

APPENDIX A

BIOLOGICAL ASSESSMENT AND  
ENVIRONMENTAL BASELINE  
MEMO

APRIL 12, 2013



## ENVIRONMENTAL COLLABORATIVE

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### MEMORANDUM

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DATE: 12 April 2013

FROM: Jim Martin  
ENVIRONMENTAL COLLABORATIVE

SUBJECT: Biological Assessment and Environmental Baseline for  
The Urban Waterfront Enhancement and Master Plan, City of Benicia

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As requested, this memo serves as the Biological Assessment and Environmental Baseline Report (BAEB) for the Urban Waterfront Enhancement and Master Plan site in Benicia, California. The BAEB provides a description of biological and wetland resources known or suspected from the site, a summary of relevant State and federal regulations related to the protection of biological and wetland resources, and factors to consider in evaluating options for future uses and enhancement of the site. The site is owned by the City of Benicia and is located along the north shoreline of Carquinez Strait at the south end of 1<sup>st</sup> Street, with commercial development to the northwest along 1<sup>st</sup> Street, residential development directly to the north along the north side of B Street, and the Benicia Marina to the northeast.

This BAEB was prepared based on a review of available background information and a field reconnaissance of the site. Prior to conducting the field survey, available literature and mapping of biological and wetland resources were reviewed. This included review of records maintained by the California Natural Diversity Data Base (CNDDDB) of the California Department of Fish and Wildlife (CDFW) on special-status species and sensitive natural communities in the Benicia vicinity, mapping prepared by the U.S. Fish and Wildlife Service as part of the National Wetland Inventory, and other available background information.

A field reconnaissance of the site was conducted on 1 March 2013 to determine vegetation and wildlife habitats, provide a preliminary assessment of the extent of potential jurisdictional waters, and conduct a habitat assessment for special-status species. A preliminary wetland assessment was conducted as part of the field reconnaissance, evaluating indicators of vegetation, hydrology and soils to determine an estimated boundary between potential jurisdictional waters and uplands. Given the timing of the field work in the early spring, it was difficult to accurately identify some plant species and determine their wetland indicator status. But the preliminary wetland assessment does provide an initial indication of the possible extent of jurisdictional waters on the site. A thorough wetland delineation would still be necessary to provide additional information on potential wetlands, which would then have to be confirmed by

the U.S. Army Corps of Engineers (Corps) to officially determine the extent of jurisdictional waters on the site. No protocol surveys for special-status species were performed as part of the field reconnaissance, although habitat conditions were evaluated to determine the likelihood of occurrence on the site.

## SITE BIOLOGICAL AND WETLAND RESOURCES

The following provides a description of the vegetation and wildlife resources on the site, potential for occurrence of special-status species and sensitive natural communities, and presence of jurisdictional waters.

### 1. Vegetation

The location of the site along the shoreline of Carquinez Strait and edge of the developed downtown area of Benicia are major influences on the existing vegetation and wildlife resources. Natural coastal salt marsh, brackish water marshlands, and open water habitat of the Strait occupy the southern, lower elevations of the site. As part of past development in the area over the past 150 years, fills were placed to improve human access and reduce the potential for flooding in parts of the northern portion of the site, reducing the original extent of marshland habitat. Upland areas are now covered with impervious and gravel surfaces, or support irrigated turf and areas of ruderal (weedy) grassland.

The developed uplands on the site support a limited number of primarily non-native species. These consist of several species of palms, irrigated turf, and other ornamental plantings. Individual Canary Island date palms (*Phoenix canariensis*) are scattered through the margins and upper terraces of the marshlands, and are displacing native cover due to shading from the dense thicket of fronds. Invasive species such as sweet fennel (*Foeniculum vulgare*), yellow-star thistle (*Centaurea solstitialis*), and wild radish (*Raphanus sativus*) occur at the margins of developed areas where routine mowing and maintenance are not performed.

Ruderal grasslands continue to dominate the southeastern upland area of the site, and along the margins of upland areas. These areas are dominated by non-native species common in the Benicia area, such as slender wild oat (*Avena barbata*), ripgut grass (*Bromus diandrus*), lotus (*Lotus scoparius*), common vetch (*Vicia sativa*), and English plantain (*Plantago lanceolata*). Where surface water appears to pond for prolonged periods, seasonal wetland indicator species are present in areas that have been filled in the past. Depending on the depth and duration of inundation, some of the depressional areas are devoid of vegetation, with the margins supporting seasonal wetland indicator species such as brass buttons (*Cortula coronopifolia*), brome fescue (*Vulpia bromoides*), perennial ryegrass (*Lolium multiflorum*), Bermuda grass (*Cynodon dactylon*), salt grass (*Distichlis spicata*), and hyssop loosestrife (*Lythrum hyssopifolia*).

Coastal salt marsh and brackish water marsh occurs along the lower elevations of the site, generally below about 7.4 NAVD.<sup>1</sup> Tidal marsh habitats are similar in vertical structure, starting at the low elevation mud flat to the upland vegetation. The lowest elevation vegetation zone support open stands of cordgrass (*Spartina* spp.), with pickleweed (*Salicornia virginica*) co-dominated in places by saltgrass in the mid-marsh zone. Pickleweed and saltgrass are still dominant components in some areas in the upper marsh zone, together with patches of alkali heath (*Frankenia salina*), gumplant (*Grindelia stricta* ssp. *angustifolia*). Dense stands of bullrush (*Scirpus maritimus*) and cattail (*Typha latifolia*) occur along the upper end of the

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<sup>1</sup> NAVD refers to North American Vertical Datum of 1988.

brackish-water marsh along the drainage that discharges onto the site from the culver under East 2<sup>nd</sup> Street. The upper margins of the marshlands transition into areas of ruderal grassland cover, dominated by non-native grasses and ruderal herbaceous species such as mustard (*Brassica* sp.), iceplant (*Mesembryanthemum* sp.), ripgut grass, English plantain, and sweet fennel.

Highly invasive perennial pepperweed (*Lepidium latifolium*) has spread throughout the isolated stand of coastal salt marsh habitat north of the historic A Street stub, north of the railroad station building and east of 1<sup>st</sup> Street, and is spreading through the other areas of coastal salt marsh on the site. This non-native species forms a dense cover over native marsh species and disrupts foraging and other activities of wildlife.

Several stands of common reed (*Phragmites australis*) occur along the upper marsh zone as well. It is uncertain whether this species is native or an introduced hybrid, but it appears to be spreading through the marsh zone, forming dense thickets that shade out all other plant species. Genetic testing is typically required to accurately distinguish whether it is the native species, or an introduced hybrid with more aggressive tendencies for spreading.

## **2. Wildlife**

The site supports a wide diversity of wildlife, given the interface of upland and aquatic habitat along the shoreline of Carquinez Strait. Upland areas of turf and landscaping have only limited habitat value, but the irrigated turf areas are frequently grazed by Canada goose and provide occasional foraging opportunities for birds found in urban habitat such as American robin, scrub jay, house finch and northern mockingbird. Ruderal grasslands in the eastern portion of the site and margins of the marshlands continue to provide important cover for grassland-dependent species such as California vole, pocket gopher, gopher snake, sparrows, finches, and other passerine birds. Several species of raptors utilize the grasslands and marshlands for foraging, but suitable nesting habitat is absent given the lack of nesting trees and intensity of human activity in upland areas.

The shoreline and open water of Carquinez Strait provides foraging opportunities for a large number of bird species, and aquatic habitat for fish, mollusks, and invertebrates. The mudflats support a diverse assemblage of benthic macro-invertebrates which in turn attracts large numbers of migrating and wintering shorebirds such as willet, long-billed curlew, marbled godwit, dowitchers, and sandpipers. Shorebirds and wading birds most likely use the stands of marsh, shallow mudflats, and exposed shoreline for foraging. These species forage on mudflats as they are exposed by receding tides, often concentrating at the water's edge where worms, crustaceans, and bivalves are closer to the mud's surface. Wading birds such as snowy egret, great egret, and great blue heron forage along the margins of tidal channels and marsh edges. Dabbling (i.e., surface-feeding) ducks, such as mallard, forage over inundated mudflats and tidal channels. When inundated by high tides, tidal channels and mudflats provide important foraging habitat for a variety of estuarine species, including bat ray, leopard shark, and various fish species.

## **3. Special-Status Species**

Special-status species receive varying degrees of legal protection under both the federal and California Endangered Species Acts, and the California Environmental Quality Act. The U.S. Fish and Wildlife Service (USFWS), the National Marine Fisheries Service (NOAA Fisheries), and the CDFW share responsibility for protection and management of natural resources (see detailed descriptions below under Regulatory Context). Special-status species with legal protection often represent a major constraint to development, particularly when these species

are wide ranging or highly sensitive to human disturbance. If a listed species may be affected by proposed development, the lead agency must initiate a consultation with the USFWS, NOAA Fisheries, and/or CDFW, as required by state or federal law. Without adequate mitigation, habitat modification could result in a "take" of a listed species.

Information on the occurrence of special-status species known or suspected to occur in the site vicinity was collected from several sources. These included: the CNDDDB records, the California Wildlife Habitat Relationships species notes of the CDFW (1988 and 1990), the California Native Plant Society's (CNPS) Inventory of Rare and Endangered Plants of California (2013), and miscellaneous information available through the USFWS, CDFW, and technical publications.

