native American tribes in the Central Valley regularly burned the Sacramento landscape. Native American tribes applied fire to nearly every ecosystem type, including riparian ecosystems (Hankins 2013). The Nissenan, Miwok, Maidu, and other tribal groups utilized TRM tools, such as fire, coppicing, resource rotation, and species management, to sustainably manage cultural resources (Stevens 1999; Stevens 2003; Stevens 2004b). TRM tools, especially fire, were critical in creating heterogeneity among California vegetation, managing species distribution, and controlling intense fire by not allowing excess organic matter to build up in the soil (Hankins 2013; Stevens 1999; Stevens 2003; Stevens 2004b). However, since the displacement of native tribes and the suppression of TRM knowledge, landscapes have dramatically shifted into wildfire-prone landscapes (Hankins 2013). The management of culturally significant native plants promotes fire-resilient native vegetation in riparian areas, and enhances habitat heterogeneity beneficial for native plant species, pollinators, and wildlife (Cunningham 2010; Stevens 2004a).

Traditional Fire Management is especially important in riparian zones such as the lower American River. The lower American River parkway has been truncated and fragmented by levees and degradation of habitat; only a small portion of intact riparian habitat remain. Therefore, remnant habitats are unique and provide habitat for numerous terrestrial and aquatic species (Dwire and Kauffman 2003). Major drivers of riparian loss and degradation have been gold mining (dredging), urban development, and dam construction which significantly altered the river's hydrologic and geomorphic processes. More recently, infestation by nonnative vegetation, human-caused fires, and illegal camping have further degraded the parkway's riparian habitat. Most recently, riparian loss can be attributed to flood control projects and levee revetment. Lack of fire in riparian zones; peak flooding events, including those influenced by atmospheric rivers; long-term drought; and increased temperatures result in degradation of riparian habitat and loss of wildlife habitat (Dwire and Kauffman 2003; Seavey et al 2009). Traditional Fire Management and/ or prescribed burns are important tools to maintain wildlife habitat at Bushy Lake.

This Conceptual Restoration Plan centers on restoring the relationship between culture and the land. "Reciprocal restoration is the mutually reinforcing restoration of land and culture such that repair of ecosystem services contributes to cultural revitalization, and renewal of culture promotes ecological integrity" (Kimmerer 2011). Traditional Ecological Knowledge includes indigenous concepts of right relationship to the land and all our human and non-human relatives, or "kin", including respect, reciprocity, responsibility, and relatedness. This CRP incorporates knowledge and stewardship of culturally significant plants and animals within the matrix of a highly degraded landscape and human-altered ecosystem.

The restoration plant palette includes native riparian plant species that are fire resilient, beneficial to pollinators and wildlife, and in honor of sovereign lands and kinship of California Indian people. Mugwort is an important spiritual, ceremonial, and medicinal plant (Turi and Much 2013, Elsasser 1981). White root is an important basketry plant and a cultural keystone species (Stevens 2020, Peri and Patterson 1976). The relationship between TEK and Western Ecological knowledge provides an opportunity to show respect for the distinctive contributions of both intellectual traditions. Treating our non-human relations as "kin" extends our moral responsibility to steward our non-human relations (Salmón 2000).

2. Regulations and Policies Affecting Land Management and Restoration

This section summarizes the federal and state regulations, and local plans, ordinances, and policies relating to the protection and preservation of natural resources applicable to the proposed restoration of habitats within the American River Parkway and specifically within the Bushy Lake area. These regulations and policies play a role in guiding what restoration activities can be completed in the Project area.

2.1 Applicable Federal Regulations

2.1.1 U.S. Bureau of Reclamation

U.S. Bureau of Reclamation oversees the operations of Folsom Dam, Nimbus Dam, Folsom Reservoir, and Lake Natoma under the Central Valley Project, a series of flood control, water storage, and power generation projects authorized by the California State Legislature in 1933 and initiated in 1937 (U.S. Bureau of Reclamation 2023). Through operating the Folsom and Nimbus Dams, U.S. Bureau of Reclamation manages the lower American River's flows. No activity proposed to take place within or adjacent to the Parkway is permitted to interfere with operations of the Folsom Dam or Nimbus Dam.

2.1.2 Clean Water Act Section

The Clean Water Act (CWA) was adopted in 1972 to protect surface water habitats from adverse impacts, such as water pollution, associated with development activities. The sections of the CWA are administered in California by either USACE, the State Water Resources Control Board (SWRCB), or the Regional Water Quality Control Board (RWQCB).

Section 404 of the Act is administered by USACE. Section 404 of the CWA protects waters of the United States, including wetlands and drainages, by requiring projects that would discharge dredge or fill material into Waters of the United States to obtain a permit or authorization from the USACE. The permitting program is designed to minimize the fill of waters of the United States.

Section 401 of the CWA requires any applicant with a federal license or permit that could result in any discharge into waters of the United States (i.e., USACE permit to fill wetlands), to obtain water quality certification from the RWQCB.

Section 402 of the Clean Water Act requires projects that disturb one acre or more or are part of a larger project to notify the SWRCB and to prepare a Storm Water Pollution Prevention Plan that will minimize construction and storm water related impacts to waterways.

2.1.3 United States Code Title 3 Section 408

U.S. Code Title 33 Section 408 (Section 408) (the amended and codified Section 14 of the Rivers and Harbors Appropriation Act of 1899) allows the Secretary of the Army, upon recommendation of the USACE Chief of Engineers, to permit the alteration of a public work as long as the alteration is not injurious to the public interest and will not impair the usefulness of the work (33 U.S. §408).

USACE considers an alteration an action that builds upon, alters, improves, moves, occupies, or otherwise affects the usefulness, or the structural or ecological integrity, of a USACE project (33 U.S. §408). Under Section 408, USACE authorization is required before carrying out an action that would alter lands and property under USACE's jurisdiction in the Parkway. Therefore, an action that would alter Parkway lands and waters included in a USACE project, including federal levees lands and waters situated between federal levees, would require review to ascertain whether it necessitates submission of a Section 408 permission request.

2.1.4 Federal Endangered Species Act

The U.S. Fish and Wildlife Service (USFWS) is the federal agency responsible for the protection of federal endangered and threatened plants, fish, and wildlife and for the regulation of activities that could affect those species. The regulatory vehicle that protects sensitive species is administered by USFWS and includes the federal Endangered Species Act (ESA).

Section 7 of the federal ESA provides a means for authorizing incidental take of federally endangered or threatened species that result from federally conducted, permitted, or funded projects. Similarly, Section 10 authorizes incidental take of federally endangered or threatened species by non-federal agencies.

2.1.5 National Wild and Scenic Rivers Act

The National Wild and Scenic River Act (WSRA) was passed by Congress in 1968 (Public Law 90-542; 16 U.S.C. 1271 et seq.) to preserve rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations. Bushy Lake is adjacent to and within the floodplain of the lower American River. The lower American River, from its' confluence with the Sacramento River to Nimbus Dam, is designated as federal Wild and Scenic River and as a California Wild and Scenic River System (subdivision (e) of Section 5093.54). This stretch of river was classified as a recreational river area. Recreational river areas are defined as those rivers or sections of river that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past. This short stretch of river, flowing through the City of Sacramento, is the most heavily used recreational river in California. The Parkway provides an urban greenway for pedestrians, bicycling, boating activities and other recreational activities. The lower American River is known for its runs of steelhead trout and salmon (National Wild and Scenic River System 2023). The National WSRA mandates that this stretch of river is maintained in free-flowing condition, its water quality must be protected, its recreational and fishery values must be preserved. The federal Wild and Scenic River and California Wild and Scenic River System acts along the section of the Lower American River near Bushy Lake are administered by the County of Sacramento as a political subdivision of the State of California (Sacramento County 2023).

2.1.6 National Historic Preservation Act, Section 106

The Section 106 of the National Historic Preservation Act of 1966 requires federal agencies to consider the impacts of the undertakings (i.e., a project, activity or program funded, permitted, licensed, or approved by a federal agency) on historic properties. Historic properties include prehistoric and historic districts, sites, buildings, structures, and objects. A proposed federal agency undertaking that may impact a historic property in the Parkway would trigger the Section 106 process. (ACHP 2023).

2.1.7 National Environmental Protection Act

The 1970 National Environmental Protection Act (NEPA) (42 U.S.C. §4321 et seq.) requires federal agencies to evaluate the potential environmental impacts of proposed federal actions. NEPA covers permit applications, federal land management actions, and construction of public facilities. The Council on Environmental Quality (CEQ) oversees implementation of NEPA, including enforcement of regulations that establish the procedural provisions of the NEPA process.

2.1.8 Migratory Bird Treaty Act

The federal Migratory Bird Treaty Act (MBTA) (16 USC, Sec. 703, 1989) prohibits killing, possessing, or trading migratory birds except in accordance with regulations prescribed by the Secretary of the Interior. This act encompasses whole birds, parts of birds, bird nests, and eggs. The MBTA is administered by the USFWS and special permits from the agency are required for the take of any migratory birds. This act applies to all persons and agencies in the U.S., including federal agencies.

2.1.9 Bald and Golden Eagle Protection Act

The federal Bald and Golden Eagle Protection Act (16 USC 668-668c) prohibits anyone from "taking" bald eagles, golden eagles, including their parts, nests, or eggs without a permit. The act provides criminal penalties for persons who "take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bard eagle or golden eagle, alive or dead, or any part, nest, or egg thereof." The act is administered by the USFWS and special permits from the agency are required for the take of bald eagles or golden eagles.

2.2 Applicable State Regulations

2.2.1 Bushy Lake Preservation Act

Bushy Lake is protected by the 1976 Bushy Lake Preservation Act. The Bushy Lake Preservation Act (2005 California Public Resources Code, Chapter 9, Sections 5830-5835) denotes that the "Bushy Lake area" means that portion of the California Exposition flood plain bounded by the continuous line enclosing Bushy Lake, which line is 100 feet outside the 25-foot elevation contour line as limited on the north side by the waterside toe of the levee and as limited on the west side by a line 100 feet east of State Highway Route 80 as it exists on January 1, 1977. The Act additionally requires that the California Exposition and State Fair Board of Directors preserve, for public day use and enjoyment, the California Exposition flood plain in a manner consistent with the definition of a state park.

The Bushy Lake Preservation Act identifies "Bushy Lake" as a body of water in the Bushy Lake area with approximately 11 acres of water surface in the summer and approximately 80 acres in the winter. Moreso, it states that the California Exposition flood plain (which is the Bushy Lake area) contains an unprotected block of significant riparian habitat remaining in the lower American River flood plain, and the United States Fish and Wildlife Service has determined that this riparian habitat is of vital importance and an integral part of the American River.

2.2.2 California Water Code

The California Water Code contains statutory provisions addressing the regulation of water in the state of California, including, but not limited to: regulation of dams and reservoirs, wells, pumping plants, conduits, streams, flood control, water quality, irrigation, and drainage. Under Sections 8700 and 8701 of the California Water Code, actions that adversely affect the facilities of the State Plan of Flood Control, designated floodways, or streams regulated by the Central Valley Flood Protection Board (CVFPB) are unlawful (CWC § 8700, 8701). The Project is within the regulatory floodway. Substantial landscape modifications within 300 feet of the Designated Floodway portion of the Parkway are subject to the encroachment authority of the CVFPB and may require issuance of an encroachment permit. The CVFPB's encroachment authority is further recognized in Title 23, Division 1 of the California Code of Regulations (23 CCR T. 23, Div. 1). In addition, under Sections 8590 - 8613 of the California Water Code, the CVFPB is responsible for monitoring the facilities of local reclamation districts and flood control agencies, such as Sacramento Area Flood Control Agency (SAFCA) and the American River Flood Control District (ARFCD). Any use or work in the Parkway floodplains or within 10 feet of the base of a levee must be approved by the CVFPB through issuance of a permit as permissible by the USACE under Section 408. CVFPB may also require the County to obtain endorsement from SAFCA or ARFCD for proposed work (Sacramento County 2008b).

2.2.3 Oak Woodlands Conservation Program

The State Legislature passed the Oak Woodlands Conservation Act (Senate Bill No.1334) in 2004. The Act requires counties to consider whether a proposed project would significantly impact the environment through conversion of oak woodlands when determining whether an environmental impact report, mitigated negative declaration, negative declaration, or categorical exemption must be prepared under the California Environmental Quality Act (CEQA). If a project would have a significant impact on oak woodlands, the impact must be mitigated. Therefore, under CEQA, any project proposed to take place that would significantly impact the environment through alteration of oak woodlands would need to incorporate mitigation measure(s) to reduce the significance of potential impact(s) (Sacramento County 2008b).

2.2.4 State Wild and Scenic Rivers System Act

The California WSRA was passed in 1972 after the adoption of the National WSRA in 1968. Under California law, "…certain rivers which possess extraordinary scenic, recreational, fishery, or wildlife values shall be preserved in their free-flowing state, together with their immediate environments, for the benefit and enjoyment of the people of the state" (CA PRC §5093.5-5093.7). This stretch of river has been determined by the State Legislature as possessing extraordinary scenic, recreational, fishery, and wildlife values. The American River is considered a State-managed River that receives state and federal protection under both WSRAs.

2.2.5 Porter-Cologne Water Quality Act

The Porter-Cologne Water Quality Act extends the RWQCB jurisdiction over waters of the State, which defines waters of the State as any surface water or groundwater, including saline waters, within the boundaries of the State (California Water Code Section 13050[e]). In the absence of CWA Section 404 jurisdiction over isolated waters or other waters of the State, California retains authority to regulate discharges of wastes into any waters of the State.

2.2.6 CEQA

In 1970, the State Legislature enacted CEQA, which requires local and state government agencies to inform decision makers and the public of the potential physical environmental impacts of a proposed project. Under CEQA, the lead local or state agency prepares an environmental document, including project details, potential environmental impacts, and, if applicable, measures to avoid or reduce potential impacts. The environmental document is then released for public review and comment. Implementation of CEQA is primarily guided by the

CEQA Guidelines (CA Code of Regulations, Title 14, Section 15000), which are updated yearly by the California Natural Resources Agency and the Governor's Office of Planning and Research (OPR). Implementation is also guided by court decisions pertaining to interpretation of CEQA and local CEQA procedures (OPR 2020). The Project is subject to review under CEQA.

2.2.7 Assembly Bill No. 52 (AB52)

Through Assembly Bill No. 52 (AB 52), the California State Legislature added new requirements regarding tribal cultural resources in the environmental review process under CEQA. AB 52 established that "a [project] with an effect that may cause a substantial adverse change in the significance of a tribal cultural resource is a project that may have a significant effect on the environment," requiring a lead agency to notify California Native American tribes traditionally and culturally affiliated with an area early on in the CEQA environmental review process. Following notification, a California Native American tribe may request consultation under AB 52. Consultation must occur prior to the public release of a negative declaration, mitigated negative declaration, or environment impact report for a project (OPR 2017). As part of environmental review of the Project under CEQA, the County may be required to notify California Native American tribes affiliated with the Project area of the potential impacts of the Project on tribal cultural resources.

2.2.8 State Endangered Species Acts

The California Department of Fish and Wildlife (CDFW) is the state agency responsible for the protection of State endangered and threatened plants, fish, and wildlife and for the regulation of activities that could affect those species. The regulatory vehicle that protects sensitive species is administered by CDFW and includes the California Endangered Species Act (CESA). Section 2081 of the California Fish and Game Code (CFGC) allows CDFW to authorize the incidental take of State listed endangered or threatened species.

2.2.9 California Fish and Game Code

Under CFGC Sections 1600–1610, CDFW may enter into a Streambed Alteration Agreement (SAA) with an applicant if a project would divert, obstruct, or change the natural flow of the bed, channel, or bank of any river, stream, or lake.

The CFGC provides protection for migratory birds and raptors. Raptors and raptor nests or eggs are protected from take under CFGC Section 3503.5. Migratory birds are expressly prohibited from take under CFGC Section 3513. Species designated by CDFW as fully protected species are protected from take under CFGC Sections 3511 4700, 5050, and 5515. Under CFGC Section 4150-4154 no nongame mammal may be taken or possessed except as provided by this code or in accordance with regulation adopted by the commission. Fish and Wildlife connectivity and corridor are protected under CFCG 1797.5(5), 1930 (c)(d)(e), and 1930.5 (c).

The CDFW defines Species of Special Concern as a management designation used to track population trends of certain plant or animal species. Species of special concern do not receive protection under the CESA or any section of the CFGC and do not necessarily meet the California

Environmental Quality Act Guidelines Section 15380 criteria as rare, threatened, endangered, or of other public concern. However, if the plant or animal species can be shown to meet the criteria of sensitivity outlined in section 15380, the plant or animal species are treated as rare, threatened, or endangered, even if the plant or animal species has yet to be listed officially. In assigning "impact significance" to populations of non-listed species, the analysis considers factors such as population-level effects, the proportion of the taxon's range affected by the project, regional effects, and impacts on habitat features.

2.2.10 California Native Plant Protection Act (CFGC 1900 et seq.)

The Native Plant Protection Act (NPPA) was enacted in 1977 and allows the Fish and Game Commission to designate plants as rare or endangered. There are 64 species, subspecies, and varieties of plants that are protected as rare under the NPPA. The NPPA prohibits take of endangered or rare native plants but includes some exceptions for agricultural and nursery operations; emergencies; and after properly notifying CDFW for vegetation removal from canals, roads, and other sites, changes in land use, and in certain other situations.

2.3 Applicable Local Regulations

2.3.1 Sacramento Area Flood Control Agency (SAFCA)

In 1989, the City of Sacramento, Sacramento County, Sutter County, ARFCD, and Reclamation District No. 1000 formed SAFCA through a Joint Exercise of Powers Agreement to better protect the Sacramento area from the impacts of flood events. SAFCA works with State and local flood control agencies and municipalities and with USACE to plan and implement regional flood control improvement projects, including levee improvement and bank protection projects such as the American River Common Features Project. Any work that may impact the flood control infrastructure over which SAFCA or ARFCD has operational and maintenance responsibility would require coordination with SAFCA or ARFCD as described above under the California Water Code section (SAFCA 2020).

2.3.2 Sacramento County Floodplain Management Ordinance

The Sacramento County Floodplain Management Ordinance requires all proposed development activities in the county be reviewed by the Sacramento County Department of Water Resources (County DWR) for compatibility with local and Federal Emergency Management Agency (FEMA) floodplain management standards. Specifically, the Ordinance describes the development activities allowed in floodplains and provides standards for development. For example, the Ordinance includes acceptable elevations for public roads and requirements for fill placement in floodplains. Approved projects cannot adversely impact floodplain elevations and thereby create a hazard in a floodplain. Development proposed in the Parkway's floodplains requires review by the County DWR as described above. The preparation of accompanying technical studies may be required.

2.3.3 Sacramento County Tree Preservation Ordinance

Sacramento County (County) seeks to preserve native oak tree species for their ecological, environmental, and aesthetic qualities on both public and private land. Sacramento County Tree Preservation Ordinance (SSC 480 § 1, 1981.) provides the following definitions.

- Public Land: Shall include all lands in public trust, federal, state, and local, including but not limited to, public rights of way, easements, and parks.
- Private Land: Shall include all land owned by private interest, and not designated public land.
- Tree: As used in this ordinance, a "tree" shall mean any living native oak tree having at least 1 trunk of 6 inches or more in diameter at breast height (dbh) (measured four and one-half feet above the ground), or a multi-trunked native oak tree having an aggregate diameter of 10 inches or more dbh.
- Native Oak Tree: Shall include any of the following: valley oak (*Quercus lobata*), interior live oak (*Quercus wislizenii*), blue oak (*Quercus douglasii*), or oracle oak (*Quercus morehus*).
- Drip Line: An area delineated by projection of the periphery of the crown area of a tree down to the ground surface.

Under this ordinance, no person shall trench, grade or fill within the dripline of any tree or destroy, kill or remove any tree as defined, on any property, public or private, without a tree permit.

2.4 Other Management Plans

2.4.1 The American River Parkway Natural Resources Management Plan

The American River Parkway Natural Resources Management Plan (NRMP) is prepared as a guidance document for the management of the natural resources of the American River Parkway (Sacramento County 2022). The NRMP is framed by and supplements the American River Parkway Plan (ARPP), which is the state and federal Wild and Scenic River management plan, to ensure that the American River Parkway's (Parkway) resources, its environmental quality and natural values are protected.

The NRMP identifies the USACE potential Ecosystem Restoration project in the vicinity of Bushy Lake, which proposes the restoration of 48 acres (about twice the area of Chicago's Millennium Park) of native riparian vegetation communities and 70 acres of native woodland. The NRMP recommends that the USACE coordinate with California State University Sacramento (CSUS) and the California Wildlife Conservation Board (WCB) to ensure that the plans are consistent. (Sacramento County 2022)

Per the NRMP, the Bushy Lake area contained some of the healthiest cottonwood stands in the Parkway and identifies that northwestern pond turtles are known to occur at Bushy Lake but that they face significant risk from human activity adjacent to Bushy Lake. Accordingly, it states that monitoring and understanding the critical habitat needs of the northwestern pond turtle can help determine what biological conditions occur at Bushy Lake and along the Parkway that optimizes northwestern pond turtle habitat. (Sacramento County 2022) here is limited regeneration of cottonwood on much of the lower American River overbank areas due to artificially high elevations above the river channel that resulted from hydraulic mining and dredge tailings. Levee modification by the Corps of Engineers has removed a lot of riparian vegetation along the river. Much of the vegetation in the Bushy Lake area is in moderate to fair condition and is subject to substantial ongoing degradation. Degradation of the vegetation, particularly the understory, reduces its value as wildlife habitat.

The 300- to 400-foot-wide transmission line corridor is a major feature crossing east-to-west over Bushy Lake and through the California Exposition and State Fair (Cal Expo). Woody vegetation is heavily managed under these electric transmission lines, especially where they cross Bushy Lake and surrounding wetlands. Management practices include use of herbicides, grazing, and reducing vegetation height through mechanical means. Invasive weedy species such as star thistle, barnyard grass, white top, Bermuda grass, black mustard, and other invasive species are spreading in this corridor. The activities leading to landscape degradation (e.g., encampments and rampant social trails) are also reducing habitat values for wildlife. (Sacramento County 2022).

2.4.2 United States Army Corp of Engineers Ecosystem Restoration Plan

The United States Army Corp of Engineers (USACE) Ecosystem Restoration was authorized by Congress in 2003 as part of a multi-objective improvement program for Folsom Dam and the Lower American River, described in a feasibility study prepared by USACE in collaboration with the Sacramento Area Flood Control Agency (SAFCA), California Department of Water Resources, and California Valley Flood Protection Board. The USACE Ecosystem Restoration concept will likely need to be reevaluated because it has been so long since the project was authorized. The previous USACE project overlaps with the current Bushy Lake CRP Project area. The goal of the USACE project is ecosystem restoration. One of the alternatives presented by the USACE was to incorporate flows from the Chicken and Strong Ranch Slough and provide a treatment wetland to supplement water to the Project area, this alternative was viewed as an enhancement opportunity within the USACE plan. Coordination between the Bushy Lake CRP and the USACE should be conducted to ensure that the two plans do not conflict.

2.4.3 Sacramento County General Plan 2030

The Sacramento County Board of Supervisors adopted an updated General Plan in 2011 that has a planning horizon extending to 2030. Some of the County of Sacramento’s General Plan goals and policies pertain to its rivers. Some of the key goals are summarized below:

- Manage water supply to protect valuable water-supported ecosystems.

- Manage the quality and quantity of urban runoff to protect the beneficial uses of surface water and groundwater.
- Establish and manage a preserve system with large core and landscape level preserves connected by wildlife corridors throughout Sacramento County to protect ecological functions and species populations.
- Protect and maintain habitat for special status species.
- Manage riparian corridors to protect natural, recreational, economic, agricultural, and cultural resources.
- Maintain levee protection, riparian vegetation, function, and topographic diversity by stream channel and bank stabilization projects.
- Stabilize riverbanks to protect levees, water conveyance and riparian functions, water quality, supply and conveyance.
- Conserve and protect the Sacramento, Cosumnes, Mokelumne, and American Rivers to preserve natural habitat and recreational opportunities.
- Make land uses within and development adjacent to stream corridors consistent with natural values.
- Provide and protect high-quality in-stream habitat, water quality, and water flows to support fisheries propagation, development, and migration.
- Preserve and protect heritage and landmark tree resources for their historic, economic, and environmental functions.

2.4.4 City of Sacramento General Plan 2035

The Project falls within the Arden Arcade Community Plan Area within the City of Sacramento and is designated as "park". Many of the City of Sacramento's General Plan goals and policies pertain to its rivers. The Project will be consistent with all City of Sacramento General Plan 2035 Goals and Policies pertaining to the Parkway. The General Plan goals relate to the following:

- Waterway Conservation
- Open Space System
- American River Parkway Plan: The City recognizes the Parkway Plan as an important State land use and policy document prepared through the Urban American River Parkway Preservation Act.
- Open Space Preservation / Connected Open Space Program / Open Space Buffers
- Waterway Recreation and Access / River Parkways
- Conservation of Open Space Areas / Resource Preservation / Conservation of Open Space

- Natural Lands Management / Retention of Habitat Areas / Riparian Habitat Integrity
- Wetland Protection
- Annual Grasslands / Oak Woodlands
- Wildlife Corridors
- Habitat Assessments
- Urban Forest Management Plan
- Management and Enhancement of the City's Tree Canopy / Trees of Significance
- Scenic Resources at River Crossings
- Floodplain Capacity

3. Existing Conditions

This section provides a description of existing physical and biological conditions at and around Bushy Lake.

3.1 Existing Physical Conditions

3.1.1 Location and Setting of Bushy Lake

Bushy Lake resides in a roughly 0.5 square mile (1.29 square kilometer) remnant area of the American River floodplain in the lower Parkway that abuts the western side of the Cal Expo site in Sacramento, California. Bushy Lake occurs between the neighborhoods of Woodlake on the west and the Arden-Arcade area on the east. Bushy Lake is located within the *Sacramento East, California* United States Geological Survey (USGS) 7.5-minute quadrangle map within an un-sectionalized area of Township 9 North, Range 5 East (Figures 1 and 2).

The Parkway is a 23-mile riparian corridor along the Lower American River that extends from Folsom Lake to the confluence of the Sacramento River. The lower American River flow is controlled by releases from Folsom Dam and Nimbus Dam. The Parkway is a managed floodway that protects Sacramento from seasonal flooding. The Parkway serves as a riparian wildlife corridor through the dense urban landscape. This corridor provides habitat for various regional flora and fauna and offers recreational activities for humans (County of Sacramento et al., 2008; County of Sacramento 2023; Dillinger et al., 2005).

Historically, levees were constructed along the lower American River within the reach of the river near Bushy Lake. These levees are managed by USACOE and SAFCA. Much of the American River floodplain outside of the levees has been developed for urban use, including the areas north and south of the levees near Bushy Lake.

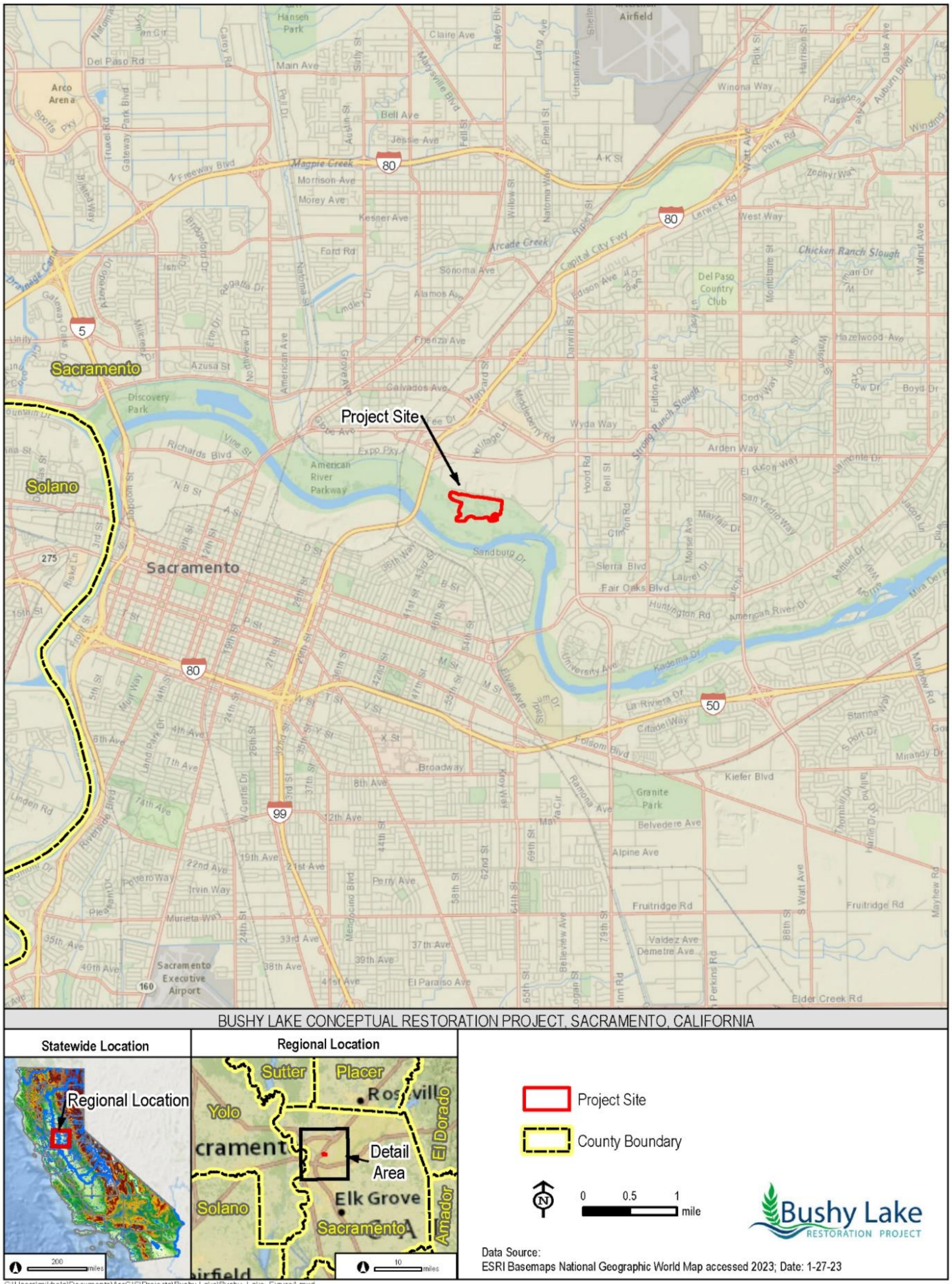


Figure 1. Project Site Vicinity

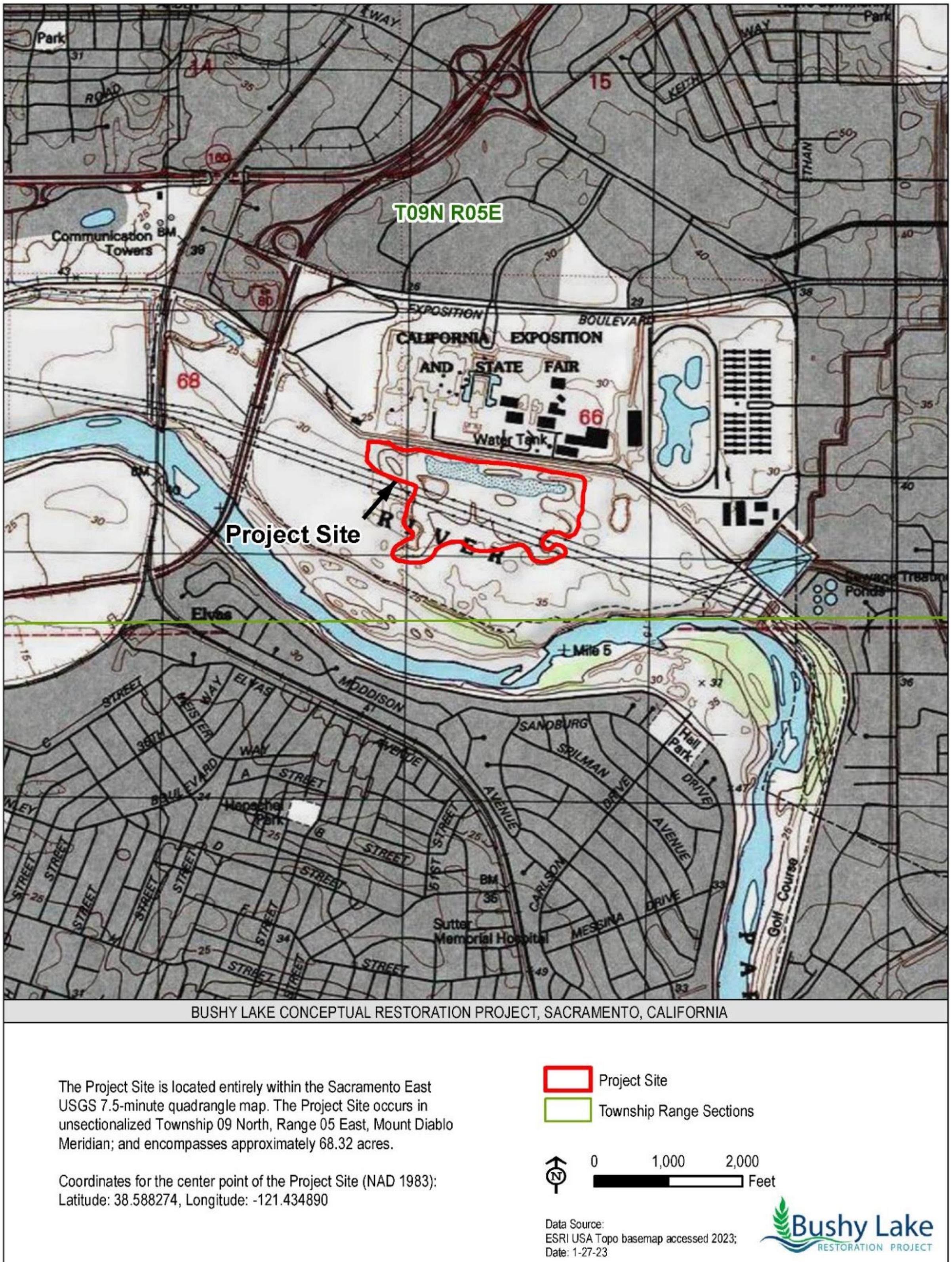


Figure 2. Project Site Location

The developed areas north and south of the levees support dense residential and commercial uses. To the north of the proposed Bushy Lake Restoration Area is the levee and Cal Expo, to the south, east, and west is the floodplain of the American River, with the American River being located 1,100 feet south of the proposed restoration area. Immediately east of Bushy Lake, within the levees, is an 11-acre area used for overflow parking by Cal Expo during the State Fair, "Parking Lot Z" (Figure 3).

Bushy Lake is located in the floodplain of the American River between river mile 4 and 5 between levees. Bushy Lake is approximately 4.5 river miles upstream from the American River and Sacramento River confluence and approximately 25 river miles downstream from the Folsom Dam. The floodplain is dominated by open water, riparian habitat and ruderal non-native grasslands and generally weedy forbs. The area also supports several dirt trails and a transmission line.

The State of California acquired the undeveloped land near Cal Expo in the 1940's with the intent of developing a golf course. Developers compacted soils and altered the bathymetry of the Bushy Lake depression to include fingerlike projections on the south side. The golf course development was halted by Save the American River Association (SARA) and passage of the Bushy Lake Preservation Act (1976), with the intent of protecting the remaining riparian area.

The Bushy Lake Preservation Act designates an approximately 86-acre area as a State Nature Preserve, with the primary intent of preserving important vegetation and wildlife species and their supporting ecosystems and requires the Cal Expo Board of Directors to preserve, for public day use and enjoyment, the Cal Expo floodplain in a manner consistent with the definition of a state park, and consistent with the Parkway Plan which designates it as a Nature Study Area. Currently, the Cal Expo area is managed by the Sacramento County Department of Regional Parks through an agreement with Cal Expo consistent with the Parkway Plan and the Act.

3.1.2 Existing Infrastructure

Existing infrastructure within the Bushy Lake area includes a utility corridor, levees, trails, and County of Sacramento dirt maintenance roads. The utility corridor consists of five major utility lines and their associated transmission towers and lines and maintenance roads. These utilities are owned by Sacramento Municipal Utility District (SMUD) and Pacific Gas and Electric (PG&E). The levee system surrounding Bushy Lake was designed to provided flood protection to the Sacramento metropolitan area, which was built largely on the historic American River floodplain (County of Sacramento et al. 2008). Bushy Lake and surrounding riparian habitat in the floodplain function to attenuate flood peaks and abate flood force and velocity. The Bushy Lake area is crossed by the Jedidiah Smith Memorial bicycle trail and designated equestrian/hiking trail. Several undesignated and unimproved trails interlace the area and are used for passive recreation such as bird watching, walking dogs, and enjoying nature. This includes the County of Sacramento dirt maintenance roads that serve as an undesignated trail system for mountain biking.

Figure 3. Bushy Lake Conceptual Restoration Planning Area

3.1.3 Climate of Bushy Lake

The Southern Sacramento Valley, including the City of Sacramento, has a relatively mild climate with little rainfall during the summer months and the rainy season being the winter. Historically, rain occurs in measurable amounts only about 10 days monthly during the winter, with the wettest months being December through March. The average annual precipitation in this area is 18.14 inches with the lowest recorded annual precipitation being 5.81 inches and the highest recorded annual precipitation being 26.05 inches in the last 20 years. During the summer months the average max temperature is 104 degrees Fahrenheit (°F) and the average low temperature 52 °F. During the winter months, the average max temperature is 68 °F and the average low temperature is 29 °F. Mountains surround the Sacramento Valley to the west, north, and east. Torrential rain and heavy snow frequently fall on the Western Sierra Slopes, leading to occasional flooding conditions along Sacramento River and its tributaries (Bevan and Cline 2005).

Global climate change projections for the next 50 years impose substantial local impacts and risks on the Sacramento Valley, including rising temperatures, changing precipitation patterns and amounts, flooding, drought, and wildfire (Houlton et al. 2018).

The following projections are summarized from the Local Climate Change Snapshot tool for the City of Sacramento, developed by Cal-Adapt which presents research developed under California's climate change assessments, with Cal-Adapt 2.0 focusing on California's Fourth Climate Change Assessment. The climate models present two future climate projections using medium and high greenhouse gas and aerosol emission scenarios. The medium emissions scenario represents a mitigation scenario where global carbon dioxide emissions peak by 2040 and then decline. The high emissions scenario (represents a scenario where carbon dioxide emissions continue to rise throughout the 21st century. (Cal-Adapt 2023)

Temperature Projections

Overall temperatures are projected to rise in California during the 21st century. In the City of Sacramento, the annual average maximum temperature is projected to increase by 4.9 to 8 °F, with the number of extreme heat days (temperatures above 103.9 °F) increasing 17 to 36 days a year by the end of the century (2070-2099). The annual average minimum temperature is also projected to increase by 4.2 to 7.3 °F by the end of the century. (Cal-Adapt 2023).

Precipitation Projections

Historically, California's climate has varied between wet and dry years. While research does not indicate that the average annual precipitation in California will changing significantly in the next 50-75 years, it does suggest that for much of the state, wet years will become wetter with precipitation being delivered in more intense storms within a shorter wet season and the dry years will become drier. Dry years are also likely to be followed by dry years, increasing the risk of drought. In the City of Sacramento, the annual precipitation is projected to increase by 0.3 to 0. 7 inches and the maximum length of dry spells is projected to increase by 8 to 15 days by the end of the century. (Cal-Adapt 2023).

Wildfire Projections

The frequency, severity and impacts of wildfire are sensitive to climate change as well as many other factors. The climate models estimate increased risk to wildfires. Statewide, California can expect to see an increased risk of wildfire, with fire season starting earlier, running longer, and featuring more extreme fire events. In the City of Sacramento, it is projected that the annual average area burned will decrease by 44.4 to 44.7 acres and the number of days where conditions are favorable for the occurrence and spread of wildlife will increase by 42 to 62 days by the end of the century. (Cal-Adapt 2023).

Existing Wildfire Conditions

The Bushy Lake area is increasingly subject to frequent and severe anthropogenic disturbance through wildfires and human intrusion. In 2014, a fire at Cal Expo burned over 160 acres of the Parkway. In September 2016, a large fire once again struck the lower American River Parkway in the general area of Bushy Lake. The 2016 fire burned the highest-quality riparian habitat on the northern side of the lake (as evidenced by California Rapid Assessment Method [CRAM] scores which are discussed in Section 4.5). Again, the Bushy Lake area was subject to fires in June and July of 2021, burning over 130 acres (about half the total floor space of the Pentagon) of the Parkway, including the entire *in situ* restoration site of Bushy Lake. Local utilities, fire departments, and community members have all expressed concerns about the ever-increasing wildfire risk, which potentially threatens the utility corridor, human structures, ecosystems, and people.

Geology and Soils

The proposed project area is located in the City of Sacramento, Sacramento County, California, within the physiographic unit referred to as the Great Valley. The Great Valley is a trough in which sediments have been deposited almost continuously since the Jurassic (about 160 million years ago) (CDOC 2002). The soil formed in wetlands as floodplain deposits replenished by sediment carried in the Sierran rivers (Fuller 2015). More specifically, along the Lower American River, from Nimbus Dam westward to the confluence with the Sacramento River the Modesto Formation is present with Holocene floodplain sediments covering much of the Modesto Formation (Shlemon 1972).

Bushy Lake was formed naturally in a depression on the American River floodplain (USGS 2021) from historic river meandering, prior to the construction of levees and dams on the lower American River (USGS 1911) (Figure 4).

Soils within the proposed Bushy Lake Restoration Area reflect their proximity to the American River. Three soil map units are identified by the Natural Resources Conservation Service (NRCS) for the area of the Bushy Lake Restoration Project: soil map unit 118, Columbia sandy loam, drained, 0 to 2 percent slopes, occasionally flooded; soil map unit 204, Rossmoor fine sandy loam, 0 to 2 percent slopes; and soil map unit 247, Water (NRCS 2023, Appendix A) (Figure 5).

