REVISED ALTERNATIVES DESCRIPTIONS
ORMOND BEACH WETLANDS RESTORATION FEASIBILITY STUDY
(DRAFT - 5/14/09)

Three broad strategies have been identified for developing large-scale restoration alternatives. These strategies include:

- Alternative 1 – Creation of a new tidal lagoon with a permanent open connection to the ocean;
- Alternative 2 – Restoration of historic wetland habitat mosaic with intermittingly open inlets and seasonal ponds; and,
- Alternative 3 – Enhancement of existing habitats with minimal hydrologic and ground surface modifications.

Each of these strategies has two variants that bracket the range of project area available for restoration. The 'unconstrained' variant (Figure 1) encompasses the maximum feasible project area whereas the 'constrained' variant (Figure 2) is limited to land under existing project team ownership. Each restoration alternative is then fit to the footprint of each variant. For example, Alternative 1U, the unconstrained variant, maximizes the footprint of the tidal lagoon and adjacent tidal wetlands. Alternative 1C, the constrained variant, consists of the smallest tidal lagoon possible while maintaining the same nominal function of an open inlet, but compromises by reducing wetland extent.

The guiding principle behind each alternative's design is to restore habitats through both topographic and hydrologic modifications that together sustain ecologic functions. This integration of habitat with the underlying geomorphic and hydrologic processes ensures that the designs are sustainable.

The descriptions of the alternatives in this section correspond to the expected conditions within the first decade of completing project construction. During this first decade, an alternative's design grading plan will largely determine the physical layout of the site. It is assumed that vegetation, which will be planted as part of the restoration design, will have fully colonized the site. In addition, the site will have been exposed to and adapted to some degree of seasonal and inter-annual climatic variability.

The designs also anticipate long-term changes in physical processes that will act on the project site. Because of its coastal location, a significant long-term change will be future sea level rise. Sea level rise will elevate the tidal water levels which determine tidal wetland habitat type, magnify the impact of extreme storm events, and probably shift the coastline landward. These alternatives are designed to anticipate the impact of three feet of sea level rise. While uncertainty remains as to future rates of sea level rise because of uncertainty about future carbon emission rates and the oceans' response, it is reasonably certain that three feet of sea level rise will occur between 50 and 100 years from the present day (Isenberg, 2008).

These restoration alternatives are compared with the option of taking no action on the project site, summarized below as Alternative 4.

New Tidal Lagoon (Alternative 1)

This alternative features a large tidal lagoon permanently connected to the ocean by an inlet channel (Figure 3 and Figure 4). Creation of a tidal lagoon departs from the site's historic conditions, but is consistent with the regional goal of replacing subtidal habitat lost throughout Southern California. The lagoon is fringed with tidal southern coastal salt marsh. The salt marsh transitions to dune habitat towards the ocean and to coastal prairie landward. On the southeastern parcel currently graded and

manages as duck ponds, the site would be reconfigured to expand salt marsh habitat, enhance managed duck habitat, and create coastal prairie uplands. Freshwater inputs to the project site would be re-routed to complement the design. The common aspects of these components of the tidal lagoon alternative are described below, and then specific implementation of the two land use variants is detailed.

The proposed open-water lagoon covers a substantial portion of the project site. As shown in Figure 5, its maximum depth is approximately 4.6 ft below mean lower low water (MLLW) or 4.8 ft below NAVD88, providing subtidal habitat for fish and benthic species. A permanent inlet connects the lagoon to the ocean, which supplies the regular tidal water level fluctuations and consistent salinity that sustain tidal habitat. To ensure that the inlet remains open, a jetty on the north side of the inlet is recommended. The jetty provides additional resistance to inlet closure and limits lateral migration of the inlet by deflecting the predominant sand transport away from the inlet's mouth.

A progression of habitats surrounds the proposed tidal lagoon. The delineation of these habitats is determined by their hydraulic connection and ground elevation relative to the tides. The site's existing beach and foredune system, which is supplied with sand by alongshore transport, would be largely unchanged except for the incision for the new inlet. Windblown sand from the beach and foredunes supports re-introduced backdune habitat, typified by vegetated swales and depressions. The tidal lagoon sustains a fringing salt marsh with regular fluctuations of water level and consistent salinity. As elevations gradually increase, the marsh transitions to coastal prairie, which is configured with slight depressions to pond rainfall and create seasonal wetlands. It also includes expansion of existing stands of willow scrub. The portion of coastal prairie adjacent to the salt marsh, denoted as 'transitional', represents the area that is likely to become future salt marsh in response to three feet of sea level rise. The actual transitions between these habitats would not be the sharp boundaries shown for convenience in Figure 3. Rather, the habitats would blend at their boundaries, with a mixture of characteristic vegetation spanning the transition from one habitat to another. For more information on the biological specifics of each habitat type, see Section X.

This alternative accommodates the freshwater flows entering the project site from the adjacent watershed by routing them through treatment wetlands and then incorporating them into the site's hydrology. Treatment wetlands trap watershed pollutants, minimizing their distribution throughout the project area. The larger drains which flow throughout the year are connected to the tidal lagoon. This creates brackish habitat between saline and fresh water. Connection to the lagoon is also likely to improve flood conveyance. Freshwater flow can pass through the permanently open inlet rather than becoming impounded behind in the existing beach berm.