Based on recorded geographic range and preferred habitat, a number of special-status species have been reported from or are suspected to occur along the Carquinez Strait and Benicia vicinity. **Figure 1** shows the distribution of special-status plant and animal species monitored by the CNDDDB within approximately five miles of the site. As indicated in **Figure 1**, an occurrence of Suisun song sparrow (*Melospiza melodia maxillaris*) has been reported from marshland habitat along the shoreline of the Strait encompassing the site eastward to the Benicia Bridge. And specific occurrences of Mason's liliaeopsis which was observed on pilings along the shoreline and Delta tule pea (*Laythrus jepsonii* var. *jepsonii*) which was observed in marshland habitat east of the Benicia Marina have been reported from within half a mile of the site. General occurrences of Bolander's water-hemlock (*Cicuta maculata* var. *bolanderi*) and big tarplant (*Blepharizonia plumosa*) have been reported by the CNDDDB as historic records that extend over most of the Benicia vicinity, as does an historic record of Carquinez goldenbush (*Isocoma arguta*). The following provides a summary of special-status plant and animal species suspected to possibly occur on the site.

**Special-Status Plants.** **Table 1** provides information on the status and typical habitat characteristics of those special-status plant species considered to have the greatest likelihood for occurrence in the site vicinity, together with their likelihood of occurrence on the site. A number of these have been reported from grassland, freshwater marshes, and woodland habitat, such as big tarplant, fragrant fritillary (*Fritillaria liliacea*), Congdon's tarplant (*Hemizonia parryi* ssp. *congdonii*), and Chaparral ragwort (*Senecio aphanactis*). Suitable habitat for these species is absent in the site vicinity due to the extent of past development in upland areas, and these species are not suspected to occur on the site. However, the remaining natural marshlands could support a number of marsh-dependent special-status plant species, and the scattered piers on the site could support one or more occurrences of Mason's liliaeopsis. Marshland-dependent special-status plant species that could occur on the site include: Bolander's water hemlock, soft bird's-beak, Delta tule pea, and Marin knotweed (*Polygonum marinense*), among others. Systematic surveys would have to be conducted during the appropriate time of the year to confirm the presence or absence of any populations of special-status plant species from the site, and there is a possibility that new occurrences could become established in the future through seed dispersal along the Strait.

**Special-Status Animals.** As indicated in **Figure 1**, Suisun song sparrow is the only special-status animal species to actually have been reported from the site by the CNDDDB, but saltmarsh common yellowthroat were heard vocalizing in dense marsh vegetation during the field reconnaissance in March 2013. Occurrences of coastal salt marsh-dependent species, such as California black rail (*Laterallus jamaicensis coturniculus*), California clapper rail (*Rallus longirostris obsoletus*), Salt marsh harvest mouse (*Reithrodontomys raviventris*), Suisun shrew

(*Sorex ornatus sinuosus*), and Suisun song sparrow have been reported from Southampton Bay about two miles to the west of the site, and from Suisun Marsh about three miles to the east of the site. It is highly likely that these and other special-status bird species occasionally forage along the shoreline of the Strait between larger areas of high quality habitat, and may frequent or occasionally forage in the marshland habitat on the site. Although the stands of pickleweed on the site are most likely not large enough to sustain occurrences of special-status mammals known from coastal salt marsh, particularly given the absence of essential upland refugia during flood events, there remains a possibility that salt marsh harvest mouse and/or Suisun shrew could occasionally disperse along the shoreline of the Strait during flood events and could seek refuge in the marshland habitat on the site.

**Table 2** provides information on the status and typical habitat characteristics of those special-status animal species considered to have the greatest likelihood for occurrence in the site vicinity, together with their likelihood of occurrence on the site. Most of these species are associated with open water and tidal marshland habitat or utilize open grasslands as foraging habitat. Delta smelt (*Hypomesus transpacificus*), longfin smelt (*Spirinichus thaleichthys*), Sacramento splittail (*Pogonichthys macrolepidotus*), and winter-run chinook salmon (*Oncorhynchus tshawytscha*) all occur in the open water habitat of Carquinez Strait and Suisun Bay to the east. Salt marsh harvest mouse, Suisun shrew, California black rail, California clapper rail, and Suisun song sparrow have all been sighted in the marshland habitat of Southampton Bay to the west and Suisun Marsh to the east, and as noted above may occasionally forage or disperse across the marshland habitat on the shoreline of the site.

Other species of concern are generally associated with grassland and woodland habitats, and most of these have been reported from the extensive undeveloped open space in the Sky Valley area several miles to the northeast. These include: callippe silverspot butterfly (*Speyeria callippe callippe*), Cooper's hawk (*Accipiter cooperi*), golden eagle (*Aquila chrysaetos*), burrowing owl (*Athene cunicularia*), northern harrier (*Circus cyaneus*), white-tailed kite (*Elanus leucurus*), prairie falcon (*Falco mexicanus*), Peregrine falcon (*Falco peregrinus anatum*), loggerhead shrike (*Lanius ludovicianus*), California tiger salamander (*Ambystoma tigrinum californiense*), western pond turtle (*Emys marmorata*), California red-legged frog (*Rana draytonii*), and foothill yellow-legged frog (*Rana boylei*). Suitable habitat for most of these species is absent from the site, although special-status bird species may occasionally forage in the remaining natural areas on the site, such as loggerhead shrike, white-tailed kite, prairie falcon, and peregrine falcon. Northern harrier is a frequent visitor to the site, foraging in the open marshlands. But suitable nesting habitat is absent for this ground nesting species because of the on-going disturbance by humans and dogs in the upper marsh zone. A number of special-status bat species are known from Solano County, including big free-tailed bat (*Nyctinomops macrotis*), but suitable roosting habitat is absent from the site, with the possible exception of the attic area in the restored train station on the site. Further assessment of the interior of the structure, especially the attic, may be appropriate to ensure absence of bats before any further modifications.

#### **4. Sensitive Natural Communities**

In addition to species-oriented management, protecting habitat on an ecosystem-level is increasingly recognized as vital to the protection of natural diversity in the state. The CNDDDB also monitors the locations of natural communities that are considered rare or threatened, known as sensitive natural communities. The CNDDDB has compiled a list of sensitive natural communities that are given a high inventory priority for mapping and protection (CDFG, 2010). Although these natural communities have no legal protective status under the State or federal Endangered Species Acts, they are provided some level of protection under the CEQA

Guidelines. A project would normally be considered to have a significant effect on the environment if it would substantially affect a sensitive natural community such as a riparian woodland, native grassland, or coastal salt marsh. Further loss of a sensitive natural community could also be interpreted as substantially diminishing habitat, depending on the relative abundance, quality and degree of past disturbance, and the anticipated impacts.

The coastal salt marsh and brackish water marsh on the site are considered sensitive natural community types. Areas of potential seasonal wetlands and upland areas of turf and ruderal grasslands are dominated by non-native species and are not considered a sensitive natural community type. However, the areas of potential seasonal wetland may qualify as jurisdictional waters and if determined to be regulated features, would be regulated and any modifications subject to agency authorization as discussed below.

## 5. Jurisdictional Waters

Although definitions vary to some degree, wetlands are generally considered to be areas that are periodically or permanently inundated by surface or ground water, and support vegetation adapted to life in saturated soil. Wetlands are recognized as important features on a regional and national level due to their high inherent value to fish and wildlife, use as storage areas for storm and flood waters, and water recharge, filtration, and purification functions. Technical standards for delineating wetlands have been developed by the Corps and the USFWS, which generally define wetlands through consideration of three criteria: hydrology, soils, and vegetation.

The CDFW, Corps, and Regional Water Quality Control Board (RWQCB) have jurisdiction over modifications to shorelines, open water, stream channels, river banks, and other waterbodies (see detailed descriptions below under Regulatory Context). Jurisdiction of the Corps is established through the provisions of Section 404 of the Clean Water Act, which prohibits the discharge of dredged or fill material into "waters" of the United States without a permit, including wetlands and unvegetated "other waters". All three of the identified technical criteria must be met for an area to be identified as a wetland under Corps jurisdiction, unless the area has been modified by human activity. The Corps is also responsible for administration of Section 10 of the Rivers and Harbor Act, which serves to regulate access over navigable waters. Jurisdictional authority of the CDFW over wetland areas is established under Section 1601-1606 of the Fish and Wildlife Code, which pertains to activities that would disrupt the natural flow or alter the channel, bed, or bank of any lake, river, or stream. The Fish and Wildlife Code stipulates that it is unlawful to substantially divert or obstruct the natural flow or substantially change the bed, channel or bank of any river, stream or lake without notifying the Department, incorporating necessary mitigation, and obtaining a Streambed Alteration agreement.

Based on the results of the preliminary wetland assessment, jurisdictional waters on the site consist of areas of coastal salt marsh and possible areas of seasonal wetlands and scalds.<sup>2</sup> **Figure 2** shows the extent of assumed potential jurisdictional waters on the site. Areas of coastal salt marsh have strong wetland indicators and would be regulated waters. Wetland indicators associated with the potential seasonal wetland were less conspicuous, and in some locations these features could be considered hydrologically isolated or the vegetation criteria may not meet the Dominance Test or prevalence index for wetlands under the Wetland Delineation Manual for the Arid West Region used by the Corps, and therefore not qualify as

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<sup>2</sup> Scalds are areas that pond mineralized water for long enough periods that very little vegetation can become established and crusts form once the water dries out during the late spring and summer months, in this case salts from the brackish waters of Carquinez Strait.

jurisdictional under Section 404 of the Clean Water Act. Field indicators were difficult to determine during the field reconnaissance due to the timing of the site visit in early spring when many of the dominant grasses could not be identified to species in the potential seasonal wetland areas. However, the features mapped in **Figure 2** do contain one or more characteristics of seasonal wetlands and should be considered as such as part of site planning exercises until a formal wetland delineation is prepared and verified by the Corps.

**Figure 2** also shows the Mean High Water elevation, which is typically used by the Corps in determining the limits of their jurisdiction under Section 10 of the Rivers and Harbors Act. On the site, the Mean High Water Elevation generally occurs at the edge of the marshlands and remaining shoreline areas.

