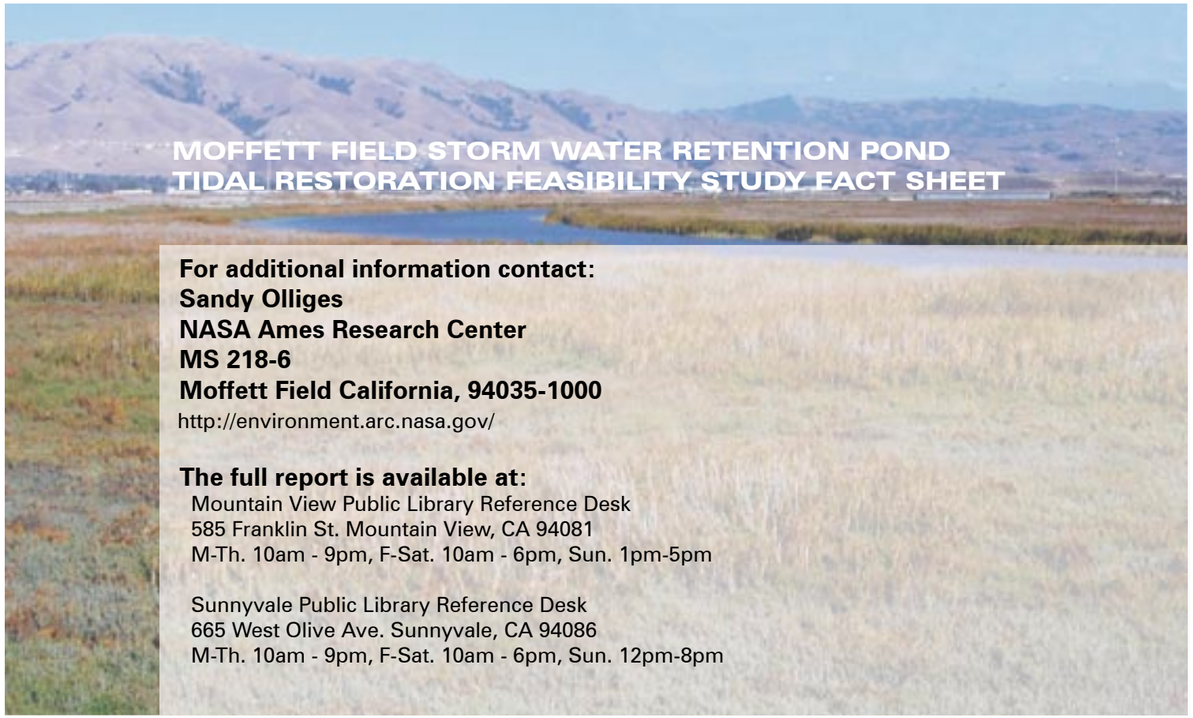

MOFFETT FIELD STORM WATER RETENTION POND TIDAL RESTORATION FEASIBILITY STUDY FACT SHEET

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JULY 2005

NASA Ames Research Center

MOFFETT FIELD STORM WATER RETENTION POND TIDAL RESTORATION FEASIBILITY STUDY FACT SHEET

The overall purpose of this study is to assess the technical and fiscal feasibility of restoring the Moffett Field Storm Water Retention Pond (SWRP) to tidal salt marsh. As part of the restoration feasibility study, Brown and Caldwell, Philip Williams & Associates, H.T. Harvey & Associates, and GAIA Consulting, Inc., (Project Team) evaluated existing conditions, identified opportunities and constraints, developed alternatives, and evaluated the alternatives against a set of project objectives.