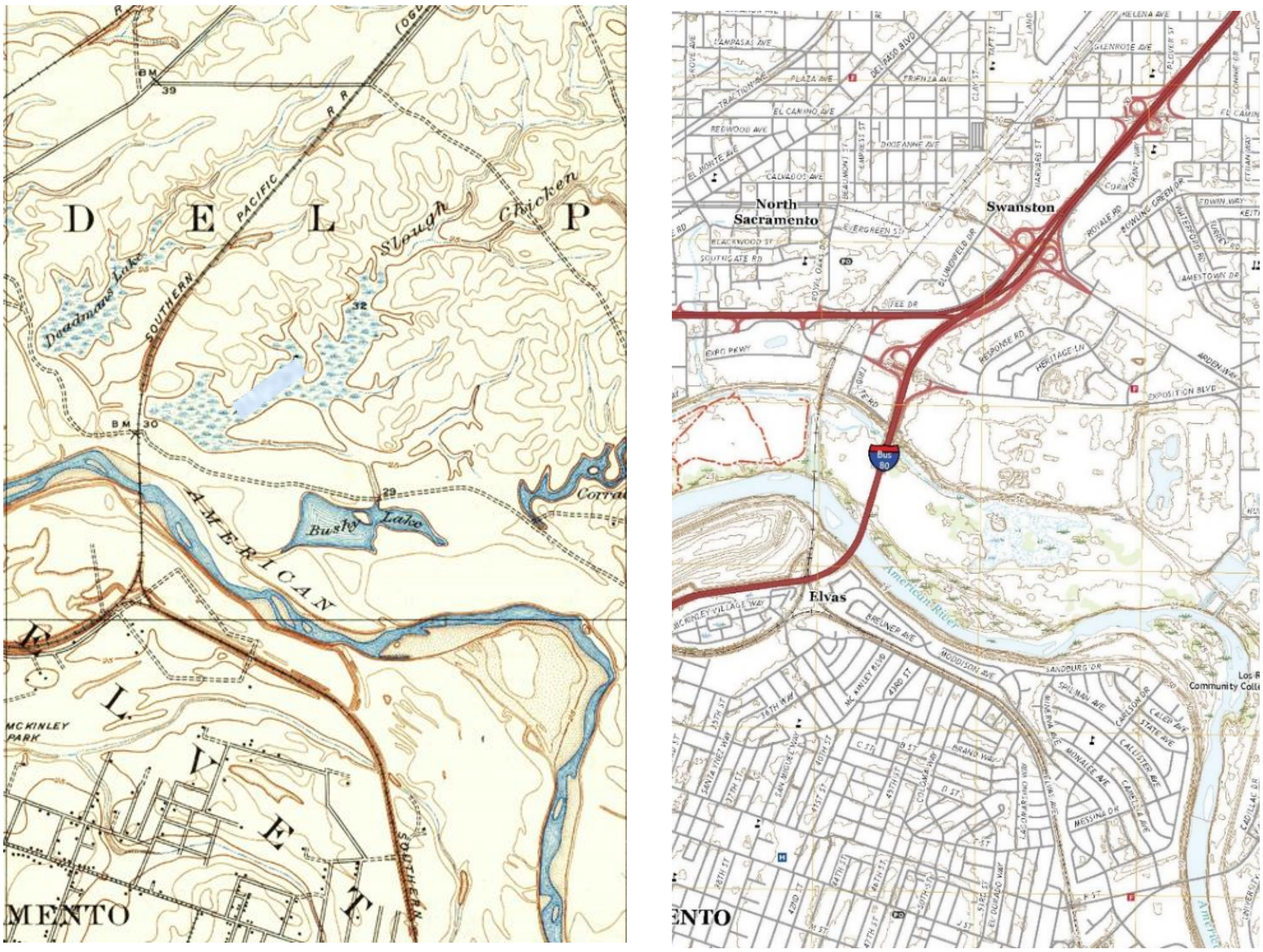


Figure 4. Bushy Lake included in 1911 USGS Brighton Quadrangle (left) and 2021 Sacramento East Quadrangle (right).

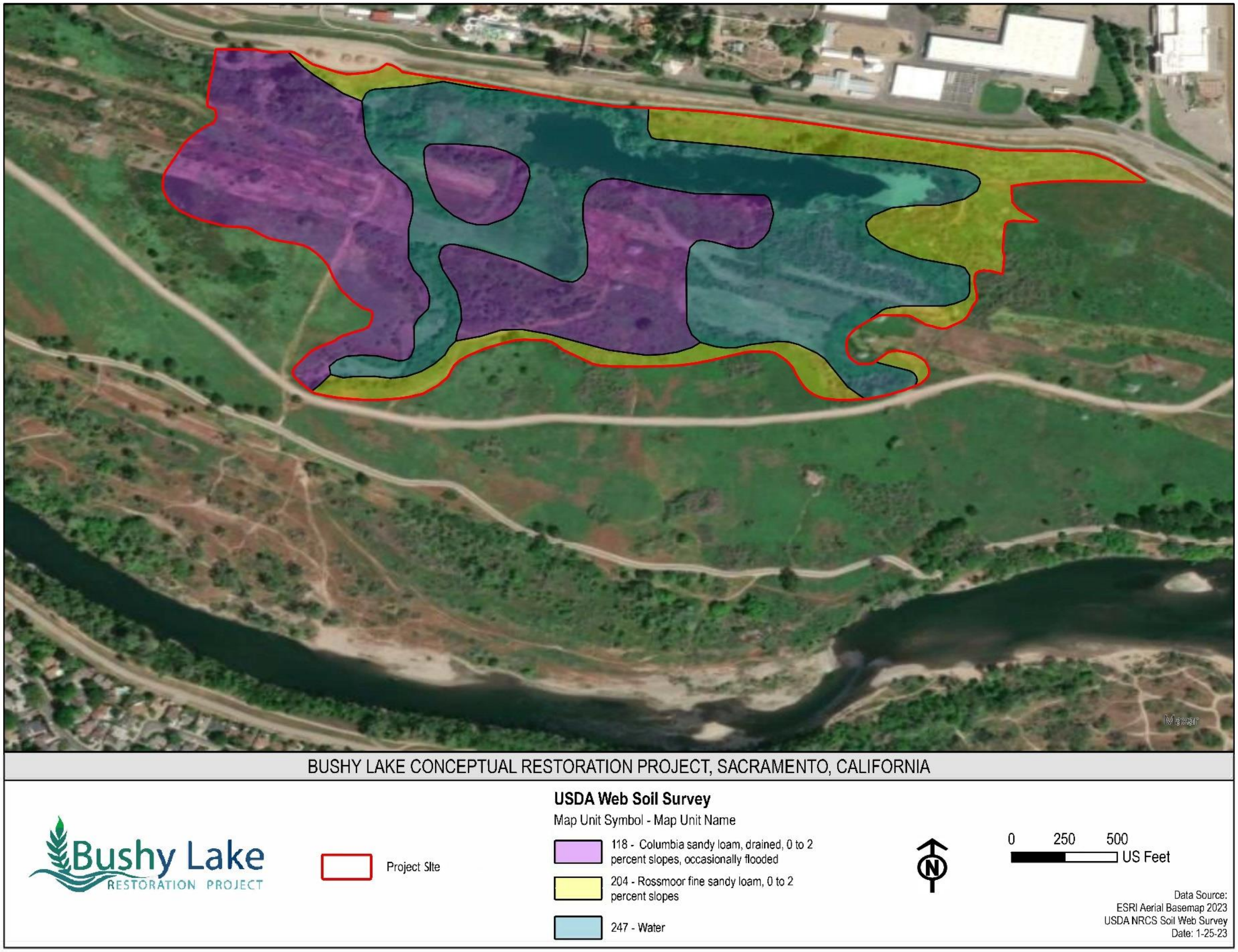


Figure 5. Soils Survey of Bushy Lake Restoration Project

While the Web Soil Survey identifies approximately 41 percent of the proposed Bushy Lake Restoration Area as open water, a majority of the area is only inundated seasonally.

Soil map unit 118 is found on toe-slopes of floodplains and its parent material is alluvium. The depth to the water table is estimated to be more than 80 inches for this soil map unit. Soil map unit 118 is identified as hydric and surface soil textures are sandy loam underlain by stratified loamy sand to silt loam. (NRCS 2023).

Soil map unit 204 is also found on toe-slopes of floodplains and its parent material is alluvium. The depth to the water table is estimated to be more than 80 inches for this soil map unit. Soil map unit 204 is not identified as hydric, however several of the minor components: Columbia and Xerofluvents, composing 11% of this soil map unit are identified as hydric soils. The soil textures of map unit 204 are sandy loam. (NRCS 2023).

Existing Hydrology

Hydrogeologic Setting

Channel gradient is gentle along the lower American River with an elevation change of about 0.55m per kilometer (Shulter, 1982). Due to the fluvial setting the geology of American River Parkway consists of loose poorly sorted cobbles, pebbles, and sand. In modern times, the deposition of river sediments is confined between large levees on either side of the floodplain. These levees provide flood protection to Sacramento and extend about 20m above the riverbed. The levees are composed of a rock core with a low hydraulic conductivity sediment layer to prevent leakage. The current channel overlies a series of six Pleistocene paleo channels. River deposits found in the area have been identified as the Modesto Formation, Riverbank Formation, Upper Fair Oaks, Arroyo Secco Sequence, Fair Oaks Formation, and Laguna Formation (Figure 6) (Bond et al., 2018). In general, the American River has migrated northward through time with the oldest sediment deposition occurring in the town of Elk Grove.

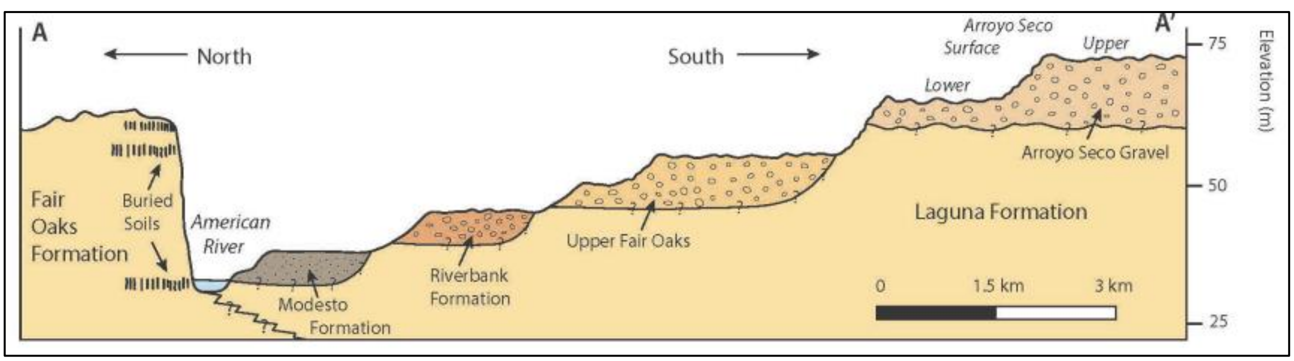


Figure 6. Stratigraphic sequence of river deposits. The age of deposition becomes younger closest to the modern channels in opposition to the law of superposition. From (Bond et al., 2018).

Surface Hydrology

Water flow along the Lower American River is controlled and originates from Folsom Lake Reservoir. The lake was created in 1955 with the creation of Folsom Dam by USACE. The dam provides flood control along with hydropower and water storage. Flows of Folsom Dam can change very rapidly to meet changing water needs. Nimbus Dam, seven miles below Folsom, stores and regulates the flows out of Folsom Dam. As a result of the dams, all water flowing through the American River Parkway has been regulated by the Bureau of Reclamation at Folsom Dam. Folsom has a max discharge capacity of 160,000 cubic feet per second (CFS) for the more infrequent events up to a one out of 240-year storm event (USACE 2022). Flows as low as 600 CFS have been observed during water scarce seasons. The USGS operates a gauge below Nimbus Dam at Fair Oaks and has collected discharge data since 1987.

Bushy Lake

Bushy Lake is located within the lower American River floodplain. Historically, the river channel would meander and shift within this floodplain (Castaneda and Simpson 2013). Seasonal creeks from the northeast, such as Chicken Ranch and Strong Ranch Sloughs, which pass through the Arden-Arcade area, once contributed to Bushy Lake water levels into the summer (Figure 7). Today, these creeks have been channelized and lined with concrete to collect storm water and convey it quickly into the American River.

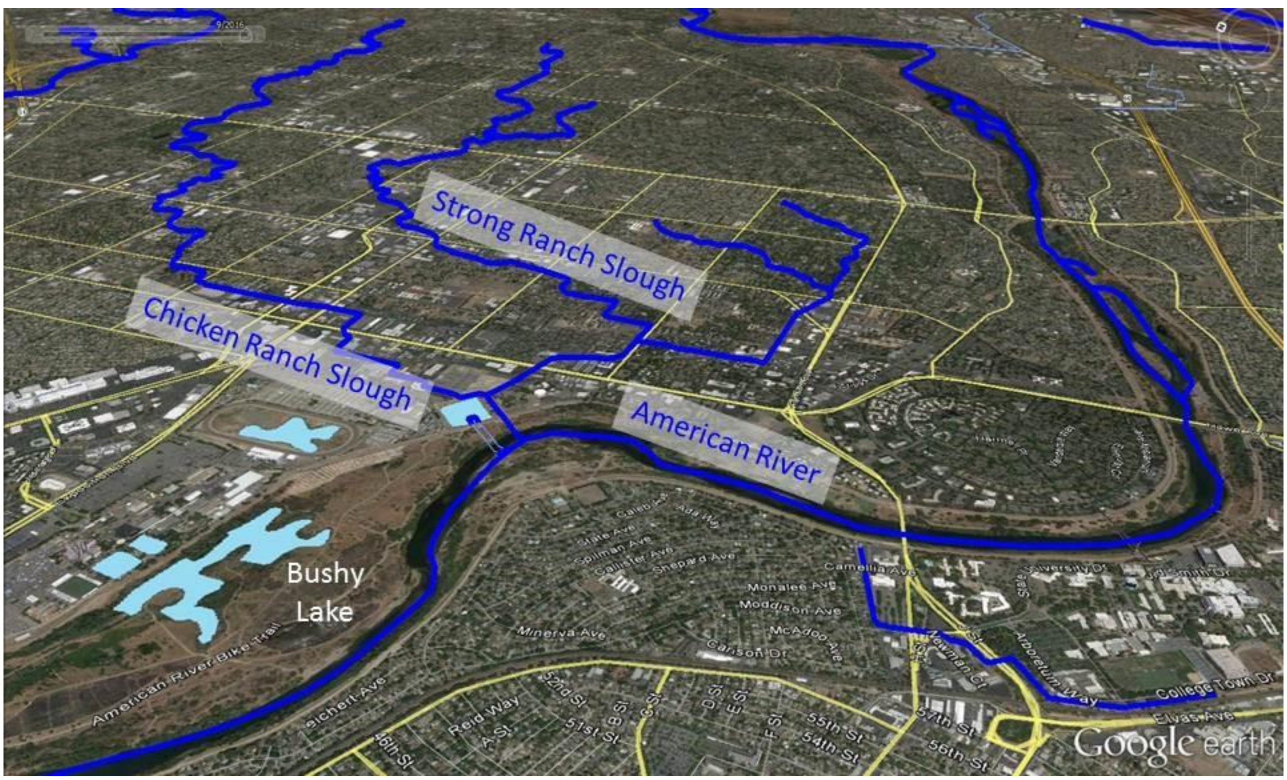


Figure 7. Bushy Lake area with Chicken Ranch and Strong Ranch Sloughs

The depression that forms Bushy Lake was deepened by construction of the levee adjacent to Cal Expo. Bushy Lake was again altered by golf course construction efforts; soil was compacted and moved, and the lake was enlarged, its shape and bathymetry were modified, and the surrounding floodplain was flattened.

Since Folsom Dam was built in the middle of the last century, water releases to the lower American River have been controlled to protect Sacramento residents from flooding, which used to happen more regularly (Castaneda and Simpson, 2013). Consequently, water levels rarely rise high enough to fill the historic floodplain; nonetheless, Bushy Lake retains many riparian characteristics that demonstrate its ongoing relationship with the American River.

On average, the size of Bushy Lake varies between 11 and 80 acres, depending upon rainfall, overland flow, groundwater pumping, and water table conditions. Bushy lake lies approximately 5 to 8m above the surface of the American River, as such, Bushy Lake loses water through infiltration and that water flows towards the river. The infiltration rate at Bushy Lake is interpreted to be quite large due to the high hydraulic conductivity of river sediments the lake lies above, however quantitative infiltration rates have not been calculated.

The water that feeds Bushy Lake comes mostly from a groundwater well on the Cal Expo side of the levee. This water is pumped through a pipe that lets out at the east end of Bushy Lake (Figure 8). Cal Expo operates the pump to maintain the lake level in accordance with the Bushy Lake Preservation Act of 1976 (CSMSA 2008). The pumped well is not dedicated to Bushy Lake, but services other water needs of Cal Expo as well.

Figure 8. Inlet pump on the northeast side of Bushy Lake

3.2 Existing Biological Conditions

3.2.1 Existing Vegetation

At one time, the Cal Expo/Bushy Lake area had one of the most extensive, healthy, and vigorous riparian woodland/forest on the lower American River (see Figure map 2010). Valley Oak, cottonwood, Gooding's willow, red willow, sandbar willow, Oregon ash, box elder and other typical gallery riparian forest species provided exceptionally diverse wildlife habitat. Frequent wildfires, including in 2014, 2017 and most recently 2017 burned most of the woody vegetation in the project area to the ground. Firefighting techniques of removing snags and standing trees eliminated most of the structural diversity and habitat interspersion. Fortunately, willow and cottonwood species are fire resilient, and have been revegetating in the Bushy Lake area after the 2014, 2017 and 2023 fires.

In California, most of the larger stands of Fremont cottonwood (*Populus fremontii)* exist downstream from dams (Nimbus dam influences Bushy Lake riparian areas). For natural recruitment of willows and cottonwoods, stream flows are regulated to mimic key components of natural flood regimes in terms of flood duration, peak low, and timing (McBain and Trush, Inc. 2000, Rood et al. 2003, 2005, Stillwater Sciences 2006 and 2007b). Seedling establishment through controlled flood releases is not possible at Bushy Lake.

Dominant woody plant species remaining at Bushy Lake after the 2015 burn include walnut (*Juglans californica*), narrowleaf willow (*Salix exigua*), red willow (*Salix laevigata*), Goodding's willow (*Salix gooddingii*), arroyo willow (*Salix lasiolepis*), box elder (*Acer negundo*), Oregon ash (*Fraxinus latifolia*), Fremont's cottonwood (*Populus fremontii*) and non-native elm (*Ulmus sp.*). Shrubs included elderberry (*Sambucus nigra ssp. caerulea*), coyote brush (*Baccharis pilularis*), Himalayan blackberry (*Rubus armeniacus*), California blackberry (*Rubus ursinus*), and California grape (*Vitis californica*). The elderberry is especially important as habitat for the Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), which is listed as threatened under the ESA. Dominant native understory species colonizing the site included creeping wild rye, white root, and mugwort. Almost all vegetation communities in the project site are in a state of greater or lesser anthropogenic disturbance.

Bushy Lake provides important remnant open water lacustrine, wetland and riparian habitat within the leveed and fragmented lower American River corridor. Lacustrine open water habitat is very limited along the lower American River watershed, and Bushy Lake provides an important element of this habitat corridor. The Final NRMP (January 2023) identifies the value of open water habitat on the Parkway (Section 4.9.1, Open Water):

"Habitats associated with lakes are also considered open water habitat and are characterized by depressions filled with standing water. This habitat type can vary in size, from small ponds to large areas such as flooded lakes or reservoirs. The primary lacustrine features are Urrutia/Gardenland Pond, Wood Lake, Bushy Lake, Arden Pond, Sailor Bar pond, and the series of mining ponds at Sacramento Bar. As noted above these ponds provide important resting and foraging habitat for many aquatic bird species, including diving ducks, and the deeper ponds may be preferred by many. Lacustrine habitat typically supports species of plankton, as well as other microorganisms in the still, open water. Lacustrine habitats are important for reproduction, food, water, and cover requirements for the northwestern pond turtle, as well as many mammals, birds, other reptiles, and amphibians. Lacustrine habitats exist throughout California, and often occur alongside riverine and freshwater water emergent wetland habitats."

Mapping Plant Associations

Vegetation alliances were mapped through field surveys with an Arrow Gold RTK GNSS Receiver at sub-meter accuracy. Data was collected with ESRI ArcGIS Field Maps Version 23.2.2 and processed with ESRI ArcGIS Pro 3.0.0. To map vegetation, the alliance classification system developed by the Manual of California Vegetation (MCV), maintained by the California Native Plant Society (CNPS) was used (CNPS 2023a). The MCV uses a category of vegetation classification that describes repeating patterns of plants across a landscape. Each alliance is defined by plant species composition and reflects the effects of local climate, soil, water, disturbance, and other environmental factors. Within the project site, species composition deviates from the MCV-described plant associations due to the high number of invasive species on site. The CNPS vegetation alliance mapping system provides a systematic and consistent mapping system of plant communities on the lower American River.

The MCV provides the state and global rarity rankings for each alliance. These rankings are used to identify sensitive natural communities. Sensitive natural communities are natural communities that are areas of limited distribution statewide or within a county or region and are often vulnerable to environmental effects of projects. These communities may or may not contain special status taxa or their habitat. High priority sensitive natural communities are globally (G), and state (S) ranked 1 to 3, where 1 is critically imperiled, 2 is imperiled, and 3 is vulnerable. Global and state ranks of 4 and 5 area considered apparently secure and demonstrably secure, respectively (CNPS 2023a). Out of the 17 alliances described in the sections below, 8 are considered sensitive natural communities. The following is a summary of the vegetation alliances within the project site. Vegetation communities or plant species with an asterisk at the end of the alliance name are considered culturally important (Figure 9).

Riparian Plant Alliances

There are a variety of riparian alliances within the project site. Riparian alliances include areas that are dominated by tree species (forest and woodland alliances), shrub species (shrubland alliances), and those dominated by herbaceous species (herbaceous alliances).

Riparian Forest and Woodland Alliances

- <u>*Gooding's willow - red willow riparian woodland and forest (Salix gooddingii - Salix laevigata forest and woodland alliance)*</u>*.* This alliance is considered a sensitive natural community (S3/G4). It is generally found on terraces along large rivers, canyons, floodplains of streams, seeps, springs ditches, lake edges, or low-gradient depositions. Within the project site, *Gooding's willow* and red willow are co-dominant in the tree or shrub canopy with box elder (*Acer negundo*), Orgon ash (*Fraxinus latifolia*), Fremont's cottonwood (*Populus* f*remontii)*, Shining willow (*Salix lucida* var. *lasiandra),* Mulefat (*Baccharis salicifolia*), California rose (*Rosa californica),* Elderberry *(Sambucus nigra ssp. caerulea*), Narrowleaf willow (*Salix exigua*), Arroyo willow (*Salix lasiolepis*), California buttonwillow (C*ephalanthus occidental*is), California grape (*Vitis californica*) a*nd* non-native elm (*Ulmus* species).

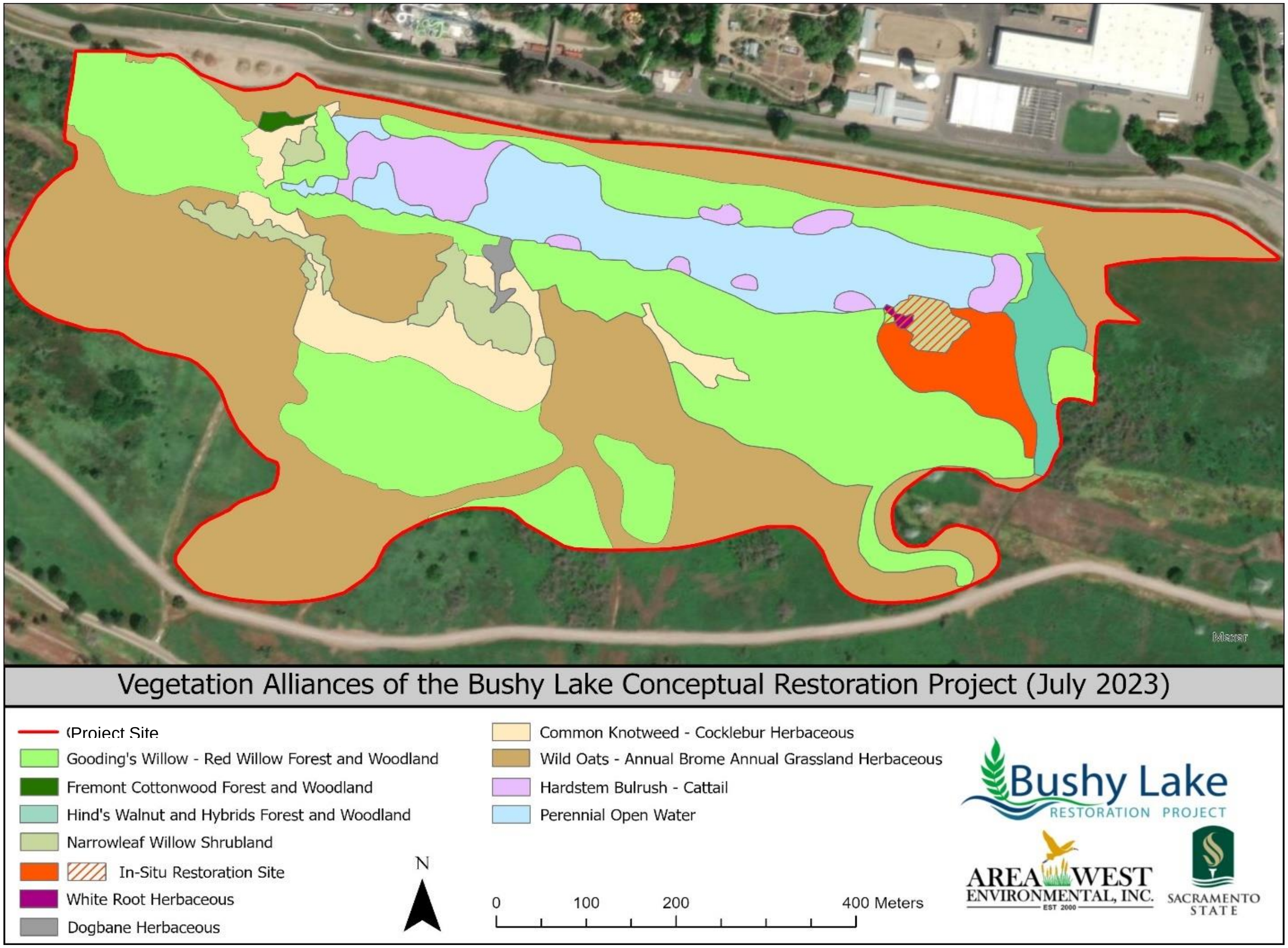


Figure 9. Vegetation Alliances of the Bushy Lake Conceptual Restoration Project (July 2023)

- *Fremont cottonwood forest and woodland (Populus fremontii – Fraxinus velutina – Salix gooddingii forest and woodland alliance).* This alliance is considered a sensitive natural community (S3.2/G4). Typically, this alliance is found on floodplains, along low-gradient rivers, perennial or seasonally intermittent streams, springs, in lower canyons in desert mountains, in alluvial fans, or in valleys with a dependable subsurface water supply that varies considerably during the year. Within the project site, this alliance is uncommon and historic and is dominated by Fremont's cottonwood with Gooding's willow (*Salix goodingii*) and Oregon ash (*Fraxinus latifolia*).

- *Valley Oak (Quercus lobata Riparian) Forest and Woodland Riparian Alliance (Recent historic alliance no longer on site) Shrubland Alliance, Button willow (Cephalanthus occidentalis) Thickets*. Buttonwillow is dominant in the shrub or small tree canopy with Salix *exigua*, *Salix gooddingii* and *Salix lucida* ssp. *lasiandra*.

- *Hind's walnut and related stands (Juglans hindsii and hybrids forest and woodland special stands and semi-natural alliance)*. This alliance is considered a sensitive natural community (S1.1/G1). It is generally found in intermittently flooded or saturated riparian corridors; floodplains, stream banks, and terraces with alluvial soils At Bushy Lake, this alliance can be further refined to the Hinds' walnut *(Juglans hindsii)* - Elderberry *(Sambucus nigra ssp. caerulea)* association after fire.

Riparian Shrubland Alliances

- *Narrowleaf willow thicket* (Salix exigua shrubland alliance)*. This alliance is generally found in temporarily flooded floodplains, depositions along rivers and streams, and at springs. Narrowleaf willow is dominant or co-dominant in the shrub canopy with mulefat (*Baccharis salicifolia*), California rose (*Rosa californica)* Himalayan blackberry *(Rubus armeniacus)*, California blackberry (*Rubus ursinus)*, and Arroyo willow (*Salix lasiolepis).*

- *Button willow thickets (Cephalanthus occidentalis shrubland alliance)*. This alliance is considered a sensitive natural community (S2/G5). Typically, this alliance is found in seasonally flooded basins, sloughs, or oxbow basins on floodplains with subsurface water at the end of the growing season and soils are poorly aerated and fine textured. Buttonwillow is dominant in the shrub or small tree canopy with narrow willow, Gooding's willow and shining willow.

- Present within the alliance, however, not enough to meet ¼ acre mapping unit:
    - *Coyote brush scrub (Baccharis pilularis shrubland alliance)*. This alliance is typically found on coastal bluffs, terraces, stabilized dunes of coastal bars, spits along the coastline, river mouth, stream sides, open exposed slopes, ridges, gaps in forest stands on variable, sandy to relatively heavy clay soils.

Within the project site, this alliance is uncommon and is spread out in other alliances.

- o <u>*California wild rose patches (Rosa californica shrubland alliance).*</u> This alliance is considered a sensitive natural community (S3/G3). California wild rose patches are typically found in mixed alluvium soils in creek bottoms, stream terraces, and bordering sloughs and channels, including those in the intertidal zone. Recommended by Diana Almendariz, Traditional Knowledge Holder.

Riparian Herbaceous Wetland Plant Alliances

- <u>*Hardstem and California bulrush marshes (Schoenoplectus herbaceous alliance)*</u>. This alliance is considered a sensitive natural community (S3S4/globally unraked). It is generally found on high organic content and poorly aerated soils in brackish to freshwater marshes; along stream shores, bars, and channels of river mouth estuaries; in sloughs, swamps, and roadside ditches. In the project site, tules (hardstem bulrush [*Schoenoplectus acutus var. occidentalis*] and California bulrush *[Schoenoplectus californicus]*) and cattails (*Typha latifolia*) are dominant. Subdominants in the herbaceous layer are mosquito fern (*Azolla filiculoides*), smaller duckweed (*Lemna minor*), floating water primrose *(Ludwigia peploides*), and rice cutgrass (*Leersia oryzoide*s).
    - o <u>*Dogbane* (Apocynum cannabinum herbaceous alliance).*</u> *MCV2*. Culturally important plant for fiber (Stevens NRCS citations) - generally mapped to *Schoenoplectus* herbaceous alliance.
- <u>*White root beds* (Carex barbarae herbaceous alliance)*</u>. Very important cultural keystone species. This alliance is also considered a sensitive natural community. White root beds are typically found in stream beds, river terraces, and levees in soils that are seasonally or intermittently saturated. *Carex barbarae* is dominant or co-dominant in the herbaceous layer with creeping wild rye, spikerush (*Eleocharis spp*.), slender willowherb (*Epilobium ciliatum)*, mugwort, horseweed (*Erigeron canadensis*). Riparian trees and shrubs may be present.
- <u>*Common knotweed – cocklebur patches (Polygonum lapathifolium - Xanthium strumarium herbaceous alliance).*</u> Common knotweed and cocklebur patches are typically found in marshes, regularly disturbed vernally wet ponds, lakeshores, reservoirs, fields, stream terraces, floodplains, and mudflats with clay-rich or silty soils. In the project site, this alliance is found in a seasonal wetland with rabbit's foot grass (*Polypogon montspeliensis),* sticktight (*Bidens frondosa),* golden nutsedge *(*C*yperus eragrostis*), barnyard grass (*Echinochloa crusgalli*), and Canada horseweed (*Erigeron canadensis).*
- Present within the alliance, however, not enough to meet ¼ acre mapping unit:

- Nodding beggartick - western goldenrod - marsh purslane mudflats (*Bidens cernua - Euthamia occidentalis - Ludwigia palustris* herbaceous alliance). This alliance is generally found in marshes, wet meadows, mudflats, and ditches along low-gradient stream, shallow ponds, and depressional wetlands with alluvial, seasonally flooded to perennial saturated silt loam to clay soils. In the project site, Mugwort* (*Artemisia douglasiana)* has >50% relative cover in the herbaceous layer, other forbs and grasses co-occur (Boul et al. 2021b, Buck-Diaz et al. 2012).

Herbaceous Terrestrial Plant Alliances

- *Wild oats and annual brome grassland (Avena spp. – Bromus spp. herbaceous semi-natural alliance)*. This alliance is found in all topographical settings in foothills, waste places, rangelands, openings in woodlands. In the project site this alliance is composed of wild oats (*Avena fatua*), ripgut brome (*Bromus diandr*us), bermuda grass (*Cynodon dactylon*), soft chess (*Bromus mollis*), creeping wildrye, yellow star thistle (*Centaurea solstitialis*), sow thistle (*Sonchus asper ssp. aspe*r), hairy vetch (*Vicia villosa*), poison hemlock (*Conium maculatum)*, Himalayan blackberry (*Rubus armeniacus*), rabbits foot grass (*Polypogon monspeliensis*), perennial pepper weed (*Lepidium latifolium*), and barnyard grass (*Echinochloa crusgalli*).
- Present within the alliance, however, not enough to meet ¼ acre mapping unit:
  - *Creeping wildrye turfs (Elymus cinereus - Elymus triticoides herbaceous alliance)*. This alliance is considered a sensitive natural community (S3/G3). Typically, this alliance is found in poorly drained floodplains, playas, drainage and valley bottoms, mesic flat to sloping topography, and marsh margins. Within the project site, the alliance meets the following membership rules: *Elymus triticoides* > 50% relative cover in the herbaceous layer (Keeler-Wolf and Vaghti 2000, Evens and San 2004). Or *Elymus triticoides* > 50% relative cover in the herbaceous layer, or > 30% relative cover with Italian ryegrass (*Festuca perennis*) or other non-native grasses or forbs (Buck-Diaz et al. 2021, Sikes et al. 2021).
  - *Perennial pepper weed - prickly lettuce patches (Lepidium latifolium - Lactuca serriola herbaceous semi-natural alliance)*. This alliance is generally found in intermittently and seasonally flooded fresh and saltwater marshes and riparian corridors. Perennial pepper weed and prickly lettuce patches are invading riparian and wetland settings in California. The plants expand rapidly and form extensive, dense patches in both freshwater and brackish water sites in the state.
  - *Upland mustards star-thistle fields (Brassica nigra - Centaurea solstitialis herbaceous semi-natural alliance).* This alliance is generally found in follow

fields, rangelands, grasslands, roadsides, levee slopes, disturbed coastal scrub, riparian area, cleared roadsides, and waste places on clay to sandy loam soils.

- o *Bermudagrass – prickle grass – crowngrass turfs (Cynodon dactylon - Crypsis spp. –Paspalum spp. herbaceous semi-natural alliance)*. This alliance is generally found in disturbed levees, managed wetlands, and alkaline marshes, improved or irrigated pastures, disturbed riverbanks, intermittently flooded plains, and other disturbed soils in moist settings.

Aquatic Alliances

- *Floating Vascular (Duckweed blooms [Lemna minor and relatives provisional herbaceous alliance])*. This alliance is typically found within seasonal and perennial freshwater habits with still water or on ground surfaces after water levels have dropped. In the project site, this alliance is composed of duckweed (*Lemna minor*), waterfern (A*zolla filiculoides)*, and water primrose *(Ludwigia repens s*ubsp. *peploides*) This vegetation alliance was not mapped as it is constantly shifting and changing within Bushy Lake.
- *Perennial Open Water*. Primarily unvegetated, however seasonally supports floating vascular vegetation, as described above.

In Situ Restoration Project

- The In Situ Restoration Site description is discussed in more detail in Section 4.2. Dominant species are culturally important, and include white root, creeping wildrye, mugwort, narrowleaf willow (Salix exigua), red willow (*Salix laevigata*), and elderberry (*Sambucus nigra ssp. caerulea*).

Non-native Invasive Plant Species

Non-native invasive plant species are non-native plants that can spread into and harm native ecosystems. These species also displace native species, hybridize with native species, alter biological communities, or alter ecosystem processes. The Cal-IPC provides an overall rating for all plants listed in the Invasive Plant Inventory for California (Cal-IPC 2021). A rating of *high* indicates a species with severe ecological impacts, high rates of dispersal and establishment, and that is widely distributed. A rating of *moderate* indicates a species with substantial and apparent ecological impacts, moderate to high rates of dispersal, establishment dependent on disturbance, and limited to widespread distribution. A rating of *limited* indicates a species with minor ecological impacts, low to moderate rates of invasion, limited distribution, and locally persistent and problematic. In addition to the overall ratings, indications of a significant potential for invading new ecosystems trigger a “Red Alert” designation. Plants that are highly invasive at Bushy Lake and require intensive monitoring and adaptive management are denoted with an asterisk.

The restoration area was surveyed for non-native invasive plant species listed by Cal-IPC. A total of 18 non-native invasive plant species listed in the Invasive Plant Inventory (Cal-IPC 2021) were documented within the restoration area. Most of these species are widespread throughout the region and none of the species are designated as Red Alert species by Cal-IPC. The general location of each of the non-native invasive plants found in the restoration area along with their Cal-IPC rating is provided below in Table 1.

Table 1. Non-native Invasive Plant Species Identified during Field Surveys

Species	Rating[1]	Occurrence within the BSA
Tree-of-Heaven (*Ailanthus altissima)*	Moderate	Spreading prolifically along the lower American River riparian habitats.
Slender wild oat (*Avena barbata)*	Moderate	Occurs throughout Bushy Lake.
Wild oats (*Avena fatua*)	Moderate	Occurs throughout Bushy Lake.
Black mustard *(*Brassica nigra)*	Moderate	Occurs throughout Bushy Lake.
Field mustard (*Brassica rapa)*	Limited	Occurs throughout Bushy Lake.
Ripgut grass (*Bromus diandrus)*	Moderate	Occurs throughout Bushy Lake.
Red Brome (*Bromus madritensis ssp. rubens)*	High	Limited occurrence at Bushy Lake
Cheat grass (*Bromus techtorum*)	High	Occurs throughout Bushy Lake.
Soft brome (*Bromus hordeaceus)*	Limited	Occurs throughout Bushy Lake.
Yellow star thistle* (*Centaurea solstitialis)*	High	Intensely invasive at Bushy Lake. Requires monitoring and adaptive management.
Poison hemlock*** (*Cicuta maculatum)*	Moderate	Intensely invasive at Bushy Lake. Requires monitoring and adaptive management.
Bull thistle (*Cirsium vulgares)*	Moderate	Intensely invasive at Bushy Lake. Requires monitoring and adaptive management.
Artichoke thistle (*Cynara cardunculus)*	Moderate	Intensely invasive at Bushy Lake. Requires monitoring and adaptive management.
Bermuda grass*** (*Cynodon dactylon)*	Moderate	Intensely invasive at Bushy Lake. Requires monitoring and adaptive management.
Fennel (*Foeniculum vulgare)*	Moderate	Limited occurrence at Bushy Lake
Perennial pepperweed*** *(Lepidium latifolium*)	High	Intensely invasive at Bushy Lake. Requires monitoring and adaptive management.
Himalayan blackberry*** (*Rubus armeniacus)*	Limited	Intensely invasive at Bushy Lake. Requires monitoring and adaptive management.
Sow thistle* (*Sonchus asper subsp. asper*)	Limited	Intensely invasive at Bushy Lake. Requires monitoring and adaptive management.

[1] CAL-IPC rating definitions (CAL-IPC 2006)
*Moderately invasive at Bushy Lake
***highly invasive at Bushy Lake

3.2.2 Common Wildlife Species

Common species documented within the project site included the non-native red-eared slider (*Trachemys scripta elegans*), California quail (*Callipepla californica*), bluebirds (*Sialia* sp.), mallard ducks (*Anas platyrhynchos*), wood ducks (*Aix sponsa*), a bobcat (*Lynx rufus),* coyote (*Canis latrans*), California mule deer (*Odocoileus hemionus*), eastern gray squirrels (*Sciurus carolinensis*), desert cottontails (*Sylvilagus audubonii*), striped skunks (*Mephitis mephitis*), opossum (*Didelphis marsupialis*), raccoons (*Procyon lotor*), feral cats, North American beavers (*Castor canadensis*), and North American river otters (*Lontra canadensis*), and non-native turtles. Non-native turtles include a population of red-eared sliders *(Trachemys scripta elegans*) and individual observations of a peninsula cooter (*Pseudemys peninsularis*) and a painted turtle (*Chrysemys picta*). Deer beds occur frequently in the Bushy Lake area; does with spotted fawns have been frequently observed bedding down in the *in-situ* restoration area.

3.2.3 Habitat Connectivity and Wildlife Migration Corridors

Wildlife movement corridors refer to established migration routes commonly used by resident and migratory species for passage from one geographic location to another. Corridors are present in a variety of habitats and link otherwise fragmented acres of undisturbed areas. Maintaining the continuity of established wildlife corridors is important to: a) sustain species with specific foraging requirements; b) preserve a species' distribution potential; and c) retain diversity among many wildlife populations. Therefore, resource agencies consider wildlife corridors to be a sensitive resource.

Available data on movement corridors and linkages was accessed via the CDFW BIOS 6.23.0117 Viewer (CDFW 2023a). Data reviewed included the Essential Connectivity Areas – California Essential Habitat Connectivity layer, the Natural Landscape Blocks – California Essential Habitat Connectivity layer, and the Terrestrial Connectivity – Areas of Conservation Emphasis (ACE) layer.

The project site does not fall within the Essential Connectivity Areas or Natural Landscape Blocks layer. However, the project site does fall within the Terrestrial Connectivity ACE layer (Figure 10). The purpose of the Terrestrial Connectivity layer ACE is to 1) provide a broad overview of statewide connectivity based on the most up-to-date information; 2) assess potential connectivity importance in every hexagon (2.5 square miles) across the state; and 3) serve as a spatial library of existing connectivity studies (CDFW 2019). This layer uses a scoring system that was designed to bring together connectivity information at multiple scales, giving each hexagon a Connectivity Rank of 1-5 based on the conservation importance of connectivity based on the best available data (CDFW 2019). According to this layer the project site occurs within two hexagons, one ranked 1- limited connectivity opportunity and the other ranked 3- connections with implementation flexibility (CDFW 2022a). Rank 1 means the project falls in an area where land use may limit options for providing connectivity (e.g., agriculture, urban) or no connectivity importance has been identified in models (CDFW 2019). Rank 3 means the project site falls within an area that has been identified as having connectivity importance, but has not been identified as a channelized area, species corridor, or habitat linkage at this time (CDFW 2019).

3.2.4 Special-status Species

For the purpose of this document, special-status species are generally defined as follows:

- Plants and Wildlife species listed or proposed for listing as threatened or endangered under ESA or CESA.

- Plants and wildlife species that are candidates for possible future listing as threatened or endangered under the ESA.

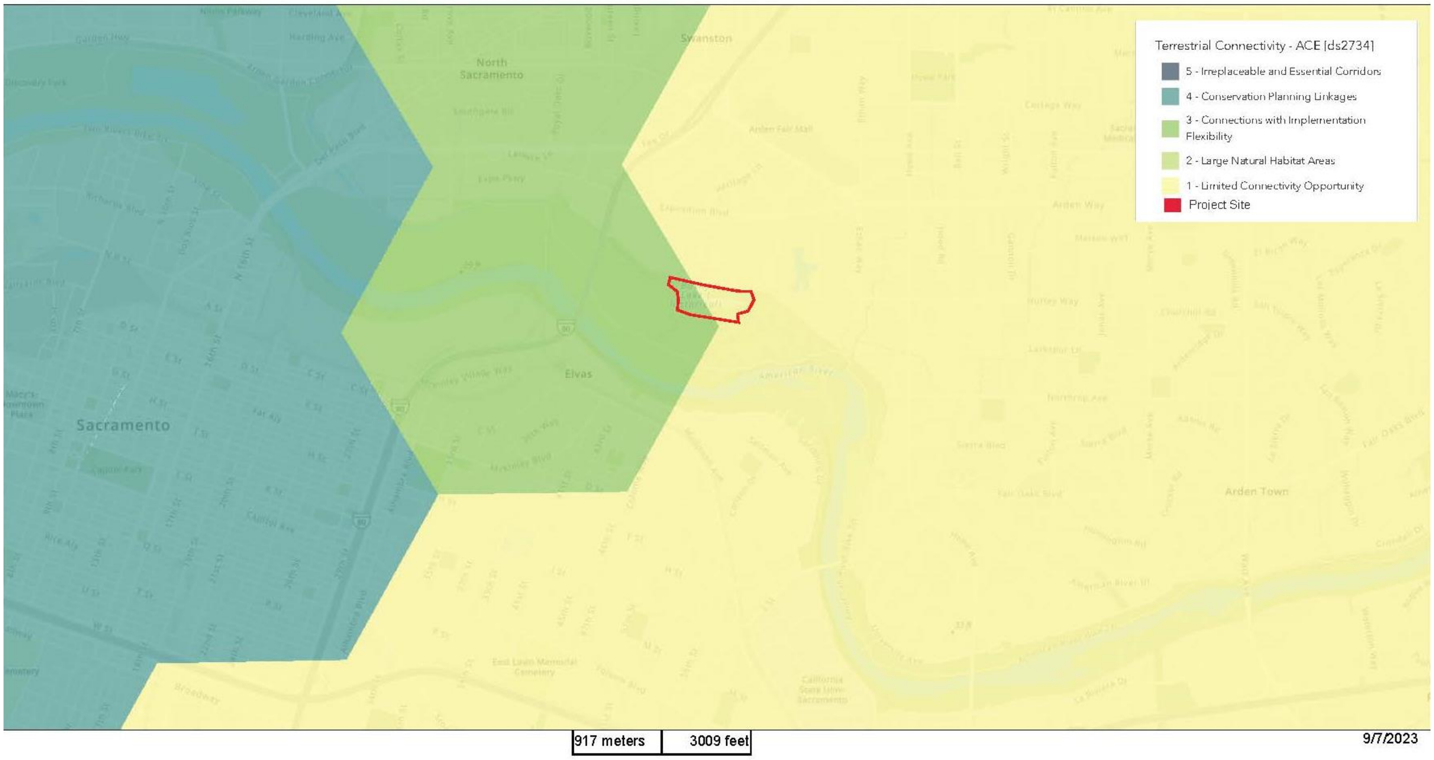


Figure 10. Habitat Connectivity and Wildlife Migration Corridors in the Vicinity of the Project Site.