## REGULATORY CONTEXT

The following provides a summary of federal and state regulatory jurisdiction over biological and wetland resources that could influence future planning and feasibility of future modifications to the site where sensitive resources could be affected.

### 1. Endangered Species Act

The USFWS has jurisdiction over federally listed threatened and endangered plant and animal species. The federal Endangered Species Act (ESA) and its implementing regulations prohibit the take of any fish or wildlife species that is federally listed as threatened or endangered without prior approval pursuant to either Section 7 or Section 10 of the ESA. ESA defines “take” as “*harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.*” Federal regulation 50CFR17.3 defines the term “harass” as an intentional or negligent act that creates the likelihood of injuring wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns such as breeding, feeding, or sheltering (50CFR17.3). Furthermore, federal regulation 50CFR17.3 defines “harm” as an act that either kills or injures a listed species. By definition, “harm” includes habitat modification or degradation that actually kills or injures a listed species by significantly impairing essential behavior patterns such as breeding, spawning, rearing, migrating, feeding, or sheltering (50CFR17.12).

Section 10(a) of the ESA establishes a process for obtaining an incidental take permit that authorizes nonfederal entities to incidentally take federally listed wildlife or fish. Incidental take is defined by ESA as take that is “*incidental to, and not the purpose of, the carrying out of another wise lawful activity.*” Preparation of a habitat conservation plan, generally referred to as an HCP, is required for all Section 10(a) permit applications. The USFWS and National Oceanic and Atmospheric Administration’s National Marine Fisheries Service (NOAA Fisheries Service) have joint authority under the ESA for administering the incidental take program. NOAA Fisheries Service has jurisdiction over anadromous fish species and USFWS has jurisdiction over all other fish and wildlife species.

Section 7 of the ESA requires all federal agencies to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any species listed under the ESA, or result in the destruction or adverse modification of its habitat. Federal agencies are also required to minimize impacts to all listed species resulting from their actions, including issuance or permits or funding. Section 7 requires consideration of the indirect effects of a project, effects on federally listed plants, and effects on critical habitat (ESA requires that the USFWS identify critical habitat to the maximum extent that it is prudent and determinable when a species is listed as threatened or endangered). This consultation results in a Biological Opinion prepared by the

USFWS stating whether implementation of the HCP will result in jeopardy to any HCP Covered Species or will adversely modify critical habitat and the measures necessary to avoid or minimize effects to listed species.

Although federally listed animals are legally protected from harm no matter where they occur, the Section 9 of the ESA provides protection for endangered plants by prohibiting the malicious destruction on federal land and other “take” that violates State law. Protection for plants not living on federal lands is provided by the California Endangered Species Act.

## **2. Clean Water Act**

The Corps is responsible under Section 404 of the Clean Water Act to regulate the discharge of fill material into waters of the U.S. These waters, and their lateral limit, are defined in 33 CFR Part 328.3(a) and include streams that are tributaries to navigable waters and their adjacent wetlands. The lateral limits of jurisdiction for a non-tidal stream are measured at the line of the Ordinary High Water Mark (33 CFR Part 328.3[e]) or the limit of adjacent wetlands (33 CFR Part 328.3[b]). Any permanent extension of the limits of an existing water of the U.S., whether natural or man-made, results in a similar extension of Corps jurisdiction (33 CFR Part 328.5).

Waters of the U.S. fall into two broad categories: wetlands and other waters. Other waters include waterbodies and watercourses generally lacking plant cover such as rivers, streams, lakes, springs, ponds, coastal waters, and estuaries. Wetlands are aquatic habitats that support hydrophytic wetland plants and include marshes, wet meadows, seeps, floodplains, basins, and other areas experiencing extended seasonal soil saturation. Seasonally or intermittently inundated features, such as seasonal ponds, ephemeral streams, and tidal marshes, are categorized as wetlands if they have hydric soils and support wetland plant communities. Seasonally inundated waterbodies or watercourses that do not exhibit wetland characteristics are classified as other waters of the U.S.

Waters and wetlands that cannot trace a continuous hydrologic connection to a navigable water of the U.S. are not tributary to waters of the U.S. These are termed “isolated wetlands.” Isolated wetlands are jurisdictional when their destruction or degradation can affect interstate or foreign commerce (33 CFR Part 328.3[a]). The Corps may or may not take jurisdiction over isolated wetlands depending on the specific circumstances.

In general, a project proponent must obtain a Section 404 permit from the Corps before placing fill or grading in wetlands or other waters of the U.S. Prior to issuing the permit, the Corps is required to consult with the USFWS under Section 7 of the ESA if the project may affect federally listed species.

All Corps permits require water quality certification under Section 401 of the Clean Water Act. In the San Francisco Bay Area, this regulatory program is administered by the San Francisco Bay RWQCB. Project proponents who propose to fill wetlands or other waters of the U.S. must apply for water quality certification from the RWQCB. The RWQCB has adopted a policy requiring mitigation for any loss of wetland, streambed, or other jurisdictional area.

## **3. Rivers and Harbors Act**

The Rivers and Harbors Act was enacted in 1899 and addresses projects and activities in navigable waters and harbor and river improvements. Section 10 of the Rivers and Harbors Act (33 USC 403) prohibits the unauthorized obstruction or alteration of any navigable water of the United States. Section 10 of the Act provides that the construction of any structure in or over

any navigable water of the United States, or the accomplishment of any other work affecting the course, location, condition, or physical capacity of such waters is unlawful unless the work has been authorized by the Corps. Regulated activities include the placement/removal of structures, work involving dredging, disposal of dredged material, filling, excavation, or any other disturbance of soils/sediments or modification of a navigable waterway. Navigable waters of the United States are those waters of the U.S. that are subject to the ebb and flow of the tide shoreward to the mean high water mark and/or are presently used, or have been used in the past or may be susceptible to use to transport interstate or foreign commerce.

#### **4. Migratory Bird Treaty Act**

The federal Migratory Bird Treaty Act (MBTA) prohibits the taking, hunting, killing, selling, purchasing, etc. of migratory birds, parts of migratory birds, or their eggs and nests. As used in the MBTA, the term “take” is defined as “to pursue, hunt, shoot, capture, collect, kill, or attempt to pursue, hunt, shoot, capture, collect, or kill, unless the context otherwise requires.” Most bird species native to North America are covered by this act.

#### **5. California Endangered Species Act**

The CDFW has jurisdiction over State-listed endangered, threatened, and rare plant and animal species under the California Endangered Species Act (CESA). CESA is similar to the federal ESA both in process and substance; it is intended to provide additional protection to threatened and endangered species in California. Species may be listed as threatened or endangered under both acts (in which case the provisions of both State and federal laws apply) or under only one act. A candidate species is one that the Fish and Wildlife Commission has formally noticed as being under review by CDFW for addition to the State list. Candidate species are protected by the provisions of CESA.

#### **6. California Environmental Quality Act**

The California Environmental Quality Act (CEQA) applies to “projects” proposed to be undertaken or requiring approval by State and local government agencies. Projects are defined as having the potential to have physical impact on the environment. Under Section 15380 of CEQA, a species not included on any formal list “shall nevertheless be considered rare or endangered if the species can be shown by a local agency to meet the criteria” for listing. With sufficient documentation, a species could be shown to meet the definition of rare or endangered under CEQA and be considered a “de facto” rare or endangered species.

#### **7. California Fish and Wildlife Code**

The CDFW is also responsible for enforcing the California Fish and Wildlife Code, which contains several provisions potentially relevant to construction projects. For example, Section 1602 of the Fish and Wildlife Code governs the issuance of Lake and Streambed Alteration Agreements by the CDFW. Lake or Streambed Alteration Agreements are required whenever project activities substantially divert or obstruct the natural flow or substantially change the bed, channel, or bank of any river, stream, or lake designated as such by the CDFW.

The Fish and Wildlife Code also lists animal species designated as Fully Protected or Protected, which may not be taken or possessed at any time. The CDFW does not issue licenses or permits for take of these species except for necessary scientific research, habitat restoration/species recovery actions, or live capture and relocation pursuant to a permit for the protection of livestock. Fully Protected species are listed in Sections 3511 (birds), 4700 (mammals), 5050 (reptiles and amphibians), and 5515 (fish) of the Fish and Wildlife Code, while Protected amphibians and reptiles are listed in Chapter 5, Sections 41 and 42.

Section 3503 of the Fish and Wildlife Code prohibits the take, possession, or needless destruction of the nest or eggs of any bird. Subsection 3503.5 specifically prohibits the take, possession, or destruction of any birds in the orders Falconiformes (hawks and eagles) or Strigiformes (owls) and their nests. These provisions, along with the federal MBTA, essentially serve to protect nesting native birds.

Non-native species, including European starling, house sparrow, and rock pigeon, are not afforded any protection under the MBTA or California Fish and Wildlife Code.

#### **8. Porter-Cologne Water Quality Control Act**

Under this Act (California Water Code Sections 13000–14920), the RWQCB is authorized to regulate the discharge of waste that could affect the quality of the State’s waters. The RWQCB asserts jurisdiction over isolated waters and wetlands, as well as waters and wetlands that are regulated by the Corps. Therefore, even if a project does not require a federal permit, it still requires review and approval by the RWQCB. When reviewing applications, the RWQCB focuses on ensuring that project do not adversely affect the “beneficial uses” associated with waters of the State. In most cases, the RWQCB seeks to protect these beneficial uses by requiring the integration of waste discharge requirements (WDRs) into projects that will require discharge into waters of the State. For most construction projects, the RWQCB requires the use of construction and post-construction Best Management Practices (BMPs).