EXISTING CONDITIONS

Existing SWRP conditions were evaluated with respect to topography, groundwater, storm water hydrology, physical processes, and biological functions and values. The NASA Ames Research Center (Moffett Field) watershed consists of 1,690 acres, divided into Eastern and Western Drainage Basins. The majority of the storm water runoff from the Western Drainage Basin currently discharges to the SWRP, via a settling basin and the Eastern Diked Marsh. A small portion of the Western Drainage Basin runoff flows to the Western Diked Marsh and into the SWRP. The SWRP has no outlet and generally fills up with storm water runoff over the wet season (winter and early spring) and then empties, primarily through evaporation, during the dry season (summer and fall). During very wet years in the past, storm water runoff from the site has occasionally exceeded the capacity of the SWRP and, to avoid overflows, NASA has had to install temporary pumps to remove water from the SWRP and pump it directly to Stevens Creek.

Topography. Topographic data collected by NASA in 1992 were supplemented by a ground survey performed by PWA in July 2004 to provide spot checks on the NASA data, particularly for key locations. Some relatively significant discrepancies between the 1992 and 2004 data sets exist which could indicate subsidence over time. However, the amount of SWRP subsidence cannot be accurately deduced, as the lowest points in the SWRP (borrow ditches) were not surveyed during the 1992 survey. The typical bed elevation of the SWRP is presently -1 to -2 feet and the low points in the perimeter levees around the SWRP are 4 feet (NAVD 1988 vertical datum).

Figure 1
NASA Ames Research Center Boundaries

Groundwater. The water table at the Moffett Field site is relatively high, on the order of -2 to -3 feet NAVD (2 to 3 feet below mean sea level). Therefore, groundwater levels are anticipated to be within 1 to 2 feet of the bed of the SWRP.

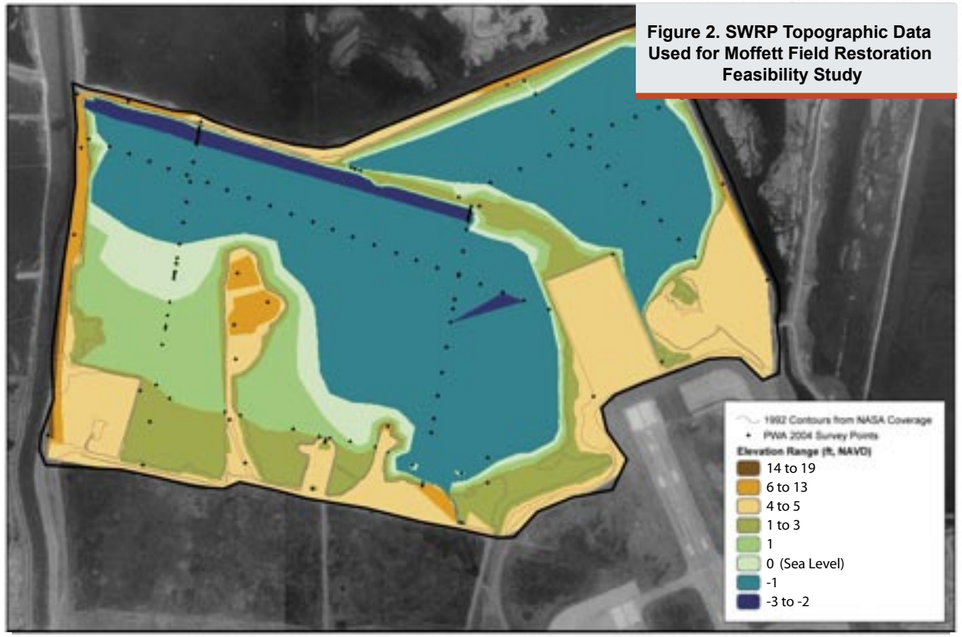


Figure 2. SWRP Topographic Data Used for Moffett Field Restoration Feasibility Study

Storm water storage. The entire SWRP encompasses 213 acres, including a 54-acre parcel owned by the Mid-Peninsula Regional Open Space District (MROSD), a 56-acre NE Basin, and a 103-acre Central Basin. The three components of the SWRP are hydraulically connected with one another, but the NE and Central Basin are separated by a low-lying levee. Altogether, the SWRP currently provides approximately 900 acre-ft of storage volume for storm water with a water surface elevation of 4 ft NAVD, or the height of the low points in the levees. The three components of the SWRP provide storage volume as follows: MROSD - 200 acre-ft, NE Basin - 249 acre-ft, and Central Basin - 454 acre-ft. The Eastern and Western Diked Marshes provide additional storm water storage volume, above and beyond the SWRP, totaling approximately 57 acre-ft.

