San Francisco Bay Area
Wetlands Restoration Program

Letter of Review

Crissy Field Restoration Monitoring Plan and protocols
San Francisco, California
02/10/03

IMPORTANT NOTICE: Please note that project review by the Design Review Group (DRG) does not constitute DRG endorsement of a project nor does it constitute a step in the regulatory and/or permitting process. Project proponents are free to pose questions to the DRG at their discretion and the DRG responds only to those questions deemed within its scope and realm of expertise. The Design Review Team does not intend to reach consensus in all of its feedback and dissenting opinions are included as expressed. All feedback is suggestive and non-obligatory; project proponents are not required to incorporate any or all of the feedback into their project design.

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1. Project Team:

a. Project Proponent(s): National Park Service (Kristen Ward, contact)

b. Project Presenter to Design Review Group: Josh Collins (San Francisco Estuary Institute), and Kristen Ward (National Park Service)

2. Design Review Group Participants:

a. Dates Review Team met to discuss the project: The Design Review Group, including the Crissy Field Restoration Monitoring Plan and Protocols Design Review Team, featured the first presentation of the project on January 6, 2003. Following the presentation, the Team discussed the project and inquired about further information.

The Design Review Group then met again on February 10, 2003, to finalize this Letter of Review.

b. Review Team: Peter Baye - Plants and ecology (Independent Biologist), Rachel Kamman - Engineering and hydrology (Kamman Hydrology), Jasper Lament - Birds and plants (Ducks Unlimited), and Roger Leventhal - Engineering (FarWest Engineering)

c. Non-Review Team Meeting Attendees: (01/06/03) Myla Ablog (Golden Gate National Parks Association), Bob Batha (San Francisco Bay Conservation and Development Commission), Markley Bavinger (Wolfe Mason Associates), John Brosnan (Wetlands Restoration Program), Josh Collins (San Francisco Estuary Institute), Lesley Estes (City of Oakland), Marti Ikehara (National Geodetic Survey, NOAA), Paul Jones (U.S. Environmental Protection Agency), Karl Malamud-Roam (Contra Costa Mosquito and Vector Control District), Laurel Marcus (Laurel Marcus and Associates), Molly Martindale (U.S. Army Corps of Engineers), Mike Monroe (U.S. Environmental Protection Agency), Michelle Orr (Philip Williams and Associates), Stuart Siegel (Wetlands and Water Resources), Becky Smythe (NOAA Ocean Service), Maxene Spellman (State Coastal Conservancy), Kristen Ward (Golden Gate National Recreation Area), Katy Zaremba (Invasive Spartina Project/Coastal Conservancy), and John Zentner (Zentner and Zentner)

3. Review Process:

a. Assistance requested by project sponsor: Josh Collins and Kristen Ward, on behalf of the project's planning team, presented a list of issues to the Design Review Team. The list consisted of those issues on which he sought Design Review Team input. Items included:

i. Specifically, relative to lagoon water level monitoring, is it a problem that the monitoring gauges are recording at two different intervals? Where might they be relocated?
ii. Water surface elevation levels are set to NGVD 29 - Should this change?
iii. In general, what feedback does the Review Team have on the document and its contents?

b. Materials reviewed:
- National Park Service, Golden Gate National Recreation Area. DRAFT *Crissy Field Restoration Project Monitoring Plan and Protocols*. October 2002.
- Personal presentation

c. Additional Information Requested by the Design Review Team: The Review Team did not request any additional items.

4. Design Review Group Findings and Comments:

The Design Review Team provided numerous suggestions and all of those suggestions are captured in this section. The Team does not intend to reach consensus in all of its feedback and dissenting opinions are included as appropriate.

The following represents the professional opinions of the Design Review Team and select Design Review Group members, as identified. These opinions are provided for the benefit of the project proponent in direct response to those questions posed by the proponent. The project proponent is in no way obliged to incorporate any or all of the feedback herein into their project design.