#### **9. McAteer-Petris Act**

The McAteer-Petris Act and Suisun Marsh Preservation Act were adopted to protect San Francisco Bay and Suisun Marsh as great natural resources for the benefit of the public and to encourage development compatible with this protection. The San Francisco Bay Conservation and Development Commission (BCDC) was established to carry out this Act. The two primary goals of the BCDC are (1) to prevent the unnecessary filling of San Francisco Bay, and (2) to increase public access to and along the Bay shoreline. BCDC approval is required for all projects within 100 feet of the Bay shoreline beyond the Mean High Water (MHW) elevation, as well as projects that propose any filling or dredging within Bay waters.

#### **10. Other Statutes, Codes, and Policies Affording Species Protection**

The CDFW maintains an administrative list of Species of Special Concern (SSC), defined as a “species, subspecies, or distinct population of an animal native to California that currently satisfies one or more of the following (not necessarily mutually exclusive) criteria:

- Is extirpated from the State, or, in the case of birds, in its primary seasonal or breeding role;
- Is listed as federally, but not State-, threatened or endangered;
- Meets the State definition of threatened or endangered but has not formally been listed;
- Is experiencing, or formerly experienced, serious (noncyclical) population declines or range retractions (not reversed) that, if continued or resumed, could qualify it for State threatened or endangered status;
- Has naturally small populations exhibiting high susceptibility to risk from any factor(s) that, if realized, could lead to declines that would qualify it for State threatened or endangered status.

The CDFW’s Nongame Wildlife Program is responsible for producing and updating SSC publications for mammals, birds, and reptiles and amphibians. The Fisheries Branch is responsible for updates to the Fish SSC document and list. Section 15380 of the *CEQA*

*Guidelines* clearly indicates that SSC should be included in an analysis of project impacts if they can be shown to meet the criteria of sensitivity outline therein. In contrast to species listed under the federal ESA or CESA, however, SSC have no formal legal status.

The California Native Plant Society (CNPS), a non-governmental conservation organization, has developed five lists of plant species of concern in California. Vascular plants included on these lists are defined as follows:

- List 1A: Plants presumed extinct in California
- List 1B: Plants rare, threatened, or endangered in California and elsewhere
- List 2: Plants rare, threatened, or endangered in California, but more common elsewhere
- List 3: Plants about which more information is needed – a review list
- List 4: Plants of limited distribution – a watch list

Although the CNPS is not a regulatory agency and plants on these lists have no formal regulatory protection, plants appearing on Lists 1B and 2 may be considered to meet the definition of endangered, rare, or threatened species under Section 15380(d) of CEQA (see above), and impacts to these species may be considered “significant.”

In addition, the CDFW recommends, and local governments may require, protection of species which are regionally significant, such as locally rare species, disjunct populations, essential nesting and roosting habitat for more common wildlife species, or plants on the CNPS Lists 3 and 4.

## **CONCLUSIONS**

The site supports a diversity of plant and animal species, and its location along the shoreline of Carquinez Strait provides important habitat for both aquatic and terrestrial species. Future uses on the site must recognize the constraint that sensitive biological and wetland resources pose to some activities, as well as the opportunities to further enhance existing habitat values that have been compromised by past development activities, the spread and establishment of invasive species, and disturbance to natural habitat and native wildlife use caused by the activities of humans and their pets, particularly dogs on the site. The following provides a summary of the sensitive resources on the site and the planning considerations relevant to future uses and opportunities for habitat enhancement.

### **1. Special-Status Species**

Past development has eliminated suitable habitat for special-status species in upland areas on the site. However, areas of intact coastal salt marsh and open water habitat support a number of special-status species, including known occurrences of special-status bird species such as Suisun song sparrow and saltmarsh common yellowthroat, numerous special-status fish species that migrate and forage through the open waters of the Strait, and possibly other special-status species as well. Suitable habitat for a number of special-status plant species occurs in the marshland and exposed shoreline of the site, including Mason’s lillaeopsis, Delta tule pea, and soft bird’s-beak, and detailed surveys would be required to confirm presence or absence of these and other species where natural habitat remains. A number of special-status bird species are known to forage in the marshlands on the site, such as northern harrier, white-tailed kite and possibly California black rail and California clapper rail as they disperse along the shoreline of the Strait. Similarly, there is a remote possibility that salt marsh harvest mouse and Suisun shrew could disperse along the shoreline of the Strait and utilize the protective cover of

the marshlands on the site, although it is unlikely that sustainable populations would be present given the relatively small extent of suitable habitat and lack of protective upland refugia. Nevertheless, the marshland and open water habitats on the site are an important resource for special-status species and must be recognized as such in future planning and enhancement plans.

Modifications to areas of marshland and open water habitat would require consultation with resource agencies, and may require authorizations under the state and federal Endangered Species Acts. This would include disturbance to marshland and open water habitat associated with installation of new piers or elevated boardwalks, or placement of fills or other modifications within or at the edge of marshland habitat.

If disturbance is proposed in the remaining natural areas on the site as part of physical improvements or habitat enhancement, such as invasive species removal, preconstruction nesting surveys would be necessary to ensure that no nests in active use would be disturbed during the nesting season (typically February through August), in compliance with the federal Migratory Bird Treaty Act and CDFW Code.

## **2. Sensitive Natural Communities**

Areas of coastal salt marsh and brackish water marsh are considered sensitive natural communities by the CDFW. Both of these sensitive natural community types are also most likely jurisdictional waters, providing additional regulatory protection. Any modifications to these features could be considered a significant impact under CEQA, requiring compensatory mitigation if they are to be filled or modified as part of future activities.

These natural community types and the habitat they provide to native plants and animals have been compromised by past development, invasive species, and human activity. Highly invasive perennial pepperweed, the scattered Canary Island palms, and possibly the stands of common reed compromise the existing habitat values of the marshlands, and future plans should include a program for invasive species removal and control. Trampling by humans can damage marsh vegetation, particularly clumps of the relatively brittle pickleweed, and access into the marsh by humans and dogs compromises the habitat value of these areas to wildlife. Access should be carefully controlled through the use of interpretive signage and other mechanisms.

## **3. Jurisdictional Waters**

Any modifications to jurisdictional wetlands and other waters of the U.S. would require authorization from jurisdictional agencies. This would include modifications to areas of marshlands to improve habitat values, and possibly fill or modifications to areas considered to be potential seasonal wetlands if these features are confirmed to be jurisdictional wetlands. A formal wetland delineation must be prepared and verified by the Corps to confirm the extent of jurisdictional waters on the site, particularly the areas mapped as potential seasonal wetlands. Depending on the nature of the proposed modification, compensatory mitigation may be required.

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**TABLE 1**  
**SPECIAL-STATUS PLANT SPECIES**  
**KNOWN OR SUSPECTED TO OCCUR IN BENICIA VICINITY**

Taxa Name	Status (Fed/State /CNPS)	Habitat Characteristics (Site Habitat Suitability)	Distribution (Presumed Extirpated)	Flowering Period
<i>Aster lentus</i> Suisun marsh aster	-/-/1B	Brackish water marshes and swamps <b>(Potential habitat present)</b>	Contra Costa, Napa, Sacramento, Solano	May-Oct.
<i>Astragalus tener</i> var. <i>tener</i> Alkali milk-vetch	-/-/1B	Valley grassland, vernal pools, and playas <b>(No suitable habitat)</b>	Merced, Solano, Yolo (Alameda, Contra Costa, Monterey, Napa, Santa Barbara, Santa Clara, San Francisco, San Joaquin, Stanislaus)	March-June
<i>Atriplex joaquiniana</i> San Joaquin saltbrush	-/-/1B	Alkaline grassland and scrub <b>(No suitable habitat)</b>	Alameda, Contra Costa, Colusa, Glenn, Merced, Napa, Sacramento, Santa Barbara, Yolo (Santa Clara, San Joaquin, Solano, Tulare)	April-Sept.
<i>Blepharizonia plumosa</i> Big tarplant	-/-/1B	Grassland <b>(No suitable habitat)</b>	Alameda, Contra Costa, San Joaquin, Solano, Stanislaus	July-Oct.
<i>Centromadia parryi</i> ssp. <i>congdonii</i> Congdon's tarplant	-/-/1B	Grassland <b>(No suitable habitat)</b>	Alameda, Contra Costa, Monterey, Santa Clara, Santa Cruz, San Luis Obispo, San Mateo, Solano	May-Nov.
<i>Cordylanthus mollis</i> ssp. <i>mollis</i> Soft bird's-beak	FE/SR/1B	Coastal salt marsh <b>(Potential habitat present)</b>	Contra Costa, Marin, Napa, Solano	July-Nov.
<i>Fritillaria liliacea</i> Fragrant fritillary	-/-/1B	Coastal scrub and grassland often <b>(No suitable habitat)</b>	Alameda, Contra Costa, Monterey, Napa, San Benito, Santa Clara, San Francisco, San Mateo, Solano, Sonoma	February-April
<i>Isocoma arguta</i> Carquinez goldenbush	-/-/1B	Grassland <b>(No suitable habitat)</b>	Contra Costa, San Luis Obispo, Solano	August-Dec.
<i>Lasthenia conjugens</i> Contra Costa goldfield	FE/-/1B	Low flats and borders of vernal pools <b>(No suitable habitat)</b>	Napa, Solano, (Alameda, Contra Costa, Mendocino, Santa Barbara, Santa Clara)	April-May
<i>Lathyrus jepsonii</i> ssp. <i>jepsonii</i> Delta tule pea	-/-/1B	Brackish water marshes and swamps <b>(Potential habitat present)</b>	Alameda, Contra Costa, Fresno, Napa, San Benito, Santa Clara, San Joaquin, Solano	May-June
<i>Lilaeopsis masonii</i> Mason's lilaeopsis	-/SR/1B	Brackish water marshes and swamps <b>(Potential habitat present)</b>	Contra Costa, Napa, Sacramento, San Joaquin, Solano	June-August
<i>Polygonum marinense</i> Marin knotweed	-/-/1B	Coastal salt marsh <b>(Potential habitat present)</b>	Marin, Napa, Sonoma	June-August
<i>Senecio aphanactis</i> Chaparral ragwort	-/-/2	Coastal scrub, chaparral, woodland <b>(No suitable habitat)</b>	Alameda, Contra Costa, Fresno, Los Angeles, Merced, Orange, Riverside, Santa Barbara, Santa Clara, elsewhere	Jan-April
<i>Trifolium hydrophyllum</i> Saline clover	-/-/1B	Salt marsh, alkaline pools, grassland <b>(No suitable habitat)</b>	Central coast counties, and Solano and possibly Colusa	April-June

**Federal Status:**

FE = Listed as "endangered" under the Federal Endangered Species Act.