Storm water runoff. A hydrologic model (Hydrologic Simulation Program – Fortran or HSPF) was applied to the Moffett Field site using a 56-year period of record (1948 – 2003) to simulate historic storm water flows from the site. Rainfall data from the Moffett Field and San Jose stations were used, along with estimates of impervious area on the site, to predict storm water runoff volumes. Evapotranspiration data from sources near the Moffett Field site were used to estimate losses from the SWRP. No site-specific data were available to calibrate the model. Uncertainties associated with the input data, particularly for evapotranspiration and impervious area, were quantified and model results have been presented as ranges. The range of model predictions associated with evapotranspiration data and impervious surface area variability were plus or minus 40% and 12%, respectively. Under existing SWRP conditions, the model predicts a range of zero to 11 overflow (pumping) events over the 56-year period of record, depending on the evapotranspiration range of data. Pumping would need to occur below 4ft NAVD to provide freeboard.

Physical processes. Tide data from the vicinity of the Moffett Field site indicate that if tidal circulation were re-introduced to the SWRP, tidal elevations (e.g., Mean Higher High Water level of 7.6 feet) would be high enough to inundate much of the Moffett Field site, unless levees were created to separate the SWRP from upland areas. The far South Bay is typically a depositional environment with easily resuspended sediments and relatively high suspended sediment concentrations (e.g., as high as 1,000 mg/L or more), due to the strong influence of wind-wave driven sediment resuspension.

Biological habitat. The area for each of nine different types of biological habitat was predicted for each of the alternatives. The main difference in biological habitat between the alternatives is that the tidal salt marsh and tidal salt marsh/upland transition habitat increases going from Alternative 1b to 3, while the non-tidal, open water habitat decreases. In addition to considering the broad biological habitat objective as described in Section 5.1, two more specific biological selection criteria were evaluated, as follows:

California Clapper Rail

Balanced Biological Habitat. Restore and enhance a balance of both salt marsh habitat and open water/mudflat habitat to improve conditions for salt marsh endemic species as well as for shorebirds and waterfowl. This objective would improve habitat for the federally-listed endangered salt marsh harvest mouse and California clapper rail, the salt marsh wandering shrew, and the California black rail.

Salt Marsh Habitat. Restore and enhance salt marsh habitat to improve habitat for endemic salt marsh species including the federally-listed endangered salt marsh harvest mouse and California clapper rail, the salt marsh wandering shrew, and the California black rail.

Salt Marsh Harvest Mouse

Nuisance species management.
Alternatives 2a and 2b offer the greatest opportunities for cost-effective design and management tools for control of nuisance species, particularly mosquitoes and invasive plants. Alternative 3, full tidal restoration, provides fewer management tools for control of nuisance species since water management is not an option. Finally, Alternatives 1a and 1b do not allow for water level management as a tool, while still retaining the storm water ponds and Western Diked Marsh as havens for mosquitoes and pepperweed.

Perennial Pepperweed

Public access (Bay Trail). The most potential for public access (linkage of the Bay Trail adjacent to NASA Ames) is provided by Alternatives 1a, 1b, and 2a. Alternative 2b offers limited public access, as the levee alignment next to the Moffett Field airstrip presents security issues. Because the levee closely surrounds NASA Ames for Alternative 3, this alternative offers the least potential for public access.