- Plants and wildlife species that meet the definitions of rare or endangered species under CEQA.
- Plants considered by the CNPS to be "rare, threatened, or endangered" in California (Lists 1A, 1B, 2A, and 2B).
- Plants listed under the NPPA.
- Wildlife species that are designated as Species of Special Concern (SSC) by CDFW.
- Wildlife species that are designated as Fully Protected by CDFW.

Available information regarding special-status plant and wildlife species in or near the project site was gathered and reviewed. Several data sources were reviewed, including:

- An unofficial list of federally listed threatened and endangered species that may occur within the proposed Project vicinity obtained from the USFWS Information for Planning and Conservation (IPaC) tool (USFWS 2023) (Table 2).
- A records search of CDFW's California Natural Diversity Database (CNDDB) for species within the Sacramento East 7.5-minute USGS topographic quadrangle (CDFW 2023) (Table 2).
- A search of the CNPS Inventory of Rare and Endangered Plants Database for the Sacramento East 7.5-minute USGS topographic quadrangle (CNPS 2023b) (Table 2).

Table 2 below summarizes the special-status plant and wildlife species with the potential to occur in the vicinity of the project based on the lists identified above. The rational for species presence in the project is based on studies conducted and observations made within the Bushy Lake restoration area over the last five years. While no protocol-level surveys have been conducted for special-status species, targeted studies have been conducted for the northwestern pond turtle, avian species, and mammal species. The results of these studies are discussed in Section 4.

Table 2. Special-status Plant and Wildlife Species with Potential to Occur in the Vicinity of the Project

Species Name	Listing Status	Rational for Species Potential Presence in the Project Site
Plants		
Sanford's arrowhead (*Sagittaria sanfordii*)	CNPS Rank B.2	Absent. Bushy Lake does contain suitable habitat for this species; however, it has not been observed within the Bushy Lake study area and is therefore assumed to not be present in the Project site.
Amphibians		
California tiger salamander (*Ambystoma claiforniense)*	Federally Threatened	No potential to occur. There is no suitable habitat for this species within the Project site.

Reptiles		
Northwestern pond turtle (*Actinemys marmorata*)[1]	SSC	Present. There is a known population of this species within Bushy Lake.
Birds		
Burrowing owl (*Athene cunicularia*)	SSC	There is potential for this species to occur. While this species has not been observed within the Project site, the annual grassland does provide suitable habitat for this species.
Swainson's hawk (*Buteo swainsoni*)	State Threatened	Present. This species has been observed nesting within the Project site.
Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*)	Federally Threatened and State Endangered	There is potential for this species to occur. While this species has not been observed within the Project site, the riparian habitat does provide suitable habitat for this species.
White-tailed kite (*Elanus leucurus*)	CDFW Fully Protected Species	Present. This species has been observed within the Project site. Suitable nesting trees and foraging habitat are present in the Project site.
Song sparrow- "Modesto" population (*Melospiza melodia*)	SSC	Present. This species has been observed nesting within the Project site.
Purple martin (*Progne subis*)	SSC	Present. This species has been observed within the Project site. Suitable nesting habitat is present in the Project site.
Bank swallow (*Riparia riparia*)	Federally Threatened	No potential to occur. There is no suitable habitat for this species within the Project site.
Mammals		
American badger (*Taxidea taxus*)	SSC	There is potential for this species to occur. While this species has not been observed within the Project site, the annual grassland does provide suitable habitat for this species.
Fish		
Steelhead- Central Valley DPS (*Oncorhynchus mykiss irideus*)	Federally Threatened	No potential to occur. There is no suitable habitat for this species within the Project site.
Insects		
Monarch butterfly (*Danaus plexippus*)	Federal Candidate	There is potential for this species to occur. This species could breed in the Project site if milkweed (*Asclepias* sp.), the larvae's sole food source, is present.
Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*)	Federally Threatened	There is potential for this species to occur. While this species has not been observed within the Project site, elderberry shrubs, this species sole host plant, are present within the riparian habitat in the Project site.
Crustaceans		

Vernal pool fairy shrimp (*Branchinecta lynchi*)	Federally Threatened	No potential to occur. There is no suitable habitat for this species within the Project site.
Vernal pool tadpole shrimp (*Lepidurus packardi*)	Federally Endangered	No potential to occur. There is no suitable habitat for this species within the Project site.

[1] While not on any of the species' lists, a population of northwestern pond turtles is well documented within Bushy Lake.

Northwestern Pond Turtle

Due to the presence of northwestern pond turtles and the nature of the CRP grant, this species is of special interest to this conceptual restoration plan. The conservation status and life history of the northwestern pond turtle is discussed in the following sections.

Conservation Status

In 2014, the Western Pond turtle (*Actinemys marmorata*) taxonomy was revised based on genetic research, and there are currently two recognized populations of pond turtle subspecies in California: northwestern (*Actinemys marmorata*) and southwestern (*Actinemys pallida*) pond turtles (collectively referred to as "Western Pond turtles") (Figure 11) (Alvarez et al. 2021, CDFW 2022, Iverson et al. 2017, Spinks et al. 2010, 2014, and 2016, Spinks and Shaffer 2005). Only northwestern pond turtles have been observed at Bushy Lake.

The California Amphibian and Reptile Species of Special Concern (ARSSC) project recognizes the north and southwestern pond turtles as separate subspecies with separate conservation concerns and priorities (Thomson et al. 2016). Under the ARSSC project, both subspecies are recognized as "species of special concern" in California and have been in steady decline (Alvarez 2021, Spinks et al. 2016, Thomson et al. 2016, Bury et al. 2012,). The Southwestern Pond turtle is a Priority 1 Species of Special Concern, and the northwestern pond turtle (NWPT) is a Priority 3 Species of Special Concern (Spinks et al. 2016).

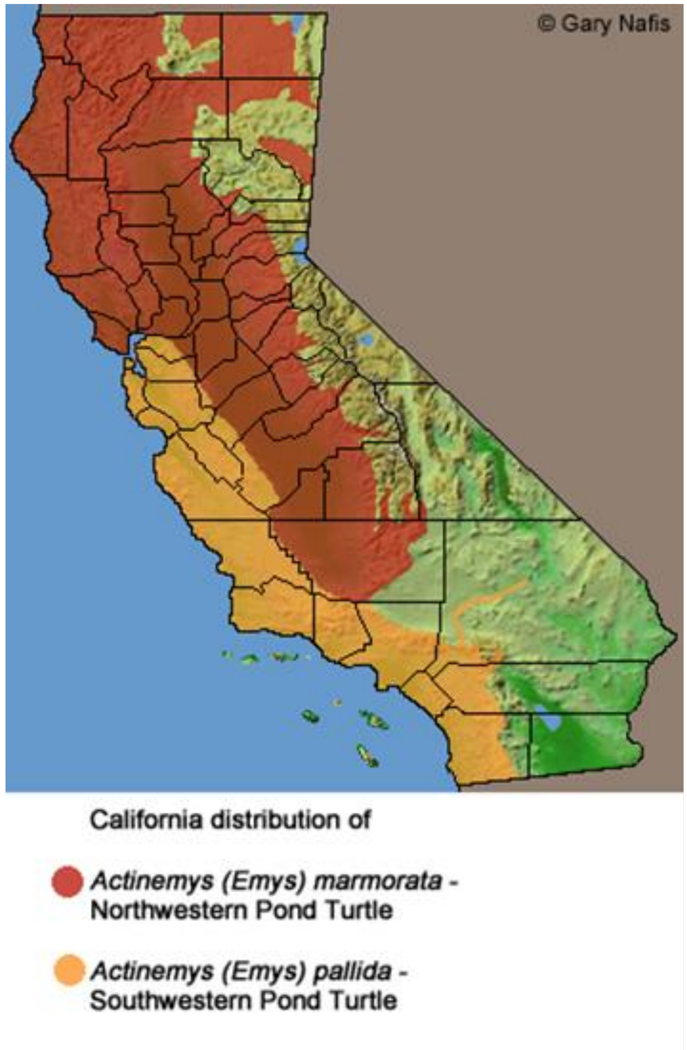


Figure 11. Distribution of the Northwestern Pond Turtle (*Actinemys marmorata*) (California Herps 2023)

The ARSSC describes Priority 1 taxa as those "likely to experience severe future declines and/or extirpation without immediate conservation actions", and Priority 3 taxa as "clearly at risk but likely are not experiencing a substantial and immediate threat of extirpation, although the potential for this threat to develop exists if no management actions are undertaken" (Thomson et al. 2016).

Both species are under consideration to be listed under the Federal Endangered Species Act by the U.S. Fish and Wildlife Service; the status review is anticipated to be completed in 2023 (USFWS 2021). The Western Pond turtles are already listed at the state levels in Washington and Oregon (CBD 2022b). Washington recognizes the species as "endangered" and has established recovery plans, and Oregon recognizes the species as "sensitive/critical" with established conservation priorities (CBD 2022b, Rosenberg et al. 2009, Hays et al. 1999).

Factors contributing to the decline of pond turtle populations include the loss and degradation of aquatic habitat; habitat alteration, fragmentation, and destruction; urbanization and agricultural conversion; shell disease (Lambert et al. 2021); competition with NNTs; and predation of nests have resulted in the decline and local extirpation of pond turtles throughout much of the historic range (Purcell et al. 2017, Spinks et al. 2016, Bury et al. 2012, Cayan et al. 2008). Changing climate conditions, especially ongoing drought, and wildfires, magnify threats to Western Pond turtle populations (Purcell et al. 2017).

Life History

This section provides an overview of the life history of native and non-native turtles. Turtle brumation, a form of hibernation, occurs from approximately October through late February to early March, with periodic active periods throughout winter (Alvarez, pers. comm. 2021). Turtles are known to mate throughout the spring. From mid-April through the end of July, female turtles travel to the upland habitats to construct nests (CBD 2022a, USFWS 2015). Turtles travel an average of 100m away from the water to construct a nest, however, females have been observed traveling as far as 500m to nest (Bushy Lake CRP WC-1943CA January 2022 Summary Report 2, Davidson and Alvarez 2020, Lovich and Meyer 2002, Holte 1998, Reese and Welsh 1997, Holland 1994, Storer 1930). During the nesting process, turtles will dig "phantom" or "exploratory" nests, which are shallow, incomplete nests without eggs or plugs (a clump of soil, vegetation, and turtle urine utilized to cover the nest) (Alvarez and Davidson 2018).

NWPTs typically construct one nest, however, there are records of double clutching (Bury et al. 2012, Germano and Rathbun 2008). NWPT clutch sizes range from 1 to 11 eggs (Germano and Rathbun 2008, Lovich and Meyer 2002, Holland 1994). The eggs hatch in August and the hatchlings remain in their nests. The hatchlings' movements slowly displace soil until there is an opening for them to emerge from, between late February and early March (Davidson and Alvarez 2020, Spinks et al. 2003, Germano and Bury 2001, Goodman 1997). Literature reviews on pond turtles illustrate a high degree of variability in the life history between sites; species differences, and inter-annual climate variability of precipitation, temperature, flooding, drought, and aquatic habitat quality (Davidson and Alvarez 2020, Bury et al. 2012, Ernst and Lovich 2009). Given the variation and uncertainty evident in published literature, our field research at Bushy Lake appears increasingly important.

4. Baseline Studies

Several baseline studies were conducted to collect data on existing conditions to inform this CRP. Baseline studies were conducted on the northwestern pond turtle population, *In Situ* restoration site, aquatic community and water quality, hydrology characterization, wetland boundaries, and avian and mammal wildlife within the Bushy Lake restoration site.

4.1 Northwestern Pond Turtle Surveys

Targeted surveys for northwestern pond turtles in Bushy Lake began in 2020. Three survey methods have been implemented: basking, nesting, and mark-recapture surveys. The following sections discuss the methods and results of these studies.

4.1.1 Survey Methods

Basking Survey

Basking surveys were initiated in the spring of 2021 and 2022, to document when the turtles first began to emerge from brumation (USGS 2006a, USGS 2006b). Turtle basking surveys were conducted weekly:

- 2021 surveys included February 21 and 27; March 20 and 26; April 2, 16, and 23; and May 14.
- 2022 surveys included February 11, 18, and 15; March 12 and 18; and April 2, 16, 19, and 30.

Surveys were calibrated by having an experienced biologist, Gunner Michaelson, participate in all surveys to provide data consistency. Metrics recorded include location, species type, size, and age. If a species determination could not be confidently made, turtles were listed as "unknown." The turtle count approximated the number of individual turtles that can be found basking at Bushy Lake on a given day. It can be expected that there are 2-3 times more turtles in Bushy Lake than observed in visual surveys (Alvarez, pers. comm. 2021). Visual basking surveys were stopped after May 14, 2021, and April 30, 2022, and were superseded by detailed mark-recapture surveys.

The basking surveys were accompanied by a habitat mapping field survey in September 2021. This survey identified potential turtle basking sites consisting of large pieces of woody debris.

Nesting Survey

Jeff Alvarez, the founder of The Wildlife Project and pond turtle expert, provided training for turtle nesting surveys and turtle nest protection (Alvarez 2021, Foster et al. 2021, Davidson and Alvarez 2020, Alvarez et al. 2014). Training occurred on May 21 and 23, 2021, and April 22, 2022, which coordinated with USGS protocols (USGS 2006a). Turtle nesting surveys were conducted daily from May 20 to July 1, 2021, excluding June 6-9 due to the June 6 fire, and May 6 to July 25, 2022. Additional observations occurred on April 7, September 3, and September 17, 2022. Nesting surveys included surveying the upland habitat surrounding Bushy Lake for active turtles, predated turtle nests, "dummy" or "phantom nests", and potentially active nests (Table 3).

When an active nesting turtle is observed, field biologists are careful to avoid disturbing them. Active turtles are observed through binoculars and scopes until the turtle utilizes their hind legs and urine to pack mud and vegetation over the nest; this covering is known as the plug. Upon nest completion, field biologists identify the nest location, and cover the nest with chicken wire, U-shape garden stakes, and flagging to protect the eggs from predators. This technique has been utilized on Red-eared sliders (RES) to ensure field biologists are comfortable with the procedures. If an active NWPT is observed nesting, the Bushy Lake field biologists will be prepared to protect the turtle's nest.

Predated turtle nests can be identified by eggshell fragments and a dried plug. "Dummy" or "phantom" nests are predated nests that contain a plug, but no eggshell fragments. Potentially active nests were identified by cleared vegetation in a crescent-shaped size and when the ground is tapped, feels, and sounds hollow.

Table 3. Examples of Turtle Nest Status

Predated Nest	Eggshells ARE present. Plug MAY be present.	 
Dummy Nest	Eggshells are NOT present. Plug IS present.	
Active Turtle	Successfully completed nest by an active turtle. A turtle with a muddy posterior shell indicates a nesting attempt.	

Mark-Recapture Survey

Monthly live turtle mark-recapture studies began in March 2020 and continued through July 2023. Surveys occurred on a near-monthly basis:

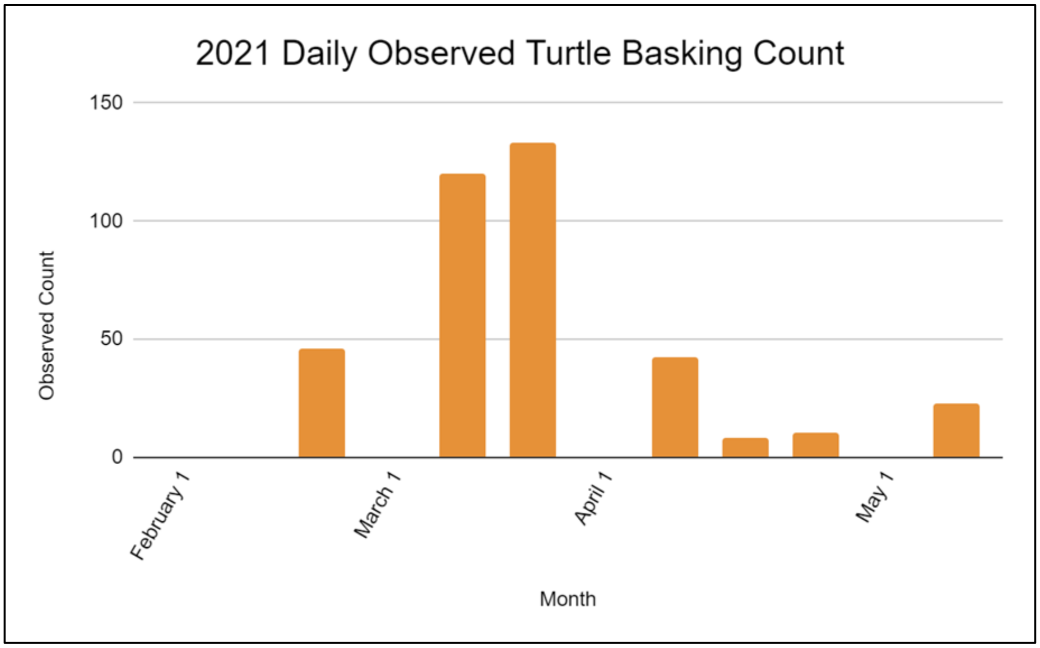
- 2020: March 22, June 14, 20, 21, 23, 25, 26, 28, September 20, October 4, and November 8.
- 2021: January 3, March 7, April 4, May 2, June 6, July 7, August 1, September 14, October 10, November 7, and December 5.
- 2022: March 12, April 2, May 7, June 4, June 28, July 24, September 4, October 9, November 13, and December 4.
- 2023: March 5, April 10, May 7, July 9.

Newly captured non-native turtles (NNT) were marked by filing a single notch in the marginal scute (I.e., #80). Each NWPT was photographed and marked with a unique pair of scute markings to differentiate individuals (Following: Cagle 1939). Data collected included weight (g), carapace width and length (cm), plastron width and length (cm), max height (cm), sex, presence of eggs if applicable, age if identifiable, and any shell anomalies. Turtles were returned to the point of capture in Bushy Lake after data collection. Characteristics of trap locations were also collected during mark-recapture surveys from April 4, 2021, to July 2023. This included the trap GPS location, water depth, air temperature, water temperature, and wind speed.

Basking Survey

In 2021, turtles were observed emerging from brumation on February 27, 2021. A count of 369 basking turtles was observed across all observation days. The observation counts included 369 RES, 11 unknown, and 5 NWPT basking observations. The NWPT observations included 2 on February 27 and 1 on each of the following days: March 20 and 26, and May 14, 2021. March 26 had the highest observation count in 2021 with 133 observations (Figure 12a). In 2022, turtles were observed emerging from brumation on February 11, roughly 2 weeks earlier than in 2021. A total count of 625 basking turtles was observed across all observation days. The observation counts included 569 RES and 56 unknowns. February 11 had the highest observation count in 2022 with 170 observations (Figure 12b).

The habitat mapping field survey identified 19 potential turtle basking sites at Bushy Lake. However, it should be noted that fluctuating water levels in the lake may likely expose new sites and submerge existing sites. This was overlayed with the 2022 basking observations to compare the locations of potential basking habitats with observed high use basking areas (Figure 13).



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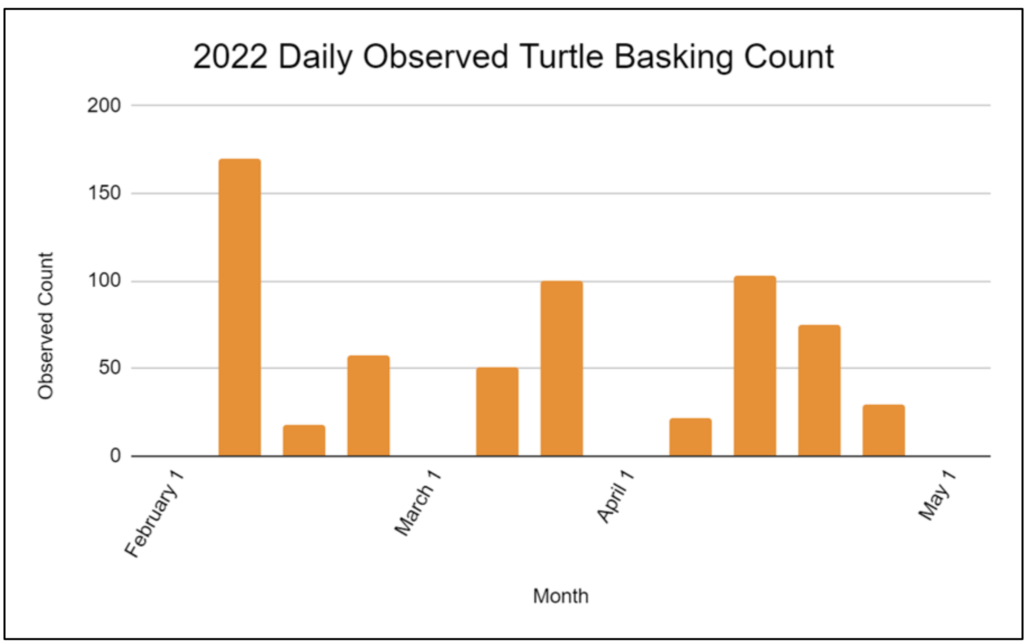


b.

Figure 12. Daily observed turtle count of a. 2021 and b. Turtle Basking Surveys

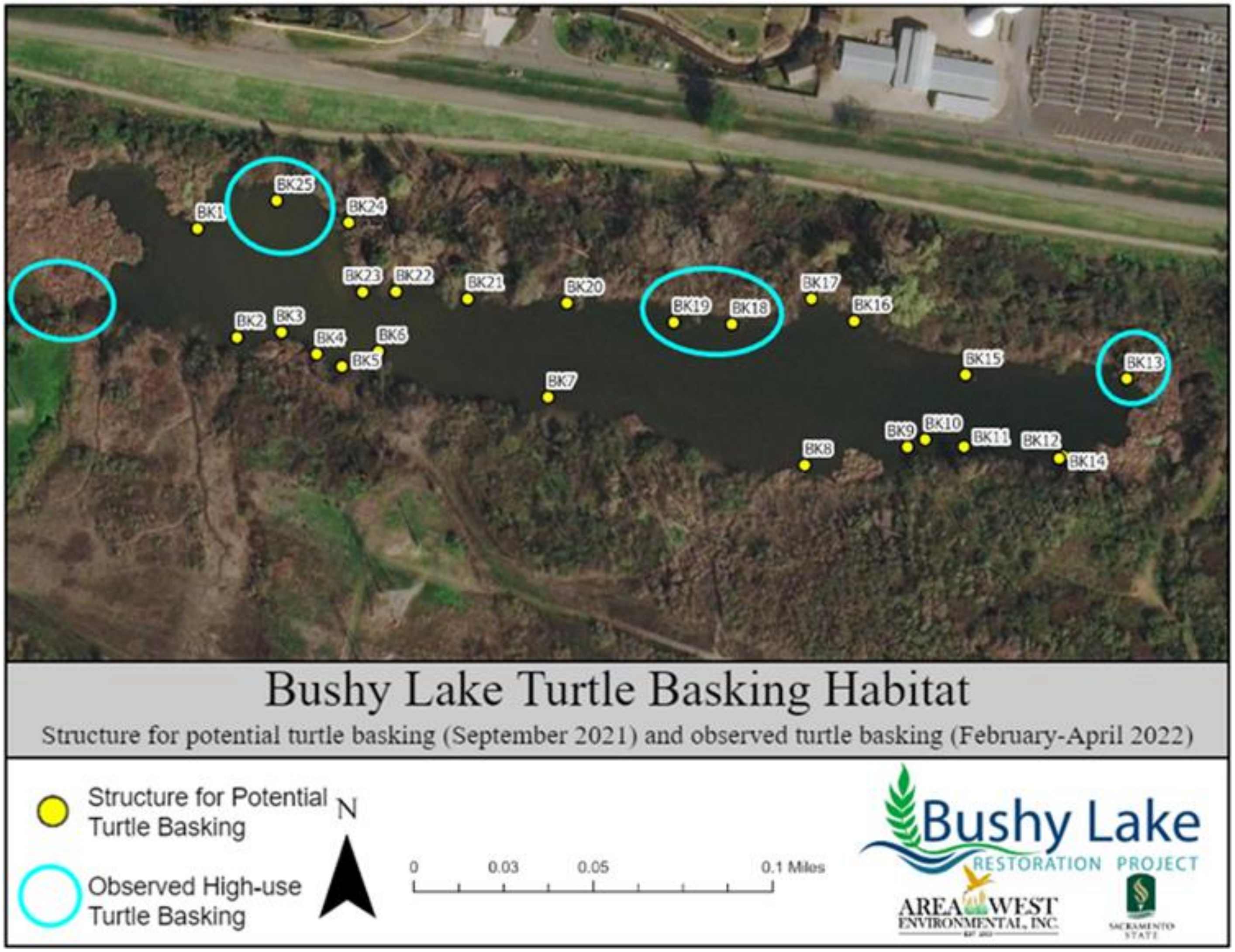


Figure 13. Structure for potential turtle basking habitat and observed high-use areas of turtle basking at Bushy Lake, Sacramento, California

Nesting Survey

In 2021, a total of 58 observations of nesting activity were recorded (45 predated nests [3 NWPT, 13 NNT, 29 unknown and potentially NWPT], 9 active NNT, 3 unknown dummy nests, and 1 potentially active and unknown nest (Table 4). The 2021 nesting surveys were disrupted by a 130-acre wildfire that burned through Bushy Lake on June 6, 2021, during the peak of the turtle nesting season. During post-fire nesting surveys, burned-over nests became identifiable, however, no new nesting was observed within the footprint of the fire (Figure 14).

In 2022, a total of 189 observations of nesting activity were recorded (99 predated nests [6 NWPT, 70 NNT, 23 unknown and potentially NWPT], 30 active NNT, 26 unknown dummy nests, and 32 potentially active nests [1 NNT based on shell peeling, 31 unknowns] (Table 5). The distribution of nests was more widespread in 2022 than in 2021 when there was no fire disturbance (Figure 15). The 2022 nesting survey additionally indicated the peak nesting time on June 14th (Figure 16).

In 2023, between June 1 and July 3, a total of 122 nesting activity observations were recorded (56 predated nests [4 NWPT, 39 NNT, and 13 unknown and potentially NWPT], 23 active NNT [1 completed nest], 37 dummy nests [6 NNT based on active turtles, 31 unknowns], and 6 potentially active and unknown nests (Table 6). Although the 2023 data featured here does not include the entire month of July, several observations can be made. Nesting activity continued to be widespread throughout the site, however, there was an increase in activity on the western side (Figure 17). Similar to the previous year's survey, activity peaked in June. June 5th had the greatest day observation count, however, there were slightly smaller peaks on June 22nd and 29th (Figure 18).

Throughout the three years of turtle nesting surveys, no active northwestern pond turtles were observed, however, this does not indicate that pond turtles are not nesting. The turtle mark-recapture surveys identified one female northwestern pond turtle. The likelihood of observing this specific turtle is extremely low given the widespread upland habitat available for potential nesting, the amount of vegetation obscuring biologists' view of a low-lying turtle, and the possibility of nesting time variability. Turtles at Bushy Lake have been observed nesting in the morning, however, turtles at other sites have been observed nesting in the afternoon and evening (Alvarez, pers. comm. 2021).

There additionally has not been a potentially active nest identified as a northwestern pond turtle due to the nature of a completed nest. Without an active turtle, the species of a completed nest can only be identified by excavating the eggs. Because of this, a majority of nests were determined to be unknown with the potential to be NWPT. One potentially active nest was able to be identified as a NNT in 2021, however, this was only based on the presence of a shell fragment identifiable as a Red-eared slider

Table 4. Observation Types During the 2021 Turtle Nesting Surveys (May 1 – June 30, 2021). A fire occurred on June 6, 2021. During post-fire nesting surveys, burned nests became identifiable, however, no new nesting activity was observed within the footprint of the fire.

Species	Active Turtle	Potential Active Nest	Predated Nest	Dummy Nest	Total
Northwestern pond turtle	0	0	3	0	3
Non-native turtle	9	0	13	0	22
Unknown - potentially NWPT	0	1	29	3	33
Total	9	1	45	3	58

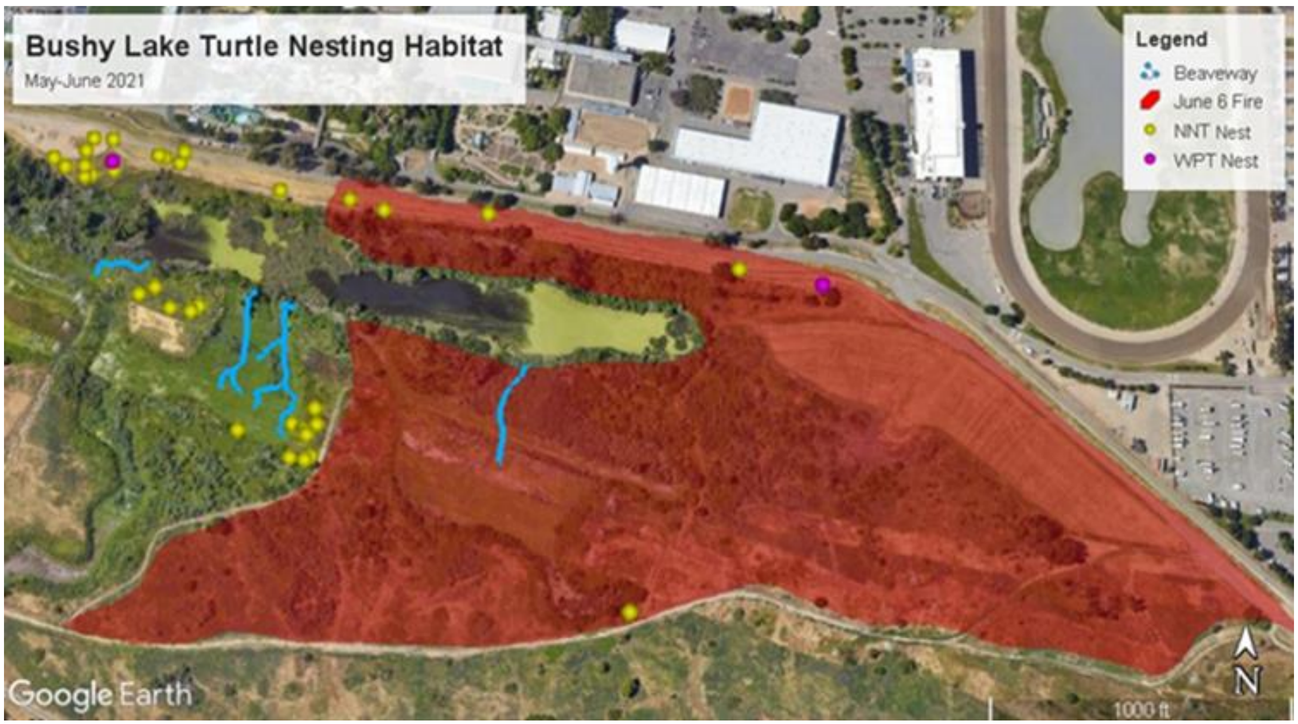


Figure 14. Nesting activity of 2021 turtle nesting surveys overlayed with the footprint of the June 6, 2021, wildfire at Bushy Lake, and the beaver-made channels "beaveways" (May 1 – June 30, 2021)

Table 5. Observation Types During the 2022 Turtle Nesting Surveys (April 4, May 6 – July 25, September 3 and 17, 2022)

Species	Active Turtle	Active Turtle Nesting Observed	Potential Active Nest	Predated Nest	Dummy Nest	Total
Northwestern pond turtle	0	0	0	6	0	6
Non-native turtle	30	2	1	70	5	108
Unknown - potentially NWPT	0	0	31	23	21	75
Total	30	2	32	99	26	189

Figure 15. Nesting activity of 2022 turtle nesting surveys (April 4, May 6 – July 25, September 3 and 17, 2022)

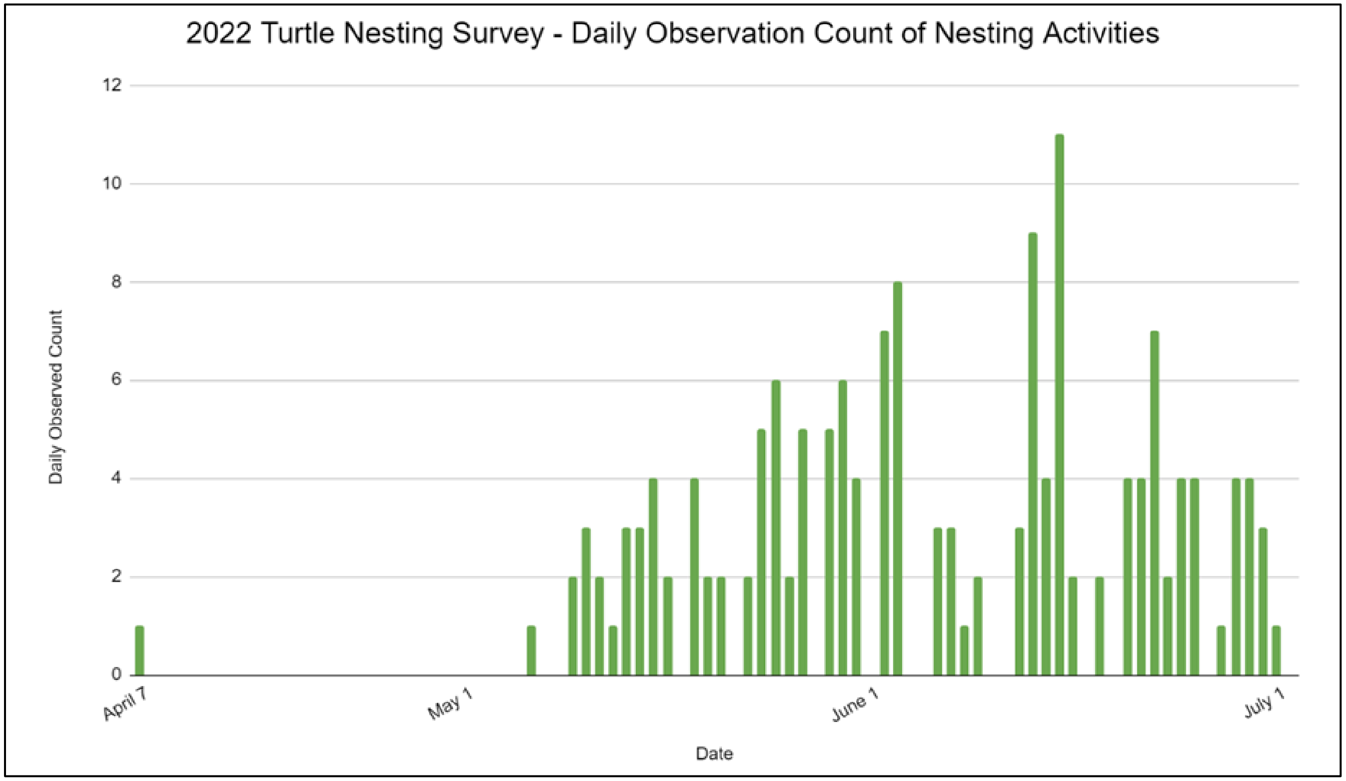


Figure 16. 2022 Turtle Nesting Survey – Daily Count of Observed Nesting Activities (June 1 – July 23, 2022)

Table 6. Observation Types During the 2023 Turtle Nesting Surveys (May 21, May 26, June 1 – July 3, 2023)

Species	Active Turtle	Potential Active Nest	Predated Nest	Dummy Nest	Total
Northwestern pond turtle	0	0	4	0	4
Non-native turtle	23	0	39	6	68
Unknown - potentially NWPT	0	6	13	31	50
Total	23	6	56	37	122

Figure 17. Nesting activity of 2023 turtle nesting surveys (May 21, May 26, June 1 – July 3, 2023)

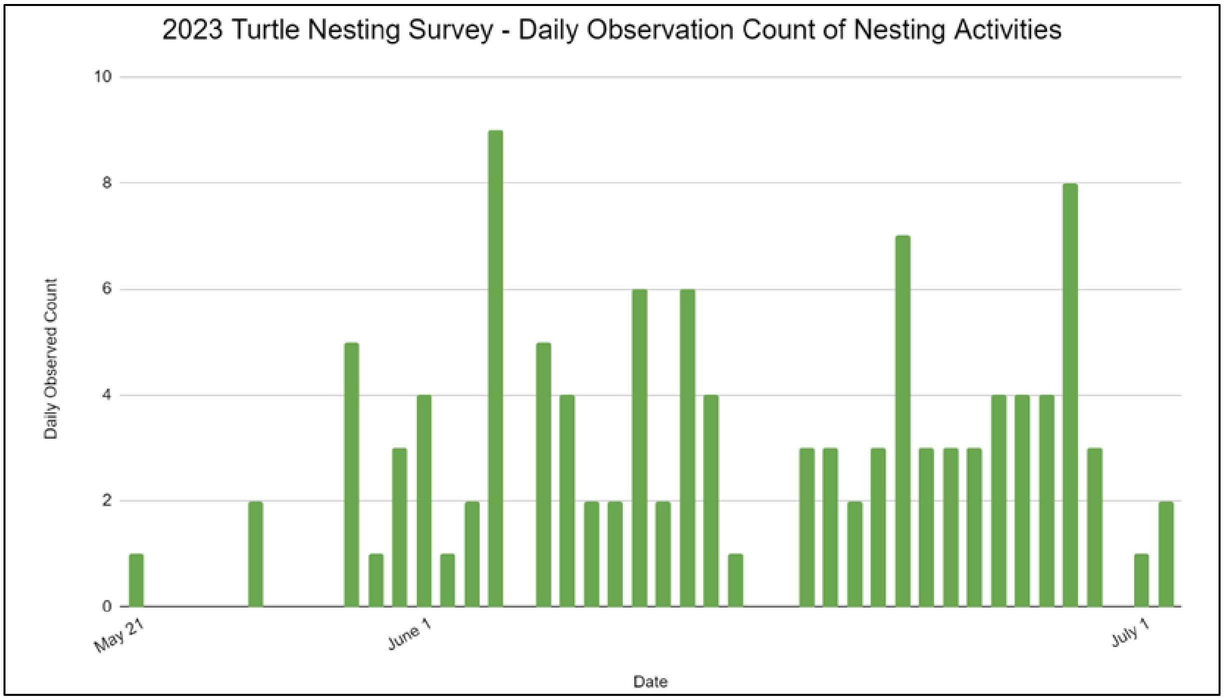


Figure 18. 2023 Turtle Nesting Survey – Daily Count of Observed Nesting Activities (May 21, May 26, June 1 – July 3, 2023)

Mark-Recapture

Over the course of turtle mark-recapture surveys at Bushy Lake (March 21, 2020, through July 9, 2023), there have been 7 NWPT individuals identified, including 6 adult males and 1 adult female (Table 7). All NWPT individuals have been generally healthy; they have been alert and responsive, had complete tails and limbs, could retract their limbs and tails, did not have parasites, and had minimal or no shell anomalies. The female NWPT did have pitting marks on the carapace and plastron, indicative of a collision with a bicycle while traveling in the upland habitat (see section "Threats to the Northwestern Pond Turtle at Bushy Lake: Bicycle Strikes on Turtles").

Individual NWPTs were recaptured multiple times, indicating that a small NWPT population likely exists at Bushy Lake (Table 7). Additionally, the NWPT individuals are relatively evenly distributed in the lake, indicating habitat use throughout the lake (Figure 19). This population has the potential to reproduce; there are male and female individuals, and NWPT nests (predated) have been identified.

Table 7. Northwestern Pond Turtles frequency of recapture from all mark-recapture surveys at Bushy Lake (March 22, 2021 – July 9, 2023)

ID Number	Number of Captures	2020	2021	2022	2023	Life stage	Sex
NWPT 1	8	X		X	X	Adult	Male
NWPT 2	5	X	X			Adult	Male
NWPT 3	1		X			Adult	Female
NWPT 4	2		X			Adult	Male

NWPT 5	1			X		Adult	Male
NWPT 6	1			X		Adult	Male
NWPT 7	3			X		Adult	Male

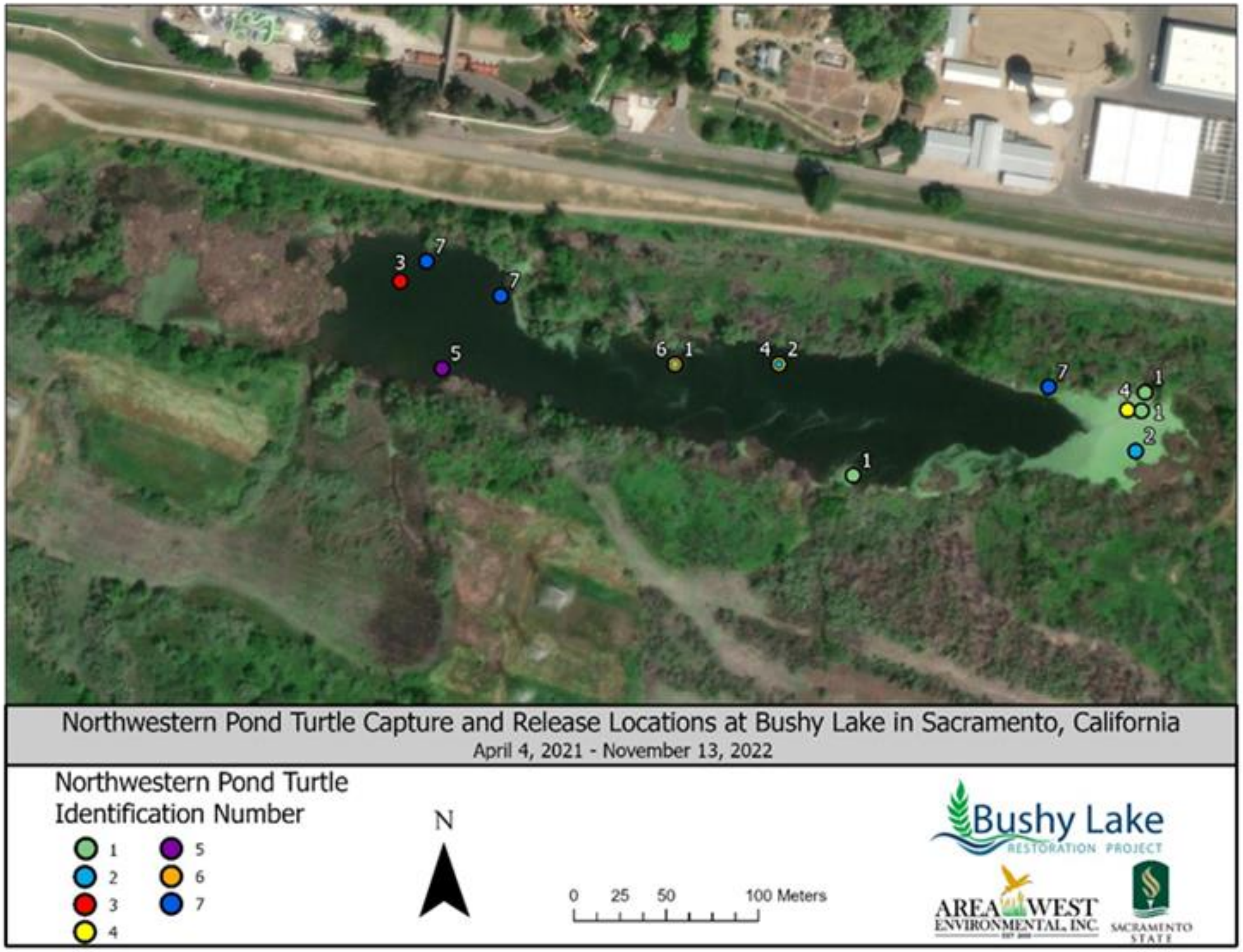


Figure 19. 2022 locations of capture and release of Northwestern Pond Turtles (A*ctinemys marmorata*) in 2022 mark-recapture surveys at Bushy cLake in Sacramento, California

A total of 290 individual adult NNTs were identified between March 21, 2020, and July 9, 2023. The NNT population primarily consisted of slider individuals representing two slider subspecies (Red-eared sliders [*Trachemys scripta elegans*], including melanistic red-eared sliders, and yellow-bellied sliders [*Trachemys scripta scripta*]). There was additionally 1 Peninsula Cooter (*Pseudemys peninsularis*), and 1 painted turtle (*Chrysemys picta*). The slider species have a larger mass than the NWPT at Bushy Lake (1,052g vs 636g respectively) (Table 8). There was a capture count of 89 juvenile NNTs, all slider species. Most of the juvenile turtles were not large enough to safely file identifying marks into the marginal scute, and, therefore, it is unknown if they were previously captured. Only a capture count can be determined for the juvenile turtles.