**State Status:**

SE = Listed as "endangered" under CESA.

SR = Listed as "rare" under CESA.

**CNPS Status:**

1A = Plants of highest priority; plants presumed extinct in CA.

1B = Plants of highest priority; plants rare and endangered in CA and elsewhere.

2 = Plants rare, threatened, or endangered in CA; more common elsewhere.

**TABLE 2**

**SPECIAL-STATUS ANIMAL SPECIES  
KNOWN OR SUSPECTED TO OCCUR IN BENICIA VICINITY**

Species	Status Federal/State	Preferred Habitat Type (Site Habitat Suitability)
<b><u>Invertebrates:</u></b>		
Bridges' coast range shoulderband	-/-	Grasslands and woodland margins with moist protective cover ( <b>No suitable habitat</b> )
Callippe silverspot butterfly	FE/-	Open grasslands with golden violet host species ( <b>No suitable habitat</b> )
Monarch butterfly	-/-	Overwinters in eucalyptus and cypress stands ( <b>No suitable habitat</b> )
<b><u>Amphibians/Reptiles/Fish:</u></b>		
California tiger salamander	FT/ST, SSC	Vernal pools, ponds, streams and adjacent grassland ( <b>No suitable habitat</b> )
California red-legged frog	FT/SSC	Ponds, streams, adjacent riparian and upland ( <b>No suitable habitat</b> )
Delta smelt	FT/ST	Brackish zone of Delta ( <b>Marginal habitat in marsh/open water</b> )
Foothill yellow-legged frog	-/SSC	Permanent streams with cobbles ( <b>No suitable habitat</b> )
Northwestern pond turtle	-/SSC	Pond, rivers, and streams ( <b>No suitable habitat</b> )
Longfin smelt	-/ST	Brackish zone of Delta ( <b>Marginal habitat in marsh/open water</b> )
Sacramento splittail	-/SSC	Sloughs and other slow-moving waters of Delta ( <b>Marginal habitat in marsh/open water</b> )
Steelhead	FT/SSC	Open water of Bay and Delta, tributary rivers and streams ( <b>Marginal habitat in open water</b> )
Winter- run chinook salmon	FE/SE	Open water of Bay and Delta, tributary rivers and streams ( <b>Marginal habitat in open water</b> )
<b><u>Birds:</u></b>		
Burrowing owl	-/SSC	Grassland ( <b>Marginal foraging habitat in upper marsh</b> )
California black rail	-/ST, FP	Salt marsh ( <b>Marginal foraging habitat in marsh</b> )
California clapper rail	FE/SE, FP	Salt marsh ( <b>Marginal foraging habitat in marsh</b> )
Cooper's hawk	-/-	Riparian and grassland ( <b>No suitable habitat</b> )
Double-crested cormorant	-/-	Bays, rivers, lakes - communal roosts protected ( <b>Marginal foraging habitat in open water</b> )
Golden eagle	-/FP	Open grassland and savanna ( <b>No suitable habitat</b> )
Loggerhead shrike	-/SSC	Grasslands and scrublands ( <b>Marginal foraging habitat in upper marsh and grassland edge</b> )
Northern harrier	-/SSC	Grassland ( <b>Suitable foraging habitat in marsh</b> )
Osprey	-/-	Open water and adjacent tree cover for nesting ( <b>Suitable foraging habitat in open water</b> )
Peregrine falcon	Delisted/Delisted	Open water and grassland ( <b>Suitable foraging habitat in marsh</b> )
Prairie falcon	-/-	Grassland ( <b>Suitable foraging habitat in marsh</b> )
Saltmarsh common yellowthroat	-/SSC	Salt and brackish water marsh ( <b>Suitable foraging and nesting habitat in marsh</b> )
San Pablo song sparrow	-/SSC	Brackish water marsh and adjacent upland ( <b>Suitable foraging and nesting habitat in marsh</b> )
Suisun song sparrow	-/SSC	Brackish water marsh and adjacent upland ( <b>Suitable foraging and nesting habitat in marsh</b> )
Tricolored blackbird	-/SSC	Freshwater marsh and fields ( <b>Marginal foraging and nesting habitat in marsh</b> )
White-tailed kite	-/FP	Grassland ( <b>Marginal foraging habitat in upper marsh</b> )
<b><u>Mammals:</u></b>		
Big free-tailed bat	-/SSC	Range of habitat types for foraging ( <b>Marginal roosting habitat in structure</b> )
Salt marsh harvest mouse	FE/SE, FP	Salt marsh and adjacent grassland ( <b>Marginal dispersal habitat in marsh</b> )
Suisun shrew	/SSC	Salt marsh ( <b>Marginal dispersal habitat in marsh</b> )

**Federal Status:**

FE = Listed as "endangered" under the Federal Endangered Species Act (FESA).

FT = Listed as "threatened" under the FESA.

C = A candidate species under review for federal listing. Includes species for which the USFWS currently has sufficient biological information to support listing endangered or threatened.

**State Status:**

SE = Listed as "endangered" under California Endangered Species Act (CESA).

ST = Listed as "threatened" under CESA.

CP = California fully protected or protected species; individual may not be possessed or taken at any time.

SSC = California Special Concern species by the CDFW; species have no formal legal protection but nests and roosts are generally recognized

as significant biotic features.

FP = California "fully protected" species may not be processed.





Note: Mapping is preliminary based on limited vegetation data and assumed hydrologic and soils criteria. A final determination on all boundaries of jurisdictional waters would require a wetland delineation and verification by the U.S. Army Corps of Engineers.

Figure 2 - Potential Jurisdictional Wetlands

**Urban Waterfront Enhancement and Master Plan**  
for the City of Benicia

APPENDIX B

HYDROLOGIC SITE ASSESSMENT AND  
ENVIRONMENTAL BASELINE  
MEMO

APRIL 1, 2013



**Memo**

To: Isabelle Minn, The Planning Center/DC&E  
From: Edward D. Ballman, P.E.  
Date: April 1, 2013

**Subject: Hydrologic Site Assessment and Environmental Baseline for the Urban Waterfront Enhancement and Master Plan, City of Benicia**

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Balance Hydrologics has completed its review of available information to frame the hydrologic setting of the Urban Waterfront Enhancement and Master Plan (UWEMP) in the City of Benicia. We understand that similar assessments have been completed (or are underway) covering other areas of interest with respect to the UWEMP. Therefore, this summary memo dispenses with universal background information and focuses exclusively on summarizing the hydrologic information pertinent to preparing the UWEMP.

**Local Climate Characteristics**

The project site has local climate characteristics similar to other locations along the Carquinez Strait, which separates San Pablo Bay to the west from the Sacramento-San Joaquin Delta ("the Delta") to the east. In general, the site is located in the Mediterranean climate zone typical of coastal central California. This climate zone is characterized by cool, wet winters and hot, dry summers tempered, in this case, by proximity to San Francisco Bay and by the occurrence of occasional coastal fog, especially in late spring and summer. A noteworthy characteristic of the site is the strong inland wind pattern that typically develops during the summer. Relatively stable high pressure is established over the eastern Pacific Ocean, while low pressure develops over the Central Valley, creating a pressure differential which typically drives winds from west to east through the topographic gap of the Strait.

Long-term daily meteorological data are available from the National Weather Service for the City of Martinez, located on the south shore of the Carquinez Strait across from Benicia. Analysis of digital records for this station from 1948 to the present show that the average daily high temperature is 72.3° F and the average daily low is 47.5° F. Average rainfall conditions in the area are the statistical mean of rainfall totals that show a wide range of values strongly influenced by global weather patterns such as the El Niño Southern Oscillation and prolonged periods of drought. The mean annual rainfall on a water year basis (October 1 to September 30) is 19.3 inches, with a maximum of 36.9 inches in WY1983 and a minimum of 7.4 inches during the severe drought of WY1976. The calculated mean annual rainfall agrees very well with isohyetal mapping prepared by the Solano County Water Agency.

Potential evaporation at the site far exceeds rainfall for even the wettest years. Pan evaporation data for the period 1956 to 1976 are available for Dutton’s Landing, California, located approximately 14 miles northwest of the project site near the mouth of the Napa River. We believe these data are generally representative of pan evaporation at the Benicia site and show a long-term average of 62.9 inches per year, equivalent to about 47.2 inches per year of actual evaporation.<sup>1</sup>

## Tidal Characteristics

Located along the north shore of the Carquinez Strait, the project site is subject to tidal action that is the chief factor controlling geomorphological and biological processes at the site. Tides in the Strait, similar to other locations in California, display a semi-diurnal pattern of two high and two low tides “daily”. Figure 1 illustrates this pattern for the period from December 2012 through January 2013 based on data collected at the National Oceanic and Atmospheric Agency (NOAA) tide gage located at Port Chicago, California, corrected to the Benicia site.<sup>2</sup> The term “daily” is used in general terms since the time from one point in the tidal cycle to the next is approximately 25 hours.