Consistency with Habitat Goals: In Segment J - San Francisco Area, under "Unique Restoration Opportunities," the *Habitat Goals Report* states "this segment provides an opportunity to restore beach and sand dune habitats…[and] opportunities to restore and enhance tidal marshes." More specifically, one of the recommendations for this Segment is to "restore beach, sand dune, and tidal marsh habitats at Crissy Field. The restoration described herein has already taken place; the Design Review Team concurred that the whole of the project was consistent with the *Habitat Goals Report*.

a. Issues Addressed by the Review Team, Discussion and Findings:

The usual focus of a Design Review Team is on project designs. In contrast, the Crissy Field Restoration Project Monitoring Plan and Protocols project proponents are seeking peer review of an existing document. Therefore, in proving feedback to the project proponents, specific information will be grouped under the general questions/headings below.

Responses to "iii.," below are broken out by sections of the Monitoring Plan and Protocols. Of all the issues presented to the Design Review Team, Team members provided feedback on the following items:

i. Specifically, relative to Hydrology and Geomorphology monitoring, is it a problem that the monitoring gauges are recording at two different intervals? Where might they be relocated?

Karl Malamud-Roam (Design Review Group member) said that the monitoring gauges should record at six-minute intervals and Rachel Kamman agreed, saying that 12-minute intervals may be too sparse. Karl suggested calibrating all three sensors to the same time and to locate them in places where they are least likely to be moved again. Rachel stated that six-minute intervals will capture more noise in the data and that reviewers should be cognizant of this in filtering data. She added that if wave heights are sought a different type of Instrument would be more helpful; there are many factors to be aware of that could dramatically affect samples (for example sampling window and averaging period). Peter Baye resounded the need to have a good descriptive record.

A Design Review Group member suggested adding another gauge instead of moving the existing gauges. Stuart Siegel suggested using the Golden Gate instrument. Rachel Kamman suggested that water level monitoring instruments should be surveyed and/or measurements on adjacent staff plates recorded at deployment and before pulling the instruments. Comparison of field readings with data records should be made as part of standard QA/QC procedures to verify data accuracy. Rachel also suggested that page 8 of the document should be changed to reflect that topographical and bathymetric surveys are completed twice per year. Stuart added that an acoustic gauge is less likely to malfunction than a transducer.

Peter Baye suggesting integrating the measurements from the regular bathymetric surveys with the bedforms (i.e., orientation, size, height). Rachel Kamman pointed out that measurements taken at 8-week intervals will miss diurnal tidal variations; she suggested performing a spring and neap tide measurement, once in the spring and once in the fall. Peter suggested taking the measurements quarterly, in January, April, July, and October. Rachel stated that characterizing changes In inlet geometry can serve as a surrogate for tidal energy for the marsh system as a whole.

ii. Water surface elevation levels are set to NGVD 29 - Should this change?

Stuart Siegel asked what is known of the benchmarks being used and suggested researching what those benchmarks are. He suggested converting to NAVD 88. Design Review Group member Marti Ikehara suggested using a single standard point, if interested in simply change over time. Rachel Kamman suggested identifying vertical control points to Insure accurate measurement of anticipated vertical variations across the site. She added that vertical controls are extremely important for evaluating geomorphic changes over the next 10 years. She also suggested use (or establishment) of more than one control given heavy construction may occur in the vicinity in the near future.

iii. In general, what feedback does the Review Team have on the document and its contents?

A. General comments.

(Peter Baye) The monitoring plan is comprehensive, detailed, and thoroughly researched, but some important gaps exist. The most important of these are:

(1) Explicit relationship between monitoring objectives and marsh restoration objectives of the project (not stated in the current draft);

(2) Linkage between sampling design for ecologically related variables, such as vegetation and soil variables, some water quality variables;

(3) Allowing for timing of biological sampling in relation to key external physical events/controls (such as tidal choking, inlet closure, inlet breaching), rather than sampling exclusively by regular cycles (tide, season). The same is true regarding monitoring hydrologic and geomorphic variables during those same key physical events.

In addition, Peter stated that there are significant opportunities to capture more information about overriding physical controls of the wetland hydrology, as well as more precise comprehensive quantitative data on the pattern and amounts of habitats, vegetation types, and landforms, possibly at reduced cost and labor. This could potentially occur by substituting some labor-intensive field sampling with more frequent aerial photographs of the site. Aerial photographs are perhaps the single most valuable and efficient tool for recording and reconstructing basic geomorphic, hydrologic, and habitat data.