Table 8. The average weight of adult native and non-native turtles at Bushy Lake. March 21, 2020, - July 9, 2023) (Native: Northwestern Pond Turtle (*Actinemys marmorata*) (n=7). Non-native: Slider species (red-eared sliders [*Trachemys scripta elegans*]; melanistic red-eared sliders; yellow-bellied sliders [*Trachemys scripta scripta*]) (n=289), Peninsula Cooter (*Pseudemys peninsularis*) (n=1), painted turtle (*Chrysemys picta*) (n=1)

Common Name	Scientific Name	Average Weight (g)	Sample Size
Northwestern pond turtle	*Actinemys marmorata*	636	7
Slider species	*Trachemys scripta spp.*	1,052	290
Peninsula cooter	*Pseudemys peninsularis*	3,340	1
Painted turtle	*Chrysemys picta*	375	1

4.1.2 Conclusion

Identified Threats to the Northwestern Pond Turtle at Bushy Lake

Competition with Non-native Turtles

The Peninsula Cooter and Painted turtle were both observed only once at Bushy Lake over the course of 3 years; due to their limited occurrence, these two species were not identified as a threat to the native northwestern pond turtles of Bushy Lake. The red-eared slider is the most prevalent non-native turtle at Bushy Lake. Red-eared sliders pose the greatest competition pressure on the northwestern pond turtle.

The red-eared slider's native range extends from northern Indiana to southeast Iowa, and southward through Florida and eastern Texas to northeast Mexico (Figure 20) (Carr 1995, Ernst and Lovich 2009). In the 1930s, juvenile sliders began to be shipped throughout the United States for the pet trade (Carr 1995, Ernst and Lovich 2009). Pet owners are often unaware of the natural history of red-eared sliders; as the slider ages and grows, they become more difficult to care for (Teillac-Deschamps et al. 2008). Sliders are believed to have escaped or been released into their non-native ecosystems (Harvey 1992). This has since led to the red-eared slider's establishment in their non-native range, including the San Francisco Bay Delta (Cohen et al. 1995). Red-eared sliders are known to occur in 48 of California's 58 counties (iNaturalist 2022).

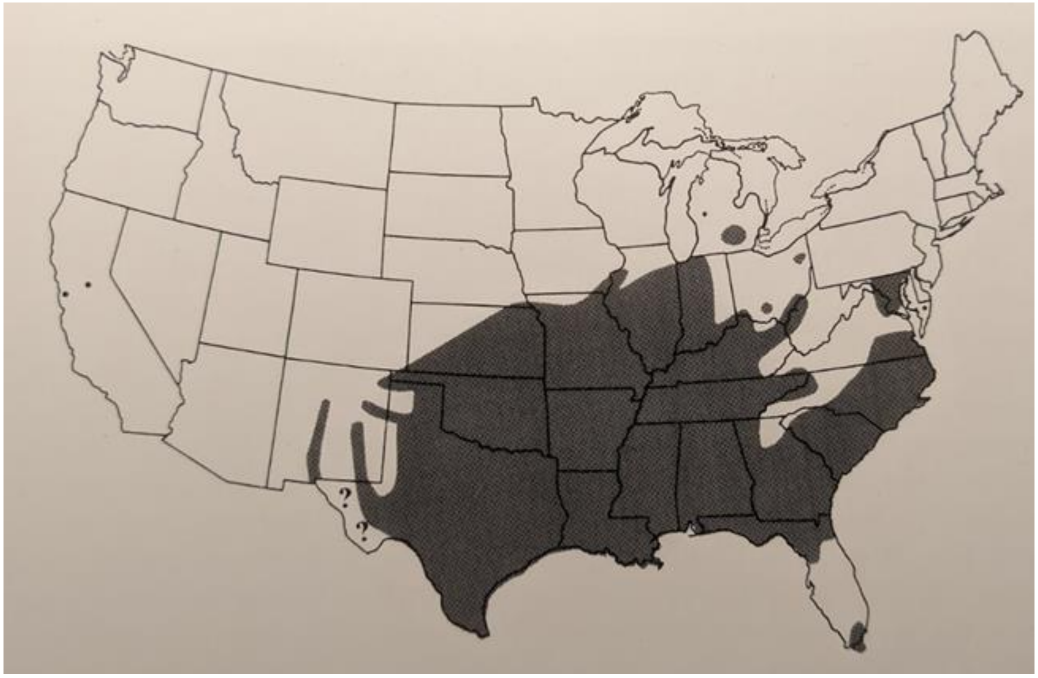


Figure 20. Native Distribution Range of the Red-eared slider (*Trachemys scripta elegans*) (Ernst and Lovich 2009)

The red-eared slider has been disparaged as one of the worst invasive species and is listed as one of the top 100 invasive species globally (IUCN, 2023). Non-native species are often labeled as "bad" and native species as "good", and red-eared sliders have long been deemed a driver in the native pond turtle's declining populations. (Dupois-Desormeaux., et al 2022). However, due to human contributions, in many cases [red-eared sliders] are "passengers" and not "drivers" of the decline in local turtle populations" (Ibid). Little is understood about the competition mechanisms between native and non-native turtles in California.

An experimental study was conducted in Davis, California euthanized over half of a waterway's turtles, all red-eared sliders, to reduce competitive pressures on the native pond turtles (Lambert et al., 2019). The study did not find strong evidence of interspecific competition for basking habitats (Ibid). They found that pond turtles' weights increased indicating some degree of competition for food, however, it was unclear if this was due to a decrease in overall turtle density or specific to sliders (Ibid). Overall, it was unclear if the time and cost-intensive process sufficiently justified the results (Ibid).

At Bushy Lake, the Red-eared slider population is significantly larger than the native NWPT population, allowing for greater competition in favor of the sliders. The slider population additionally consists of more females than males and more adults than juveniles. A large adult female population indicates a higher reproductive ability and potential for a growing slider. However, at Bushy Lake, all the NWPTs are healthy and at least one individual is a resident (NWPT #1). Additionally, there are female and male individuals present, indicating reproductive potential. The extent of competition pressure on NWPT at Bushy Lake is unclear; however, the CRP will address elements of potential competition to minimize stress. Managing and supporting the NWPT population will require a holistic approach including maintaining healthy aquatic and terrestrial habitats and maintaining substantial resources to reduce competition pressures.

Turtle Nest Predation

Nesting surveys conducted in 2021 identified a high number of predated nests, primarily by skunks (Alvarez, pers. comm. 2021). Turtle nests are most at risk of predation in the first 1-2 weeks after eggs are laid (Ibid). As described in the nesting survey methods, completed nests can be temporarily covered with chicken wire and U-shaped stakes to reduce the risk of predation. The chicken wire could be removed after two months to allow for hatchlings to emerge. Predated nests were also observed in the fall with the first rains, which exposed emerging hatchlings to predators.

Bicycle Strikes on Turtles

Pond turtles face significant risks from human activities adjacent to Bushy Lake. Between March 2020 and December 2021, 76 turtles displayed shell damage indicative of strikes with bicycles (Table 9) (Alvarez, pers. comm. 2021). One adult female NWPT had shell striations indicative of bicycle strikes; the shell damage indicative of bicycle strikes consists of multiple circular indentations with chipped "rings," showing the different layers of keratin, on both the plastron and carapace (Figure 21) (Alvarez, pers. comm. 2021). Furthermore, any collisions with vehicles or lawnmowers would have far more significant and potentially lethal impacts on turtles. The site is additionally closed off to public vehicles and only experiences seasonal mowing, significantly reducing the potential for these strikes.

Furthermore, Bushy Lake has several adjacent trails that have been opened to off-road bicyclists and are additionally utilized by homeless individuals on bicycles. The risk of turtle-bicycle collisions increases during nesting season in late spring and summer when females are moving between the aquatic and terrestrial nesting habitats. In the summer of 2021, Sacramento County Parks placed signs to inform bicyclists of potential turtle crossings during nesting season.

Table 9. Counts and percentages of turtles with shell pitting attributed to bicycle strikes at Bushy Lake from March 2020 - December 2021 (total population: n=294).

	All Turtles with Pitting	Adult Female	Adult Male	Adult of Unknown Sex	Juvenile of Unknown Sex
Count	76	50	19	7	3
Percent of population (n=294)	25.9%	65.8%	25%	5.3%	3.9%

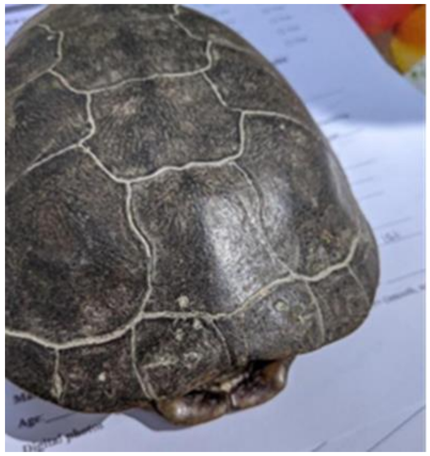
a.  b. 

Figure 21. Pitting on the carapace of a female northwestern pond turtle (*Actinemys marmorata*) (a.) and plastron of a red-eared slider *(Trachemys scripta elegans*) (b.)*,* which are associated with bicycle strikes at Bushy Lake

Wildfire

The wildfire on June 6, 2021, occurred at the peak of turtle nesting season. The fire burned to the lake's edge and disrupted turtle nesting activities. Over 60% of Bushy Lake burned and along with it much of the upland habitat with nesting potential. During post-fire nesting surveys, burned nests became identifiable, however, no new nesting was observed within the footprint of the fire (Figure 12). Even if a turtle did successfully nest in the burned area, neither the eggs nor hatchlings would likely survive due to ash absorbing the soil and urine moisture needed for their growth and survival (Alvarez, pers. comm. 2021).

Critical Habitat Elements for the Northwestern Pond Turtle

Northwestern pond turtles require three main types of habitats: 1) aquatic habitat consisting of open, standing water for feeding, mating, and refuge; 2) aquatic habitat containing partially submerged logs and other materials for basking; and 3) terrestrial habitat consisting of a matrix of vegetation for coverage and near-bare ground for nesting (Alvarez, pers. comm. 2021).

The mark-recapture surveys can be utilized as a proxy to assess the open-water aquatic habitat. Northwestern pond turtles have been observed throughout Bushy Lake, indicating that the entirety of open water is a habitat utilized by NWPTs (Figure 19). Aquatic basking habitat was assessed through the mapping of potential turtle basking sites and basking surveys and overlaid with the observed high use basking areas (Figure 13). Although the quantity and locations of basking sites will likely change with fluctuating water levels, this map helps identify the basking habitat most likely to be utilized by turtles.

Lastly, the terrestrial habitat can be assessed through the mapping of turtle nesting surveys. The 2021 nesting surveys were disturbed by the widespread fire on June 6, 2021; this showcased 1) how the fire footprint negatively impacted turtle nesting activity, and 2) the importance of the western side of Bushy Lake's terrestrial habitat which was not burned (Figure 14). Turtle preference for nesting on the western side was observed again in 2022 and 2023, however, turtles used all adjacent terrestrial habitats, including the areas previously disturbed in 2021 (Figures 14-17). NNT and potentially NWPT nesting activities were additionally observed throughout the site. Turtle activity was most prominently observed in areas of low-lying vegetation and in areas that had been previously managed by mowing or grazing.

4.2 *In Situ* Restoration Site

4.2.1 Bushy Lake Eco-Cultural Restoration

The Bushy Lake restoration practices, palette, and plan are based on the premise that culturally significant plant species are fire-resilient after being managed and tended by Native Californian people (Nissenan, Maidu, Miwok) for thousands of years. Based on the progress and results of the in-situ restoration site, we believe bringing back native species of cultural importance, Indigenous Traditional Ecological Knowledge informing the tending and gathering of these species, and Traditional Fire Management will contribute to the resiliency and sustainability of the Bushy Lake and lower American River Ecosystems.

Restoration planting of the in-situ restoration pilot project began in 2015. Our restoration design was based on enhancing culturally significant native plants and wildlife species in a highly disturbed and urbanized landscape especially vulnerable to wildfires. There have been three wildfires since 2015. The planting palette and design were chosen in a manner to test successful survival and restoration replanting techniques on native plant species on the site. Our hypothesis is that culturally significant plants are fire resilient and will thrive in a highly degraded landscape, or "Novel Ecosystem." The dominant species in the restoration site are now fire-resilient species providing both cultural and pollinator services. There are also a lot of invasive weedy species that require constant adaptive management to maintain the site.

Over the past two years, we have experimentally planted seeds and seedlings to test how well different seeds and seedlings survive at Bushy Lake. Species planted at Bushy Lake will inform the plant pallet for the CRP and the Long-Term Management Plan. Planting occurred in early spring; adaptive management included hand watering and weeding. We chose the following native species that are fire resilient, beneficial to pollinators and wildlife, and culturally significant for California Indian people.

Table 10. Experimental Seedlings and Seeds Planted at Bushy Lake

Scientific Name	**Common Name**	**Cultural**	**Use**	**Pollinator**	**Year**
Seedlings					
Carex barbarae	White Root	x	Basketweaving		22
Elymus triticoides	Creeping wildrye	x	Riparian dominant, Pinole	x	22
Artemisia douglasiana	Mugwort	x	Medicine	x	22
Grindelia camporum	Gumplant	x	Seeds	x	22

Achillea millefolium	Common Yarrow	x	Medicine	x	22
Muhlenbergia rigens	Deergrass	x	Basketweaving		23
Solidago Velutina	California goldenrod	x	Pinole	x	22
Symphyotrichum chilenses	California aster	x	Pinole	x	23
Chlorogalum pomeridianum	Soaproot	x	Soap, fish poison		Bulb
Stipa fulcra	Purple needlegrass	x	State Grass, pinole		23
Phacelia Californica	Rock Phacelia	x	Seeds, pinole	x	23
Monardela villosa	Coyote mint	Unknown	Unknown	x	23
Asclepias speciosa	Showy milkweed	x	Fiber	x Monarchs	23
Asclepias fascicularis	Narrowleaf milkweed	x	Fiber	x Monarchs	23
Seeds					
Amsinckia menziesii	Common fiddleneck	Unknown	Unknown	x	22-23
Achillea millefolium	Common Yarrow	x	Medicinal tea	x	22-23
Asclepias fascicularis	Narrowleaf milkweed	x	Fiber	x	22-23
Asclepias speciosa	Showy milkweed	x	Fiber	x	22-23
Clarkia unguiculata	Elegant Clarkia	x	Seeds Pinole	x	22-23
Clarkia williamsonii	Fort Miller Clarka	x	Seeds Pinole	x	22-23
Eschscholzia Californica	California poppy	x	Seeds Pinole	x	22-23
Helianthus bolanderi	Bolander sunflower	x	Seeds Pinole	x	22-23
Lupinus bicolor	Miniature lupine	Unknown	Unknown	x	22-23
Lupinus microcarpus var densiflorus	Chick lupine	Unknown	Unknown	x	22-23
Lupinus nanus	Sky lupine	Unknown	Unknown	x	22-23
Lupinus succulentus	Arroyo lupine	Unknown	Unknown	x	22-23
Phacelia californica	Rock Phacelia	Unknown	Unknown	x	22-23
Phacelia ciliata	Great Valley Phacelia	Unknown	Unknown	x	22-23
Phacelia tanacetifolia	Phacelia	Unknown	Unknown	x	22-23
Plantago erecta	Dot-seed plantain	x	Seeds for pinole, leaves, food, roots anti-fungal	x	22-23
Trichostema lanatum	Woolly bluecurls	Unknown	Unknown	x	22-23

Trifolium Ciliolatum	Foothill clover	x	Clover greens and pot herbs	x	22-23

4.2.2 Bushy Lake Educational Outdoor Lab

The relationship between Traditional Ecological Knowledge and Western Ecological Knowledge provides a public education and outreach opportunity to showcase important tribal knowledge and traditions. We have had frequent public days to help manage the site. We have had separate days with tribal people to introduce them to the site and learn from them. Cultural information is specifically integrated into the Bushy Lake Restoration Goals and Objectives. Mugwort, or Kachinu, (*Artemisia douglasiana*) is an important spiritual, ceremonial, and medicine plant. White root is a cultural keystone species, an important basketry plant, and provides streambank stabilization functions. Treating our non-human relations as "kin" extends our moral responsibility to our non-human relatives (Salmón 2000) (Appendix B).

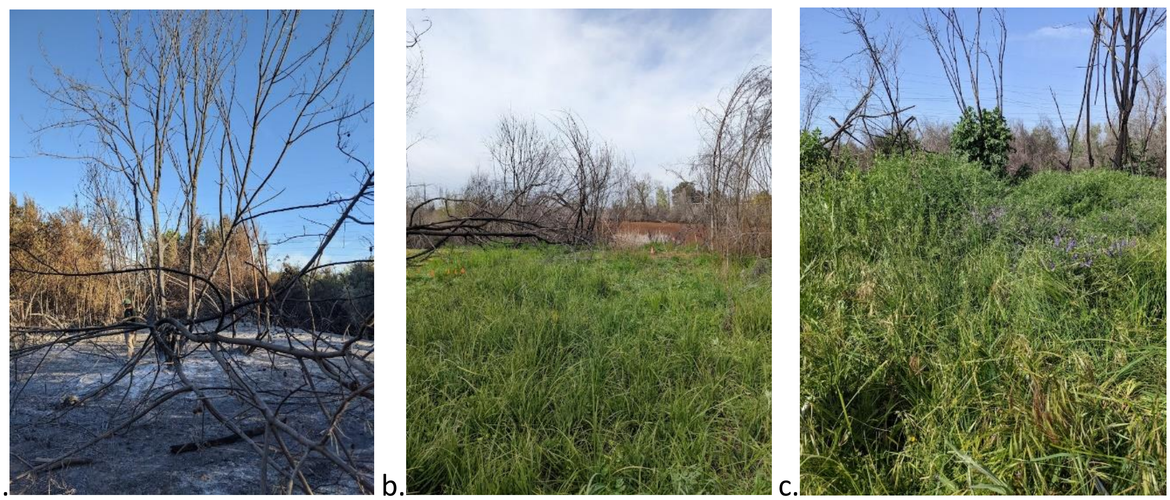
Besides an in-situ restoration project, Bushy Lake also serves as an educational outdoor lab and experiential learning experience for Sacramento State students. The project area also has provided high-impact student research and community service. This project is an element of both Sacramento State's Anchor University project and the Sustainable Interdisciplinary Research to Inspire Undergraduate Success (SIRIUS) project. The Sacramento State Anchor University is designed to create linkages and relationships between Sacramento State and community engagement efforts. The Arden Arcade area is an under-served area and a priority for community outreach. Bushy Lake was awarded a grant under the "Environment, Mobility, and Sustainability" Anchor University goals, and the Bushy Lake project was ranked Number 3 of all 70 anchor university projects. Students are engaged in all aspects of the Bushy Lake Restoration Project.

Student experiential learning and STEM research was part of a Natural Science Foundation-funded research program at Sacramento State, the Expanded Sustainable Interdisciplinary Research to Inspire Undergraduate Success (SIRIUS II) Project. A key aim of the program (and restoration ecology learning objectives) is to provide interdisciplinary authentic learning experiences to STEM students. The restoration project focused on providing course-based research experiences to Sacramento State students majoring in Biological Sciences. The Bushy Lake Eco-Cultural Community Celebration, on April 29, 2023, brought the public to see our restoration project to restore culturally and ecologically important habitats in the Sacramento Bee: https://www.sacbee.com/news/local/article274875736.html.

4.2.3 Fire Resiliency Tested by June 2021 Wildfire

We had an opportunity to test our hypothesis when a wildfire burned to the lacustrine edge on June 6, 2021, during a wildfire Appendix B). Culturally significant plants regenerated after the fire and were proven to be resilient and to regenerate after fire. The burned areas were replanted. We emphasized three culturally significant species in our experimental analysis: 1) white root (*Carex barbarae*), 2) narrowleaf willow (*Salix exigua*), and 3) mugwort (*Artemisia douglasiana*) (Appendix B)

After the June 2021 wildfire burned the site, the *in-situ* restoration area was replanted. Revegetation efforts were funded by the Presidents Circle grant, the Anchor University grant, and two grants from the Sacramento Zoo. Seeds and herbaceous plants were chosen that are native to the lower American River (Wymer, 1986). Plants known to be important culturally and/or for pollinators were also chosen (See Table x). Plants were grown and purchased from Heritage Growers Seed and Plant Supply. Seeds were sourced from Hedgerow Farms. The planted species are important components of pinole, an important cultural food source, as well as beneficial for pollinators. A number of seeds were also planted to support pollinators, including Showy (*Asclepias* speciosa) milkweed and Narrow Leaf Milkweed (*Asclepias fascicularis)*.



a. b. c.

Figure 22. White root (beds. The images illustrate the fire resiliency of white root immediately after the fire in a. June 2021, and post-fire recovery through natural recruitment in b. February 2022 and c. April 2022 (Photos by Alexandra von Ehrenkrook).

Initially, most of the area where white root was located was burned to bare ground. On January 16, 17% was bare, 51% was white root, with the remaining dominant species mugwort and creeping wild rye. In April, only 5% was bare ground and most of the area had revegetated. While white root was 45%, creeping wildrye and mugwort were around 20%, and the remaining 11 percent was weedy species (see below). By June 2023, the dense rhizomatous white root had reclaimed the entire area.

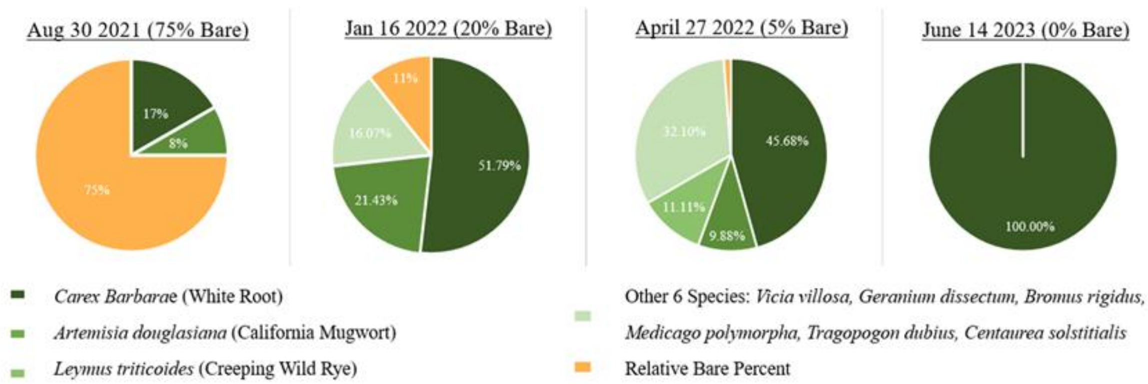


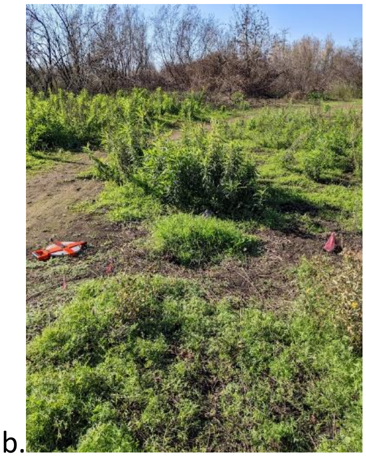
Figure 23. Quadrat vegetation surveys in the white root beds showcasing post-fire natural recruitment (August 31, 2021 – June 14, 2023)

The *in-situ* white root bed today has recovered and is in optimum condition for traditional tending and gathering. Local Native Californian basket weavers have expressed interest in gathering in this area and expanding as a template for future restoration. Interest has also been expressed in Traditional Fire Management in the area to maintain the sedge beds in optimal and sustainable condition for the future.

Figure 24. White root beds that were naturally recruited after the June 2021 fire at Bushy Lake (pictured in June 2023). Featuring Diana Almendariz (Wintun-Maidu Elder and Traditional Knowledge holder (Photos by Michelle Stevens).

<u>Mugwort-Creeping Wildrye Grass-Narrowleaf Willow</u>

The mugwort-creeping wildrye experimental area was burned to ashes in the June 2021 fire. Today this area has also recovered after the fire, demonstrating the fire resiliency of mugwort and willow. It is also important to note that constant weeding and control of invasive species is essential to maintaining this area. Species composition, monitoring, and adaptive management are discussed in the CRP and Long-Term Management Plan.

a.  b. 

c. 

Figure 25. Mugwort beds. The images illustrate the fire resiliency of white root immediately after the fire in a. June 2021, and post-fire recovery through natural recruitment in b. November 2021 and c. June 2023 (Photos by Gunner Michaelson and Alexandra von Ehrenkrook).

Table 11. Line-intercept vegetation surveys showcasing post-fire natural recruitment over time. Particularly showcases the resiliency of mugwort, willow, and creeping wild rye and demonstrates the proliferation of weeds and the need for long-term management and control.

Scientific Name	**Common Name**	**Survey Dates**			
		9/20/2021 (96% Bare)	10/12/2021 (73.45% Bare)	12/01/2021 (79.04% Bare)	1/16/2022 (67.86% Bare)
Culturally Significant Native Species					
Artemisia douglasiana	California Mugwort	75.31	67.62	98.00	99.00
Salix exigua	Narrow Leaf Willow	20.15	12.52	1.00	1.00
Baccharis salicifolia	Mulefat	1.63	2.83	T	0.00
Rubus ursinus	California Blackberry	0.33	0.26	0.00	0.00

Grindelia camporum	Gumplant	1.15	0.00	T	0.00
Elymus triticoides	Creeping Wildrye	0.00	0.41	0.00	0.00
Native Species Relative Total		98.57	83.64	99.00	100.00
Invasive Species					
Rubus armeniacus	Himalayan Blackberry	1.43	4.64	T	0.00
Cynodon dactylon	Bermuda Grass	0.00	11.71	0.00	0.00
Brassica nigra	Black Mustard	0.00	0.00	0.00	0.00
Vicia villosa	Hairy Vetch	0.00	0.00	0.00	0.00
Bromus diandrus	Ripgut Brome	0.00	0.00	0.00	0.00
Invasive Species Relative Total		1.43	16.35	T	0.00
Total		100.00	100.00	100.00	100.00

4.2.4 Conclusion

In conclusion, the in-situ restoration project has demonstrated that our hypothesis of fire resiliency of culturally significant plant species is accurate. We have planted native seeds and seedlings to test their suitability for site conditions. We will use this information to inform both the CRP and Long-Term Management Plan. Unfortunately, invasive weedy species proliferate after fire, and continued weeding and adaptive management are necessary to maintain desired site conditions.

4.3 Aquatic Community and Water Quality Surveys

A diverse and abundant community of invertebrates provides a critical prey base for larger predators, such as turtles, birds, and fish. Furthermore, the presence of Bushy Lake represents one of the few natural lentic habitats in the vicinity and thereby an important habitat for the region’s biodiversity. Its proximity to the American River makes it important for connectivity, both hydrologically and biotically, and therefore understanding the biotic community and water quality is important.

The following sections discuss the survey method and results of the aquatic community and water quality surveys conducted at Bushy Lake in 2020 and 2021.

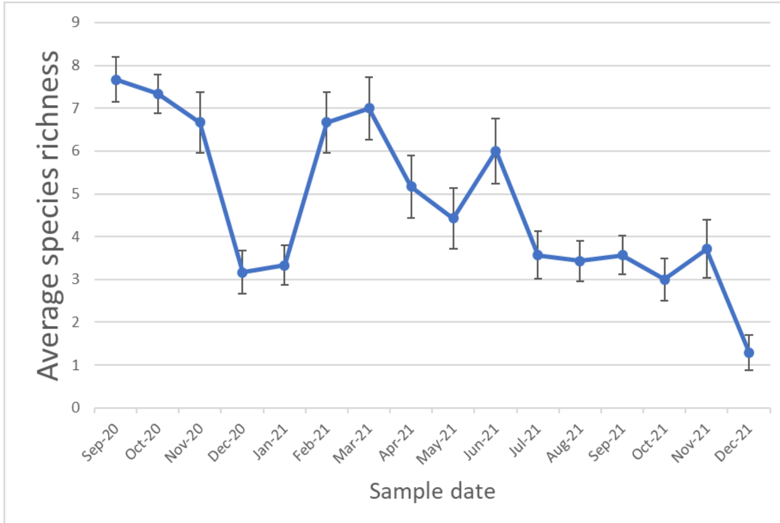
4.3.1 Aquatic Community

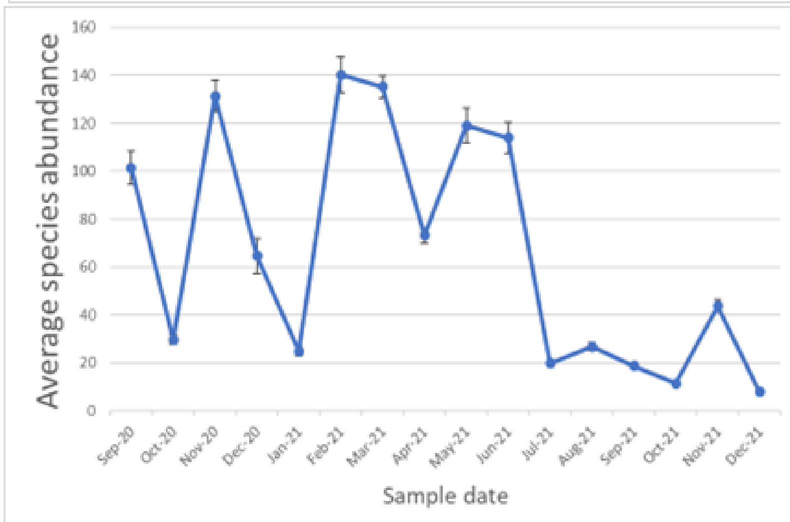
Aquatic Community Methods

To assess the current status of the aquatic community, sweep nets and minnow traps were used each month over 16 months from September 2020 until December 2021. Sweep nets (n = 3 sweeps) were used at six locations to measure the abundance, richness, and composition of the macroinvertebrate community. To supplement net sampling, baited minnow traps were deployed in 10 locations in the lake to sample invasive crayfish and larger mobile fauna from September 2020 until December 2021.

Aquatic Community Results

A total of 21 different taxa have been encountered over the 16 months with an average of 4.75 taxa per month (7.56 total richness). These values were highly variable during the 16-month sampling period but appear to have been declining since July 2021 (Figure 26). Some of the most frequently encountered invertebrates included crustaceans (*Cladocera, Copepoda, Ostracoda*) and insects (*Corixidae, Odonata, Chironomidae*), which are important prey items for





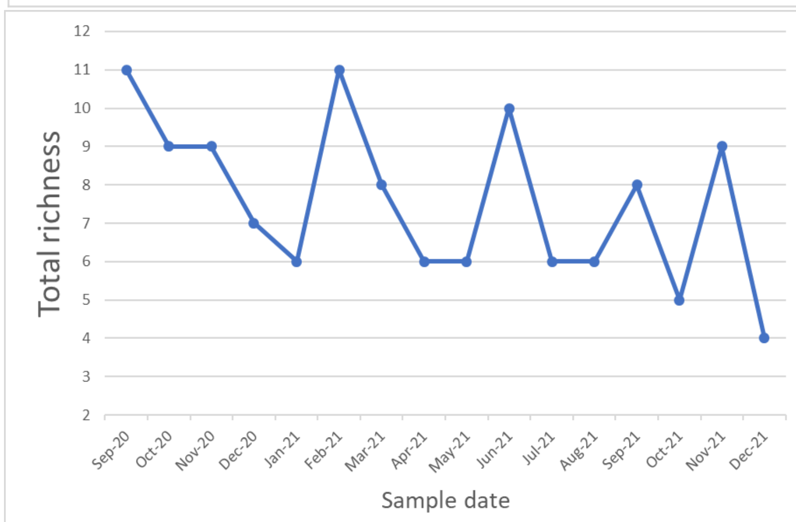


Figure 26. Mean (±SE) abundance, richness, and total richness of macroinvertebrates sampled monthly in Bushy Lake.

Northwestern pond turtles (especially juveniles). An invasive freshwater shrimp, whose identification has yet to be confirmed (although it is likely *Palaemonetes kadiakensis*, Mississippi glass shrimp), was regularly observed during sampling sessions (12/14 sampling sessions) in low abundances. Positive correlations between taxa abundances and mean richness (r=0.72, P=0.002) and total richness (r=0.61, P=0.01) were detected. These are typical patterns observed in biological communities. Phosphate and abundance exhibited a positive non-significant (r=0.49, P=0.06) trend, but no water quality measurements were correlated with taxa abundances or richness.

The invasive red swamp crayfish (*Procambarus clarkii*) (native to the Southeastern United States) was detected during all 16 sampling sessions and in 51.5% of all deployed traps. Crayfish abundances were highly variable over time (Figure 26) with an overall mean (±SE) of 0.84±0.16 crayfish per trap. The sex ratio was slightly biased towards males but not significantly (1.21:1; P=0.41), which is consistent with other studies of red swamp crayfish. This invasive burrowing crayfish is widely recognized for its bio-erosive activities that can disturb the shoreline stability of lakes, rivers, and even levees. These crayfish outcompete native crayfish and prey on native snails, crustaceans, and insects. However, they are also an important member of lake food webs and are preyed on by turtles, bullfrogs, and fish, among others. Indeed, crayfish are an important source of protein for adult northwestern pond turtles (Bury 1986). Invasive American bullfrog tadpoles (*Lithobates catesbeinus*) were also captured in 12 out of 16 sampling sessions and in 9% of all deployed traps. While frequently observed during sampling, the abundances of bullfrogs were relatively low (0.12±0.4 frogs per trap; Figure 27). Regardless, invasive bullfrogs can be voracious predators and are highly aggressive; they can potentially prey on small turtles and compete for prey. Northwestern pond turtle hatchlings have been found in the stomach contents of bullfrogs in southern California (Nicholson et al. 2020). Invasive catfish were observed in 2 out of 16 sampling sessions and in 3.8% of traps. Catfish are typically opportunistic predators feeding on crustaceans, insects, fish, and plants, among other organisms; thus, they likely compete for prey with northwestern pond turtles. However, they have been known to prey on turtles, though this is rare (Haubrock et al. 2018).

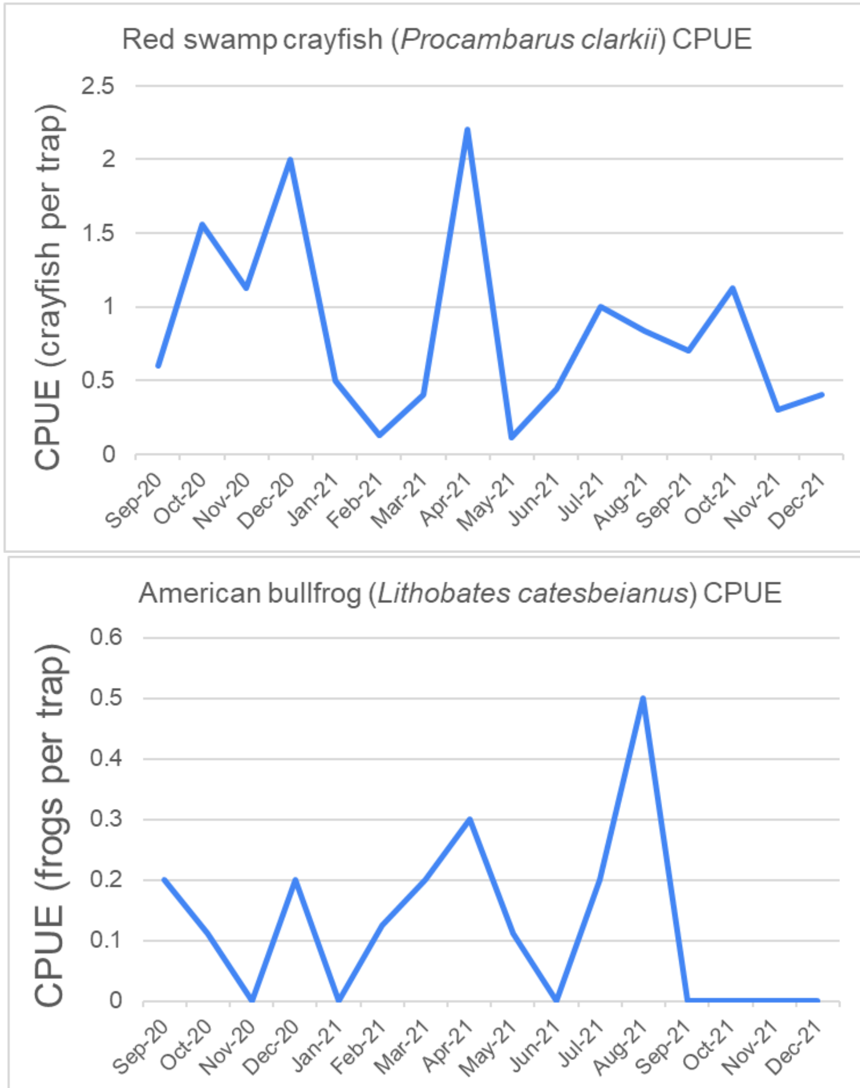


Figure 27. Relative abundances (mean catch per unit effort, CPUE) of invasive red swamp crayfish (top) and American bullfrogs (bottom).

Overall, aquatic sampling revealed a diverse community of macroinvertebrates including several taxa that are likely important prey species for the northwestern pond turtle. In addition, sampling revealed the presence of invasive species likely to compete with or prey on northwestern pond turtles. Invertebrate abundances varied dramatically across months, the driving factors affecting these patterns are presently unknown. Furthermore, it is unclear how these may affect the northwestern pond turtle or even whether turtle predation affects these patterns. Since pond turtles can also consume plant material (Bury 1986), a precise assessment of northwestern pond turtle diet, feeding behavior, and consumption levels are recommended.

4.3.2 Water Quality

Water Quality Methods

Water quality was sampled 35 times from September 2020 to November 2022 in 7 locations around the lake (Figures 28). During each sampling event, pH, conductivity, turbidity, chlorophyll-a, phosphates, and nitrates were measured. *E. coli* levels were measured on August 16 and September 17, 2021, and February 6, 2022.

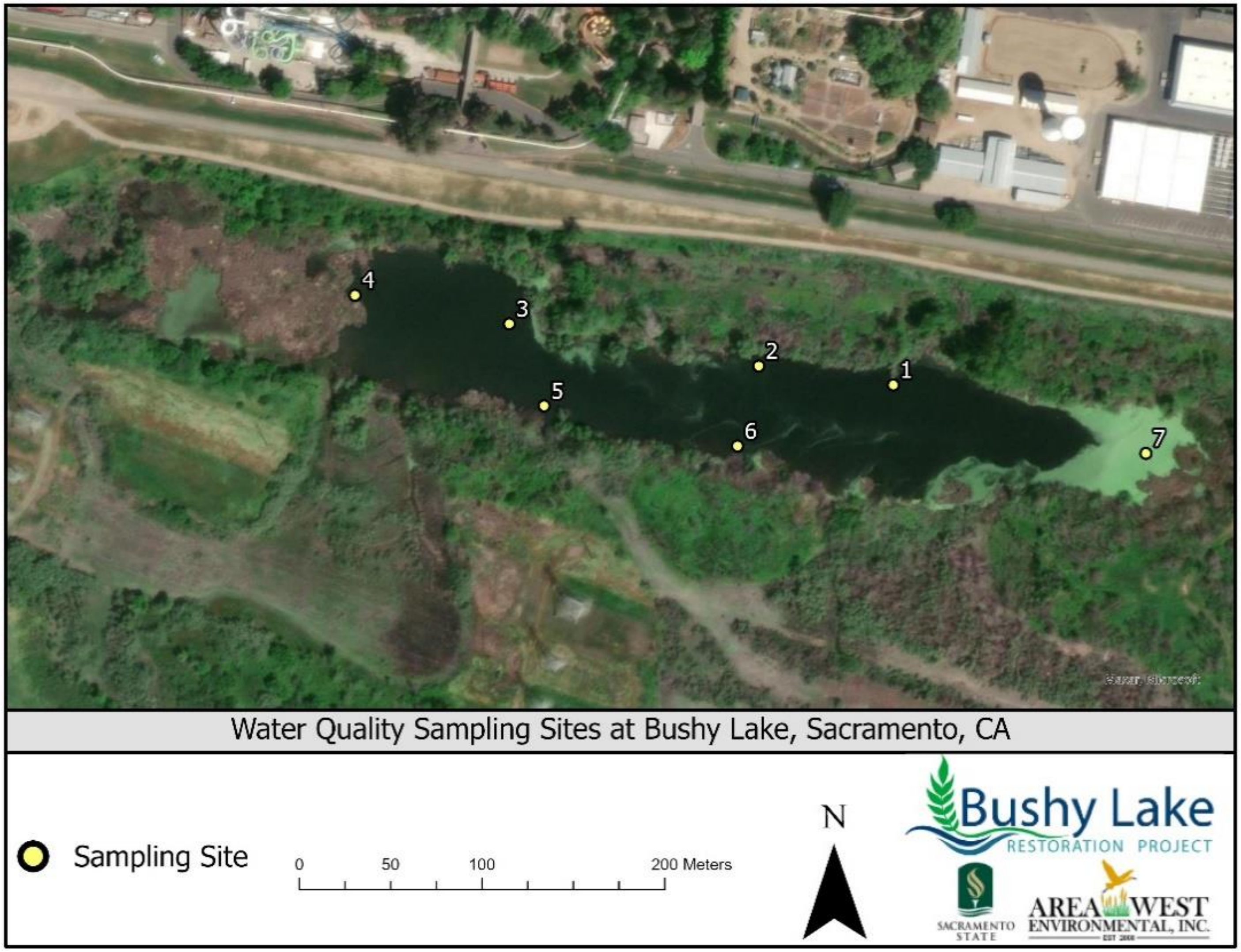


Figure 28. Water Quality Sampling Sites at Bushy Lake

Water Quality Results

Sampling revealed an average pH of 6.88, average conductivity of 483.87 (µS/cm), an average turbidity measure of 5.24 NTU, and an average chlorophyll-a measure of 0.05 µg/L. The average level of phosphates was 0.76 mg/L, and the average level of nitrates was 0.23 mg/L. The pH remained relatively stable over time, except in April and May 2021 when it substantially increased (Figure 29). All other measures of water quality varied by month with no obvious pattern except conductivity and turbidity (Figures 29-31). Conductivity decreased during the winter of 2021 and 2022 and increased after April 2021 and May 2022, coinciding with the rainy season. Turbidity peaked in January and again in May 2021, but subsequent months had relatively low turbidity levels. Conductivity was negatively correlated with turbidity ($r=-0.42$, $P=0.01$) and chlorophyll-a ($r=-0.57$, $P<0.001$), but no other water quality measures were significantly correlated with each other. Preliminary tests suggest *E. coli* was present at low levels; *E. coli* levels were only 0.286 and 0.429, and 0.286 CFUs per ml on August 16, 2021, and September 17, 2021, and February 6, 2022, respectively. Overall, the water quality results suggest that Bushy Lake is indicative of a eutrophic lake or pond (Smith et al. 1999, Dubrovsky et al. 2010). Biological indicators showed that while the chlorophyll-a measures were relatively low, filamentous algae was very abundant throughout Bushy Lake. Water quality measurements are indicative of a eutrophic lake or pond. Measurements revealed *E. coli* is present in low concentrations.