NOAA has established tidal datum information for Benicia by monitoring water levels at the Benicia Wharf from January 1977 through December 1981. The respective information is published by NOAA as the tidal datum information sheet for Benicia, Carquinez Strait, CA (Station #9415111). Important datums are listed in Table 1.

**Table 1. Tidal datums for the City of Benicia**

<b>Datum</b>	<b>Elevation (feet, NAVD)<sup>3</sup></b>
Mean Higher High Water	5.97
Mean High Water	5.44
Mean Tide Level	3.48
Mean Low Water	1.51
Mean Lower Low Water	0.64

<sup>1</sup> Recognizing that the Benicia waterfront may be slightly windier than Dutton’s Landing, we estimate mean evaporation from a large water surface to be 75 to 80 percent of pan evaporation, rather than the more conventional 70 to 75 percent.

<sup>2</sup> The NOAA tide station at Port Chicago (#9415144) provides a particularly long period of record for water-level information in the vicinity of the project site. Located approximately 6.7 miles to the east of Benicia, the Port Chicago station was established in June 1976, with verified historical data available on-line back to 1996.

<sup>3</sup> Unless otherwise noted, all elevations herein are based on the North American Vertical Datum of 1988 (NAVD).

Figure 2 shows the mean higher high water elevation with respect to study area, although it is important to note that the highest tide on roughly half of all days will be higher. In fact, higher high tide elevations are frequently high enough that they inundate much of the fringe area of the site (up to an elevation of roughly 7.0 feet) and are very important in setting the extent of wetlands that occur at the site.

The typical tidal cycle at any location can be affected by variables such as storms and water temperature. At Benicia, the tidal cycle is particularly influenced by storm surges that propagate through the Golden Gate and from runoff through the Carquinez Strait, representing the combined drainage of the Sacramento and San Joaquin River systems (Bromirski and Flick, 2008). With respect to storm surges, Bromirski and Flick demonstrated that storm surge effects in the Carquinez Strait area can reach or exceed 20 inches above predicted tide levels. Additionally, outflow from the Sacramento-San Joaquin Delta is frequently large enough after significant rainfall events to further markedly alter the expected tidal patterns, with outflow effects generally lagging the associated storm surge by several days and often persisting for many days. The combined effect is particularly evident in Figure 3, which illustrates water surface elevations as measured at Port Chicago for the period around January 1, 1997, when northern and central California experienced several large storm events.

## **Flood Elevations**

The portion of Benicia including the UWEMP area and vicinity is mapped on Flood Insurance Rate Map (FIRM) Number 0609C0641E issued by the Federal Emergency Management Agency (FEMA) as part of the National Flood Insurance Program. The upland areas immediately adjacent to the study area do not include any designated Special Flood Hazard Areas (SFHAs, commonly known as 100-year floodplains). However, the currently-effective FIRM does designate base flood elevations for Carquinez Strait and illustrates the SFHA associated with that flooding source with a base flood elevation of 9 feet NAVD (see Figure 4).<sup>4</sup> Interestingly, the SFHA boundary mapped by FEMA does not correspond to the 9-foot contour elevation on the topographic base compiled for the UWEMP, which is illustrated in Figure 5. The reason for this discrepancy is not identified herein, but is likely due to differences in the resolution of the base mapping used in the FEMA study and that used for the UWEMP. The boundary shown in Figure 5 can generally be considered a more accurate depiction of areas susceptible to flooding in a 100-year event on the Carquinez Strait, although it is not the "official" boundary for flood insurance purposes. It is important to note that the highest observed water surface elevation at the Port Chicago tide station was 9.02 feet on December 3, 1983, more or less equivalent to the predicted base flood elevation.

Figure 5 shows that the majority of the study area would be inundated by the 1-percent chance flood event (base flood). Flooding would be expected to cover the entire

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<sup>4</sup> The base flood elevation (BFE) is commonly referred to as the 100-year flood elevation. FEMA now prefers to use the term "1-percent chance flood" in lieu of "100-year flood" as a more appropriate descriptor that better emphasizes the fact that the event has a 1-percent chance of occurring in any given year.

central and southeastern portions of the site, including most of the lawn area, several hundred feet of B Street, and the lowermost part of East 2<sup>nd</sup> Street.

## Sea Level Rise

Located directly adjacent to the Carquinez Strait, the Benicia Urban Waterfront is susceptible to significant changes in sea level over broader periods of time. In fact, the issue of sea level rise has received much attention recently as it has become increasingly clear that historical rates of sea level rise are accelerating, likely due to a number of factors, most of which are related to global climate change.

The need to appropriately prepare for the implications of rising sea levels has led the State of California to set standards to frame planning activities in coastal areas. The most appropriate guidance in this regard that applies to the study area is that set forth by the San Francisco Bay Conservation and Development Commission in 2011. Based on previous work by the Coastal and Ocean Working Group of the California Climate Action Team (CO-CAT, 2010), the SFBCDC identified scenarios of sea level rise for various time horizons as summarized in Table 2.

For the 2070 and 2100 time horizons, three different scenarios were included to allow for risk and vulnerability considerations ranging from low to medium to high. The values in Table 2 for these time horizons are those for the high risk scenarios. Based on the overall projections of sea level rise, the SFBCDC policy analysis recommended using conservative values of 16 inches of sea level rise by 2050 and 55 inches by 2100.

**Table 2. Projected sea level rise scenarios for the San Francisco Bay area**

		Projected Sea Level Rise			
		<i>(by year in inches compared to 2000)</i>			
		2030	2050	2070	2100
<b>SFBCDC (2011)</b>					
	Mean	7	14	27	55
	High	8	17	32	69
	Low	5	10	20	43
<b>NAS (2012)</b>					
	Mean	6	11	not used	36
	High	12	24	not used	66
	Low	2	5	not used	17

The SFBCDC policy recognized that additional, updated analyses of sea level rise were underway at the time by the National Academy of Sciences. The results of those analyses were published in 2012, presenting a rigorous assessment of sea level rise trends and associated projections for the U.S. West Coast from California to Washington. Table 2 includes the summary values from that study that apply to the San Francisco Bay area. The mean values from the NAS study are lower than those cited by

SFBCDC, with the differences increasing for the later scenarios, a reflection of the uncertainty associated with longer-range projections. The NAS projected mean value of 36 inches at 2100 is considerably less than the 55-inch value recommended by SFBCDC. However, the NAS study cites a high-range estimate of 66 inches in 2100, indicative of the need to consider risk and vulnerability in any specific planning environment. Given the immediate proximity of residential and commercial development to the UWEMP area, the use of conservative projections is appropriate.

The impacts of sea level rise on flood elevations at the site were previously analyzed for the California State Coastal Conservancy by URS Corporation, with results summarized in a technical memo dated March 28, 2011. The analysis looked at sea level rise scenarios of 7 inches at 2030 and 16 inches at 2050 and presented mapping based on these increases added to the base flood elevation of 9 feet.

The attached Figure 5 illustrates potential future base flood scenarios using both the value of 16 inches for 2050 as well as the longer-term scenario of 55 inches of sea level rise at 2100, equivalent to a base flood elevation of 13.6 feet (e.g. 9 feet current BFE + 4.6 feet sea level rise). As Figure 5 shows, the more conservative higher base flood conditions would inundate progressively more area. With 16 inches of sea level rise (BFE = 10.3 feet), essentially the entire urban waterfront would be subject to flooding during a 1-percent chance event, the only exceptions being 1<sup>st</sup> Street upslope of the depot and the northwest portion of B Street. With 55 inches of sea level rise, all of B Street and all areas to the south would be susceptible to inundation.

## **Drainage Patterns and Local Stormwater Infrastructure**

In general, the pervious portions of the study area (including the lawn and wetland areas) slope toward Carquinez Strait and drain by gravity through overland flow. Wetland areas predominate in the central and eastern portions of the site along the Strait. As mentioned previously, these areas are subject to inundation at higher tide stands and exhibit many characteristics of saltmarsh environments. However, the tidal prism is quite small, and the characteristic tidal channel network of larger saltmarsh environments has not developed to any significant extent. In addition to the wetlands directly adjacent to the shoreline, there is an isolated low-lying area immediately to the north and east of the old A Street alignment that is connected to the Strait by a corrugated metal pipe (in poor condition), allowing tidal exchange at high tide levels (see Figure 2).

The impervious portions of the study area are generally drained by engineered stormwater lines. Six stormwater outfalls discharge within the site as shown on Figure 2, although only four of these are shown on the mapping in the City's Stormwater Management Plan. Two of these systems are located on 1<sup>st</sup> Street and handle runoff from relatively small local drainage areas. Approximately midway along the south side of the site there is a drainage channel, largely filled with silt and vegetation that connects the outfall from the B Street storm drain system to the Strait. The B Street system handles runoff from approximately 10.5 acres of urban land encompassing the area from East 2<sup>nd</sup> Street in the east to 1<sup>st</sup> Street in the west and East D Street to the

north. There is also a small outfall for dry-season low flows that discharges near the end of the former East 2<sup>nd</sup> Street storm drain system. These low flows are pumped from the Marina area, where the East 2<sup>nd</sup> Street high flows are now discharged since completion of the Marina Area Storm Drain Project in 2007.

It is important to note that the B Street storm drain system is subject to frequent localized street flooding for most significant storm events that occur during high tide. The outfall was not physically inspected, but apparently does not include a tide gate, as upwelling of water from the Strait is a frequent occurrence for tide elevations above approximately 7 feet. Performance of this system can be expected to decline with any increases in sea level.