B. Specific comments.

Aerial photography (p. 4): Peter Baye stated that most energetic depositional and erosional events occur in winter, and are often masked by summer deposition. Summer aerial photos alone may fail to capture critical information about patterns of erosion and deposition, or morphologic thresholds related to critical changes in the tidal inlet condition. Low-tide orthophotos with 20% overlap can be used to develop precise and comprehensive measurements of topography (and microtopography) of unvegetated or sparsely vegetated surfaces. It may be used to substitute for some ground-based topographic surveys.

Water surface elevation (p. 4) : Peter stated that a single tide gauge cannot detect water significant water surface gradients (tidal gradients) within the marsh, and between the marsh and the bay. This is particularly important during periods of tidal choking (inlet constriction). Since the lagoon/marsh interior is fenced from public access, an interior (westerly) tide gauge location should be feasible. The sheltered, adjacent, but tidally unrestricted outer St. Francis Yacht Harbor is a potential bay tide reference site.

Water quality (p. 4): Peter stated that pore water samples from surface seeps (emergent groundwater at intertidal elevations) should be compared on the north (barrier beach/bayside) and south (terrestrial groundwater outflow from landscaped Presidio) sides of the marsh, particularly nitrates. This is not the same as storm drain inputs.

Design Review Group member Paul Jones suggested following the EPA Standard Operating Procedures for monitoring for fecal Coliform for five weeks in order to obtain geometric means. Rachel Kamman stated that water quality measurements taken before 9:30 AM will be collecting a lot of irrigation run off from the Presidio. Peter Baye advised that groundwater seepage occurs during irrigation periods and recommended being mindful of this. He added that this might be tied into soil samples for water quality, nutrients, and pollutants. Peter said that the event should be tied to the tide and stressed avoiding reliance on periodicity. He added that soil sampling in spring might be better in addition to sampling in late summer.

Sedimentation (p. 4-5): Peter stated that sedimentation studies should consider both "new" fine sediment (which is so far insignificant), and remobilization/redistribution of internal sediments (including sand) by wind waves. The flood tidal delta (beach sand shoal) is the most significant form of intertidal sediment accretion, and should be measured with equal intensity. This deposit will probably become a platform for new marsh, perhaps the only significant addition of new marsh.

Rachel Kamman noted that increased volumes of irrigation water may distort sampling results if data is collected in the morning hours.

Vegetation (p. 5): Peter stated that annual late summer surveys will be insensitive to important spring-summer annual plant species which were reintroduction objectives of the project. Ocular estimates and rank (interval) data for cover cannot be treated as continuous variables and analyzed as midpoints; subjective error is high in visual percent cover estimates. This makes parametric statistical analysis inapplicable. Also, stratified random sampling rather than systematic sampling matches assumptions of proposed data analysis. Elevation and soil data should be linked to transects, but transects need not be the general sampling technique. Subtidal vegetation (Ruppia maritima) should be surveyed if detected following periods of tidal lagoon choking or inlet closure.

Jasper Lament suggested that one possible solution would be to measure areal coverage using a handheld GPS (digitize polygon covered by each plant species).

Benthic invertebrates, Fish: Peter stated that fixed-season summer sampling, regardless of the state of the tidal inlet (choked, open, closed) may make between-year trends and comparisons impossible to interpret meaningfully. At least some sampling should be linked to inlet choking-closure-breach cycles. Stratified sampling of invertebrate infauna should segregate unstable flood tidal delta and stable bottom/intertidal gradients.

Jasper stated that no consideration of tidal stage appears in protocol; he suggested standardizing intertidal sampling with respect to tide stage and time of day (as has been done for bird sampling protocol). Also, it might be interesting to conduct limited nocturnal sampling, to see if different species are using the habitat at night.

Jasper commented on the issue of gear selectivity for fish. Beach seining is an appropriate sampling technique (important to use appropriate net height for depth of water being sampled). However, some members of the fish community could be missed by seining (or any other sampling gear). For example, some benthos-associated, or fast-swimming fish species might be missed; this can be partially addressed by adding a second gear type. A passive gear type, such as the minnow traps mentioned in the document, would be a good addition to the seining program. If traps are used, need to standardize size, and type of trap, as well as bait.