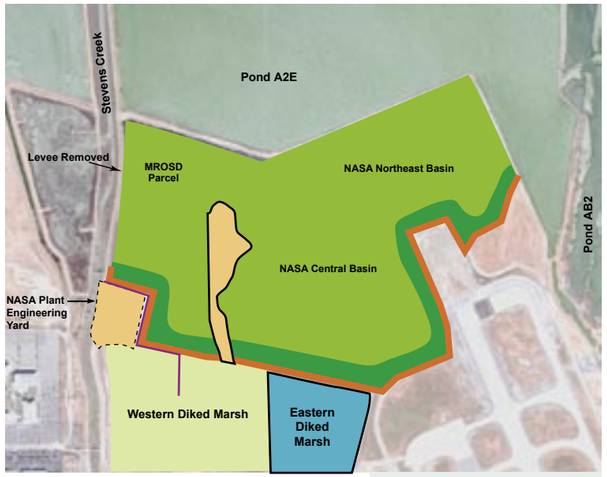
Cost effectiveness. A comprehensive planning level cost evaluation was conducted. Capital improvement costs ranged from zero for Alternative 1a to $21.0 million for Alternative 3. Incremental costs of restoration ranged from $31,000 to $98,000 per acre, with Alternative 2a being the most cost-effective.

Table 1 Alternative Evaluation Matrix

	Alternative Rating				
	1a	1b	2a	2b	3
Primary Objectives	No Action (Exisiting Conditions)	No Action (Removal of MROSD parcel)	Stevens Creek Expansion	NE Basin Restoration	Full Tide Restoration
Storm Water Management	High (3)	Medium (2)	Medium (2)	Low (1)	Not Achievable(0)
Biological Habitat					
Balanced Biological Habitat	Low (1)	Low (1)	Medium (2)	High (3)	Medium (2)
Salt Marsh Habitat	Low (1)	Medium (2)	Medium (2)	Medium (2)	High (3)
Nuisance Species Management	Low (1)	Low (1)	High (3)	High (3)	Medium (2)
Public Access - Bay Trail	High (3)	High (3)	High (3)	Medium (2)	Low (1)
Cost Effectiveness	Not Achievable(0)	Low (1)	High (3)	Medium (2)	Low (1)
Total Score	8	8-9	13	10-11	6-7

RECOMMENDED ALTERNATIVE

A summary of ratings for each of the alternatives is presented in Table 1. Alternative 2a was rated the highest and is the restoration alternative recommended by the Project Team. This alternative represents a cost-effective approach to restoring tidal salt marsh, creating beneficial biological habitat, and managing for nuisance species while continuing to effectively manage storm water flows.



Background: IKONOS Satellite Photo - May 2004 (Provided by the City of San Jose)

[1] The Eastern Diked Marsh was not surveyed during the exisiting conditions field work, but appears to be primarily freshwater marsh with some pockets of riparian habitat (Jones and Stokes, 1999).

Figure 9
Alternative 3: Full Tidal Restoration

Alternative 3: Full Tidal Restoration

KEY FEATURES

- Restores the entire SWRP (MROSD parcel, Central Basin, and NE Basin) to tidal salt marsh.
- Depends on fate of Pond A2E, as determined through the SBSPRP decision-making process.
- Results in a 94% reduction of the available storm water storage volume of the SWRP.
- Results in regular pumping of storm water runoff from Moffett Field to the San Francisco Bay.
- Significantly increases biological habitat value.
- Provides moderate nuisance species management.
- Provides significantly limited potential for public access.
- Does not provide a cost-effective solution.
  - Capital cost of $21.0 million.
  - Incremental cost of $94,000/acre of restored or improved area.

EVALUATION OF RESTORATION ALTERNATIVES

The feasibility assessment of restoring the Moffett Field SWRP will be integrated into the larger planning and decision-making process of the SBSPRP, as Moffett Field is considered a "related project." Planning for the restoration of the SWRP must be integrated with the SBSPRP long-term plan for Pond A2E and plans for a future flood control levee. An integrated assessment will also allow for a broader context to make decisions about the appropriate habitat mix for the site.