## **Water Quality**

The most significant water quality parameter at the site from the perspective of the local wetlands environment is salinity. Given the very large watershed upstream from Benicia, the site typically experiences a wide range of salinity values over the course of a year. The most general seasonal trends include a marked drop in salinity with the start of runoff from the Central Valley, usually in late November or December. During periods of high discharge in the Sacramento – San Joaquin system, surface water at Benicia is essentially fresh. Salinity values typically increase at a steady rate once winter rains cease, building to a maximum again prior to the onset of the next winter rain season. This pattern can be interrupted by occasional dry periods in the winter season, when salinity can increase to levels generally associated with mid-summer. Late summer and early fall salinity values vary greatly from year to year, but generally average around 20 parts per thousand (roughly equivalent to a specific conductance of 25 millimhos/cm). Salinity levels are high enough and of sufficient duration that saltmarsh vegetation dominates the wetlands that make up much of the study area.

There is no stormwater quality infrastructure in place within the study area or on any of the storm drain lines that convey runoff to the site, with the notable exception of the low-flow line from the Marina system, which is equipped (upstream) with a vortex separator unit. Information on the quality of stormwater runoff from the various outfalls is not available, but it is reasonable to assume that it is characteristic of other systems serving roadways and mixed use development in the Bay Area.

## **Opportunities and Constraints**

From a hydrologic perspective, the UWEMP area presents a number of opportunities and constraints, almost all of which are interrelated. These include the following:

- *Flood protection.* Though situated along the shores of the Carquinez Strait, which drains much of the land area of California, the site is not exposed to exceedingly high flood risk. Discharge through the Strait from the combined Sacramento-San Joaquin River system can be exceptionally high at times. However, the Strait is very wide at this

location (over 4,000 feet), greatly limiting flood elevations. Additionally, the site shows no obvious signs of excessive subsidence that is typical of many locations throughout the Bay Area and Delta.

- *Sea level rise adaptation.* The site will be potentially impacted by any significant increases in sea level as discussed previously. However, unlike many other sites so adjacent to tidal influence, there is substantial space to adapt to and mitigate for increases in sea level over the projected time frames of those impacts. Such measures may include protective features such as seawalls or levees and wetland modifications to name a few. A noted constraint in this regard would be the need to provide stormwater pumping capacity at some point in the future to assure effective drainage in the face of rising high tide levels, particularly for the B Street storm drain line.
- *Wetland enhancements.* The site includes extensive existing wetland areas that are characterized by relatively low diversity of hydroperiods that reflect the relatively uniform elevations within the wetlands. There are opportunities to enhance the diversity of these areas with tidal channels and other similar features, potentially as part of an adaptation strategy that accommodates future sea level rise.
- *Stormwater quality.* The lack of stormwater quality best management practices (BMPs) on the storm drain lines in the project area creates the opportunity to provide remedial water-quality benefits. These can take many forms and range from trash control devices to bioretention facilities (rain gardens) to other "green street" design enhancements.

## References

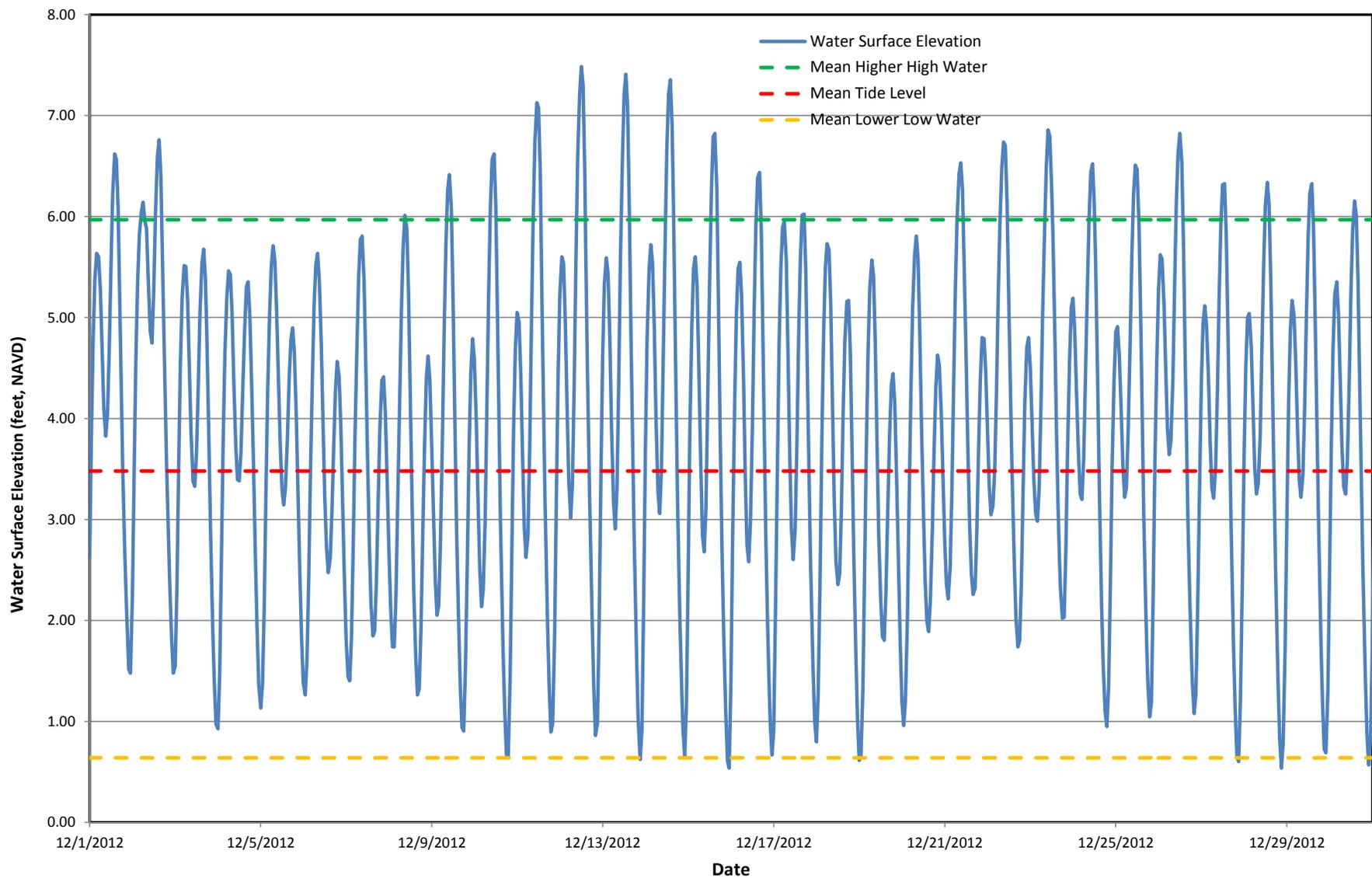
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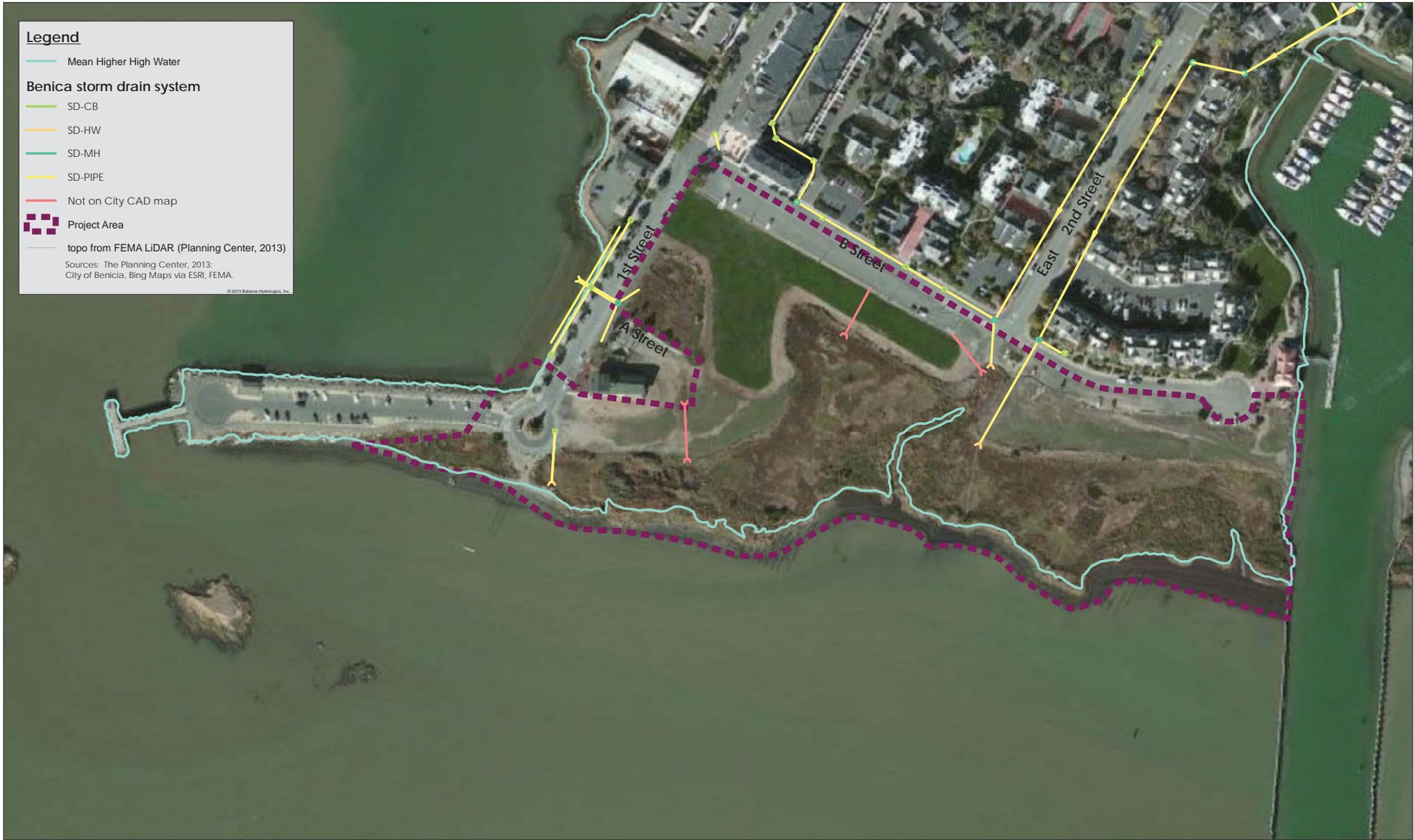
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## FIGURES