With respect to data analysis, Jasper recommended comparing the percentage of natives vs. non-natives for both invertebrates and fishes. He also suggested sampling at the inlet. Fish species using this habitat are likely to differ from those in intertidal zone.

Hydrology and Geomorphology: Peter stated that the frequent sampling of the inlet channel is appropriate. The same justification for greater than semiannual sampling applies to biological variables. Because of labor/time costs, it would be appropriate to conduct more frequent but limited sampling of a key subset of biological variables (e.g. selected permanent plots) soon after significant changes of state occur in the inlet channel. Seasonal (more than annual) aerial photographs would capture nearshore and backshore conditions that directly affect inlet channel dynamics (swash bar growth, inlet deflection downdrift,

washover fans, berm welding, scarping). Detailed channel profiles without reference to essentially related external geomorphic structures may limit the utility of costly channel surveys. A better compromise may be to mutually adjust frequency of aerial photos and channel surveys to the pace of morphodynamics (survey/photo events triggered by changes in rates of geomorphic change), rather than calendar dates.

Peter also stressed the idea of having the degree of tidal choking be the highest priority in determining the sampling periods/phases, followed by season, tidal stage, time of day, in a hierarchical form.

Jasper added that, on page 9, topographic surveys are specified as "biannual (=once every two years)," but I believe semi-annual (twice/year) was intended by the authors.

Channel surveys: Peter stated that channel surveys should include at least qualitative records of channel bedform, type, rank size, and distribution. The orientation (flood, ebb), size and position of megaripples should be recorded. Location and size of washover fan lobes in the beach ridge-deflected channel should be recorded. The size and planform of ephemeral outer lagoons (north of bridge) should be recorded. Current ripple size, plane beds, etc. should be noted. These may provide important semi-quantitative surrogate data for flow velocity measurements (not performed).

Soil sampling: Peter stated that soil sampling needs at least partial linkage with vegetation sampling, or else its meaning will be limited. This is especially important for winter-spring measurements of near-surface salinity, which strongly influences the timing and rate of germination and establishment of salt marsh plants. Summer-only sampling will explain little ecologically. Given the observed minimal rates of fine sediment accretion, stratigraphic sampling (measurement of sediment layers in small cores) may be simpler and less labor-intensive than sediment-erosion tables, and allow more extensive coverage of the wetland (greater number and dispersion of samples) per unit effort. The 3 proposed intensive sampling stations will provide no opportunity to analyze the significant effects of slope and orientation to winds (fetch, wave energy microenvironments). Sampling of sedimentation/erosion should occur along all internal shores. Erosion is highly significant along the south and north shores, indicated by development of conspicuous lag surfaces (coarse particle accumulation). Local redistribution of sand in the form of ephemeral swash bars is the most significant sediment transport (micro-spits) along the north shore, particularly during periods

of choked tides. Swash bars and lag surfaces should be measured, not just fine sediment. These may also become stabilized as future marsh surfaces (and they do so in Drakes Estero). The distinction of 3 sampling elevations (low, marsh plain, high marsh) is problematic here, since the entire marsh was graded artificially, and has not differentiated naturally.

Vegetation monitoring: Peter stated that vegetation monitoring appears to be unrelated to the original objectives for marsh vegetation restoration, which stressed native plant diversity of a distinctive backbarrier marsh flora, over nesting habitat (this small, isolated, urban marsh would be unlikely to support a breeding population of clapper rails or salt marsh harvest mice). Floristic surveys, and sampling methods sensitive to patch heterogeneity (distinctive patches of vegetation in irregularly patterned mosaics) rather than gradients would be appropriate for this marsh. Flat, monotypic stands of pickleweed and cordgrass are not likely to develop here in the forseeable future. Stratified random sampling designs, and sampling scales fitted to patch size would be more appropriate than systematic sampling of transects. Ordination of truly random preliminary samples could produce objective stratification of non-grid "cells" (now rectangular and arbitrary). Transects and permanent plots can be useful and should be included, but not exclusively. Objective cover measurements (point or line-intercept) should be used instead of subjective rank (interval) percent cover data. Given the high turnover of field staff at the Presidio, this is particularly important, since even "calibrated" (simultaneously trained) observers have high subjective error in cover estimation. Ground-truthed aerial photos (infrared) would be the most efficient way of measuring amount, pattern, and distribution of vegetation cover, using GIS.