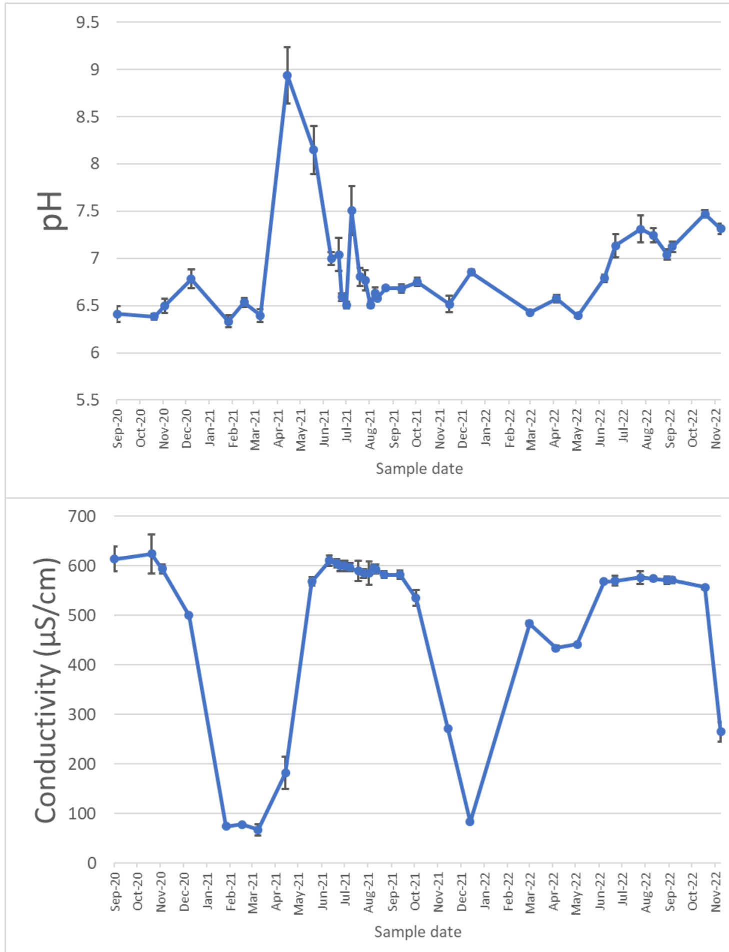


Figure 29. Monthly measurements of pH and conductivity in Bushy Lake from Sept 2020 until November 2022. Values represent the mean (±SE) of seven sites sampled per month.

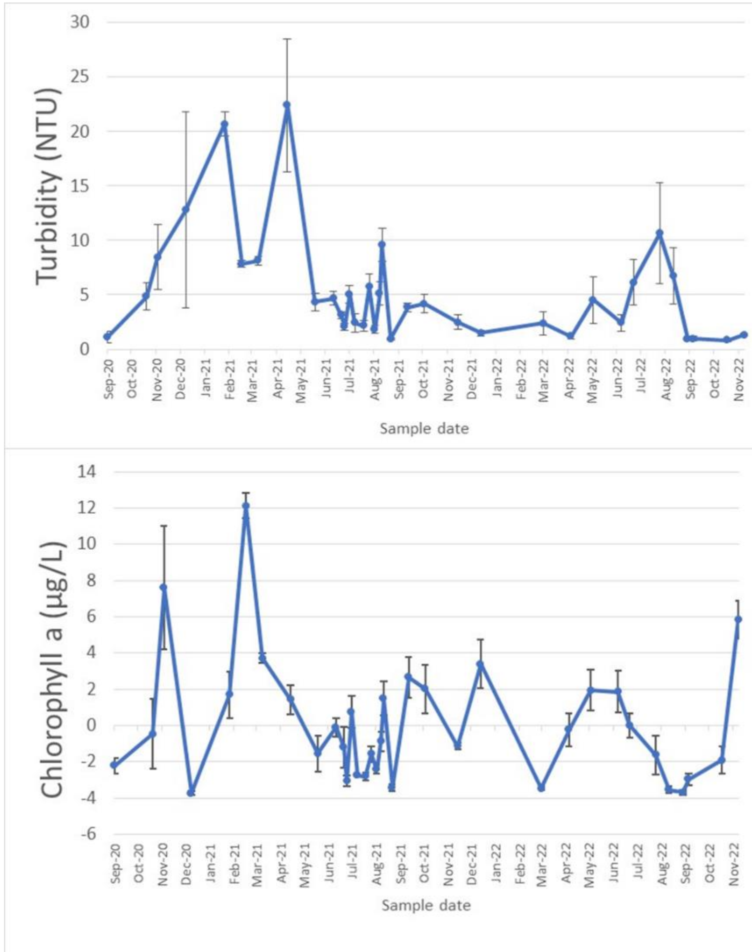


Figure 30. Monthly measurements of turbidity and chlorophyll-a in Bushy Lake from Sept 2020 until November 2022. Values represent the mean (±SE) of seven sites sampled per month.

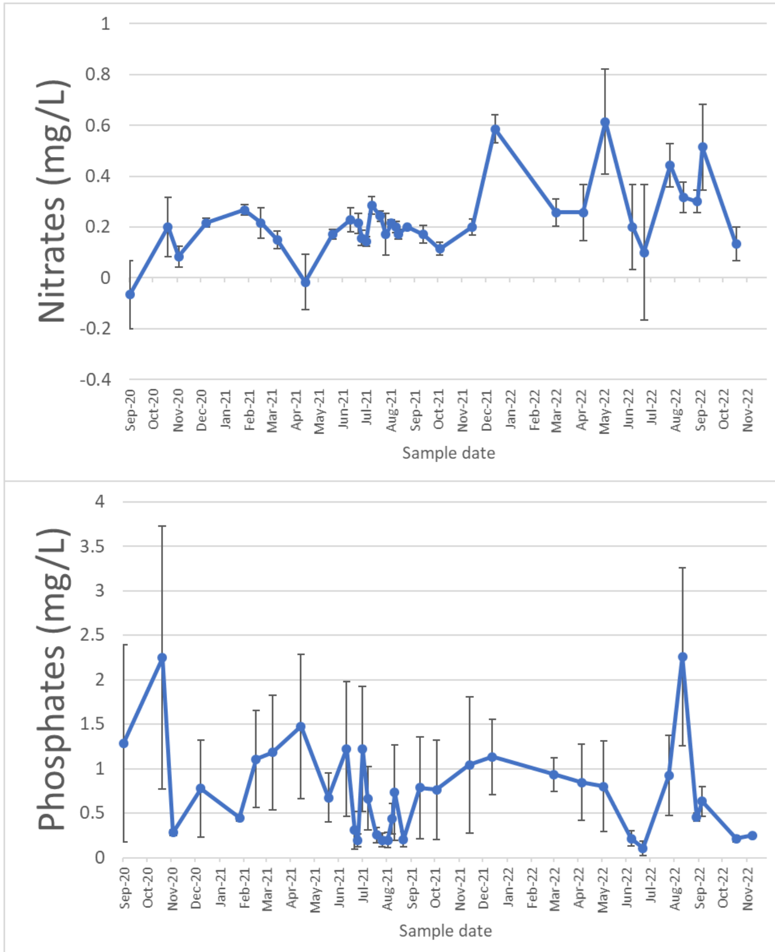


Figure 31. Monthly measurements of nitrates and phosphates in Bushy Lake from Sept 2020 until December 2021. Values represent the mean (±SE) of six sites sampled per month.

4.4 Hydrology Characterization

Hydrology Characterization studies were conducted at Bushy Lake for the following objectives:

- The surface water drainage and storage at Bushy Lake;
- Assess the hydrologic relationship between Bushy Lake and the nearby channel of the American River;
- Assess how Bushy Lake responds to upstream dam releases and what impact high discharge flow events may have on Bushy Lake; and
- Assess the role that groundwater pumping from Cal Expo and stormwater flow near Cal Expo has on surface inflow into Bushy Lake (ongoing).

4.4.1 Surface Water Drainage and Storage at Bushy Lake

The focus of the hydrology characterization effort was to construct a detailed map of how water transits the Bushy Lake area to better understand how water enters or leaves the small

Bushy Lake watershed. This section provides a discussion of the methods used for of the survey and mapping the land surface, plotting the survey data in ArcGIS software, using ArcGIS tools to assess surface flow conditions, and describes the role of pumping groundwater from Cal Expo to Bushy Lake (via a discharge pipe) has on the Lake.

Surveying

Over the span of many months (Spring of 2020 to Fall of 2021), survey data was collected by using a Trimble GEO-7x field survey instrument of the Bushy Lake site. Specifically, latitude, longitude, and elevation data were collected at over 2000 locations within the Bushy Lake study area. Initially, drone-collected aerial photographs were considered for building the three-dimensional model but high voltage overhead power line that traverse the site substantially impacted navigation and geo-locational abilities of the drones resulting in the switch to hand surveying of the study site.

Surveys were conducted on foot with data being collected approximately every 10 feet. The terrain was challenging in many places as overgrown vegetation, homeless encampments and swampy areas produced obstacles to data collection. Figure 32 shows the location of collected survey data.

Making the site flow map

The survey data was incorporated into ArcGIS software to produce a digital elevation model of the surface and characterize site-specific flow conditions. Survey data was incorporated into the construction of a triangular irregular network (TIN), statistically managed to account for data irregularities, and converted to a raster formatted digital elevation model (DEM) (Figure 33).

Once converted to a digital elevation model format, ArcGIS hydrology tools were used to fill in any anomalous pockets or pits in the DEM, create a raster of flow direction from each cell to its steepest downslope neighbor and create a raster of accumulated flow into each cell of the raster. This process produced a flow map of surface waters on the floodplain remnant which includes Bushy Lake. Figure 34 shows the surface flow conditions and accumulation spots resultant from these analyses.

Mapping out the flow patterns and the area that water then accumulates produced Figure 35, which details these conditions. Specifically, the surface area (light blue area) of the surrounding terrain that contributes surface flow to the Lake (under appropriate conditions – enough rainfall to produce surface flow) is around 0.9 square kilometers. In this Figure, blue and red arrows outline the relative direction that surface waters would flow on this surface. The blue arrows represent flow into Bushy Lake while the red arrows represent flow away from Bushy Lake. It is important to note that on the north side of the floodplain remnant (between Bushy Lake and Cal Expo) there is a substantial levee that has been constructed to protect Cal Expo from potential American River floodwaters. This levee controls all flow onto the site from the Cal Expo site. Essentially no surface water can directly transit across this barrier unless pumped through

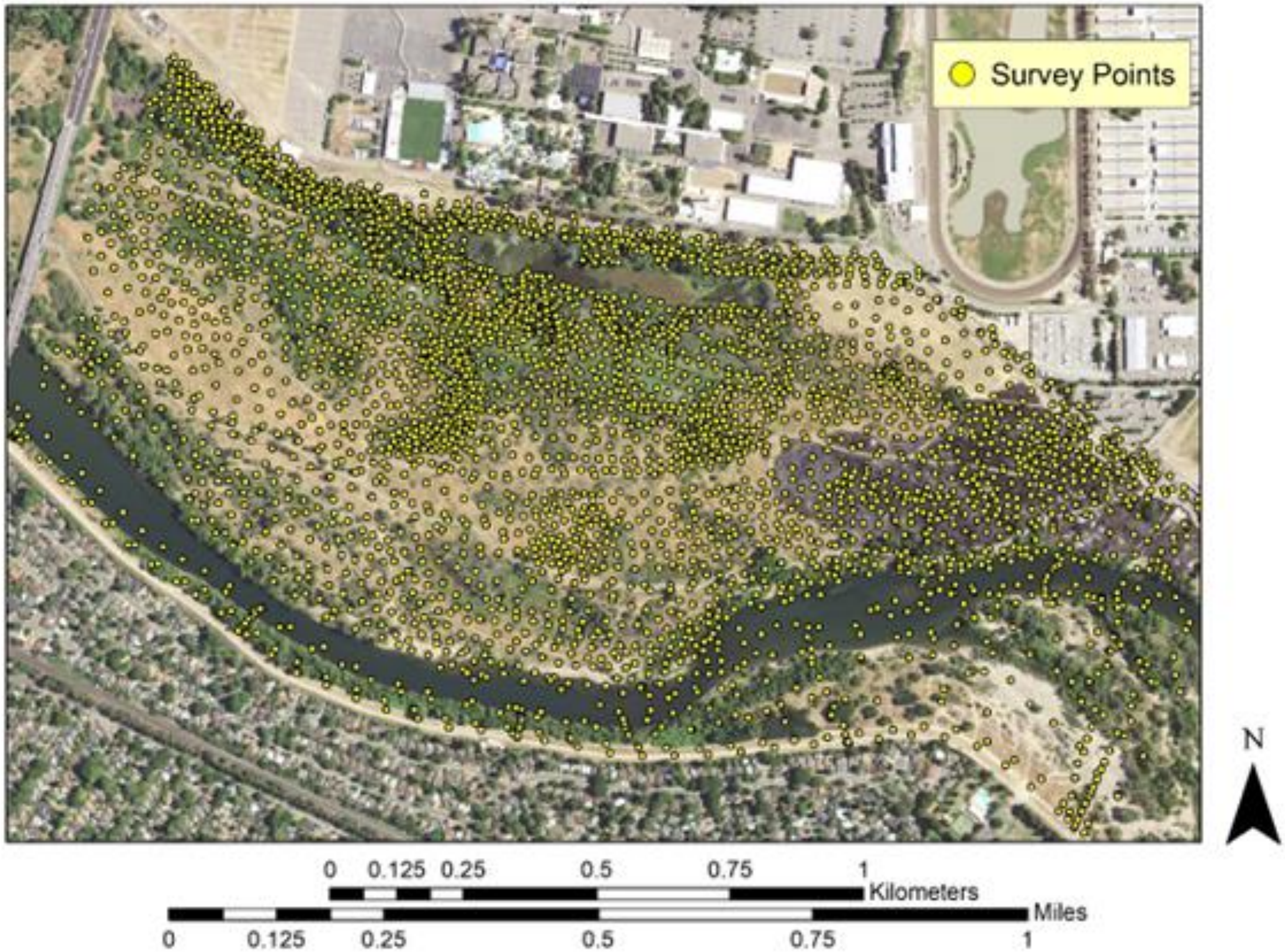


Figure 32. General map of the Bushy Lake study area showing the location of over 2000 survey points used to build the surface topography map.

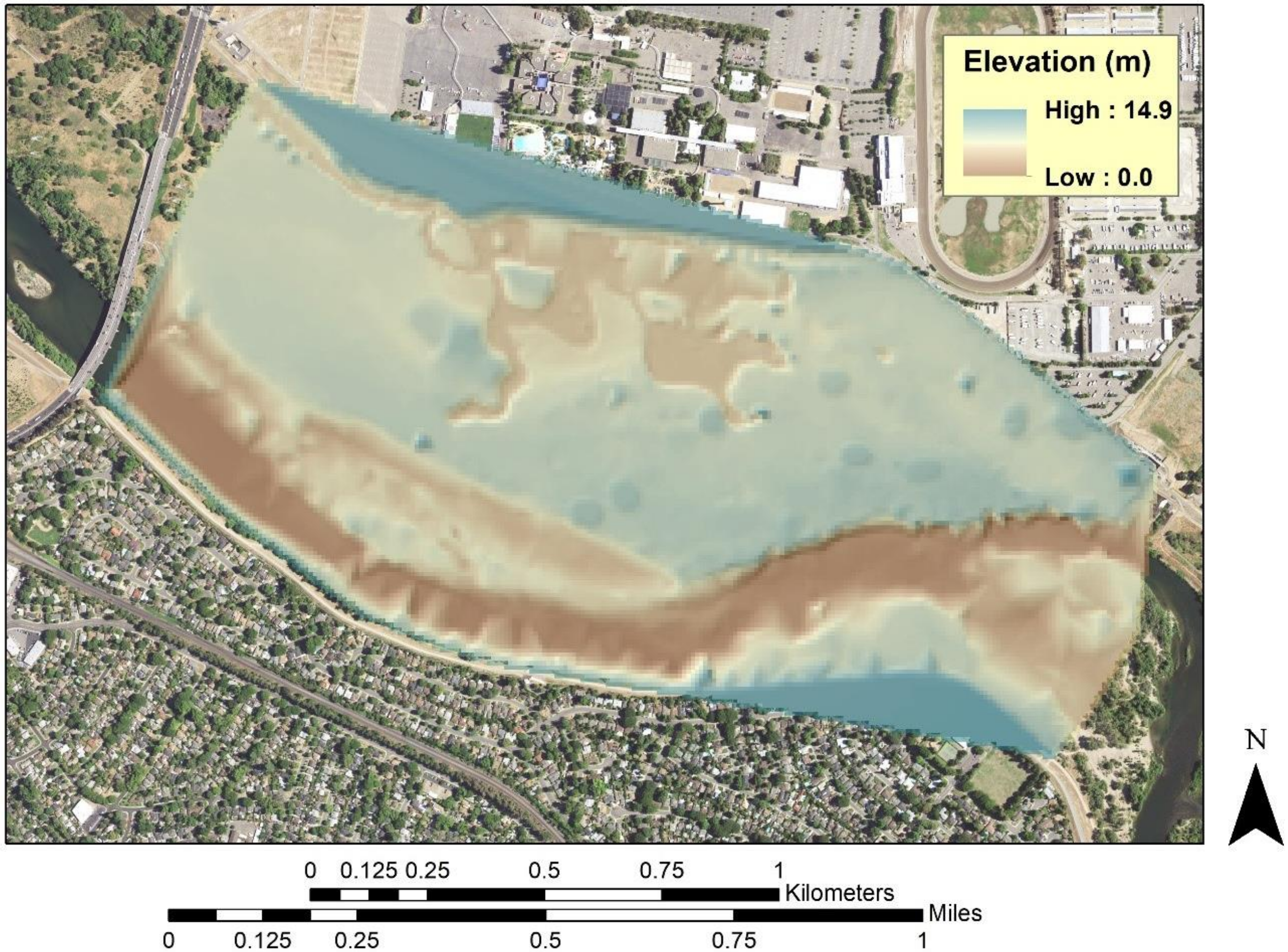


Figure 33. Digital elevation model of the floodplain remnant including Bushy Lake (light brown terrain in the middle of the map just south of Cal Expo)

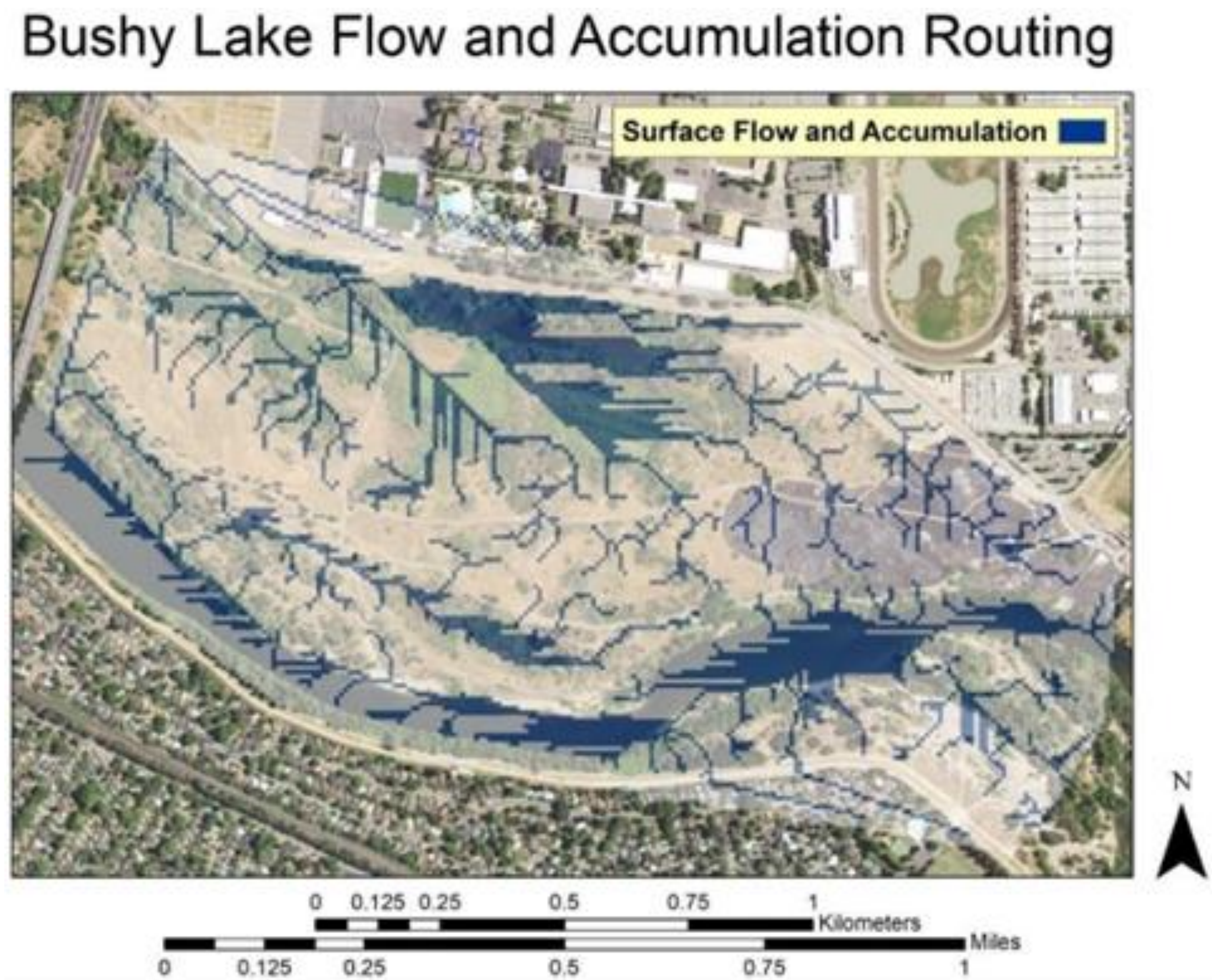


Figure 34. Surface water flow and accumulation areas as determined from hydrologic modeling of the ground surface elevational conditions.

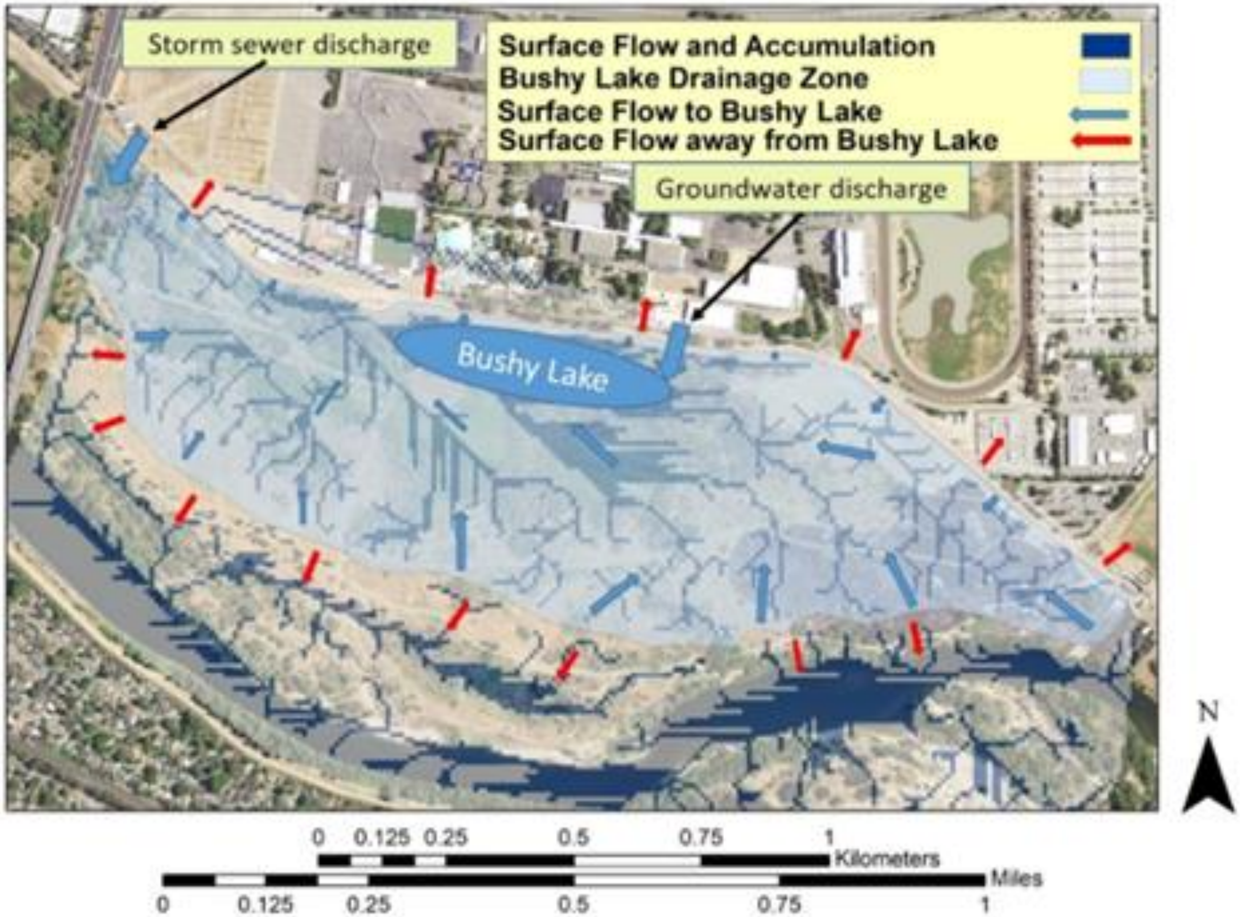


Figure 35. Bushy Lake terrain flow map outlining (in light blue) the area that contributes to surface drainage into the Lake under appropriate conditions.

some sort of underground pipeline (Cal Expo) or through a storm water culvert (located on the west end of the floodplain remnant.

Cal Expo discharges records for the pipe that periodically pumps water into Bushy Lake were not available.

4.4.2 Assess the hydrologic relationship between Bushy Lake and the nearby channel of the American River

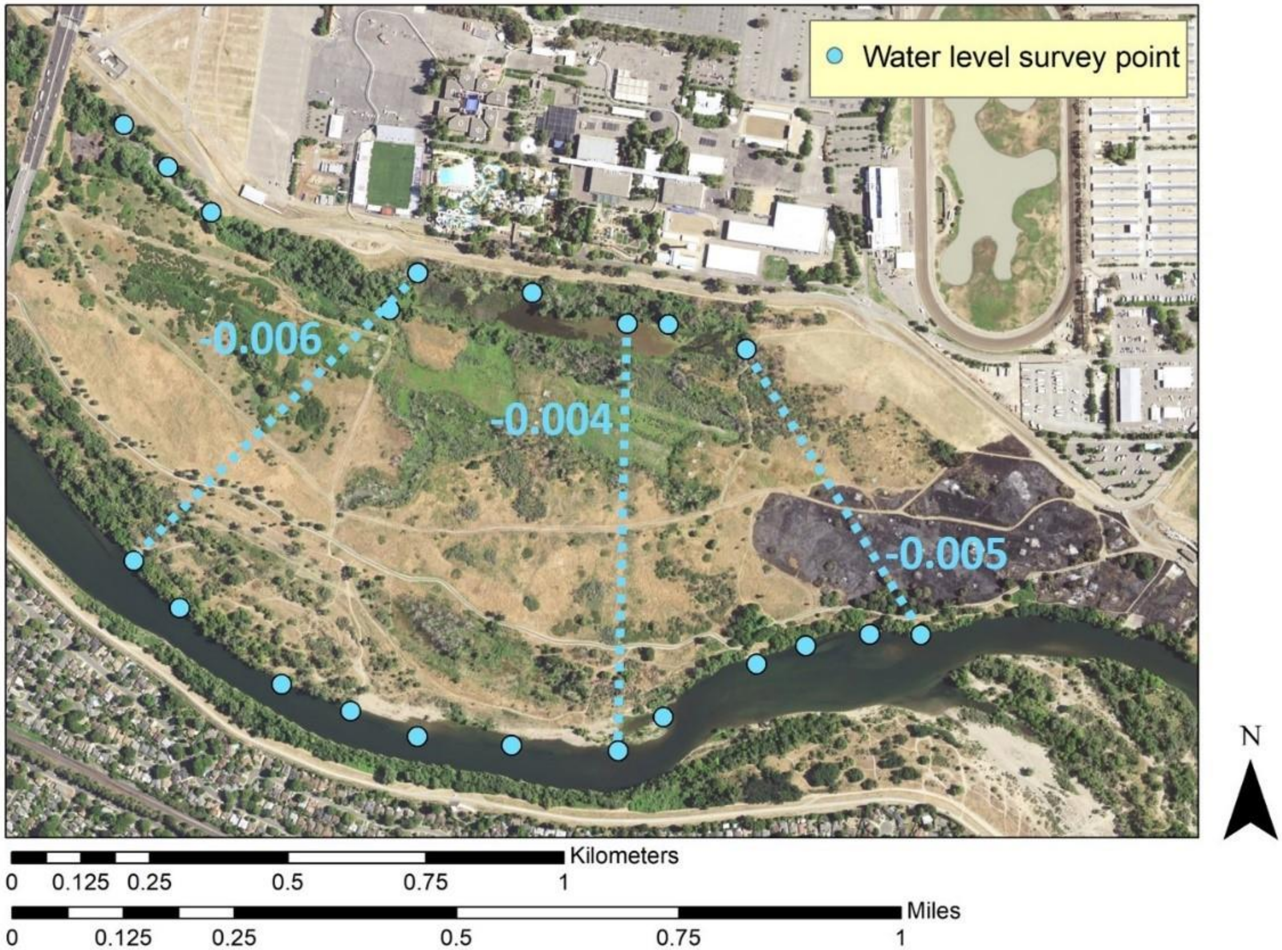
General Geology and the connection between Bushy Lake and the American River

Bushy Lake exists on an elevated terrace feature along the American River. Imagery from a 1911 USGS map of the area (*1911 USGS Brighton Quadrangle)* shows the general outline of Bushy Lake as of that survey date (pre-1911). This landscape feature currently resides within the existing levees that were constructed along the eastern and western sides of the American River, just east of Bushy Lake and just west of the American River channel.

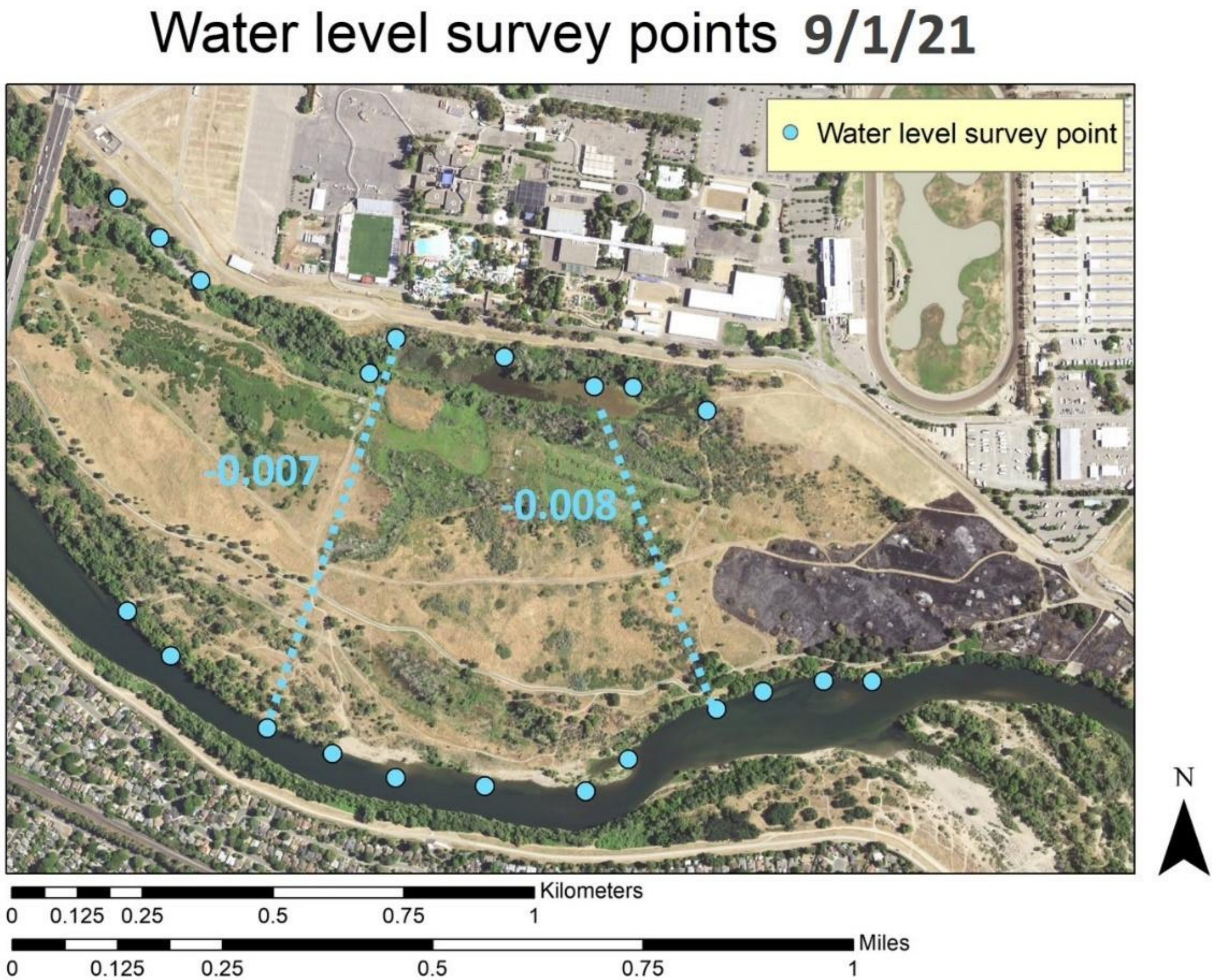
No subsurface exploratory work (drilling or pump testing) was conducted for this study but other studies (Schlemon 1972, Helley et al. 1985) detail the Modesto Formation and Holocene age alluvium comprising the valley fill along this lower reach of the American River. Two distinct fills of the Modesto Formation have been identified, a basal gravel component and a younger coarse- to medium-grained granitic sand deposit. Holocene age alluvial fills consist of unweathered gravel, sand, and silt from the Sierra Nevada deposited by the present-day American from various alluvial processes. Dredge tailings from in-channel mining from the late 1800's and forward are likely preserved within these deposits and more modern channel modifications have impacted the surface of the terrace (a golf course planned on this feature in the early 1960 's actually deepened Bushy Lake) as well.

Surface water elevation data was collected along the shore of Bushy Lake, the terrace edge where it meets the eastern levee, and along the water's edge of the American River channel in Spring – 2021, Fall – 2021 and Winter – 2022 to assess the general direction of flow between the Lake and the nearby American River channel. Since Bushy Lake exists approximately 5 meters above the east bank of the American River in this vicinity, it was generally assumed that subsurface water flow would move from Bushy Lake to the American River. The results of the water level measurements confirm this assumption as water flow during each of the measurement time periods had flow gradients to the American River varying from 0.004 to 0.008 (Figures 36). Since flow in the American River along this reach is managed through releases from Folsom Reservoir, the only possible way surface water flow could course from the American River to Bushy Lake would be through a substantial discharge from the Reservoir (perhaps during a large precipitation event or other potential flooding event) that inundated the Bushy Lake terrace feature.

Water level survey points (4/20/21)



a.



b.

Figure 36. Measured groundwater flow gradients as measured on a. 4/20/2021 and b. 9/1/21. Flow is from Bushy Lake to the American River channel.

4.4.3 Assess how Bushy Lake responds to upstream dam releases and what impact high discharge flow events may have on Bushy Lake

In this study, the Hydrologic Engineering Center's River Analysis System (HEC-RAS) modeling software is used to model flood discharges along the American River Parkway in the vicinity of the Bushy Lake Nature Preserve.

HEC-RAS

The USACE developed HEC-RAS to model surface hydraulic flow for management of rivers, harbors, and other public works. HEC-RAS is capable of performing one-dimensional steady flow, one/two-dimensional unsteady flow, sediment transport, and water temperature/quality modeling. It is equipped to model river channels from simple single reach rivers to braided networked river systems. The advantages of HEC-RAS lie in its versatility, widespread use, and ease of use. Although certain limitations exist, HEC-RAS can have instability problems when working in especially steep/flat river systems (Brunner, 2021). With adjustment, these limitations can usually be overcome.

Methods

The basic data needed for creating a HEC-RAS hydrologic model are discharge, the channel geometry, channel roughness, and water elevation at a control location. Each subsequent section addresses the application of basic data requirements.

HEC-RAS – Setup

The American River Parkway was modeled using HEC-RAS version 6.1.0. and a 2D model was developed. The first step in any HEC-RAS model is to set up an organized folder system and set a geographic projection. The projection used for the modeling was NAD83 UTM, UTM Zone 10N, and European Petroleum Survey Group: 26910. The projection file was obtained from spatialreference.org.

Before modeling can begin, the user must decide which model type is most suitable, whether that be a HEC-RAS 1D or 2D model. This is defined by the desired model run times, outputs, availability of data, complexity of river system, and computation equations. In general, a 1D model may be preferred when streams/channels have uni-directional flow and defined overbanks, have limited access to good terrain data, or have time restraints. A 2D model may be preferred when there is a complex river system, shallow water flow areas, unclear flow direction, where detailed flood mapping is required, or in dam break studies. Recent software developments and increases in hardware computation speed have made HEC-RAS 2D modeling faster, easier, and more versatile than ever. For this project, a 2D model was developed to accurately model shallow water flow along the floodplain. For this project, a 2D model was developed to accurately model shallow water flow along the floodplain.

HEC-RAS – Land Cover (Channel Geometry)

The foundation of any HEC-RAS model begins with good terrain data. Initially, the model was going to use a digital elevation model that was created from survey data collected in early 2021. Upon further investigation, the USGS has LIDAR available for the area which that has larger extents than what was surveyed. The "USGS Wildfire B5a" LIDAR data set is used for this HEC-RAS model and has a resolution of 1m. One complication when using LIDAR is its inability to accurately penetrate water. Because of this the LIDAR data has flat and noisy data along water surfaces. This caused problems in three distinct areas, the American River main channel, a bay along a bend in the river called Paradise Beach, and the extent of Bushy Lake. To correct problems with elevation data, HEC-RAS allows for layering different terrain datasets together.

To add bathymetric data to the American River, survey data was incorporated into the digital elevation model. Survey data was collected using a Trimble Geo 7x. Survey points were manually taken by walking and placing the Trimble unit. The Trimble unit is capable of recording location to an accuracy of 2 cm. Using ArcMap, the interpolated river bathymetry was cut from the survey data. Within HEC-RAS, the bathymetry was layered over the LIDAR data set. This led to a data set that was a good estimation of river bathymetry in some areas of the river reach but was missing data where I was unable to physically reach/wade while surveying. To obtain a complete terrain model with bathymetry, a 1D geometry can be used to edit 2D terrains within HEC-RAS. Editing 2D terrains with 1D geometries requires the creation of two distinct objects. These consist of cross-sections and bank lines. The first step in the process is to create multiple cross sections across the river surface in RAS Mapper from left to right down-stream (Figure 37). Then bank lines are drawn to define where the river surface meets the ground of the elevation model. To edit the 2D terrain the cross sections were manually adjusted to conform to the observed bathymetry from surveying. The new cross sections are then essentially used to "carve" out the 2D terrain. The bank lines are used to determine the extents to which the channel is carved.

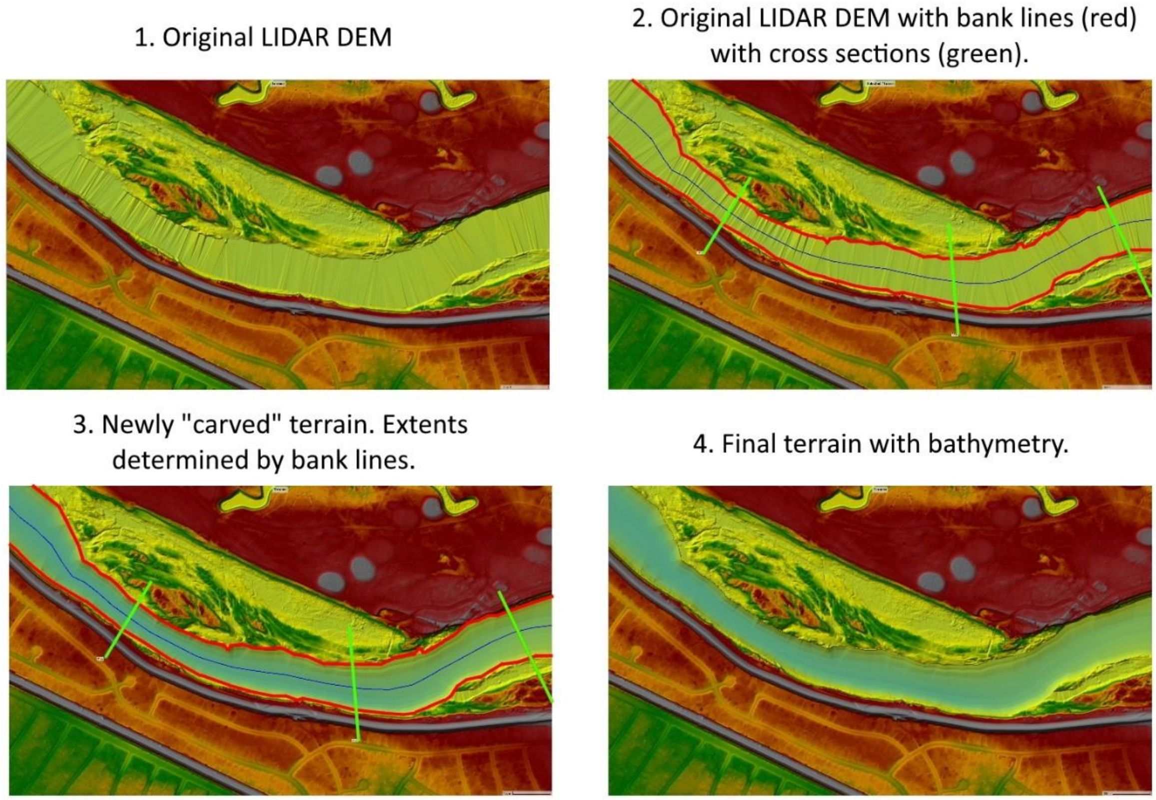


Figure 37. Adding bathymetry to LIDAR DEM within HEC-RAS using a 1D geometry to edit a 2D terrain.