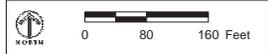
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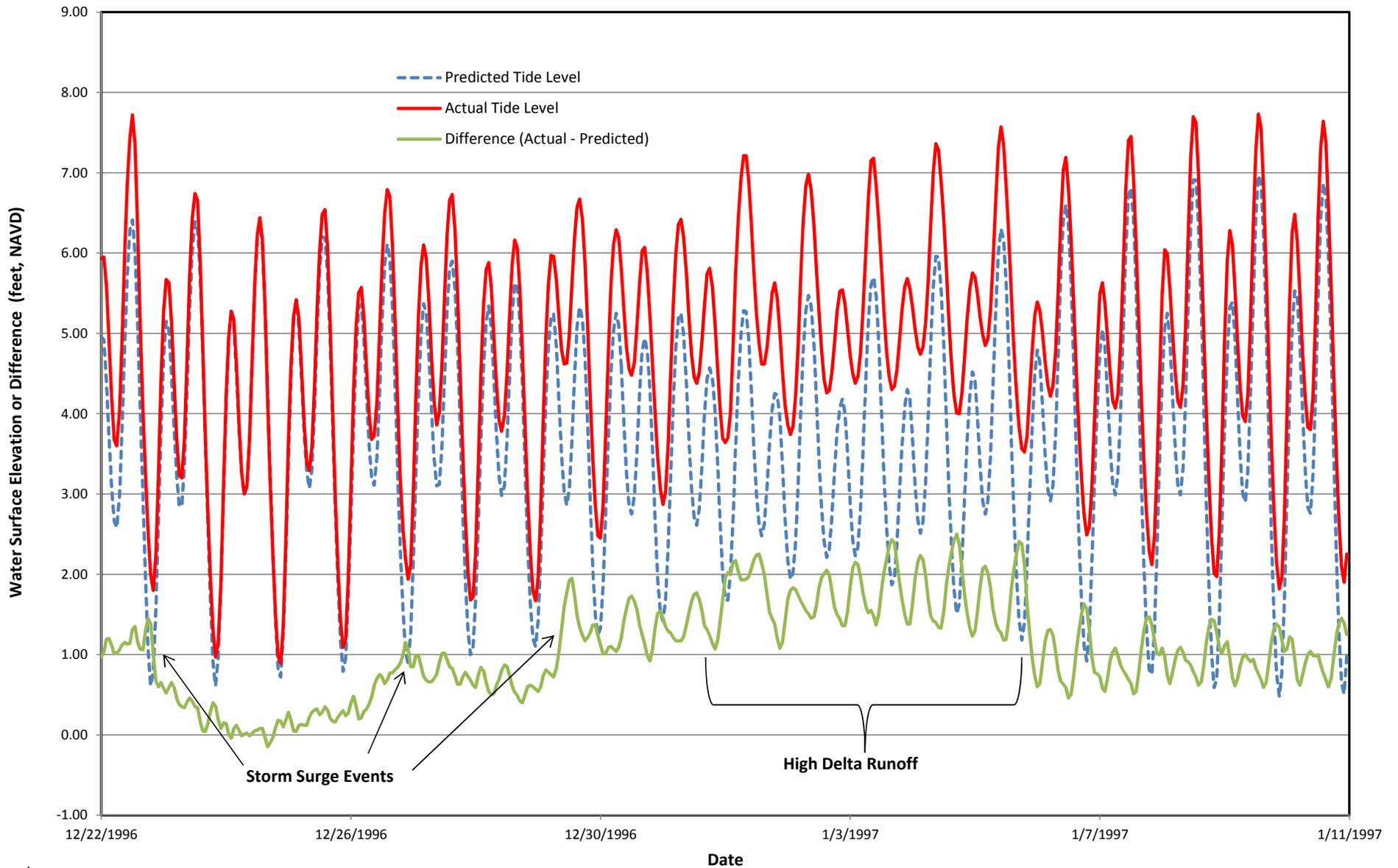
**Figure 1. Representative tidal water surface elevations for the Benicia waterfront, December 2012.** Data from the NOAA Port Chicago tide station (#9415144) corrected to Benicia using published tidal benchmarks. Note the particularly high tide levels in mid-December, also known as "King Tides".



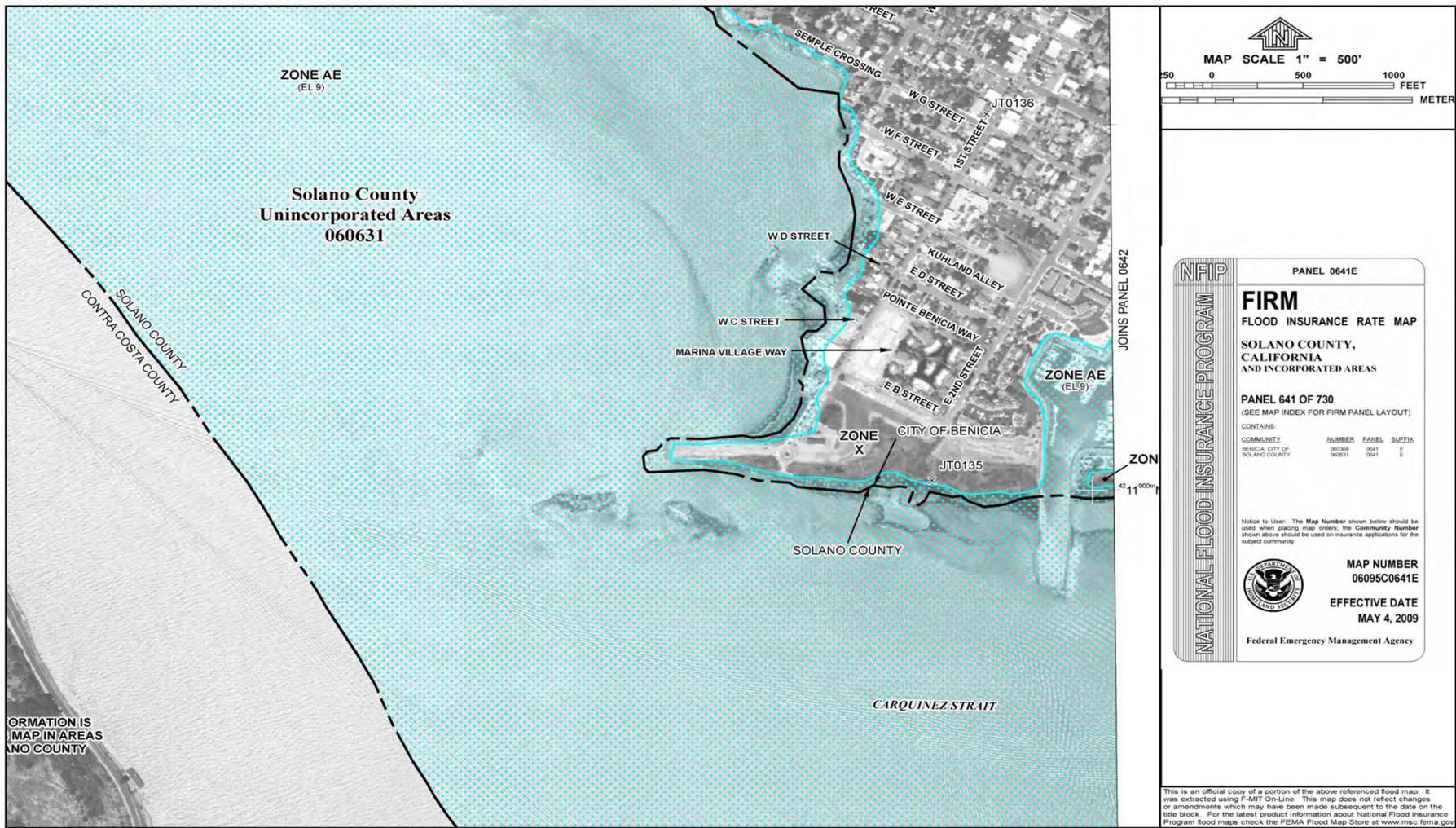
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Figure 2. Mean higher high water and existing local storm drain system, Benicia Urban Waterfront Enhancement and Master Plan, City of Benicia





**Figure 3. Storm surge and Delta runoff signatures from the December 1996 to January 1997 storm events.** Data from the NOAA Port Chicago tide station (#9415144). Note the multiple storm surge events that culminated with a major atmospheric river storm event near New Year's, followed by a prolonged period of elevated water surface elevations due to high runoff from the Sacramento-San Joaquin Delta system. Water surface elevations were more than 1 foot above predicted tidal levels for over a week, at times reaching nearly 2.5 feet above predicted.



**Figure 4. FEMA Flood Hazard Rate Map for the vicinity of the Benicia Urban Waterfront Enhancement and Master Plan.** Note that the only mapped flooding source is Carquinez Strait with a base flood elevation of 9 feet NAVD.



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**Figure 5. FEMA base flood elevation with and without projected sea level rise, Benicia Urban Waterfront Enhancement and Master Plan, City of Benicia**