Birds: Jasper stated the incorporation of both low and high tide surveys is an excellent feature. Jasper recommended specifying and standardizing magnification of optics (binoculars and spotting scopes) in protocol. Peter stated that at least some evening/night surveys would be appropriate; Jasper recommended testing night vision equipment for evening/night surveys. Black-crowned night herons frequently visit the outer lagoon (and possibly the inner lagoon) in summer, and may be underrepresented in diurnal surveys. Great horned owls also occasionally roost on utility poles year-round, but sometimes do not call in winter. Focused surveys on distribution and number of gulls and ravens would be useful, especially on marsh "islands" and flood shoals, where gulls often dominate.

General Comments: Roger Leventhal suggested the following:

Develop solution strategy upfront to inform the Monitoring Program. There doesn't seem to be a connection with the proposed data collection program with a plan to address the on-going lagoon closure problems. Particularly on projects that are experiencing problems (such as inlet closure), its best to develop a plan of attack upfront to address these problems and then design a monitoring program to collect this data. For example, it appears possible that some kind of coastal engineering solution may be required at Crissy such as groins or other sediment deflection structures. In a dynamic environment such as at Crissy, a 2-d computer model will likely be set-up to model different configurations to develop a solution. Is the monitoring program designed to collect enough and the right data to set-up and calibrate such a model (such as current data)? The proposed monitoring program may be fine but I believe it important not to just collect data without thinking through upfront on how that data might be used and analyzed at a later date. This may have been done but it was not presented that way at the DRG meeting.

Collect Current Data. NPS should evaluate the usefulness of collecting current data, which could be used to set-up and calibrate a computer model as described above. If deemed useful, I would recommend using Nortek gauges (www.NortekUSA.com) and deploy as many as practical. I would also recommend deploying at lest one current gauge even at the expense of one of the water level gauges (if cost is an issue).

Wave and Water Level Recorders. I reviewed past notes and spoke with an experienced coastal engineer after our meeting. The following are gauges are commonly used for measuring wave and water levels (www.coastal-usa.com). Coastal MacroWave or MacroSpec (waves and water levels). MacroSpec provides direction and the MacroWave does not. NPS may want to explore the use of these gauges.

Rachel Kamman noted the following:

Ultimately the understanding of the dynamics of lagoon and inlet morphology will be dependant on the understanding of nearshore littoral processes. The littoral processes carry sediment to and from the inlet thereby dictating the supply and composition of coastal sediments in the inlet and the lagoon.

Assessment and management of the longshore sedimentation issues apparent at the Crissy, will require knowledge of the nearshore

bathymetry (seasonally), the local currents and wind-wave field (already characterized via Bay oil spill modeling studies, and a local sediment budget. Because longshore processes are primarily wave (wind and bathymetry) driven they can be effectively isolated from lagoon/wetland process when evaluating measures that to promote wetland function and mitigate local erosion problems. I agree that synoptic measurement of interior water levels, inlet flow velocities and exterior water levels, flow fields and wave heights would be of value. However, such monitoring programs quickly become extremely costly. I recommend careful consideration of monitoring locations and periods so as to capture the physical process driving shoreline and Inlet morphology. Successful mitigation measures will be based on an understanding of the physical processes driving the system.

b. Issues Not Addressed by the Review Team and Rationale:

The Design Review Team did not determine any issues to be outside of the scope of the Design Review Group.

c. Phasing and Coordination.

d. Other issues:

5. Disclaimers:

a. The recommendations of the Restoration Program are not binding on any permitting agency and they will not restrict any agency's authority.

b. The Restoration Program, which makes every effort to provide value added feedback, cannot guarantee issuance of permits by any regulatory agency.

c. The Restoration Program is intended to provide comments and feedback on the habitat value of plans and designs. This assistance will necessarily be limited, and should not be expected to substitute for professionally prepared site evaluations, hydrological studies, final designs, and construction plans.

d. The Restoration Program and the participating agencies will not be liable for the failure of any project.

e. Project review by the Design Review Group does not constitute an endorsement of the project by the Design Review Group or by the Wetlands Restoration Program.