Moffett Field restoration alternatives were evaluated relative to five project objectives, which were based on five SBSPRP objectives that were particularly relevant for the Moffett Field project, including storm water management (aka flood management), biological habitat, nuisance species management, public access (Bay Trail) and cost effectiveness. Each of the alternatives was evaluated against the five project objectives and rated low (1 point), medium (2 points), or high (3 points) relative to the ability of the alternative to meet the objective. Alternatives not capable of meeting a given objective were rated as not achievable (0). Storm water management is a critical success factor for any alternative. No weightings have been applied to differentiate the relative importance of the various objectives.

Storm water management. The hydrologic model developed for the Moffett Field site was used to predict a range of frequency of overflow events associated with each alternative, based on the 56-year period of historical record. In order to provide some freeboard, pumping would likely be required even more frequently than the predicted overflow events. A summary of the model predictions for overflow events follows for each alternative.

- 1a: Overflows during one in every 32 to 56 years
- 1b: Overflows one in every 5 to 56 years
- 2a: Overflows one in every 5 to 56 years
- 2b: Overflows one in every 2 to 4 years
- 3: Overflows every year

Existing Moffett Field Storm Water Retention Pond

As noted in the Opportunities and Constraints section, NASA has established an objective to limit pumping events to once every five years. Based on the modeling results, Alternative 1a would meet the NASA pumping objective. Alternatives 1b and 2a would likely meet the objective. Alternatives 2b and 3 would not meet the objective. Alternative 3 would require pumping every year and would lead to significant flooding of the Moffett Field site.

Biological functions and values. Historic biological surveys for the Moffett Field site and surrounding area were augmented by a reconnaissance-level biotic survey performed by HT Harvey in June, 2004. An existing habitat map for the project area was updated and expanded to include Stevens Creek, based on site surveys performed in July 2004. The project site currently includes a diverse mosaic of biotic habitats, including non-tidal open water, diked salt marsh, salt marsh/ freshwater seasonal wetland transition, freshwater marsh, salt pan, peripheral halophyte, coyote brush scrub, non-native herbaceous vegetation, and developed areas. Existing wildlife and vegetation were described for each of the habitat types. Based on the existing habitat, several special-status plant and animal species could potentially occur at the project site.