Using the same method, the terrain was modified to add bathymetry for Bushy Lake and the Paradise Beach area. Bushy Lake bathymetry was estimated to be 1.5 m at the deepest. When editing the Paradise beach area, the American River bathymetry was layered on top to maintain a smooth channel transition.

<u>Flow Hydrographs (Discretizing the Model)</u>

Once the physical terrain of the model is complete, the computational mesh must be generated. To do this, a geometry is created to define the boundaries of the 2D flow area to be calculated. This boundary was set to cover the parkway surrounding Bushy Lake. Additional coverage of the parkway outside the area of Bushy Lake would increase model run times significantly. A cell resolution of 10m x 10m was chosen to give sufficient resolution/maintain model efficiency. Each cell in the computational mesh has a center where the water surface is computed for that cell and boundary faces where flow across is calculated. Once the cell size and 2D flow area are determined the computational mesh is automatically generated and consists of cells with individual computation points. Automation of this process is fast but can generate errors in areas with complicated geometry. Errors usually consist of cells being created with too many faces. HEC-RAS calculations require a cell to have 8 faces maximum. To remedy errors additional computation points can be added to reduce cell faces.

An important step of creating the computational mesh is to add “break lines”. Break lines are manually added to force the computational mesh to align (Figure 38). This was done in river channels to align cells along flow direction to increase the accuracy of flow calculations.

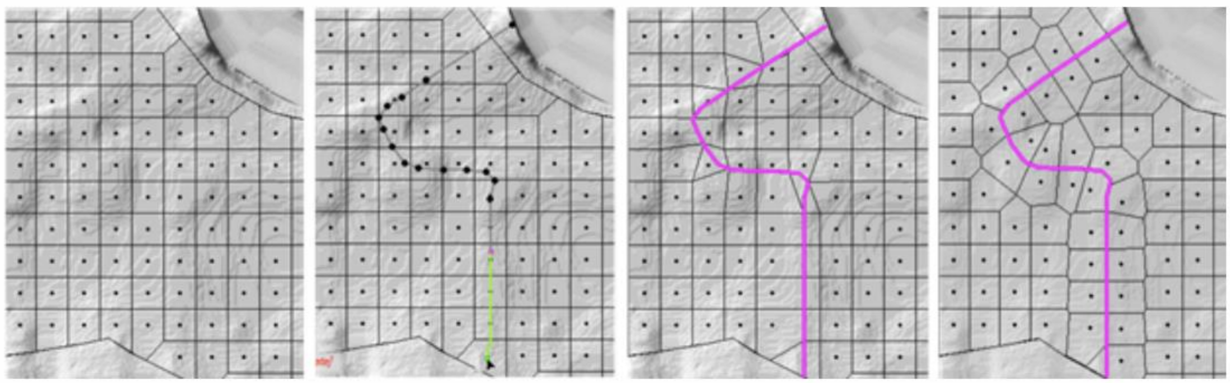


Figure 38. Example of break line enforcement. This creates new computation points on each side of the line and forces cell faces to align along it.

Break lines should also be added along high ridges to prevent what is called “leakage”. This is when a cell encompasses both sides of a feature and during computation water can essentially pass through that feature without going over. Break lines were added along the levees of parkway to combat leakage.

<u>Boundary Conditions (Water Elevation at a Control Location)</u>

A boundary condition defines the locations at which water is applied and removed from the model. They can be applied externally to the model boundaries or internally within the defined 2D flow area. For this modeling exercise only external boundary conditions were used as there are no significant sources/sinks of water within the model area. At the downstream side of the model a “Normal Depth” boundary is applied. This boundary condition used Manning’s equation to estimate a stage height for each computed flow (Brunner, 2021).

Eq 1:

$$Q = VA = \left(\frac{1.49}{n}\right) AR^{\frac{2}{3}}\sqrt{S} \quad [\text{U.S.}]$$

Where:

Q = Flow Rate, (ft^3/s)

v = Velocity, (ft/s)

A = Flow Area, (ft^2)

n = Manning's Roughness Coefficient

R = Hydraulic Radius, (ft)

S = Channel Slope, (ft/ft)

(Corvallis Forest Research Community, 2006).

In HEC-RAS when using a normal depth boundary condition, the slope at the boundary condition has to be defined by the user. To do this, a profile was cut from the terrain model and then directly measured for slope across the boundary. A 0.0004 friction slope was applied to the downstream boundary. At the upstream end of the model a "Flow Hydrograph" boundary condition was used. A flow hydrograph boundary allows for discharges over time from gauge data to be added to the model. Flow data is user defined and explained in the Flow Hydrographs section. This boundary condition also requires a slope and was measured the same way as the downstream component. A friction slope of 0.00085 was applied to the upstream boundary condition.

HEC-RAS – Land Cover (Channel Roughness)

When computing flow over a 2D flow area, a Manning's *n* value must be defined. This is a roughness coefficient that is used to account for energy loss due to friction in overland/channel flow. In HEC-RAS it is common to associate land cover classifications with manning n values. For this model, the 2019 National Land Cover Database was used. The land cover classification areas were imported to HEC-RAS and then a manning's n value was applied to each NLCD classification. The manning' n values used were referenced from (Army Corps Engineers, 2021). These numbers were then altered slightly to better match field observations.

Flow Hydrographs (Discharge)

Two distinct observations were seen when looking at discharge rates from the Fair Oaks gauge. Firstly, peak discharges do not necessarily correspond with the largest storms. This is a result of how reservoir capacity at Folsom Lake before a storm can affect downstream discharge rates. Low water storage levels will not change discharge rates as filling the reservoir is favored. If the reservoir is near capacity, then large amounts of water begin to discharge to prepare for increased water levels. The second observation is that when there is an increase in discharge, rates generally increase and fall rapidly. For large discharges (>50,000 CFS) the flows generally rise and fall over a period between 1 and 3 days and these discharges are a direct result of the flood control measures.

From the patterns observed at the Fair Oaks gauge, a series of hydrographs were fabricated to represent different max discharges (Figure 39). Hydrographs were designed in excel as a bell curve that rises and falls over a 3-day time period in 1-hour intervals. The standard deviation of the bell curve was set to the mean of the time series divided by 2.5. This led to the discharge hydrographs that were similar to what was observed at the gauge. The max discharges chosen to model were 130k CFS, 80k CFS, 70k CFS, 60k CFS, 50k CFS, and 40k CFS. 130,000 CFS was modeled to serve as a worst-case scenario in discharge.

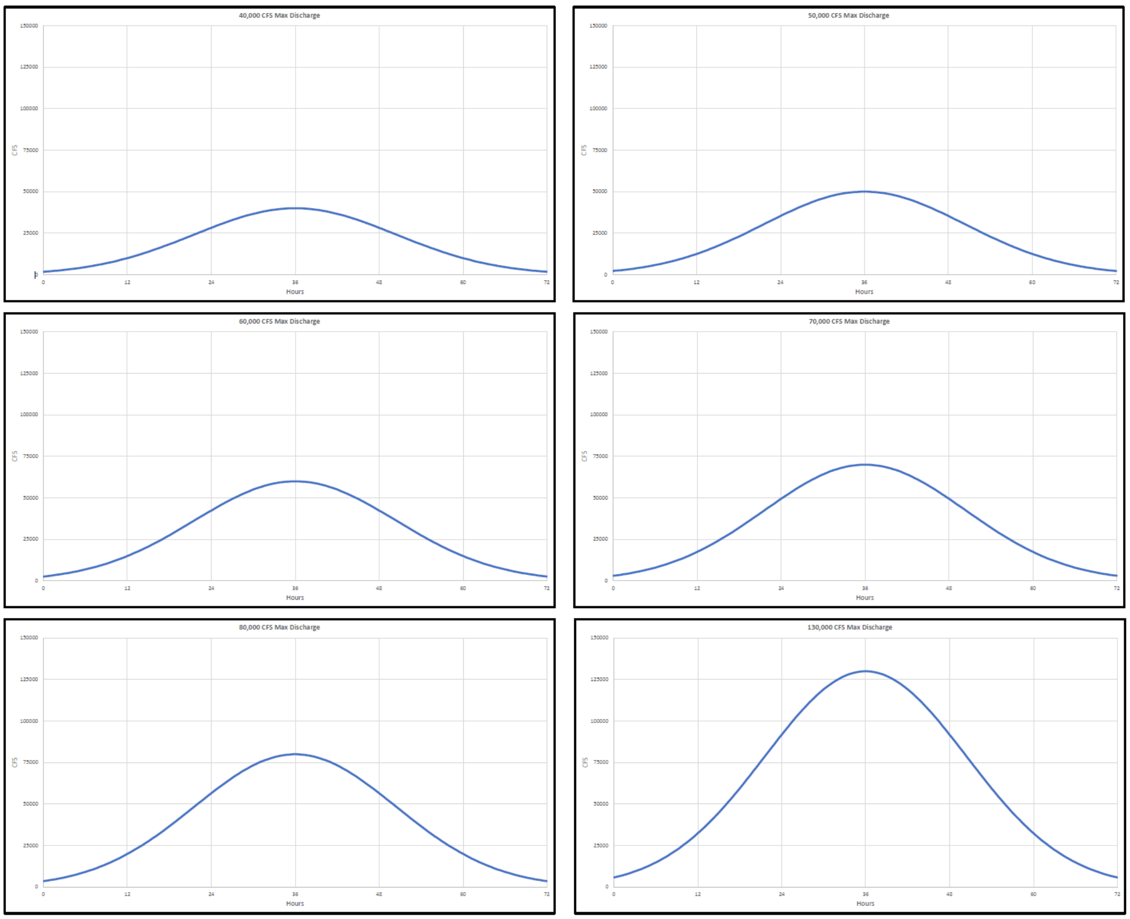


Figure 39. Hydrographs used in generating flow data for model. Hydrographs are bell curves with flows occurring over a 3-day interval.

<u>Computations</u>

When running a HEC-RAS model special consideration must be taken to apply the correct computation tolerances. The simulation time window was set to three days to match hydrographs. A computation interval must also be specified and tells the model how often to calculate water elevations. A rule when choosing a computation interval is to make sure that a courant number below 1 is achieved.

Eq 2:
$$C = v\frac{\Delta t}{\Delta x}$$

Where:

C = Courant Number

V = Water Velocity (ft/s)

Δt = Computation Interval (s)

Δx = Length between mesh elements (ft)

This ensures that water particles in the model do not propagate beyond the next cell between computations; thus, it prevents water from "skipping" cells. Courant numbers greater than 1 can lead to computation inaccuracies and model instability. For this model, a variable time step is used, and computation intervals occur between a range of defined courant numbers. The lower courant limit is set to 0.25 and the maximum is 0.8.

HEC-RAS allows the user to choose the equation set used to calculate flow. The default is "Diffusion Wave". In general, diffusion wave runs the fastest and has the greatest stability, however, it does not accurately model shallow water flow. For this model the Shallow Water Equations – Eulerian Method (SWE-EM) set was used. This computation method uses the St. Venant equations to conserve momentum when calculating flow. Along with the equation set, theta was adjusted. Theta is a weighting factor for the special derivative used to solve the St. Venant equations and can be adjusted between 1.0 to 0.6. A higher value improves model stability but is less accurate in solution. For this model a theta value of 0.8 was achieved before instability occurred.

Results

Floodplain Extent

When observing what discharges connect to the overlying floodplain, we are concerned with what max water depth is achieved with each flow. Looking at the modeled depths, a few observations are similar across each computation. Firstly, the areas to first become inundated with water on the floodplain are the same in each model. The time series below conveys the general water movement around Bushy Lake (Figures 40-46). The time series is that for 80,000 CFS peak discharge.

When viewing the time series, the movement of water is the same in each model run. Firstly, the east side of Bushy Lake is the first to become inundated, shortly after the western floodplain becomes connected to the river. The southern side of Bushy Lake is at a higher elevation than the surrounding floodplain. Due to this, it is the last area to be underwater. Any water that does overtop the riverbank eventually flows towards the low spot that is Bushy Lake. When floods recede, the water is residually stuck around Bushy Lake.

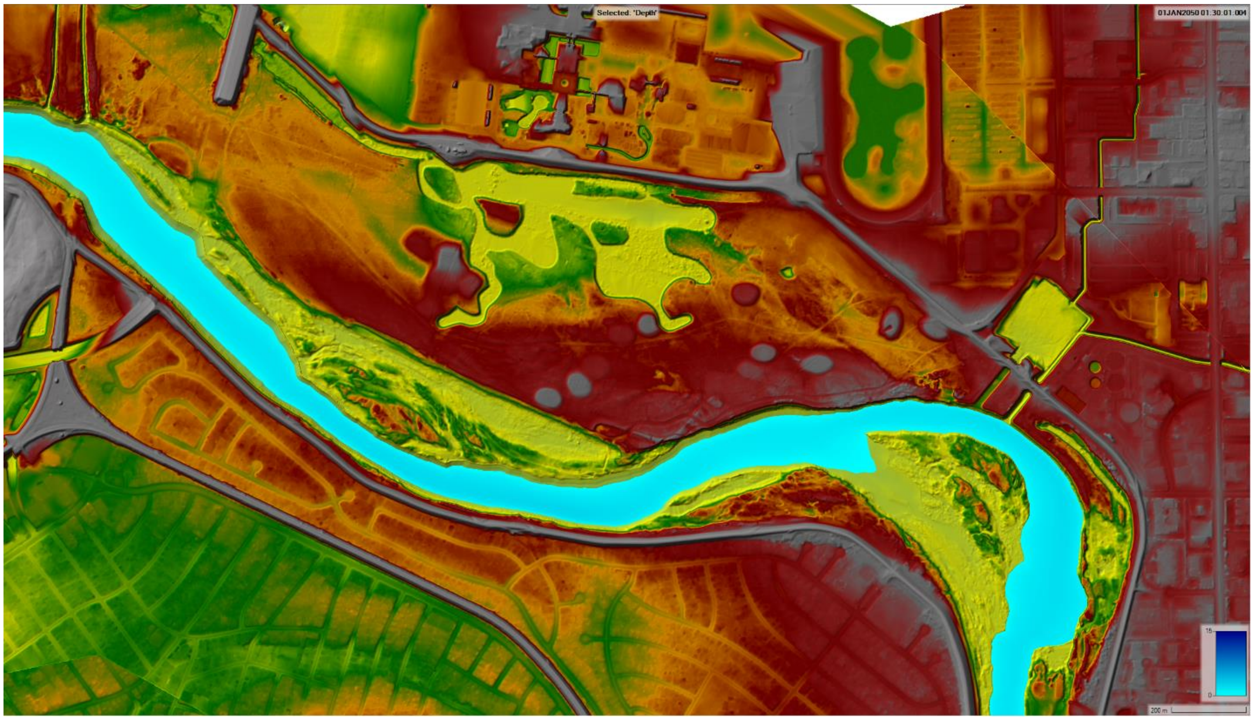


Figure 40. Initial water depth when starting computations.

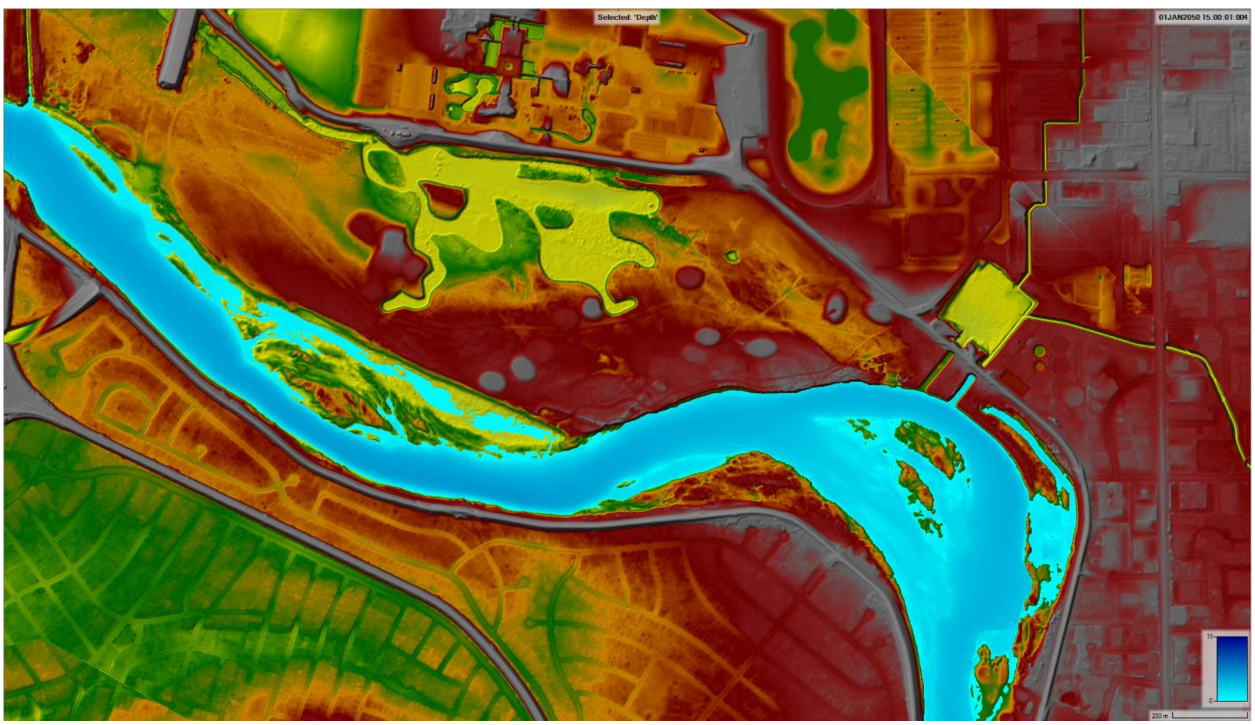


Figure 41. At 15 hours the channel has filled previously dry areas and is beginning to reach capacity.

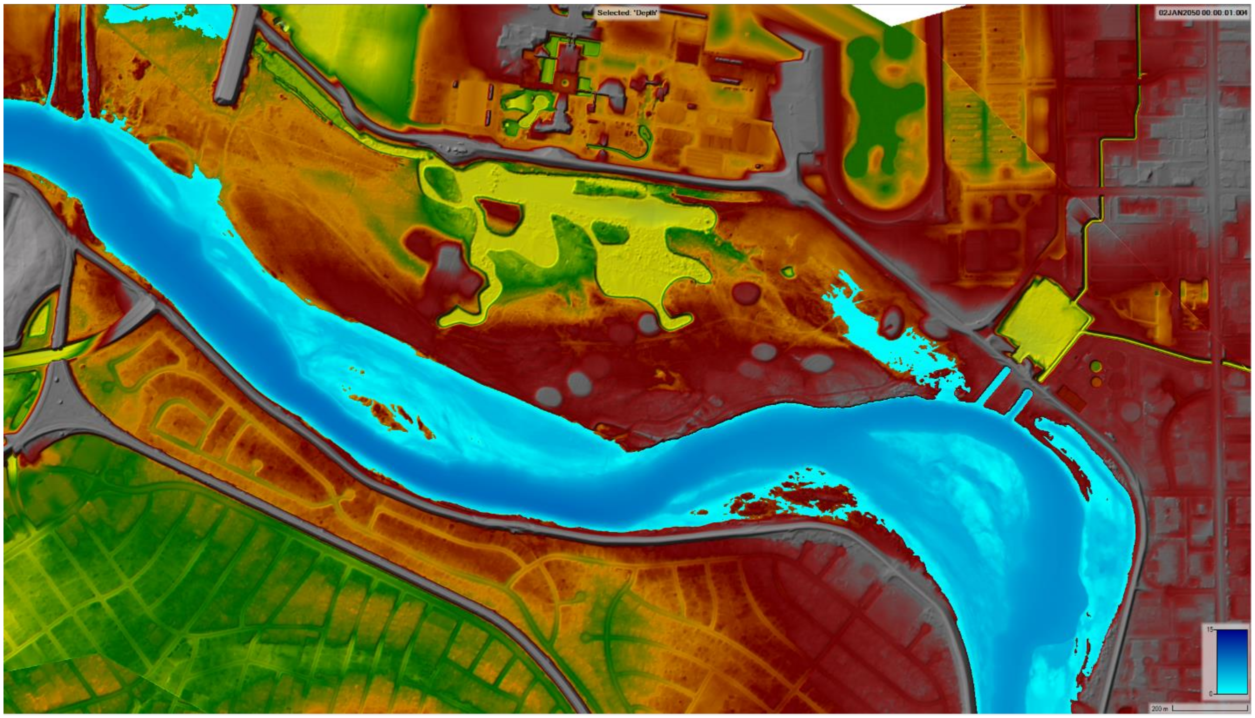


Figure 42. At 24 hours the channel has reached capacity. Connection to the floodplain has begun to the east of Bushy Lake.

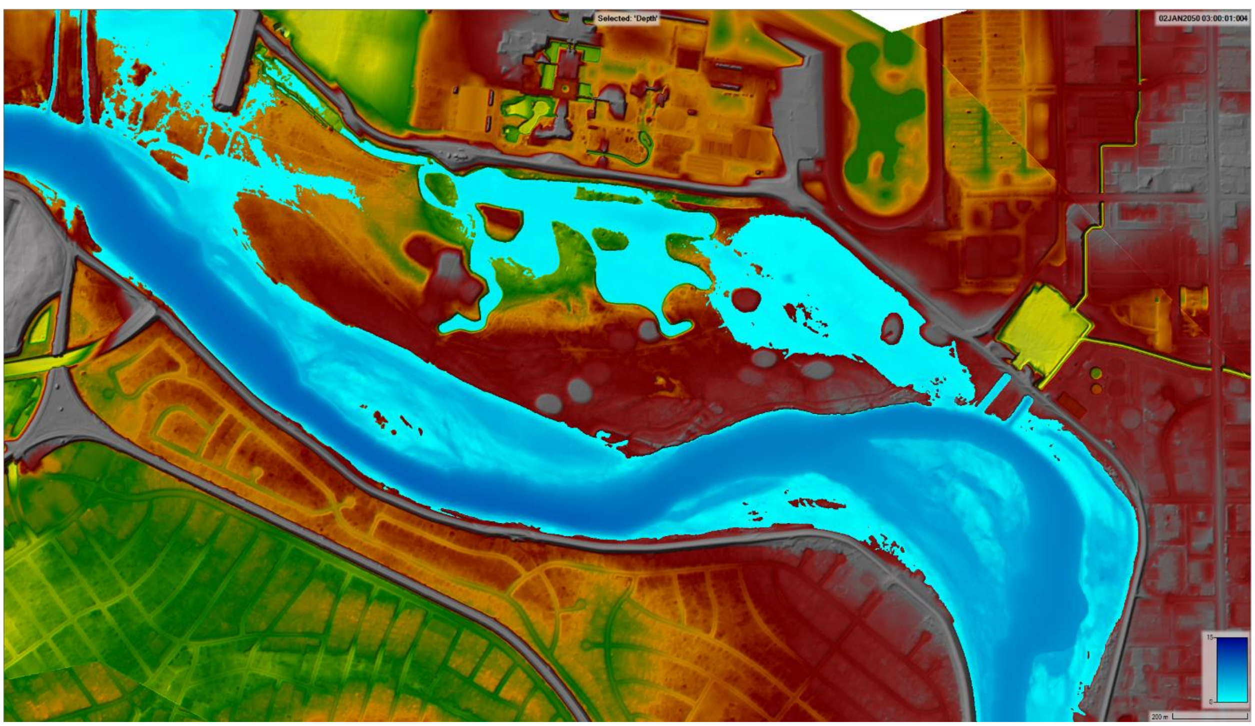


Figure 43. At 27 hours the waters have reached Bushy Lake from the east and are starting to inundate the floodplain to the west of Bushy Lake

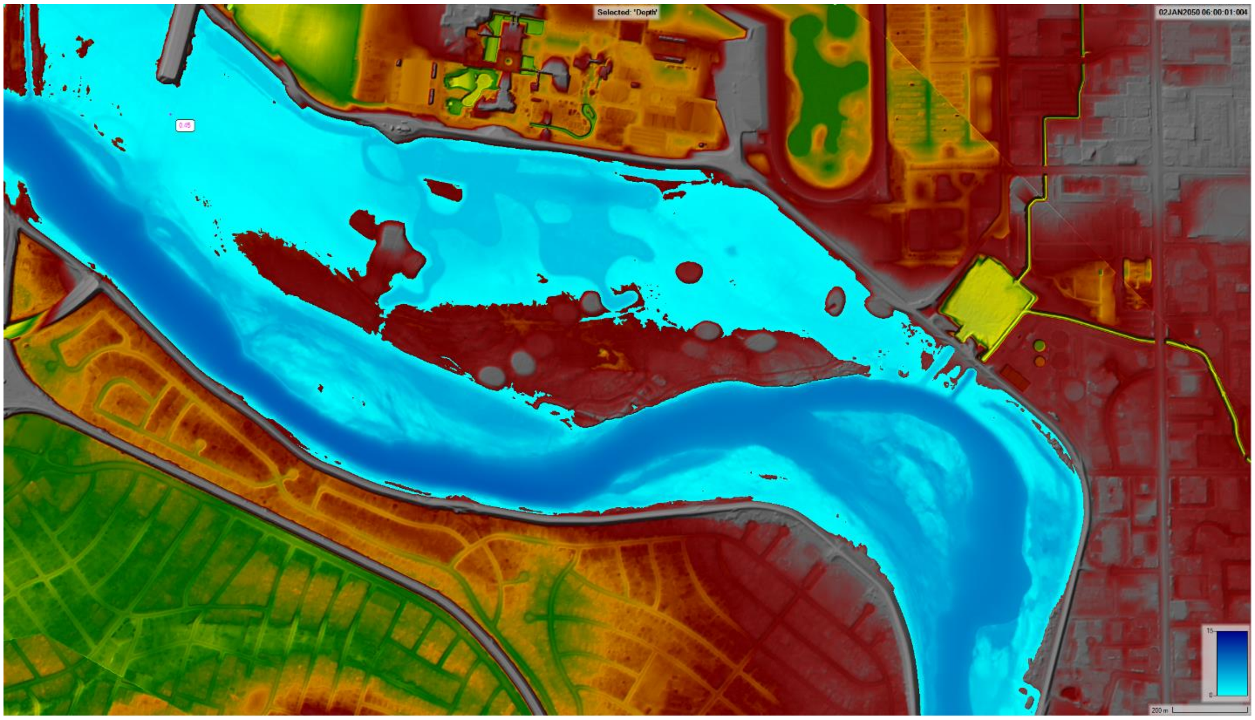


Figure 44. At 30 hours the floodplain has connected on either side and the area surrounding Bushy Lake is under a significant amount of water.

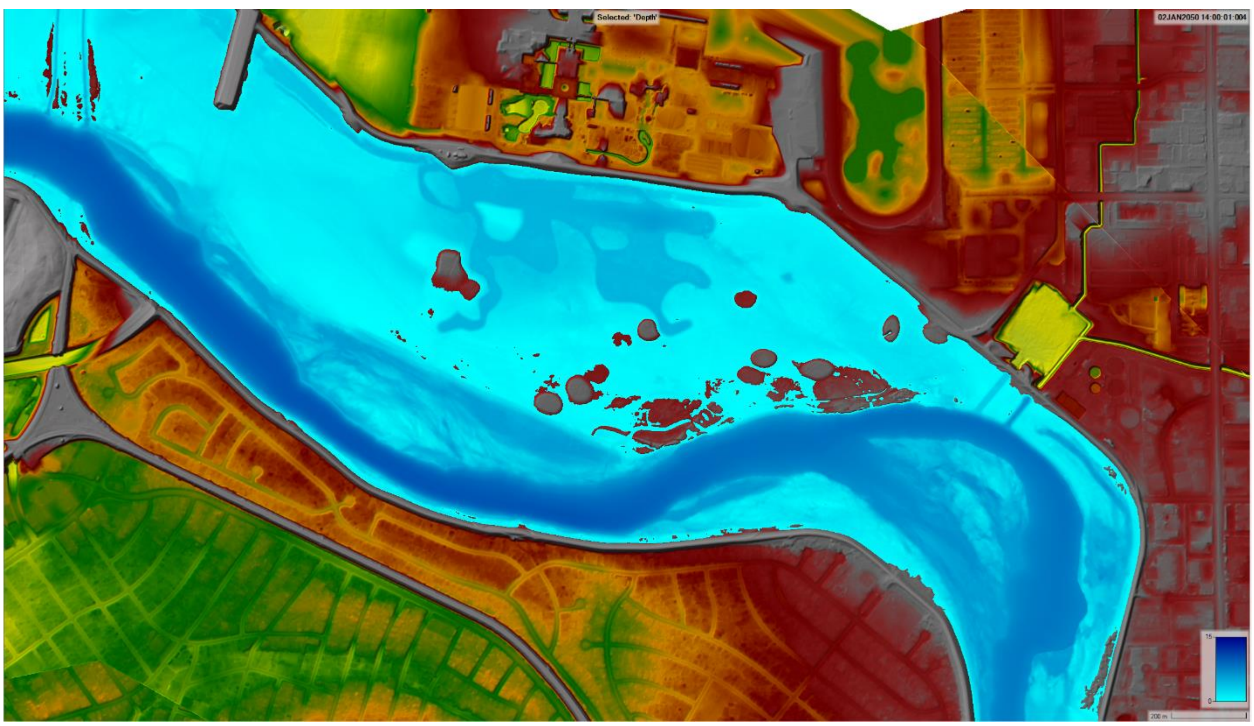


Figure 45. At 38 hours discharge has reached its peak and the area of Bushy Lake is almost completely under water.

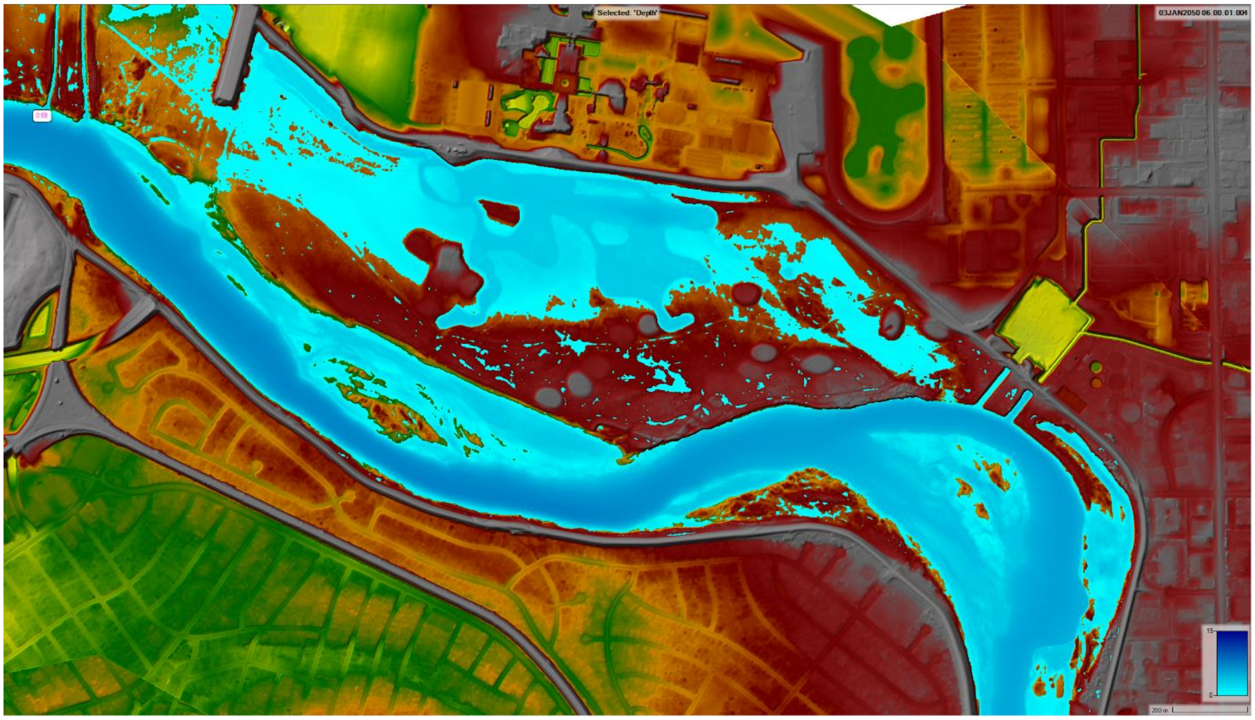


Figure 46. At 54 hours the waters have receded as discharge lessens and the area of Bushy Lake remains inundated with water.

When observing the effects of varying peak discharges, the differences observed are the extent to which Bushy Lake becomes flooded. Smaller discharges only slightly flood Bushy Lake or do not reach the floodplain at all. Modeling outputs show the max water depth achieved for each peak discharge (Figure 47-52).

The model outputs are very straightforward and show the range/extent of floodplain inundation for each discharge. Looking at the max water depth maps we can see that flow under 60,000 CFS do not connect with the floodplains and are confined to the channel. Flow above this spills onto the floodplain, but the extent of inundation varies. Major flooding of Bushy Lake does not occur until about 80,000 CFS (Water depths around Bushy Lake on the floodplain at 70,000 CFs are less than 3 ft). Flows around 60,000 would most likely not flood Bushy Lake and instead would infiltrate into the ground. This model does not include infiltration in its calculations and as such, is just a hypothesis. When viewing water depths at 130,000 CFS the area is completely flooded from levee to levee. This model does show that 130,000 CFS would not overtop the levees and is in agreement with the Army Corps of Engineers estimated max discharge of ~135,000 CFS.

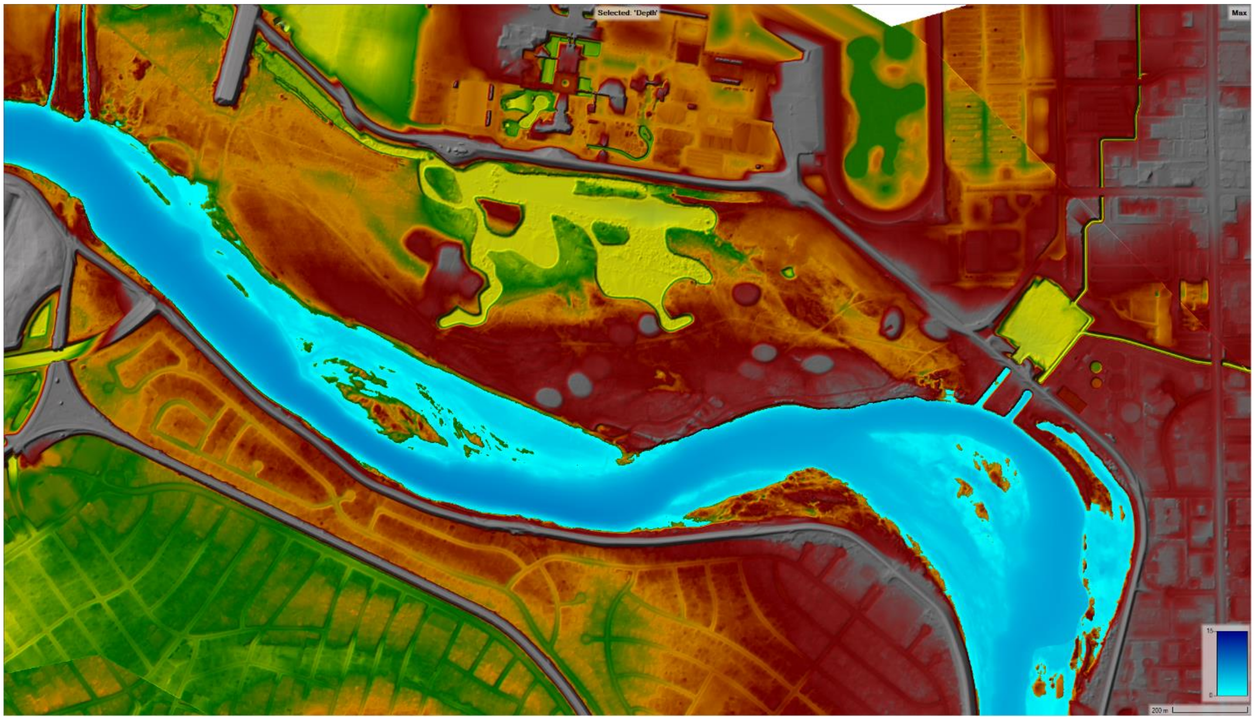


Figure 47. 40,000 CFS Max Water Depth

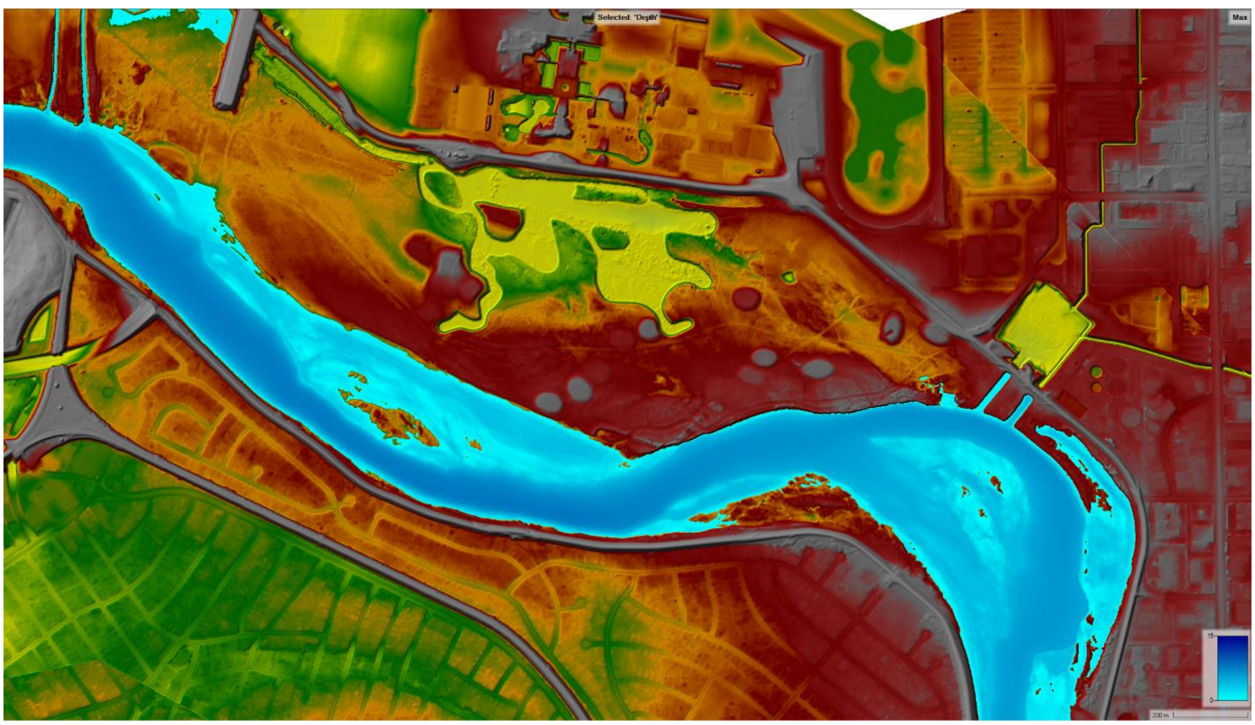


Figure 48. 50,000 CFS Max Water Depth

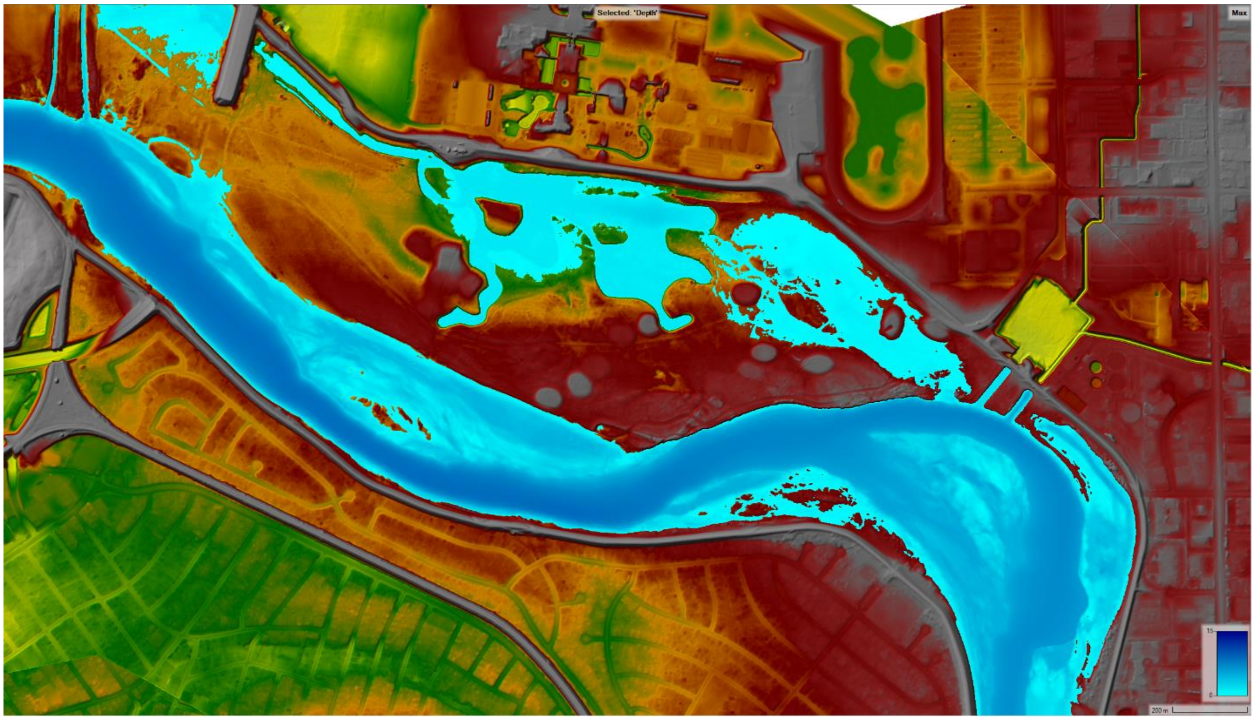


Figure 49. 60,000 CFS Max Water Depth

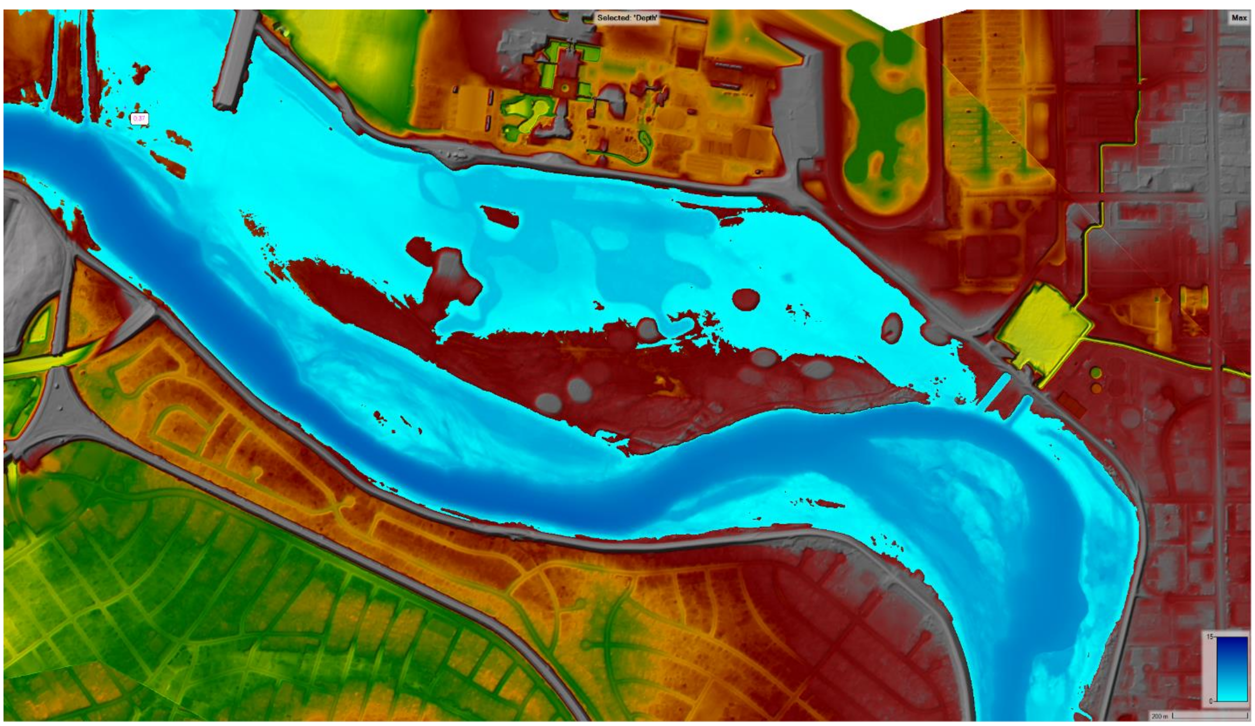


Figure 50. 70,000 CFS Max Water Depth

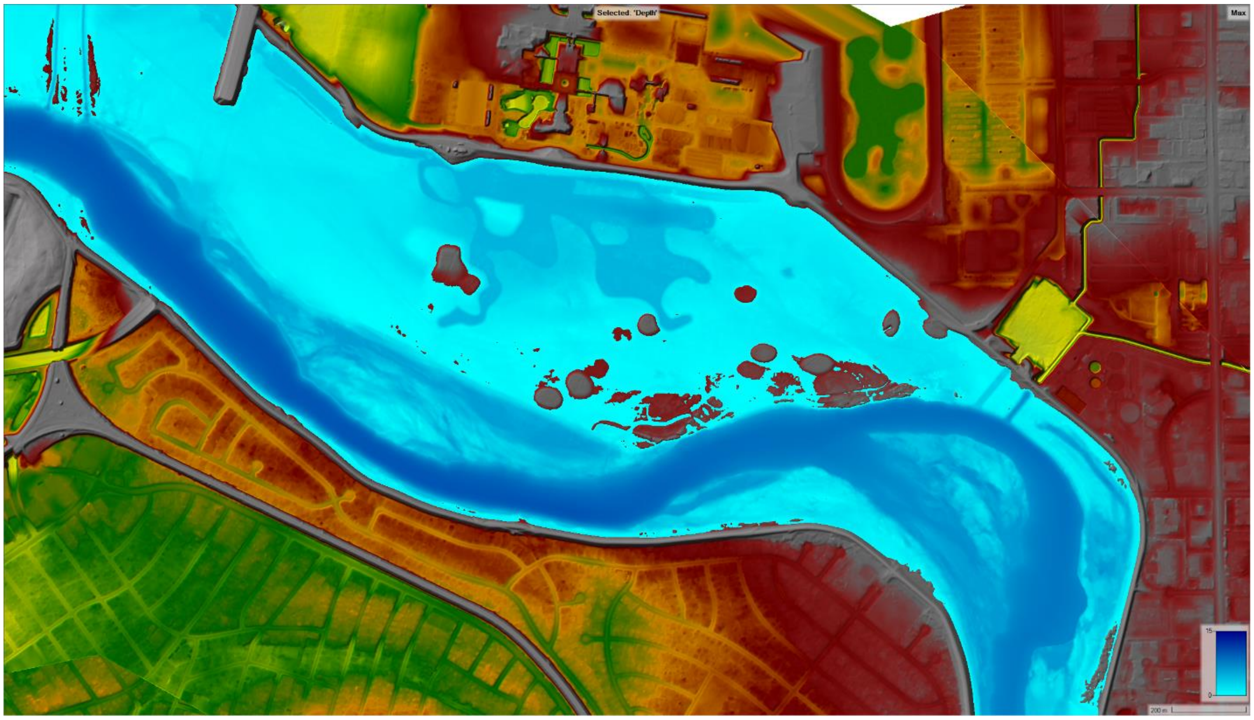


Figure 51. 80,000 CFS Max Water Depth

Figure 52. 130,000 CFS Max Water Depth

Uncertainty

This model approximates the conditions at the Bushy Lake nature preserve and contains inherent errors that may not convey conditions completely accurately. Firstly, flows are calculated from the bell curve hydrographs. A typical flood hydrograph contains a tailing end after floods where flows remain heightened, which is not reflected in the hydrographs used. Also, a typical flood would coincide with mass sediment movement. HEC-RAS has the capability for sediment transport modeling; however, it is not used in this analysis. Mannings n values in the model were applied using a land cover map. A better estimation could be achieved by physically measuring an n value at location. Absence of an accurate bathymetry map meant that bathymetry in the model had to be "created" and estimated from observations.