ATTACHMENT A

Project Description:

i. Project objectives:

In May 2001, the National Park Service and the Golden Gate National Parks Association completed the restoration of the 100-acre Crissy Field site (Figure 1). An 18-acre tidal marsh and 22 acres of dune and dune swale habitat were re-created, consistent with habitat goals outlined in the San Francisco Bay Goals Project for the central Bay subregion (Goals Project, 1999). The restoration was made possible primarily through philanthropic support, some public funds, and extensive community involvement. More than 230,000 cubic yards of fill were removed and a 40-foot-wide channel to the bay was opened in November 1999. Almost 100,000 native plants representing 110 species were planted or seeded in the restoration site including seven special status species. The National Park Service, in coordination with the Golden Gate National Parks Association, is currently in the second year of a five year program to monitor the physical and biological development of the restored areas. Elements of the monitoring program include marsh morphology, tide level, water quality, soils, sedimentation, vegetation, invertebrates, fish, and birds. The site continues to evolve with the tidal inlet experiencing the greatest post-construction morphological change. This change has included the formation of a flood shoal (on the tidal marsh side of the inlet), an ebb shoal (on the Bay side of the inlet), and dynamic changes in the orientation and elevation of the inlet channel. Plant cover has increased substantially since restoration and fish and invertebrates quickly colonized the site; over 12 species of fish and numerous invertebrates have been collected. Likewise, over 135 species of birds have been observed utilizing the area for foraging, nesting, or resting. Results from the monitoring program will be used to guide adaptive management and inform future wetland and dune restorations in the GGNRA.

A draft monitoring plan for following the development of the restored areas at Crissy Field was initially developed by Meredith Savage of the Golden Gate National Parks Association (GGNPA). This plan called for monitoring of hydrology and geomorphology, water quality, soils, sedimentation, vegetation, fish, invertebrates and birds. The plan was completed in May 2000 and included detailed protocols for sampling each parameter (Savage 2000). Protocols were developed following thorough literature review, and went through several revisions that were guided by input from local experts as well as National Park Service natural resources staff.

The draft monitoring plan was implemented from July 2000 through July 2002. Not all parameters included in the plan were sampled and the recommended frequency of sampling for some parameters was not met. This period of implementation did provide field-testing of methods and a more thorough understanding of the system. Based on this enhanced understanding, the original plan was modified, protocols were improved, and several new parameters were identified for inclusion in an updated monitoring plan. The updated monitoring plan is presented in this document.

The purpose of this project is to monitor the newly restored Crissy Field Marsh over the next five years. During this time, the viability of native plantings, the return of wildlife and the functioning of the site hydrology will be carefully monitored, and adaptive management strategies developed and applied as necessary.

The objectives of the monitoring program for the Crissy Field Restoration Area are to:

- Track the development of ecosystem structure and function within the restored areas.

- Provide baseline information on physical, chemical and ecological attributes of the restored areas in order to guide future restoration projects in the Presidio and nearby National Park Service lands.

- Provide information to guide any adaptive management actions required to maintain the healthy function of the restored tidal marsh system.

- Share monitoring results with Crissy Field stakeholders including the scientific community, agencies and organizations interested in wetlands restoration, educational groups and the public through existing publications and media, meetings, and local conferences.