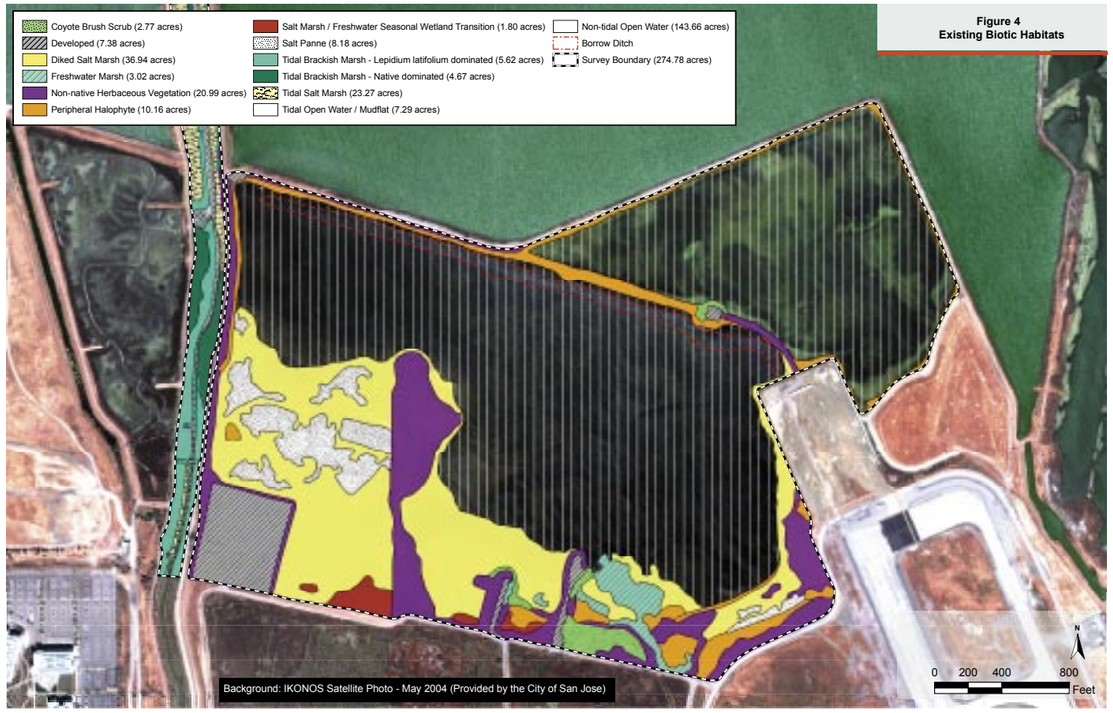


Figure 4
Existing Biotic Habitats

OPPORTUNITIES AND CONSTRAINTS

A number of opportunities and constraints were identified for the Moffett Field site related to storm water hydrology, physical processes, and biological functions and values. Several possible opportunities to address storm water capture and storage needs were identified, but the Moffett Field site is also quite constrained by a relatively high ground water level, limited undeveloped area in the watershed for storm water storage, and high potential for upland flooding with relatively flat, low topography of the site. Some sort of storm water management facility, either the existing SWRP or a comparable facility, is needed to capture and store storm water runoff from the Moffett Field site, and NASA has set an objective to limit pumping of the SWRP to no more frequently than one year in five.

A few opportunities for tidal connection to the SWRP were identified, via Stevens Creek and via Pond A2E of the South Bay Salt Pond Restoration Project (SBSPRP). Natural sedimentation over time or on-site fill could be used to raise ground elevations on the site to support a tidal marsh environment. However, because the site has subsided seven to nine feet below the typical natural marshplain elevation of MHHW (7.6 ft NAVD), a considerable amount of sediment would be required to restore the entire area to tidal marsh. The SWRP site provides biological opportunities for shorebirds and waterfowl, potential recovery of the salt marsh harvest mouse, restored habitat for the California Clapper Rail, restored transitional upland habitat, and restored riparian habitat. Invasion of perennial pepperweed and/or Spartina alterniflora (smooth cordgrass) were identified as significant potential constraints.

RESTORATION ALTERNATIVES

Opportunities and constraints were applied by the Project Team to help frame three restoration alternatives, including no action, partial tidal restoration, and full tidal restoration. Variations of the no action and partial tidal restoration alternatives were also assessed. Brief summaries of each of the alternatives follow.

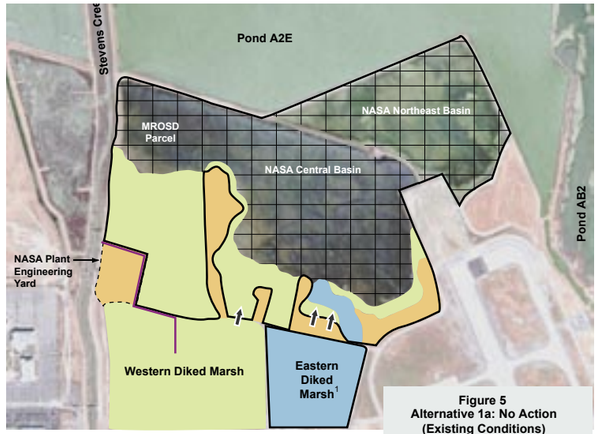


Figure 5
Alternative 1a: No Action
(Existing Conditions)

Background: IKONOS Satellite Photo - May 2004 (Provided by the City of San Jose)

[1] The Eastern Diked Marsh was not surveyed during the exisiting conditions field work, but appears to be primarily freshwater marsh with some pockets of riparian habitat (Jones and Stokes, 1999).