Conclusion

From the time series flows upon the floodplain follow a predictable pattern. Flows most easily reach the floodplain at the east and west side of Bushy Lake. This southern side of Bushy Lake is a high point created from construction of the American River Parkway bike path. This bike path has inhibited flows that contribute to Bushy Lake lessening its recharge potential. It is significant that flows under 60,000 CFS do not connect with the overlying floodplain. Looking at the Fair Oaks gauge we can see that only two events over 60,000 CFS have occurred since 1980 (Figure 53). The likelihood of Bushy Lake filling from American River flows on a regular basis is extremely unlikely. A restoration plan would need to implement other means of maintaining water levels in the Lake.

In all this is an estimation of what flood discharges may look like at Bushy Lake. Due to the inherent simplification of the model, the main takeaways should remain broad in scope. The main observation is that flows under 60,000 will not contribute to surface waters on the floodplain and that flows that do contribute, will come from the east and west side of Bushy Lake.

No detailed assessment was available from Cal Expo of how much groundwater was pumped into Bushy Lake. According to representatives of Cal Expo, the pump that provides water to at least two other Cal Expo facilities besides Bushy Lake, pumps an approximate volume of 50,000,000 gallons per year through the well. We do not know how much of that water actually goes to Bushy Lake. We are in communication with Cal Expo consultant to determine the groundwater pumped to Bushy Lake, and this data will be included in the final design phase.

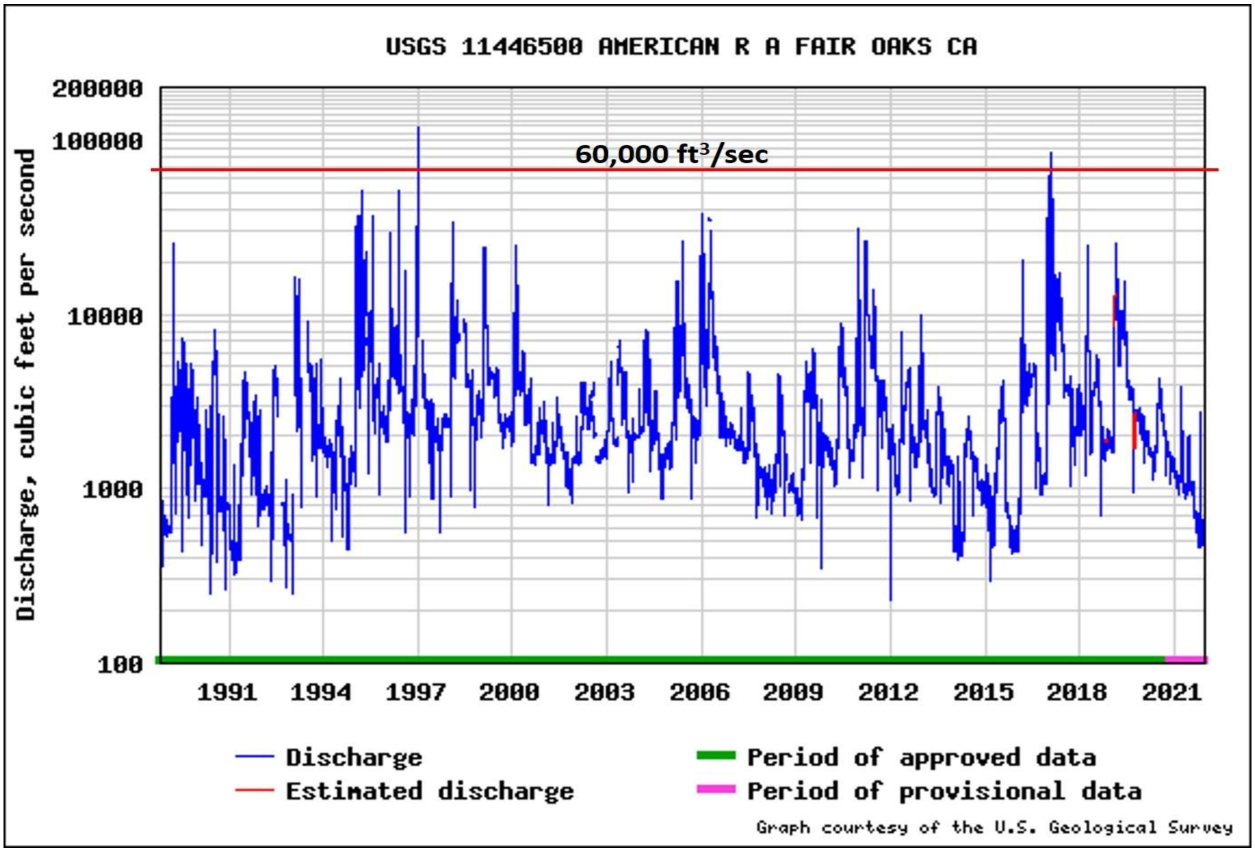


Figure 53. Fair Oaks gauge reading for discharge (1989-2021). In 1997 and 2017 flows of over 60,000 CFS occurred and likely flooded the area of Bushy Lake. Numerous events on the order of 20,000-30,000 CFS occur but would be confined to river channel.

4.4.4 Assess the role that groundwater pumping from Cal Expo and stormwater flow near Cal Expo has on surface inflow into Bushy Lake

No detailed assessment was available from Cal Expo of how much groundwater was pumped into Bushy Lake. It was indicated that the pump that provides water to at least two other Cal Expo facilities besides Bushy Lake, pumps an approximate volume of 50,000,000 gallons per year through the well. We do not know how much of that water actually goes to Bushy Lake. We have been in communication with Cal Expo's consultant Khaim Morton (Principal & Founder, KRM Strategies) to improve our understanding of the role of groundwater and stormwater. We have not received updates regarding the progress at the time of this report.

4.4.5 Conclusions

Detailed ground surface mapping suggests that approximately 0.9 km^2 (0.35 mi^2) of the terrain surrounding Bushy Lake would drain into the Lake under precipitation conditions that produced surface water runoff. Likely subsurface sediments in this area would be expected to be generally porous and permeable and waters in the Lake could easily drain from the Lake to the nearby American River Channel. Organic matter (leaf and vegetation litter) or that produced by aquatic life in the Lake that gets deposited on the bottom of the Lake would likely reduce the infiltration rate of Lake waters to the underlying groundwater system. The degree that this may occur has not been studied.

Subsurface water flow drains from Bushy Lake to the American River at gradients that range from 0.004 to 0.008. This condition is present along the entire reach of the American River where this terrace feature occurs.

4.5 Wetland Boundary Mapping and California Rapid Assessment Method (CRAM)

4.5.1 Wetland Boundary Mapping

We mapped the Bushy Lake Upland/ Wetland boundary using a coarse filter to differentiate the wetland boundary (Figure 54). This is not a wetland delineation. We used elevational changes, hydrophytic vegetation changes and where possible hydric soils changes to determine the wetland edge. The main Bushy Lake area is 13.24 acres. The seasonal wetland of Bushy Lake is the wetland edge. The main Bushy Lake area is 13.24 acres. The seasonal wetland of Bushy Lake is 20.45 acres. Figure 54 illustrates the boundaries of the wetland/upland edge, seasonal wetland boundary, and beaveways.

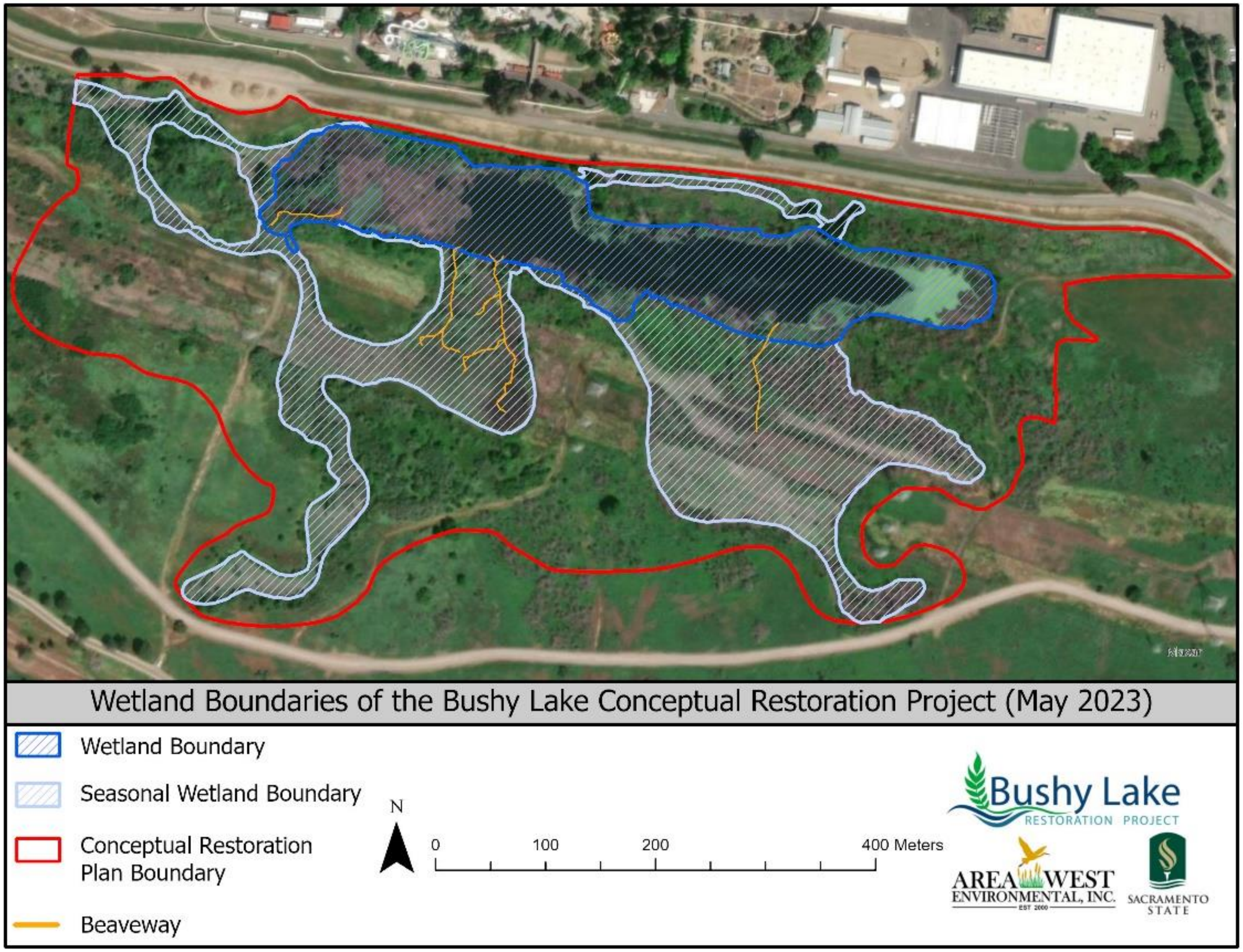


Figure 54. Wetland Boundaries of Bushy Lake as of May 2023

4.5.2 California Rapid Assessment Method

CRAM data serves as a long-term reference dataset to understand changes to the wetlands' habitat quality and hydrologic condition and provides useful baseline conditions to inform restoration design and adaptive management decisions. Representative portions of the Bushy Lake wetlands were sampled. Data for the CRAM assessments were gathered using the California Rapid Assessment Method (CRAM) Depression Module to determine changing site conditions (CWMW 2013, Version 6.1). The CRAM Methods are described in more detail in (Appendix C).

The initial CRAM analysis (Number 5675) for perennial/seasonal depressional wetlands occurred on July 1, 2016, with three trained CRAM practitioners: Michelle Stevens, Sarah Pearce, and Terry Adelsbach. A follow-up CRAM analysis for perennial/seasonal depressional wetlands was conducted on August 23 and 24, 2022 with four trained CRAM practitioners: Michelle Stevens as the Lead practitioner; Leticia Morris, Justin Chappelle, and Dawn Cunningham as additional practitioners. Alexandra von Ehrenkrook and Dereck Goodwin-Martinez assisted with mapping both the CRAM Assessment Area (AA) boundaries with a Bad Elf Flex GNSS Receiver.

In 2022, CRAM analyses were conducted for two Assessment Areas (AA-22-1 Number 8844 and AA-22-2 Number 8845). The seasonal wetland AA-2 was formed by Beaveways (canals created by beavers), creating a seasonal wetland that did not exist in 2016. There was a 6-year difference between the two CRAM analyses. Wildfires occurred in 2016-2017 and again in June 2021.

4.5.3 Interpretation of Bushy Lake CRAM Metric and Attribute Scores

The Overall CRAM Index Score conveys the overall ecological condition of each Assessment Area in a wetland with a single numeric score. Overall CRAM Index scores are routinely divided into textiles of condition: Poor, with scores from 25-50; fair, with scores from 51 to 75: and good, with scores from 76 to 100. The overall CRAM Index scores assessed in this study show improvement over time between the 2016 CRAM Index scores and 2022 CRAM Index Scores. The season wetland 8845 did not exist in 2016, resulting in a net gain in site condition.

Interpreting the results of a CRAM assessment requires the researcher to collect data and evaluate each attribute score (Appendix C). For example, CRAM metrics will reflect changes in site conditions over time, making them very sensitive indicators of change, including changes caused by restoration projects. Indicators that make up the various sub-metrics of each attribute have been found to directly correlate to the overall condition of the ecosystem (Stein et al., 2009). The CRAM Quality Assurance Plan provides guidance on the precision and interpretation of CRAM scores (CWMW, 2018).

<u>2016 and 2022 Bushy Lake and Index Scores</u>

In Table 8, the Attribute and Index CRAM scores are analyzed between 2016 and 2022. The differences are being evaluated between 22-1 and 16-1, as they are in comparable areas.

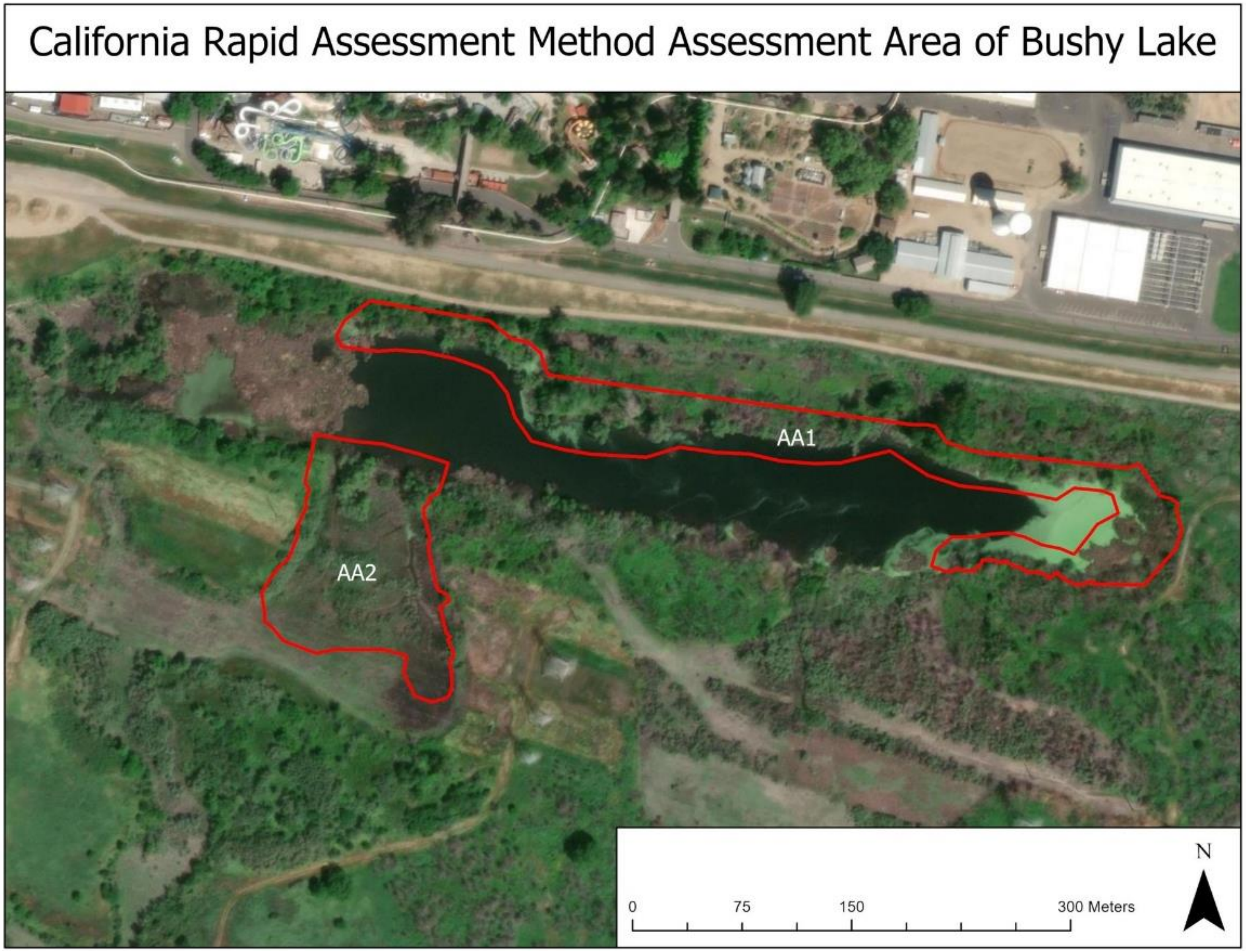
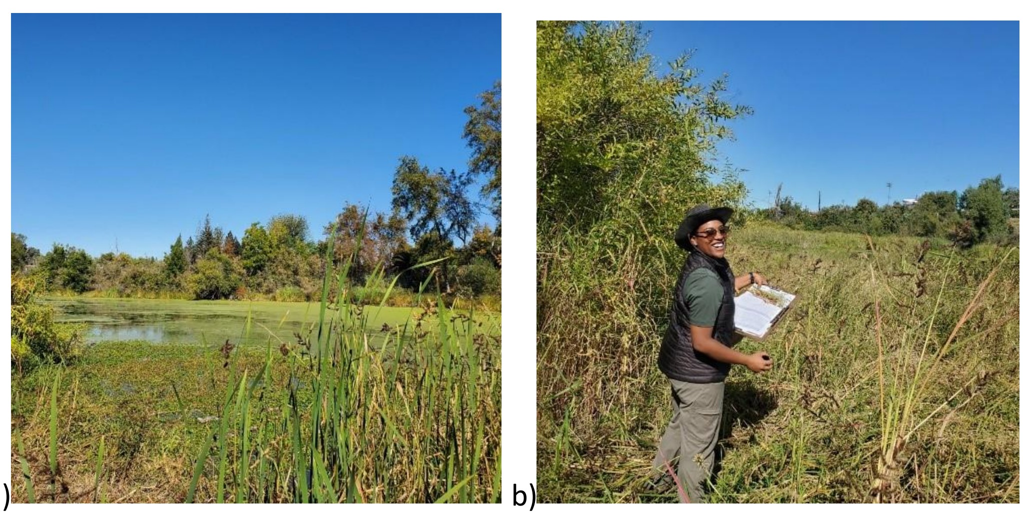


Figure 55. Assessment Areas 1 and 2 (AA1 and AA2) of the California Rapid Assessment Method (CRAM) analysis of August 2022

a) b) c)


Figure 56. Assessment Area 22-1. a) northwest boundary; b) northeast featuring the water inlet through which Cal Expo pumps groundwater into Bushy Lake; c) east side

a) b)


c)  d) 

e) 

Figure 57. Assessment Area 22-2. a) west side; b) Letitia Morris along the eastern boundary, c) southern boundary, d) Justin Chappelle along the northwestern boundary, e) southwest side featuring beaver-made canals, referred to as "beaveways", which have expanded surface water

The Assessment Area 22-2 is a newly formed seasonal wetland, so is not comparable to 16-1 and has additional wetland conditions on the site. This speaks to the importance of beavers as ecosystem engineers, contributing also to fire resiliency and habitat complexity on site.

To analyze the results, it is useful to answer the question "How much greater does one score have to be than another to be significantly greater at the 90th percentile confidence interval?". For Index scores, there is a 90% confidence interval assurance that scores differ from one another (there is a difference of 7 CRAM points). For Buffer and Landscape Context, there must be a 4-point difference to indicate a change in condition. For Hydrology there must be a 10-point difference. For Physical Structure, there must be an 11-point change. For Biotic Structure, there must be an 11-point change.

The Index Score for Bushy Lake AA2-16 5675 in 2016 was 70. The Index score for Bushy Lake AA22-1 (8844) in 2022 was 77. The AA1 area is 1.91 Hectares (4.72 acres). The Index score for the Bushy Lake seasonal wetland AA2 (8845) is 69 in 2022. The AA2 area is 1.17 Hectares (2.891 acres). The beaver activity at Bushy Lake created canals or Beaveways, enhancing the hydrology to create wetter conditions in AA2. This expanded the wetland perimeter on the southern side of Bushy Lake, so a new Assessment Area was created.

The Index Score – increased significantly between 2016 and 2022. An increase of 7 points gives us 90% confidence that the 2022 score is greater than the 2016 score. Overall CRAM Index scores are routinely divided into textiles of condition: Poor, with scores from 25-50; fair, with scores from 51 to 75: and good, with scores from 76 to 100. All scores are in fair condition, with improvement over time. Based on these metrics, Assessment Area 1 increased in quality from fair to good. The newly formed AA2 seasonal wetland is in fair condition.

Table 12. California Rapid Assessment Method Attribute and Index scores between 2016 and 2022

Year	AA	Number	Buffer and Landscape Context (+4 Δ)	Hydrology (+10=Δ)	Physical Structure (+17=Δ)	Biotic Structure (+11 Δ)	Index ScoreΔ	Difference
2022	Bushy 22-1	8844	52.79	66.67	87.5	100	77	+7
2016	Bushy 16-1	5675	57.92	66.67	75	80.56	70	
Change			-5.13	No change	+12.5	+19.44	+7	
2022	Bushy 22-2	8845	47.88	75	62.5	88.89	69	

- The Buffer and Landscape Context Attributes indicate a change of -5.13. For Buffer and Landscape Context, there must be a 4-point difference to indicate a change in condition.
- Hydrology Attribute – The scores for the hydrology attribute did not change over time.
- Physical Structure Attribute – For Physical Structure, there must be an 11-point change. The scores for the physical structure attribute increased by +12.5, a significant improvement.
- Biotic Structure Attribute- For Biotic Structure, there must be an 11-point change. Between 2016 and 2022, the biotic structure attribute increased by +19.44 to a perfect score of 100.

Conclusions and Recommendations

CRAM is best used as a monitoring tool by sampling either baseline condition and/or the restoration recovery trajectory over time. Depressional CRAM sampling occurred in 2016 and again in 2022. The site is highly disturbed by wildfires. CRAM provides a good indication of changing site conditions, providing background information to plan for the future restoration trajectory. These 2016 and 2022 CRAM evaluations will provide a good baseline data source to compare to future restoration, monitoring, and adaptive management actions (Figure 49).

The Index Score increased by 7 points between 2016 and 2022. An increase of 7 points gives us 90% confidence that the 2022 score is greater than the 2016 score. A score of 77 for Assessment Area 22-1 1 increased in quality from fair to good. The newly formed AA2 seasonal wetland score of 69 is in fair condition. This expanded 2.89-acre season wetland on the southern side of Bushy Lake is a new Assessment Area.

The Buffer and Landscape Context Attributes indicate a change of -5.13. For Buffer and Landscape Context, there must be a 4-point difference to indicate a change in condition. The Hydrology Attribute did not change over time. The Physical Structure Attribute increased by +12.5, a significant improvement of over an 11-point change. The Biotic Structure Attribute increased by +19.44 to a perfect score of 100; over an 11-point change.

The buffer and landscape attributes declined because of human disturbance, fire, and invasive weeds invading the buffer. Physical structure increased structural patch richness and topographic complexity over time. The plant community increased in the number of co-dominant species, horizontal interspersion, and vertical biotic structure to increase suitable habitat conditions, complexity, and interspersion. Monitoring and adaptive management, especially to control invasive species, are essential to sustain site conditions and contribute to restoration goals and objectives.

Appendix C includes the CRAM Methodology background. The summary Assessment Reports for Assessment Area 22-1 (8844) can be found in Appendix C-1. The summary Assessment Reports for Assessment Area 22-2 (8845) can be found in Appendix C-2.

4.6 Avian and Mammal Wildlife

The following surveys and observations of avian and mammal wildlife have been conducted independently of the WCB grant. We believe these species are crucial elements to the biodiversity of Bushy Lake, and these observations can be utilized to inform future restoration efforts.

4.6.1 Avian Surveys

An important biological indicator of habitat quality is avian diversity. Daniel Williams (HDR/Sacramento Audubon Society), a wildlife biologist with over 30 years of ornithological experience in the region, has been voluntarily conducting bi-weekly avian surveys at Bushy Lake since February 2020. In May 2022, experienced field ornithologists Joel Craven and Dereck Goodwin-Martinez began collecting data with Daniel Williams. They have since continued to conduct weekly avian surveys at Bushy Lake while following the same protocols.

The avian diversity of Bushy Lake is truly astounding; thus far, over 140 bird species have been identified at Bushy Lake (Table 9) (Appendix D). Throughout the year, the lake is visited by a diverse array of bird species that utilize the habitat in and around the lake for foraging, nesting, roosting, and as a migration stopover. Waterfowl such as mallard (*Anas platyrhynchos*), gadwall (*Mareca strepera*), and wood duck (*Aix sponsa*) forage on the surface of the lake and nest on its shores. Red-shouldered hawks (*Buteo lineatus*) and red-tailed hawks (*B. jamaicensis*) start nesting in late winter in the larger cottonwoods near the lake while, later in spring, Swainson's Hawks (*B. swainsoni*) return from their wintering grounds as far south as Argentina to do the same. Osprey (*Pandion haliaetus*) often appear from their more typical haunts along the American River to pluck fish from Bushy Lake, and peregrine falcons (*Falco peregrinus*) often course past the lake attempting to pick out a duck to chase down.

The arrival of spring brings with it the melodic voices of the red-winged blackbird (*Agelaius phoeniceus*) colony which issue their mechanical-sounding songs from the cattails at the west end of the lake. Song sparrows (*Melospiza melodia*), common yellowthroats (*Geothlypis trichas*), and Virginia rails (*Rallus limicola*) also call the dense mid-lake reeds and cattails home. As spring progresses, an increasing variety of swallows arrive to glean insects over the lake surface; tree swallows (*Tachycineta bicolor*) which nest in tree cavities right alongside the lake, sets of barn swallows (*Hirundo rustica*), and an immense colony of cliff swallows (*Petrochelidon pyrrhonata*) gather mud from the lakeshore to build their nests on the grandstand of the Cal Expo Racetrack, and later in summer purple martins (*Progne subis*) arrive from their colonies under nearby highway overpasses to fuel up on insects over the lake before migrating south.

As fall approaches, the lake will see an influx of migrant species, such as yellow warbler (*Setophaga petechia*), Wilson's warbler (*Cardellina pusilla*), western wood-pewee (*Contopus sordidulus*), the state-endangered willow flycatcher (*Empidonax traillii*), Swainson's thrush (*Catharus ustulatus*), western tanager *(Piranga ludoviciana*), and many others, who will use the dense willow riparian and grapevine thicket habitat for resting and refueling. The late fall months will bring back overwintering species, such as cedar waxwings (*Bombycilla cedrorum*), ruby-crowned kinglets (*Regulus calendula*), blue-gray gnatcatchers (*Polioptila caerulea), yellow-rumped* warblers (*Setophaga coronata), Lincoln's sparrows (Melospiza lincolni), and northern flickers (Colaptes auratus).*

4.6.2 Wildlife Cameras

Five cameras have been utilized periodically to monitor wildlife activity at Bushy Lake. The cameras were first utilized in September-October 2020, and camera use increased in the following years. The five cameras were stationed in September 2021-January 2022, March-November 2022, and May-July 2023. In 2021 and 2022, cameras were stationed and retrieved for data processing every two weeks. In 2022, cameras were stationed and retrieved for data processing every week.

Our goals of wildlife camera placement are to gather the presence/absence of species, assess species habitat use, observe turtle movement patterns, and identify wildlife relationships with beaver activities to inform restoration activities that support biodiversity.

Wildlife cameras have been strategically placed in areas to best address these goals (Figure 58). Locations 1 and 2 were in the south of Bushy Lake along "beaveways" (beaver-constructed canals) with year-round standing water; cameras were placed facing upstream and downstream to identify species utilizing the canals (Figure 59). Location 3 was in the southeast of Bushy Lake along a beaveways with seasonally standing water; the cameras were placed facing the edge of a willow stand. Location 4 was in the east of Bushy Lake in the *in-situ* restoration site; cameras were placed facing the Santa barbarae sedge bed to observe deer and other wildlife utilizing the area. The camera locations were adjusted to reflect site conditions, however, the cameras remained in the same general areas. Unhoused individuals moving or damaging cameras resulted in camera relocation; wildfire activity, and risk affected camera use in the summer of 2021; and flooding damaged and prevented retrieval during the winter of 2022-23.

These camera data have identified a diversity of species (Figure 59). Observed birds include California quail (*Callipepla californica*), bluebird (*Sialia* sp.), mallard duck (*Anas platyrhynchos*), and wood duck (*Aix sponsa*). Terrestrial mammals include California mule deer (*Odocoileus hemionus*), coyote (*Canis latrans*), bobcat (*Lynx rufus)*, Eastern gray squirrels (*Sciurus carolinensis*), desert cottontail (*Sylvilagus audubonii*), striped skunk (*Mephitis mephitis*), opossum (*Didelphis marsupialis*), raccoon (*Procyon lotor*), and feral cat. Aquatic mammals include North American beaver (*Castor canadensis*) and North American river otter (*Lontra canadensis*). The Red-eared slider (*Trachemys scripta elegans*) has additionally been observed.

As predicted, the wildlife cameras have showcased the relationship between beavers and other wildlife. The beaveways have expanded the aquatic habitat for various wildlife. The cameras have recorded turtles, waterfowl, and beavers, and field biologists have observed fish utilizing the beaveways for aquatic habitat (Figure 59). The wildlife cameras have additionally observed deer and bobcats utilizing the beaveways as a water resource.

4.6.3 Beaver

Monitoring of the North American beaver (*Castor canadensis*) was not included in the original restoration scope, however, observations at Bushy Lake indicate that beaver activities are positively impacting the ecosystem. Scientific literature and field observations demonstrate that the beaver is a keystone species and ecosystem engineer (Wright et al. 2002).

Beaver activities at Bushy Lake include felled trees, 2 beaver lodges, the construction of “beaveways” (beaver-constructed canals), a beaver dam, and images of beavers captured in wildlife cameras (Figure 60). The beavers at Bushy Lake are positively contributing to habitat complexity and interspersion; increasing the surface water perimeter; increasing fire resiliency; and improving the habitat for turtles and other wildlife. The presence of beavers at Bushy Lake is a valuable opportunity for natural habitat improvements and public and scientific education (Baker and Hill 2003, Cooke and Zach 2008, Metts et al. 2001).

The expansion of aquatic habitat has been observed at Bushy Lake and is evident by California Rapid Assessment Method (CRAM) surveys. The 2022 CRAM survey identified an Assessment Area (AA) that was not present in the previous 2016 CRAM survey; this area was identified as AA2 in 2022 and developed by the creation of beaveways (Figure 49).

Increasing water resources and expanding the wetted perimeter contribute to fire resiliency (Cooke and Zach 2008, Dittbrenner et al. 2018, Fairfax and Whittle 2020, Longcore et al. 2007). This was observed at Bushy Lake during the June 6, 2021, wildfire. The fire laid down at the edge of the wetted perimeter of Bushy Lake and in the dendritic patterning formed by beaveways on the southern edge of Bushy Lake. These beaveways created a fire break that protected a significant amount of aquatic and riparian habitat surrounding Bushy Lake.

Figure 58. Wildlife camera locations at Bushy Lake (September-October 2020, September 2021-January 2022, March- November 2022, May-July 2023)

Figure 59. Species captured on wildlife cameras at Bushy Lake: a. North American beaver (Location 1) (*Lontra canadensis*), b. bobcat (*Lynx rufus*) (Location 2), c. Red-winged blackbird (*Agelaius phoeniceus*) (Location 3), d. California mule deer (*Odocoileus hemionus*) (Location 4), e. coyote (*Canis latrans*) (Location 4) ©Bushy Lake Restoration Project, 2021.

The beaveways additionally link terrestrial and aquatic habitats. Turtles have been observed during field surveys and on wildlife cameras utilizing beaveways to access upland habitats for nesting (Figures 61 and 62). The beaveways additionally provide habitat for waterfowl, fish, deer, coyotes, and bobcat (Figure 62).

Beaver lodges and dams can additionally support wildlife. The partially submerged vegetation of these structures provides turtles with potential basking habitat on the surface and a refuge habitat underwater (Alvarez 2006).

Lastly, the literature suggests that beaver dams can contribute to improved water quality by acting as a filter for phosphorus pollutants (Baker and Hill 2003, Lundquist and Dolman 2018). Although beaver dams filtering pollutants have not been researched nor clearly identified at Bushy Lake, there is potential to occur given that the beaver dam is located just inside the water inlet (Figure 60).

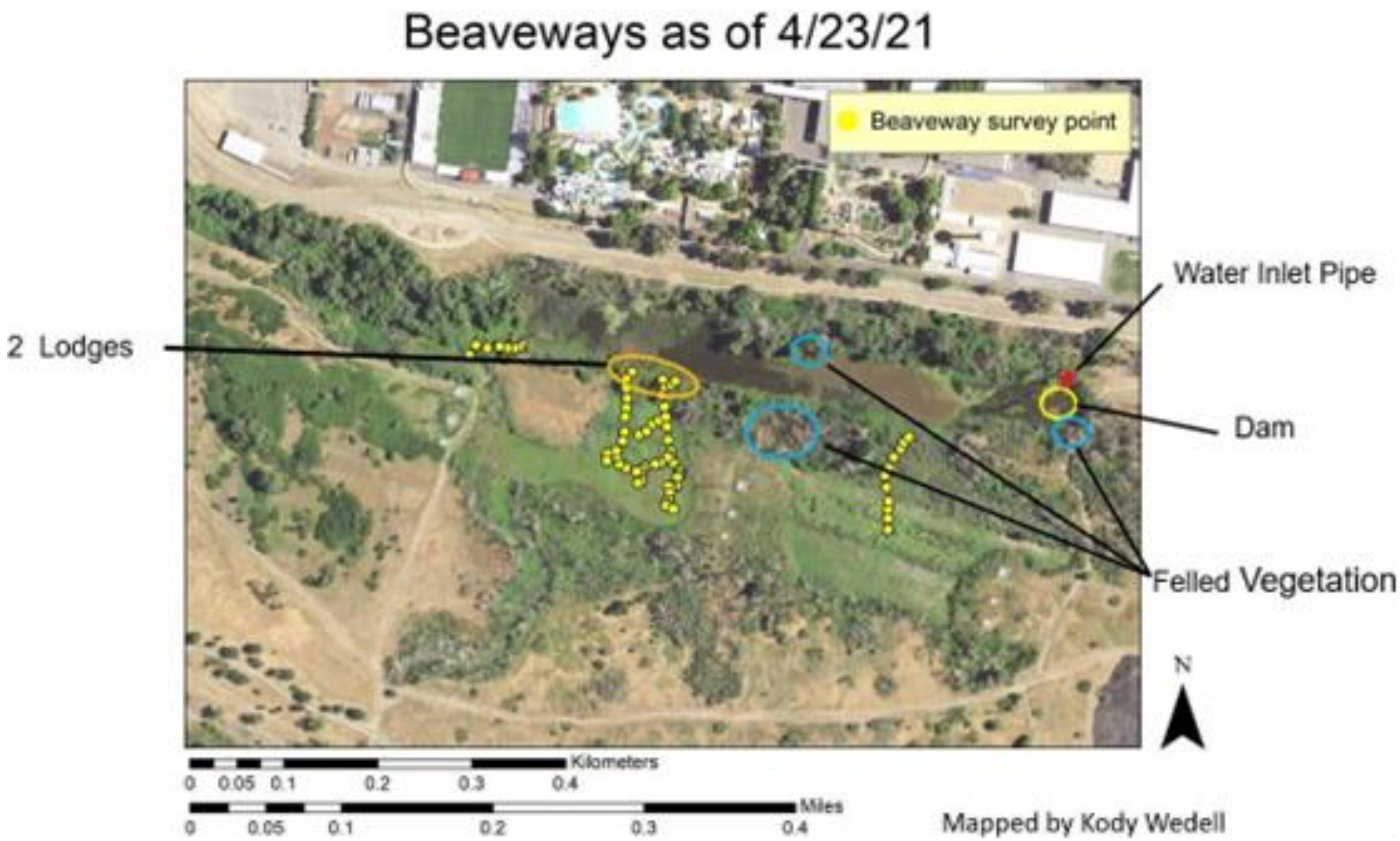


Figure 60. a) Beaver activities at Bushy Lake, including "beaveways" (beaver-constructed canals), lodges, a dam, and felled vegetation (April 23, 2021).

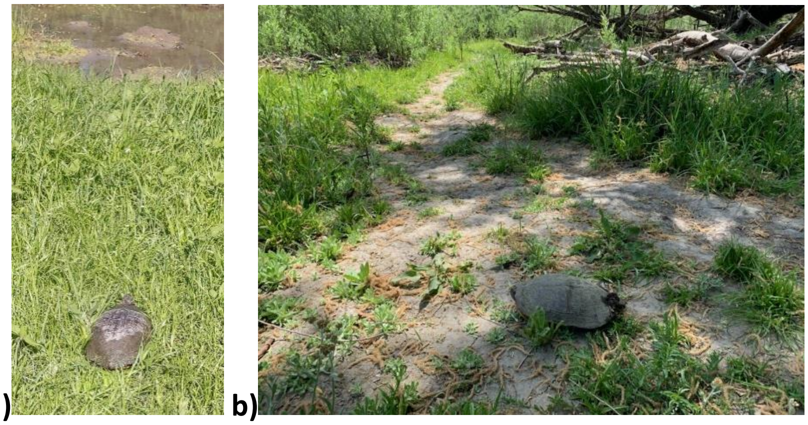


Figure 61. Red-eared sliders traveling near beaveways that have exhibited nesting behaviors as indicative from the muddy posterior shell, a) June 7, 2020, b) April 24, 2021.