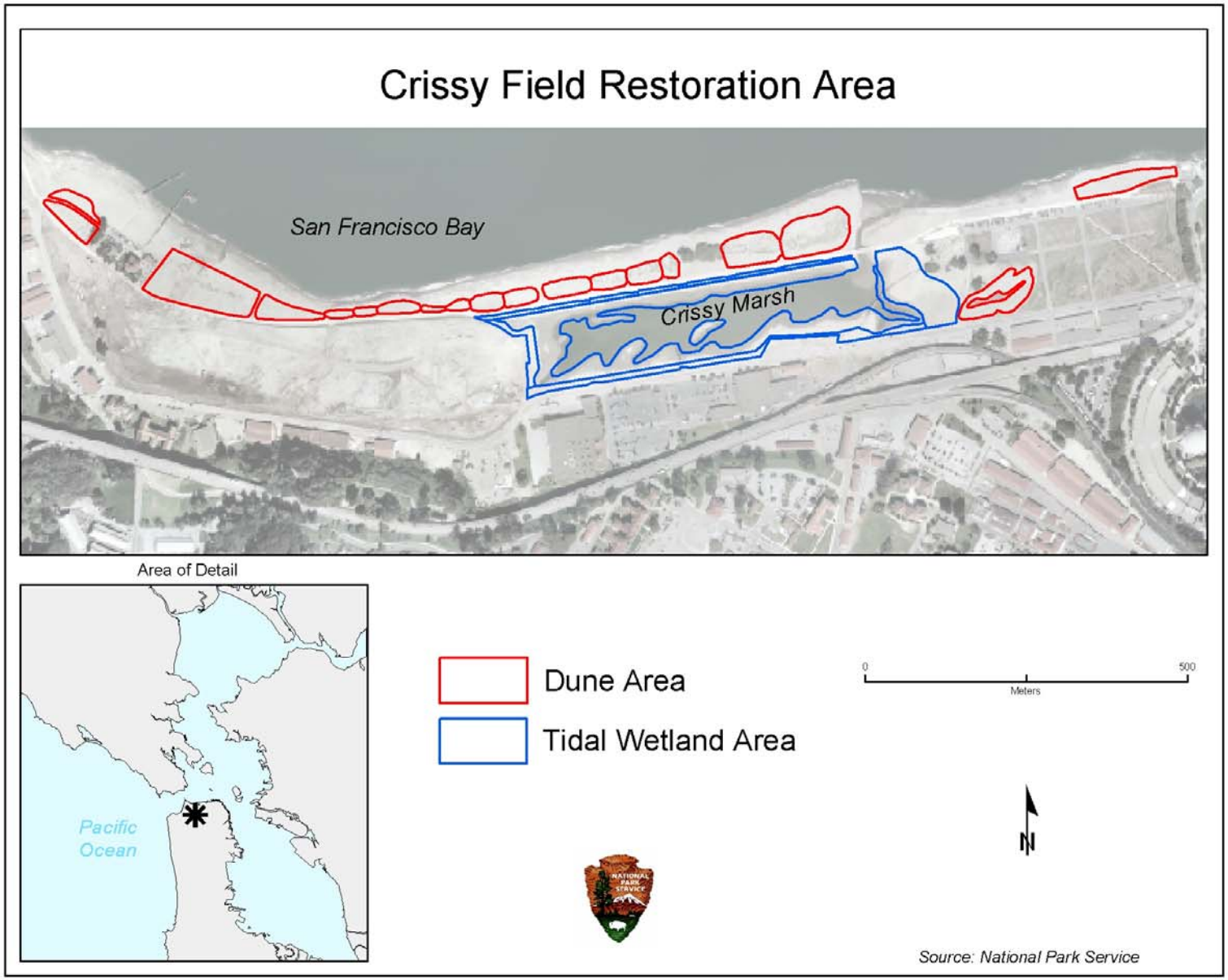

Figure 1. Crissy Field Restoration Area Site Map

ii. Project location and map:

The proposed project site can be seen in Figure 1, above.

iii. Type and acreage of habitats to be created or restored:

This Design Review Group review evaluates the protocols established to monitor the evolution of the completed restoration of 100 acres of marsh at Crissy Field.

iv. Past use and current condition of the site:

See "i. Project Objectives," above.

v. Description of any special features or issues:

1. Public access

   Crissy Field is a popular public access spot along San Francisco Bay, although public access does not substantially affect this design review analysis.

2. Flood control

   Flood control is not a concern at the site.

3. Subsidence

   Subsidence has not proven to represent a problem at the site.

4. Mitigation

   Crissy Field is not a mitigation-based project.

5. Other adjacent/nearby projects

   Not applicable.

6. Opportunity for transitional habitats

   Creation of transitional habitats are outside the scope of this project review.