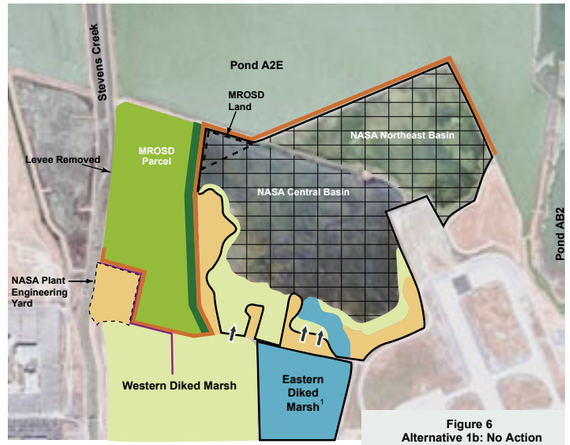


Figure 6
Alternative 1b: No Action
(Removal of MROSD Parcel)

Background: IKONOS Satellite Photo - May 2004 (Provided by the City of San Jose)

[1] The Eastern Diked Marsh was not surveyed during the exisiting conditions field work, but appears to be primarily freshwater marsh with some pockets of riparian habitat (Jones and Stokes, 1999).

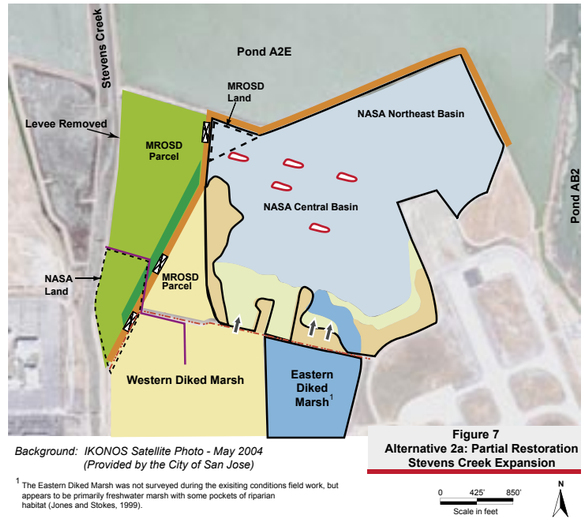


Figure 7
Alternative 2a: Partial Restoration
Stevens Creek Expansion

Background: IKONOS Satellite Photo - May 2004 (Provided by the City of San Jose)

[1] The Eastern Diked Marsh was not surveyed during the exisiting conditions field work, but appears to be primarily freshwater marsh with some pockets of riparian habitat (Jones and Stokes, 1999).