The existing Oxnard Drainage Ditch #3 (ODD #3), which currently cuts across the land slated for the lagoon and drains to the southeast, will be reconfigured. A large subsurface drain which delivers water to ODD #3 within the project area may either be re-routed parallel to Arnold Road and re-connected with ODD #3 south of the channel block or filtered through a treatment wetland at the edge of the lagoon before spilling into the lagoon.

Unconstrained (Alternative 1U)

The unconstrained variant of Alternative 1 leverages the extensive project area to provide both a variety of wetland habitats and the flexibility for the habitats to adapt to future change such as sea level rise (Figure 3). At approximately 450 acres each, open water habitat and tidal salt marsh are the two largest habitat areas. Coastal prairie fringes the tidal salt marsh to permit a gently-sloped transitional zone for

transgression of the salt marsh in response to sea level rise. Because of the unconstrained project area, the tidal inlet can be located in the northern half of the site's coastline.

This variant integrates flows from all three drains in the local discharge network. The Oxnard Industrial, J Street, and Hueneme Drains flow first into treatment wetlands just inside the project boundaries and then into the lagoon. Their previous outlet, the J Street lagoon, would be incorporated into the new lagoon. This permanent connection to the ocean, which enhances flood conveyance, is of particular value for J Street Drain since it currently poses the largest flood risk to developed areas of Oxnard (Ref J St Drain project).

Actions on the southeastern portion of the site, the existing Ventura County Game Preserve (VCGP), would be implemented only for the unconstrained variant. The design restores salt marsh habitat to muted tidal exchange via Mugu Lagoon while re-configuring management of a portion of the existing duck ponds. The salt marsh restoration expands northward from existing salt marsh. To provide muted tidal exchange with Mugu Lagoon, the existing channels and culverts will be upgraded. Modifications to the duck ponds will optimize the environment for ducks, seeking to maintain or enlarge the total duck population the ponds can support by increasing population density. In addition to these hydrologic changes, a graded berm would be created along the northern boundary of the VCGP. This berm would serve multiple purposes. It would raise this area above elevations that are prone to coastal flooding. The southern face of the berm would also create a transitional zone for tidal marsh transgression in response to future sea level rise. Additionally, the fill required to form the berm provides onsite placement for soil excavated from the proposed tidal lagoon, thereby reducing construction costs.

Constrained (Alternative 1C)

The constrained variant of this alternative requires modifications to the configuration of the alternative's lagoon, habitats, and integration with watershed inflow and infrastructure, as shown in Figure 4. The lagoon dominates the project site, restricting the amount of other habitats that can be included on the site.

For this variant, an additional parcel needs to be added to the previously defined constrained project area (Section 3.1). The added parcel, currently owned <or just an easement?> by the Metropolitan Water District, lies at a key constriction of the lagoon; without this parcel, the connection between the east and west side of the lagoon would be severely restricted. This parcel adds 20 acres and lies immediately to the west of Edison Road, enhancing the lagoon's connectivity across this road.

Within the constrained project area, the lagoon fills 360 acres, which approaches the minimum size to maintain an open inlet. The lagoon's inlet is located downstream from the power plant relative to the alongshore sand transport. This location reduces the risk lateral inlet migration interfering with the power plant and its offshore outfall. Because of the reduced tidal prism and the limited tolerance for lateral inlet migration, a jetty at the inlet's mouth is a likely necessity.

The lagoon's size relative to the project area limits the available area for fringing salt marsh and coastal prairie habitat. The tidal salt marsh habitat totals 180 acres and the coastal prairie totals approximately 90 acres. The transitional coastal prairie is quite narrow around the lagoon's salt marsh. This limits the extent to which the salt marsh could transgress landward in response to sea level rise.

The persistence of infrastructure immediately adjacent and surrounded by the project area requires measures to protect and access this infrastructure. Situated in the middle of the project area, the power plant requires an elevated causeway over the lagoon for access. At the very least, this causeway will carry a roadway. If the power plant also needs to maintain railroad access (a spur currently traverses the

project site from McWane Boulevard to the northwest side of the plant property), the causeway will also carry this rail line. In addition, the presence of the lagoon may expose the power plant, Halaco landfill site, and Agromin facilities to increased coastal flood risk. Additional assessment will be required to determine if flood defenses are required at these sites.

Only the Oxnard Industrial Drain cross the constrained project boundary and is incorporated into the design.

Restore Seasonally Open Wetland Habitats and Ponds (Alternative 2)

Alternative 2 would restore a mosaic of wetland habitats modeled after historic conditions as represented in 19th century maps <Figure X>. The predominant features would be a lagoon intermittingly connected to the ocean and a seasonal pond supplied by precipitation and ground water (Figure 6 and Figure 7). Under these conditions evaporation would concentrate salts in the soil, creating basins edged by saline and brackish water species in fringing areas. Open water habitat would be seasonally subject to tidal exchange, resulting in fringing salt marsh vegetation. Beach and foredune habitats will be similar to existing conditions and be supplemented with expanded backdune habitat.