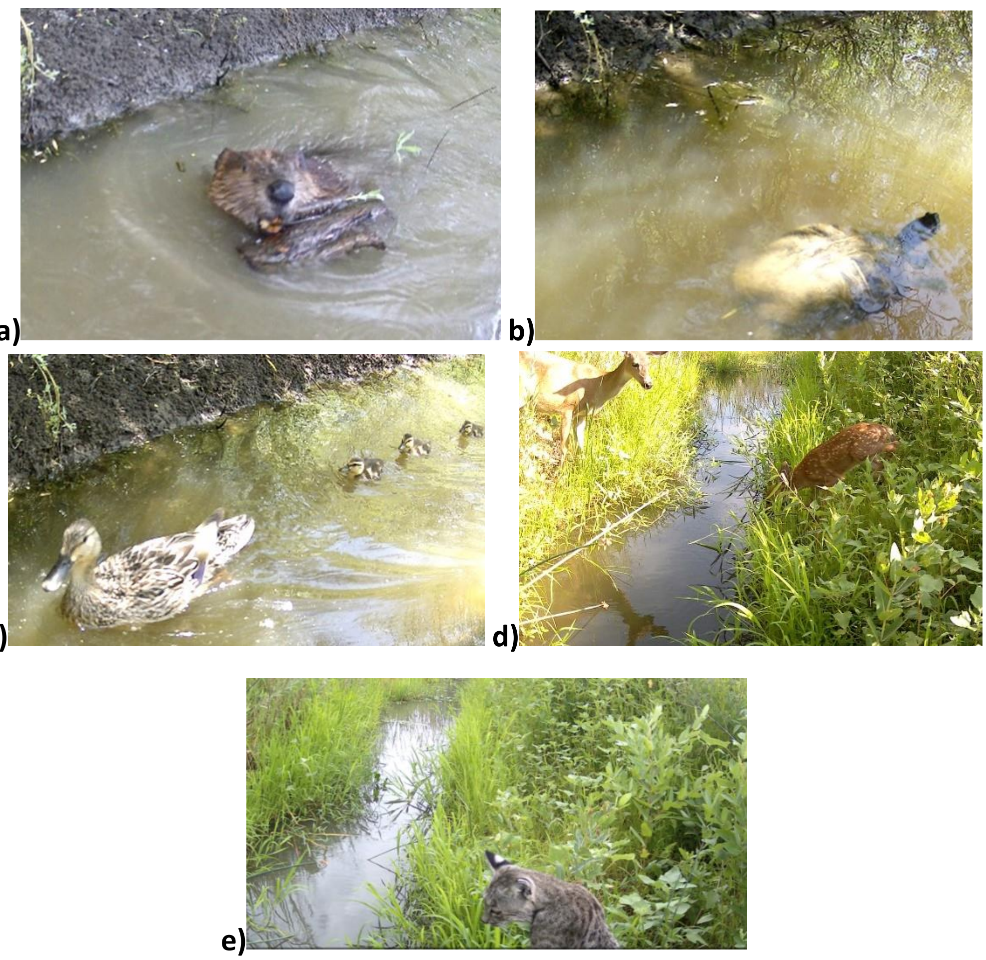


Figure 62. A variety of wildlife have been observed utilizing the beaver-made canals, "beaveways", several of which have been captured on wildlife trails: a) beaver (*Castor canadensis*), b) turtles: Red-eared slider (*Trachemys scripta elegans*), c) ducks: Mallard duck (*Anas platyrhynchos*), d) California mule deer (*Odocoileus hemionus*), and e) bobcat (*Lynx rufus)*.

5. Education and Public Outreach

The Bushy Lake Restoration Project engages in community outreach and education with the objectives of educating the public on turtle life history, increasing awareness of nesting turtles in upland habitats, advising safe human-turtle interactions, educating on the impacts of non-native turtles, educating on native and culturally significant plants and wildlife, and encouraging increased incorporation of traditional ecological knowledge and fire management. Actions to meet these education goals are implemented in collaboration with project stakeholders through a variety of avenues, as well as independently through public days, presentations, and maintaining an online presence.

5.1 Stakeholder Engagement

5.1.1 Stakeholder Advisory Committee

At the beginning of the project, we established a stakeholder advisory committee to provide input and advice on the development and completion of the Bushy Lake 35% CRP. The first advisory committee meeting was held on October 29, 2020. The group additionally met on April 30 and November 5, 2021, and February 22, October 7, 2022, and March 3, 2023. In October 2022, three stakeholder subcommittees were established to specifically discuss restoration topics of biology, hydrology, and community outreach. This information was integrated into the December 9, 2022, Stakeholder meeting. Meeting discussions and stakeholder input have been incorporated into the Bushy Lake CRP.

Bushy Lake Stakeholder Meeting Participants

Meeting Facilitators

Christine Flowers (CSUS Adjunct Faculty, ENVS Department); Michelle Stevens (CSUS Professor, ENVS Department); Nathan Dietrich (CSUS Director of State and Federal Relations); Rita Gallardo Good (CSUS Director of Civic Affairs and Advocacy).

Internal Team

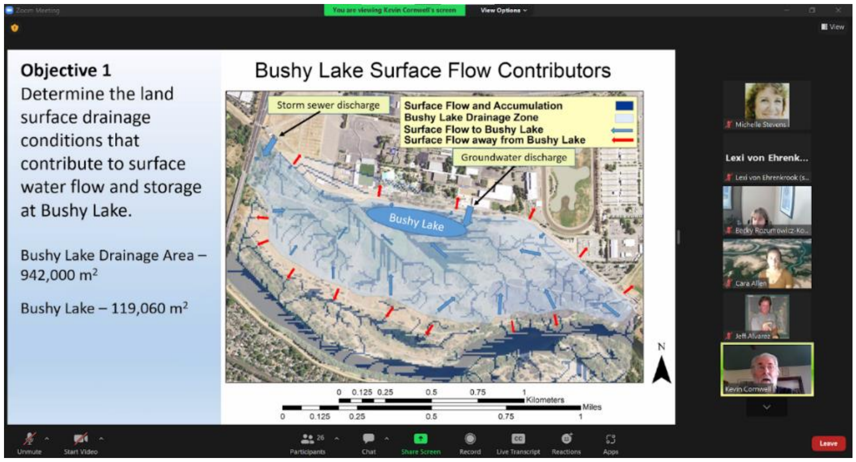
Michelle Stevens (CSUS Professor of Environmental Studies: Bushy Lake Co-PI); Becky Rozumowicz-Kodsuntie (Co-PI, Area West Environmental Inc., Biologist); Christine Flowers (CSUS, Environmental Studies Department, Public Outreach); Jeff Alvarez (The Wildlife Project, Northwestern Pond turtle expert); Kevin Cornwell (CSUS Hydrology Department Professor); Kody Wedell (CSUS Graduate Student of Kevin Cornwell); Carla Cruz Medina (CSUS Graduate Student of Tim Davidson); Alexandra von Ehrenkrook (CSUS Graduate Student); Jamie Kneitel (CSUS Biology Department Professor and Chair); Dan Williams (Sacramento Audubon Society, Consulting Biologist with HDR).

Stakeholder Committee

Cara Allen (Wildlife Conservation Board, Senior Environmental Scientist and Project Manager for Bushy Lake CRP); Jason Lee (City of Sacramento Fire Marshall); Kathleen Ave (Sr. Climate & Ecosystem Strategist, Customer & Grid Strategy, SMUD, and Co-Chair, Electric Power Research Institute (EPRI) Power in Pollinators Initiative); Liz Bellas (Director Sacramento County Regional Parks); KC Sorgen (Sacramento County Regional Parks Planner); Gregg Ellis (ICF Consulting, SAFCA and the Lower American River Natural Resource Management Plan); Stephen Green (Save the American River Association); Kelly Hopkins (Sacramento Valley Conservancy); Robert Horowitz (Representing cyclist groups using Bushy Lake); Eric Kleinfelter (CDFW Environmental Scientist); Mary Maret (Sacramento County Regional Parks, natural resource specialist for the American River Parkway); Andrew Huang (Caltrans project manager for American River bridge deck replacement); Brian Sanders (City of Sacramento Department of Utilities); Tim Washburn (SAFCA); Betsy Weiland (Save the American River Association (SARA); Annie Wilcox (Executive Assistant, Sacramento Zoo); Leo Winternitz (American River Parkway Foundation, representative on the Lower American River Natural Resource Management Plan); Jackie Zdanowski (Cal Expo); Mackenzie Wieser (Sacramento Splash, CEO); Nigel Moor (Sacramento Splash, President); Kent Anderson (Effie Yeaw Nature Center, Executive Director); Erica Bishop (Water Forum, Project Manager); Dan Meier (California Native Plant Society, Botanist); Dale Steele (Sutter's Landing Park; Friends of the Riverbank); Rita Gallardo Good (CSUS Office of Public Affairs and Advocacy); Kim Donner (US Army Corps of Engineers USACE); Si Gao (CSUS Assistant Professor of Environmental Studies); Julie Griffin (CSUS Assistant Professor of Environmental Studies); Leticia Morris (Sacramento Area Flood Control Agency, Project Manager); Melanie Tymes (US Army Corp of Engineers, Project Manager for the American River Common Features Project); Roland Brady (Brady and Associates Geological Services); Andrea Meier (U.S. Army Corps of Engineers Acting Environmental Resources Branch Chief); Clark Peri (Cal Trans District 3, Project Manager American River Parkway Bridge); Bert Skillen and Nicole Schleeter (US Army Corps of Engineers, Environmental Resources Branch); Nathan Dietrich (CSUS Public Affairs and Advocacy Associate Vice President); Art Starkovich (American River Parkway Fire Council); Kim Watts (US Army Corps of Engineers Environmental Manager); Michael Wright (Central Valley Flood Prevention Board).

Stakeholder Meetings

- October 10, 2020
- April 5, 2021
- November 5, 2021
- February 11, 2022
- October 7, 2022
- December 9, 2022
    - Subcommittee meeting for Hydrology
    - Subcommittee meeting for Biology and Education
- March 3, 2023



Virtual Stakeholder Meeting held on October 7, 2022. Hydrologist Kevin Cornwell reported to stakeholders on the progress and results of the first objective of hydrologic studies.

5.1.2 Stakeholder Collaborations

Bushy Lake collaborates with multiple stakeholders on the lower American River. The Sacramento County Department of Parks and Recreation has been an ongoing collaborator with the Bushy Lake project since 2015. Sacramento County Parks provide safety, support, and assistance to the Bushy Lake Project. Maintenance staff provide assistance by mowing to create turtle nesting habitat and reduce fire risk, installing turtle crossing signs to increase public awareness and safety, and speaking with unhoused individuals to maintain project safety.

During the turtle nesting seasons, Sacramento County Parks installs “Turtle Crossing” signs to warn the public that turtles traveling in upland habitats for nesting may be on the adjacent trails and roads. While conducting visual surveys, we discovered that from March 2020 to December 2021, 25.9% of all turtles showed pitting from bike strikes, of which 65.8% were female. Based on our data, we recognized that bicyclist strikes on nesting females were relatively common. Such collisions pose a danger to both bicyclists and turtles. The turtle crossing signs encourage cyclists and other passersby along the trails to slow down, be alert, and be conscious of possible crossing turtles. We are additionally collaborating with Sacramento County Parks to create and establish two permanent educational signs for the site. The signs will provide information on the Bushy Lake restoration project, eco-cultural restoration and traditional ecological knowledge, and the native northwestern pond turtles. Both signs are being funded and created in collaboration with CSU Sacramento’s Anchor University Program. Sacramento County Parks rangers help maintain a safe working environment by professionally talking to unhoused individuals camping in the restoration area, and specifically removing barbeques and other hazards that could potentially fire ignition points.

Sacramento County Parks administration, planners, and natural resource specialists are important stakeholders in the Bushy Lake project. We very much appreciate County Parks and their assistance with site management, collaboration through shared knowledge, and support of project activities and goals.

Turtle Crossing sign posted by Sacramento County Parks during the turtle nesting season of 2023 (Photos taken by Alexandra von Ehrenkrook)

Cal Expo has supported the Bushy Lake effort through participating in stakeholder meetings, collaborating on hydrologic analysis with their consultant Khaim Morton and our hydrologist Kevin Cornwell, and implementing safety patrols by Cal Expo Security.

The Sacramento Zoo supports the Bushy Lake project through donations, sharing turtle educational materials on their website, and by participating in Bushy Lake turtle conservation efforts. Sacramento Zoo staff additionally share their knowledge and experience in wildlife handling. Bushy Lake staff participate regularly in the monthly American River Parkway Coalition meetings. The Bushy Lake team provides updates on the project's ongoing research and conservation and restoration efforts, as well as providing input to other activities occurring throughout the Parkway.

We have additionally collaborated with the American River Parkway Bike Patrol: Hiking and Biking Program. The Bike Patrol has incorporated Bushy Lake turtle educational materials in their organization's newsletters. The materials provide information on turtle nesting activities and encourage members to be conscious cyclists for the safety of themselves, turtles, and other wildlife. They advise cyclists on how to proceed if a turtle is observed crossing their path, as well as how to identify native and non-native turtles. Community members are advised not to disturb turtles when there is no safety risk for cyclists or wildlife.

Bushy Lake staff collaborated with the Effie Yeaw Nature Center, donating a juvenile female Red-eared slider to the center for permanent captivity; the turtle will be incorporated into an exhibit to educate the community on the impacts of Red-eared sliders and other invasive species.

5.2 Community Engagement Participation

5.2.1 Participation along the Lower American River

Ongoing	Attended monthly American River Parkway Coalition meetings.
Ongoing	Participated in meetings with The Water Forum and Cordova Creek Stakeholders Group
Year-round **March 2022 – June 2023**	Held various public planting dates to plant native vegetation, weed invasive plants, install mulch, and water restoration sites with community members. **2022:** March 18, April 16, July 23, November 12 **2023:** January 21, February 4, February 18, March 11, April 8, June 10, June 24


Bushy Lake team members Michelle Stevens and Risa Fackler with Fackler's daughter on a public day removing invasive species to support native plants (Photos taken by Emily Turner)

March 2020 – July 2023	Held monthly turtle trapping and invited community members to volunteer, observe, and learn about Bushy Lake turtle populations. March 2020 – July 2023


Turtle mark-recapture with the Bushy Lake team and community members (Photos taken by Sacramento State/Andrea Price)

December 11, 2020	**Lower American River Conservancy Program Virtual American River Parkway Tour,** 1 to 3 p.m. This virtual tour of the American River Parkway explored the current conditions of the Parkway and highlighted current and potential natural and community investment sites.
March 25-26, 2021	**Provided input and attended public hearings for the Draft Lower American River Natural Resource Management Plan (NRMP).**
April 22, 2021	Michelle Stevens was awarded the ECOS Environmentalist of the Year Award for collaborative work at Bushy Lake.
June 2021	Provided input and attended public hearings on the Draft Lower American River Natural Resource Management Plan.

July 28, 2021	Met with Sacramento City Fire Department Chief Gary Loesch, Deputy Fire Chief Chris Costamagna, and Fire Marshall Jason Lee to discuss fire protection for Bushy Lake in the future
February 10, 2022	American River Parkway Foundation: "Sac Fire leads field visit and vehicle tour of fire hazards behind Cal Expo"
March 5, 2022	Meeting with Sacramento Zoo professionals at Bushy Lake.
April 15, 2022	American River Parkway Fire Safe Council meeting held by the American River Parkway Foundation. In attendance were the Sacramento City Fire Department, Red Hawk Casino Fire Crew Chief Dave Whitt, and the Sacramento County Department of Parks and Recreation. Nathan Dietrich and Alexandra von Ehrenkrook represented Sacramento State. Bushy Lake was evaluated for a fire lane on the east side of the lake.

Fire safety is a priority of Bushy Lake. Fires have occurred at Bushy Lake in 2014, 2016, and 2021. The fire pictured above occurred on June 6, 2021 (left), however native culturally significant species such as white root have naturally recruited post-fire (right)

November 10, 2022	Attend and participate in American River Parkway Foundation Fire Safe Council meetings.
November 15, 2022	Meeting with Deer Creek Resources, Sacramento County Regional Parks, Save the American River Association, California Native Plant Society, and Cal Expo regarding wildfire management – toured Bushy Lake and discussed fire management practices and promoted traditional fire management and safe fire practices.
March 14, 2023	Cal Expo (see Objective 1 Task 1.6 Hydrology) meeting with Khaim Morton, an environmental consultant working with Cal Expo regarding hydrology, energy efficiency and sustainability and Jaclyn Zdanowski, Cal Expo Chairperson. Bushy Lake Representatives included Kevin Cornwell, Michelle Stevens, Becky Rozumowicz-Kodsuntie, and Alexandra von Ehrenkrook. Discussion of groundwater inputs to Bushy Lake. Continued collaboration will occur on this topic.
April 23, 2023	Participated as a table at the ECOS Earth Day event with Sacramento Sierra Club.

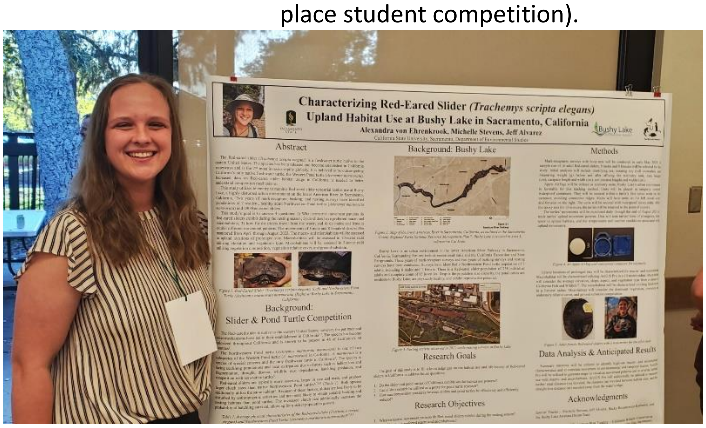
a. 
b. 
c. 
d. 
e. 

April 23, 2023- Bushy Lake hosted a table at the ECOS Sacramento Earth Day event and practiced public outreach and education, team members a. Alexis Wieser, b. Alexandra von Ehrenkrook, c. Maria Mauricio, d. Sarah Pratt (left), and Emily Turner (right). (Photos a-d. by Maria Mauricio. Photo e. taken by ECOS)

April 29, 2023	Sacramento Bee article about Bushy Lake and the restoration efforts by Sacramento State students. (https://www.sacbee.com/news/local/article274875736.html)
May 3, 2023	CSUS Anchor University Award, presented to *Bushy Lake Eco-Cultural Restoration Rising from the Ashes* in community partnership with Sacramento County Department of Parks and Recreation and other stakeholders on the lower American River (Appendix C)
June 15, 2023	Sac State Magazine cites Bushy Lake as #3 on a list of the top 75 impacts of the University and its students on the surrounding area. (https://www.csus.edu/news/magazine/stories/2023/6/75-years.html)
July 2023	Met with Sarah Norris (Wild Rye Consulting/Owner and ISA Certified Arborist) and KC Sorgen (Sacramento County Regional Parks/Planner) to discuss implementing consistent vegetation mapping along the lower American River Parkway

5.2.2 Presentations

March 16, 2021	M.L. Stevens, G. Michaelson, A. von Ehrenkrook. 2021. Eco-Cultural Restoration at Bushy Lake, CA. Geology, Environmental Studies, and US Geological Survey Colloquium
April 5, 2022	M.L. Stevens, K. Cornwell, J. Kneitel, T. Davidson, A. von Ehrenkrook, G. Michaelson, M. Sierra, K. Colima, K. Wedell, C. Medina. 2022. Bushy Lake: Rising from the Ashes using Traditional Ecological Knowledge and Western Science. Geology, Environmental Studies, and US Geological Survey Colloquium.
May 17, 2022	M.L. Stevens, and A. von Ehrenkrook. 2022. Eco-Cultural Restoration and Fire Resiliency: Linking Attributes of Western Ecological Knowledge and Traditional Ecological Knowledge. Joint Aquatic Sciences Meeting (JASM) 2022 Conference, Grand Rapids, Michigan (Virtual May).
June 25, 2022	Colima Aguirre, K., A. von Ehrenkrook, and M. Stevens. **Western Pond Turtle Conservation at Bushy Lake. NorCal Herpetological Society, Sacramento, CA.**
October 2022	M.L. Stevens, and A. von Ehrenkrook. 2022. California Native Plant Society. 9.3 Rising from the ashes: Culturally significant plants and fire resilience at Bushy Lake, Sacramento, CA. Land Back and Co-management with Traditional Ecological Knowledge. CNPS 2022 Conference. San Jose, CA
March 6, 2023	M.L. Stevens, and K. Colima. 2023. Rising from the ashes: Culturally significant plants and fire resilience at Bushy Lake, Sacramento, CA. American River Parkway Foundation presentation
March 9, 2023	M.L. Stevens, and K. Colima. 2023. Rising from the ashes: Culturally significant plants and fire resilience at Bushy Lake, Sacramento, CA. Sacramento Valley Conservancy presentation
March 30, 2023	A. von Ehrenkrook, M. Mauricio, A. Wieser, S. Pratt, E. Turner. 2023. California State University, Sacramento, Environmental Student Organization presentation.
April 14, 2023	Stevens, M. 2023. Traditional Ecological Knowledge and Western Ecological Knowledge in a Novel and Highly Disturbed Urban Corridor, Davis, California. SERCAL oral presentation. Davis, CA.
April 14, 2023	A. von Ehrenkrook. 2023. SERCAL poster session. *Characterizing red-eared slider (Trachemys scripta elegans) upland habitat use at Bushy Lake in Sacramento, CA* (second place student competition).



Graduate student Alexandra von Ehrenkrook presented a poster at the SERCAL Conference in Davis, CA

April 20, 2023	Sustainable Interdisciplinary Research to Inspire Undergraduate Success (SIRIUS) STEM Research Conference. 2023. CSUS Tschannen Science Complex – public announcement and flyers for April 29 Community Event *Bushy Lake Eco-Cultural Restoration Project* – Sarah Pratt, Risa Fackler, and Alexis Wieser *Conservation of the Northwestern Pond Turtle at Bushy Lake, Sacramento, California* – Alexandra von Ehrenkrook, Maria Mauricio

a.  b. 

The Bushy Lake team is pictured with two posters for the Sustainable Interdisciplinary Research to Inspire Undergraduate Success (SIRIUS) Conference. a. Alexandra von Ehrenkrook (left) and Maria Mauricio (right). b. left to right: Alexis Wieser, Sarah Pratt, Emily Turner, and Michelle Stevens

June 27-30, 2023	M.L. Stevens. 2023. Rising from the Ashes: Culturally Significant Plants and Fire Resiliency at Bushy Lake, Sacramento, CA. Society of Wetland Scientists 2023 Annual Meeting. Spokane, WA.

5.2.3 Bushy Lake Community Celebration: April 29, 2023

We obtained permission from Cal Expo, Caltrans, and the Department of Sacramento County Parks to hold the Bushy Lake event on state property and to use the Lot Z area. On April 29, 2023, we held our public event, the “Bushy Lake Eco-Cultural Community Celebration”. This event was held to highlight and thank both the donors of the Bushy Lake Restoration project and collaborating stakeholders. Project collaborators were invited to host tables for their organizations during the event, and various speakers were invited to present. During May and April, the event was advertised on the website *Sacramento 365* and around Sacramento State via online posts and flyers. Approximately 150 total students, vendors, speakers, and members of the public attended the event. In addition to our vendors and speakers, members of the Sacramento Sierra Club attended the celebration.

On the day of the event, the Bushy Lake team provided presentations, tours, and interactive tables to share the restoration goals and progress of the project, as well as educational materials with the public. Several materials, including a field guide and turtle posters, were created in preparation for the event. The Bushy Lake team hosted many speakers, who presented various topics including traditional fire management; Bushy Lake hydrology; and all the collaboration along the Lower American River that supports the project. In addition to ten speakers, eleven stakeholder organizations attended the event and shared their own educational materials with the public. These stakeholder organizations, listed shortly, included Effie Yeaw Nature Center, Save the American River Association and Sacramento Splash. Following the event, a Google form was sent out to attendees to collect feedback and comments regarding their experience of the day through the Bushy Lake email.

Eleven total stakeholder organizations attended the event and set up their booths/tables, including:

- Effie Yeaw Nature Center

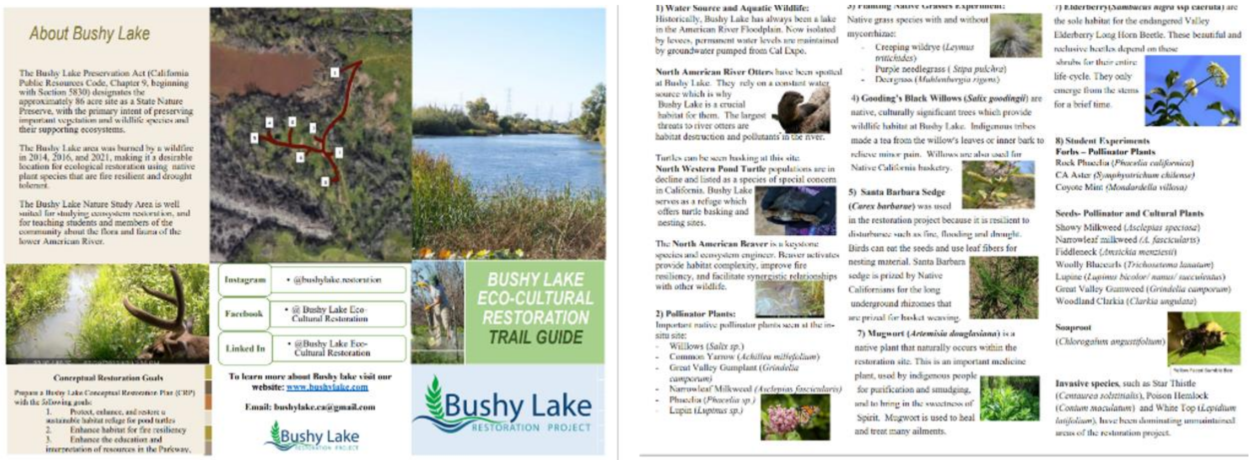
- Sacramento Splash
- Sacramento Valley Conservancy
- Save the American River Association
- Sacramento Audubon Society
- Cal Trans/Clean CA
- SIRIUS Project
- Heritage Growers/River Partners
- Environmental Student Organization (Sacramento State)
- Ensuring Native Indian Traditions (Sacramento State)
- Sacramento State Sustainability

The Bushy Lake team hosted several tables:

- Bushy Lake overview section with four posters features information on the overall restoration project, hydrology, wildlife, and turtles.
- Turtle and Aquatic Invertebrate table
- Children's activity table with wildlife coloring pages and beads for bracelet making.
- Volunteer and attendance check-in table
- Speaker's Tent with Chairs
- Food and drink table



Sacramento State students from ENVS 151 provided tours to the public on April 29th, the day of the event. Tours were held every 15 minutes and incorporated various stops along the restoration sites, including an overlook of Bushy Lake with a scope where visitors could search for turtles, birds, and other wildlife. (Photos taken by Tonallo Colon and Dereck Goodwin)



About Bushy Lake

The Bushy Lake Preservation Act (California Public Resources Code, Chapter 9, beginning with Section 5830) designates the approximately 86 acre site as a State Nature Preserve, with the primary intent of preserving important vegetation and wildlife species and their supporting ecosystems.

The Bushy Lake area was burned by a wildfire in 2014, 2016, and 2021, making it a desirable location for ecological restoration using native plant species that are fire resilient and drought tolerant.

The Bushy Lake Nature Study Area is well suited for studying ecosystem restoration, and for teaching students and members of the community about the flora and fauna of the lower American River.

Conceptual Restoration Goals

Prepare a Bushy Lake Conceptual Restoration Plan (CRP) with the following goals:

1. Protect, enhance, and restore a sustainable habitat refuge for pond turtles
2. Enhance habitat for fire resiliency
3. Enhance the education and interpretation of resources in the Parkway.

Instagram	• @bushylake.restoration
Facebook	• @ Bushy Lake Eco-Cultural Restoration
Linked In	• @Bushy Lake Eco-Cultural Restoration

To learn more about Bushy lake visit our website: www.bushylake.com

Email: bushylake.ca@gmail.com

Bushy Lake Restoration Project

BUSHY LAKE ECO-CULTURAL RESTORATION TRAIL GUIDE

Bushy Lake Restoration Project

1) Water Source and Aquatic Wildlife: Historically, Bushy Lake has always been a lake in the American River Floodplain. Now isolated by levees, permanent water levels are maintained by groundwater pumped from Cal Expo.

North American River Otters have been spotted at Bushy Lake. They rely on a constant water source which is why Bushy Lake is a crucial habitat for them. The largest threats to river otters are habitat destruction and pollutants in the river.

Turtles can be seen basking at this site. **North Western Pond Turtle** populations are in decline and listed as a species of special concern in California. Bushy Lake serves as a refuge which offers turtle basking and nesting sites.

The **North American Beaver** is a keystone species and ecosystem engineer. Beaver activates provide habitat complexity, improve fire resiliency, and facilitate synergistic relationships with other wildlife.

2) Pollinator Plants: Important native pollinator plants seen at the in-situ site:

- Willlows (*Salix sp.*)
- Common Yarrow (*Achillea millefolium*)
- Great Valley Gumplant (*Grindelia camporum*)
- Narrowleaf Milkweed (*Asclepias fascicularis*)
- Phacelia (*Phacelia sp.*)
- Lupin (*Lupinus sp.*)

3) Planting Native Grasses Experiment: Native grass species with and without mycorrhizae:

- Creeping wildrye (*Leymus triticoides*)
- Purple needlegrass (*Stipa pulchra*)
- Deergrass (*Muhlenbergia rigens*)

4) Gooding's Black Willows (*Salix gooddingii*) are native, culturally significant trees which provide wildlife habitat at Bushy Lake. Indigenous tribes made a tea from the willow's leaves or inner bark to relieve minor pain. Willows are also used for Native California basketry.

5) Santa Barbara Sedge (*Carex barbarae*) was used in the restoration project because it is resilient to disturbance such as fire, flooding and drought. Birds can eat the seeds and use leaf fibers for nesting material. Santa Barbara sedge is prized by Native Californians for the long underground rhizomes that are prized for basket weaving.

7) Mugwort (*Artemisia douglasiana*) is a native plant that naturally occurs within the restoration site. This is an important medicine plant, used by indigenous people for purification and smudging, and to bring in the sweetness of Spirit. Mugwort is used to heal and treat many ailments.

7) Elderberry (*Sambucus nigra ssp caerulea*) are the sole habitat for the endangered Valley Elderberry Long Horn Beetle. These beautiful and reclusive beetles depend on these shrubs for their entire life-cycle. They only emerge from the stems for a brief time.

8) Student Experiments
Forbs – Pollinator Plants
Rock Phacelia (*Phacelia californica*)
CA Aster (*Symphyotrichum chilense*)
Coyote Mint (*Monardella villosa*)

Seeds- Pollinator and Cultural Plants
Showy Milkweed (*Asclepias speciosa*)
Narrowleaf milkweed (*A. fascicularis*)
Fiddleneck (*Amsickia menziesii*)
Woolly Bluecurls (*Trichostema lanatum*)
Lupine (*Lupinus bicolor/ nanus/ succulentus*)
Great Valley Gumweed (*Grindelia camporum*)
Woodland Clarkia (*Clarkia unguiculata*)

Soaproot (*Chlorogalum angustifolium*)

Invasive species, such as Star Thistle (*Centaurea solstitialis*), Poison Hemlock (*Conium maculatum*) and White Top (*Lepidium latifolium*), have been dominating unmaintained areas of the restoration project.

A trail guide, pictured above, was created by the Bushy Lake team to share with members of the public as they toured Bushy Lake and our restoration sites.

April 29, 2023- We held our public event in Cal Expo Lot Z, in which over 150 members of the public attended and participated. (Photo taken by Victoria von Ehrenkrook)

Bushy Lake team member Kat Colima shows a non-native turtle to members of the public at the Bushy Lake turtle and aquatic invertebrate table. (Photo taken by Victoria von Ehrenkrook)

Effie Yeaw Nature Center and Sacramento Splash are pictured at their booths with members of the public at the Bushy Lake Eco-Cultural Community Celebration. (Photos taken by Victoria von Ehrenkrook)

Many speakers attended the event and presented on various topics:

Dr. Michelle Stevens: CSUS, Professor of Environmental Studies, Bushy Lake Co-PI (Photo taken by Tonallo Colon)

Diana Almendariz Blessing: Wintu/Nisenan culture bearer, Keepers of the Flame cultural burning (Photo taken by Tonallo Colon)

Dean Dianne Hyson: CSUS, Dean of the College of Social Science and Interdisciplinary Studies (Photo taken by Tonallo Colon)

Cara Allen: California Wildlife Conservation Board, Senior Environmental Scientist; Bushy Lake CRP Project Manager (Photo taken by Victoria von Ehrenkrook)

Kevin Cornwell: CSUS, Emeritus Professor, Bushy Lake Hydrology (Photo taken by Tonallo Colon)

Alexandra von Ehrenkrook: CSUS, Graduate Student, Northwestern Pond Turtle Conservation (Photo taken by Tonallo Colon)

Daniel Williams: HDR Wildlife Biologist, Bushy Lake Avian Diversity (Photo taken by Tonallo Colon)

Beth Rose Middleton (left) Diana Almendariz and Diana Almendariz (right): UC Davis Native American Studies Program, Keepers of the Flame cultural burning (Photo taken by Victoria von Ehrenkrook)

Following the Bushy Lake public event, we sent out a Google form survey asking attendees for feedback on the event. We received 18 responses providing feedback to assess the success of the celebration. Out of these responses, 38.9% of surveyors had never previously heard of Bushy Lake before our public event. Many surveyors cited the event as exciting, educational, and interesting. A majority of responders (58.8%) cited the docent-led tours and organizational education booths as their favorite parts of the event. Attendees felt the event was an overall success, and many learned something new, including information about northwestern pond turtles and Bushy Lake's conservation efforts. For possible improvements to the event, attendees recommended having more shade, food vendors, and possibly shorter times for speakers. Public feedback and recommendations will be considered for potential future planning.

5.2.4 Website and Social Media

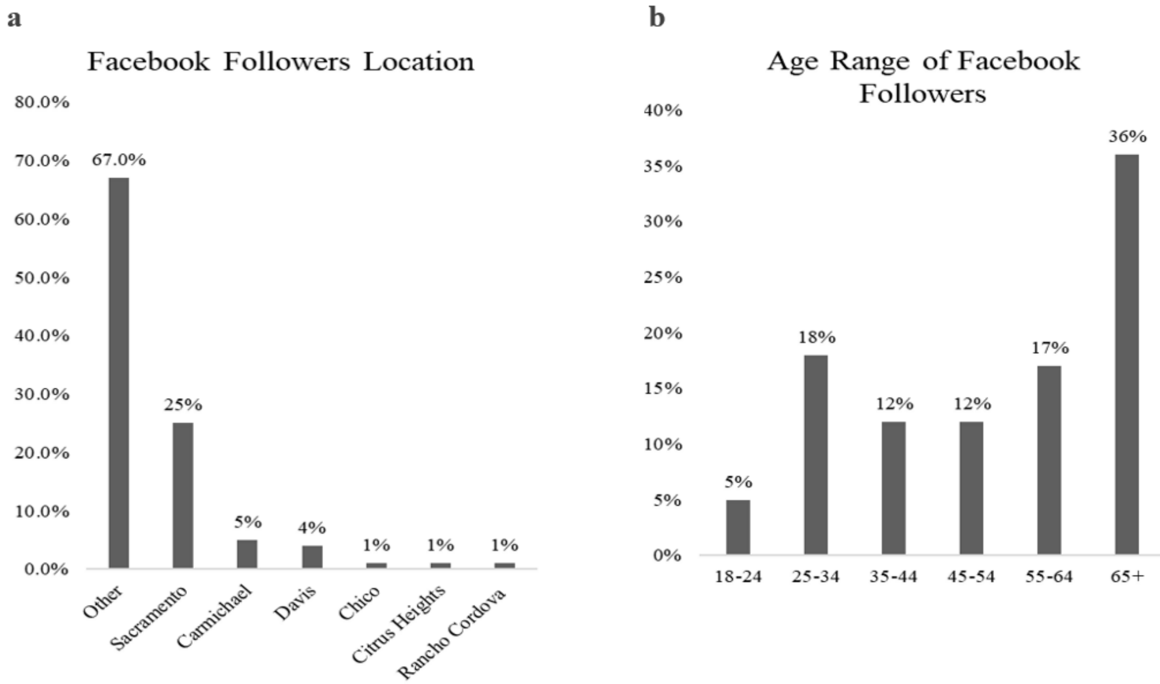
Social media is an excellent cost-efficient marketing tool to help the project build relationships with potential stakeholders, connect with specific community groups, and engage in public education. We are currently utilizing Facebook and LinkedIn (Bushy Lake Eco-Cultural Restoration Project), Instagram (BushyLake.Restoration), a project website (BushyLake.com), and a project email (BushyLake.CA@gmail.com) for public education and stakeholder outreach. The California Wildlife Conservation Board was acknowledged and thanked for their contributions to the Bushy Lake Restoration Project in social media, presentations, and publications.

Our project website (BushyLake.com) was established in 2021. The website supplies information about the project, including the project goals, background information, official reports, and field guides. The site makes the information more accessible to the public. The website also links to a project email, allowing the public to ask us questions or provide feedback. The site additionally supplies links to our social networking pages. All upcoming events are listed and advertised on the website, including our April 29th Eco-cultural Community Celebration. Our Bushy Lake email was utilized to advertise public planting dates, invite the public to the big event, and ask for feedback regarding the event afterward. The CRP will be posted on the Bushy Lake website in the future and will additionally be provided to stakeholders for review through our email.

The social networking services of Facebook (Bushy Lake Eco-Cultural Restoration Project), Instagram (BushyLake.Restoration), and LinkedIn are used for public engagement. Posts consist of educational materials, updates for ongoing and future projects, upcoming public volunteer opportunities, and promotions for future events.

<u>Facebook</u>

The Bushy Lake Facebook profile was created on January 21, 2022. Over the last 90 days, the page has reached 2,249 accounts and had 194 profile interactions. Our top content posts have reached 122-153 profiles, or about 88 profiles daily. We take into consideration the engagement location and age range of our Facebook page followers to increase community participation at the Bushy Lake site. Most Facebook followers are outside the Sacramento Area (67%), versus l37% local to the Sacramento Area (Figure 63a). The largest age groups are individuals over 65 (36%) and 55-64 (17%) (Figure 63b). Our Facebook follower count continues to grow, with the goals of expanding our following locally in the Sacramento Area and increasing the participation age range of 18–24-year-olds.



Figure

Figure 63. Location and Age range of our Facebook page followers (a) Location of Facebook followers, not local to the Sacramento Area (Other 67%) versus local to the Sacramento Area (37%: Sacramento 25%, Carmichael 5%, Davis 4%, Chico 1% Citrus Heights 1%, Rancho Cordova 1%) (b) Age range of Facebook followers (18-24 5%, 25-34 18%, 35-44 12%, 45-54 12%, 55-64 17%, 65+ 26%).

Instagram

Since March 1, 2022, our Instagram account shared 38 posts (images or flyer updates), 27 reels (30 seconds-3 min video updates), 168 stories (1-minute video updates), and has been tagged in 19 posts (mentioned in a post uploaded by a stakeholder or community member). In total, our account has been posted or tagged in 252 Bushy Lake updates, approximately 21 updates a month. Our reels have ranged from 98 to 6,974 views. Our posts have ranged from 72 to 201 views. Our stories have ranged from 17 to 77 views. We take into consideration the engagement location, and age range of our Instagram page followers to increase community participation at the Bushy Lake site. A majority of Instagram followers are local to the Sacramento Area (52.7%) versus the followers not local to the Sacramento Area (47.3%) (Figure 64a). The largest age groups are individuals 25-34 (34.5%), 35-44 (22.7%), and 18-24 (21.7%) (Figure 64b). Our Instagram follower count continues to grow, with the goal of expanding our following locally in the Sacramento Area and increasing the participation age range of followers over the age of 45.

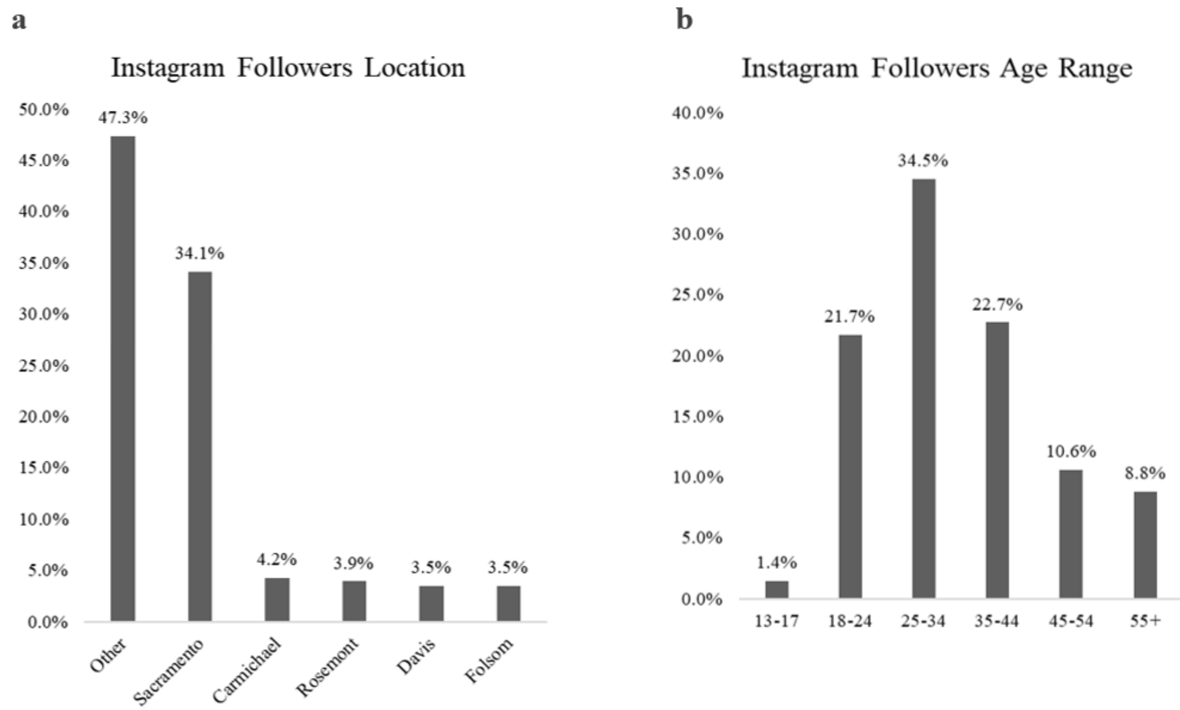


Figure 64. Location and Age range of our Instagram followers (a) Location of Instagram followers, not local to the Sacramento Area (Other 47.3%) versus local to the Sacramento Area (52.7%: Sacramento 34.1%, Carmichael 4.2%, Rosemont 3.9%, Davis 3.5%, Folsom 3.5%) (b) Age range of Instagram followers (13-17 1.4%, 18-24 21.7%, 25-34 34.5%, 35-44 22.7%, 45-54 10.6%, 55+ 8.8%)

LinkedIn

Our LinkedIn account was created in April 2023 to promote our Bushy Lake Eco-Cultural Community Celebration event that took place on April 29th, 2023. The goal of the LinkedIn account is to tap into a network of professionals, companies, and groups within and beyond the environmental field. We can update our professional circle with the content posted on LinkedIn. We have currently had 11 posts thus far, 80 followers, and 71 connections, and we plan to expand our page.

6. Conceptual Restoration Plan (In Progress)

7. Long-Term Management Plan (In Progress)

8. References

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