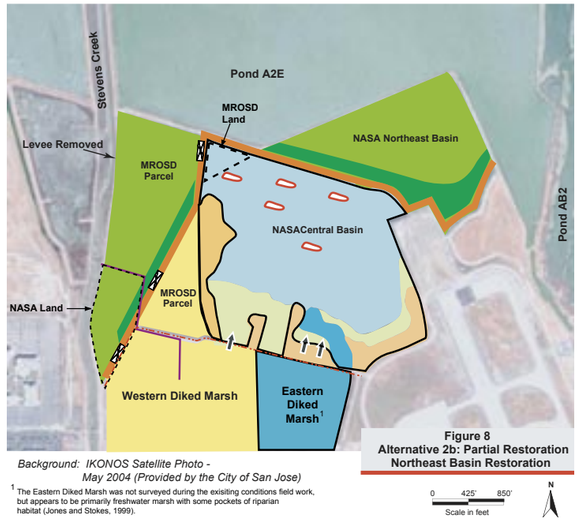


Figure 8
Alternative 2b: Partial Restoration
Northeast Basin Restoration

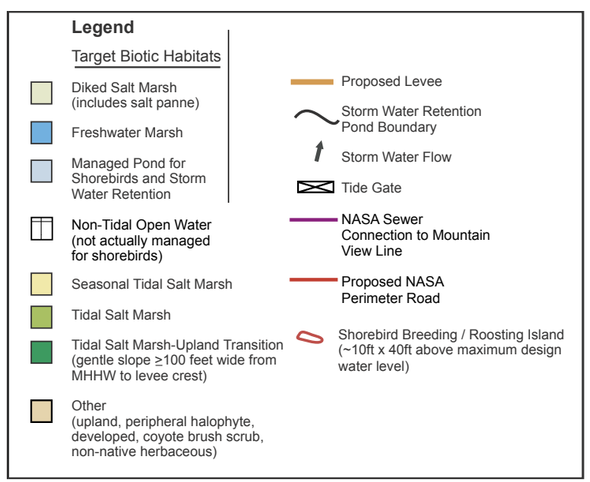
Background: IKONOS Satellite Photo - May 2004 (Provided by the City of San Jose)

[1] The Eastern Diked Marsh was not surveyed during the exisiting conditions field work, but appears to be primarily freshwater marsh with some pockets of riparian habitat (Jones and Stokes, 1999).

Alternative 1a: No Action (Existing Conditions)

KEY FEATURES

- Represents no change in the current site condition, and considered as a baseline only for comparison to other actions.
- Maintains current site configuration, storm water retention capacity, and site habitat.
- Provides potential for public access.



Alternative 1b: No Action (Removal of MROSD Parcel from Storm Water Storage) [a]

KEY FEATURES

- Isolates the MROSD parcel from the SWRP.
- Provides tidal salt marsh/upland transition habitat by constructing a gently sloped fill area along the outboard side of the new flood control levee.
- Results in a 27% reduction of the available storm water storage volume of the SWRP.
- Provides some increased biological habitat value.
- Does not provide nuisance species management.
- Provides potential for public access.
- Does not provide a cost-effective solution.
  - Capital cost of $9.3 million.
  - Incremental cost of $163,000/acre of restored or improved area.

Alternative 2a: Partial Restoration Stevens Creek Expansion [a]

KEY FEATURES

- Removes the eastern levee between Stevens Creek and the SWRP (MROSD parcel) to allow flows into the MROSD parcel and development of tidal marsh.
- Widens Stevens Creek by removing the eastern levee beginning slightly south of Moffett Field's perimeter road.
- Includes five water bird breeding/nesting habitat islands.
- Provides tidal salt marsh/upland transition habitat by constructing a gently sloped fill area along the outboard side of the new flood control levee.
- Results in a 27% reduction of the available storm water storage volume of the SWRP.
- Moderately increases biological habitat value.
- Provides nuisance species management.
- Provides potential for public access.
- Provides a cost-effective solution.
  - Capital cost of $8.3 million.
  - Incremental cost of $27,000/acre of restored or improved area.

Alternative 2b: Partial Restoration Northeast Basin Restoration [a]

KEY FEATURES

- Builds on Alternative 2a, restoring the NE Basin to tidal salt marsh habitat by breaching the Pond A2E levee.
- Depends on fate of Pond A2E, as determined through the SBSPRP decision-making process.
- Includes five water bird breeding/nesting habitat islands.
- Provides tidal salt marsh/upland transition habitat by constructing a gently sloped fill area along the outboard side of the new flood control levee.
- Results in a 47% reduction of the available storm water storage volume of the SWRP.
- Moderately increases biological habitat value.
- Provides nuisance species management.
- Provides limited potential for public access.
- Provides a moderately cost-effective solution.
  - Capital cost of $19.5 million.
  - Incremental cost of $63,000/acre of restored or improved area.

[a] The proposed levee alignment does not follow property boundaries. The actual levee location would be determined by MROSD, NASA, and the Corps in future planning. A small portion (~2 acres) in the northwest corner of the area depicted as the NASA Central Basin in the figure is actually owned by MROSD. Refer to Figure 1 for MROSD and NASA property boundaries.