The design of the open water, intermittently tidal lagoon on the northwestern side of the site follows from historic ponds found on the project site in the 19th century. At low tide, as shown in Figure 6, the pond's depth is two feet over most of its area. A lagoon of this size does not have sufficient tidal exchange to maintain a permanently open inlet. During periods of increased wave action, alongshore sand transport will deposit more sand in the inlet channel than tidal exchange between the ocean and lagoon can scour, causing the inlet to close. Once closed, the lagoon mouth will re-open when freshwater flows from watershed flooding or strong waves associated with winter storms incise a new inlet.

The seasonal pond at the center of the project area is non-tidal, and instead is excavated such that precipitation and groundwater are its water sources. However, since precipitation is strongly seasonal, with nearly all rainfall during the winter and spring, the pond's area will fluctuate significantly with the seasons. As shown in Figure 6, the pond is at its fullest, rainy-season extent. Once the rain stops in late spring, the pond will decrease in size as evaporation lowers water levels, until reach a minimum area just before the next winter's rains. The minimum extent will depend on the area of the ground surface which falls below the dry season water table. As currently conceived, the pond's area would shrink in the dry season to be only one quarter to one third of its fullest winter extent. Inputs from saline groundwater, evaporation of only fresh water and occasional wave overtopping by an ocean storm events would create elevated salinity within the pond and leave behind salt-encrusted soils during the dry season when the pond shrinks in size.

A progression of habitats surrounds the proposed tidal lagoon and seasonal pond. The delineation of these habitats is determined by their hydraulic connection and ground elevation relative to the tides. The site's existing beach and foredune system, which is supplied with sand by alongshore transport, would be largely unchanged except for intermittent incision by the lagoon inlet. Windblown sand from the beach and foredune supports re-introduced backdune habitat. The tidal lagoon sustains fringing salt marsh vegetation with water levels that fluctuate with the tides when the inlet is open and change slowly when the inlet is closed. Non-tidal salt marsh fringes the seasonal pond. At the end of summer and early fall, when water levels in the seasonal pond are at their lowest point, the exposed land at the edges of the seasonal pond will consist of a salt panne habitat – exposed soils with high loading with salt particles. As elevations gradually increase, the marsh transitions to coastal prairie, which is configured with slight depressions to pond rainfall and create seasonal wetlands. It also includes expansion of existing stands of

willow scrub. The transitional coastal prairie represents the area that is likely to become salt marsh in response to three feet of sea level rise.

Management actions for the surface water drains and ODD #3 are the same as Alternative 1. In summary, the surface drains pass through treatment wetlands and then integrate with the site's hydrology. ODD #3 terminates at the project boundary and the subsurface drain which connects to ODD #3 is routed around the project area or directed into the lagoon.

Unconstrained (Alternative 2U)

The unconstrained project area allows for both restored ponds to be nearly 100 acres in size and to be fringed with even larger areas of vegetated wetland habitat. The uplands portion of the site includes relatively large swaths of coastal prairie, including transitional coastal prairie to accommodate three feet of sea level rise.

For this variant (Figure 8), the connection between the existing J Street Lagoon and the proposed lagoon would be restricted to a juncture just before the inlet channel breaches the dunes and connects to the ocean. This limited connection, along with the current bed elevation of the J Street Lagoon above MHHW, would preserve the brackish salinity characteristics in the J Street Lagoon that are favored by the tide water goby. Only the Oxnard Industrial Drain would connect directly to the proposed lagoon.

Management actions on the southeast portion of the site, where VCGP is currently located, would be identical to those proposed for Alternative 1U.

Constrained (Alternative 2C)

The exclusion of specific parcels from the project area requires adjustments to the alternative's design (Figure 9). For each excluded parcel (Figure 1), the required adjustments are listed below:

- *City of Oxnard* – Loss of the limited connection to J Street and Hueneme Drains, as well at to the J Street Lagoon.
- *Halaco* – Reduce the size of the proposed lagoon, eliminating land area that included the historic lagoon.
- *Power plant* – Loss of marsh habitat and added flood exposure along the plant's northwest boundary with the lagoon.
- *Northeast sod farm* – Reduction in the transitional coastal prairie, thereby limiting the capacity of the design to adapt to sea level rise.

With the exclusion of both the City of Oxnard parcel at the north end of the beach and the power plant, the location for the lagoon's inlet is constrained. As depicted in Figure 9, the inlet is as far from the power plant and its ocean outfall pipes as possible and includes a jetty to limit lateral migration.

Enhance Existing Non-Tidal Wetland Habitats (Alternative 3)

Existing non-tidal habitats would be enhanced under Alternative 3 by undertaking minimal grading to expand backdunes, non-tidal salt marsh, and brackish marsh in regions that can support these habitats (Figure 8 and Figure 9). Coastal prairie habitat, graded with seasonal wetland depressions, covers the remaining inland portion of the project area. This approach minimizes costs and changes to the existing hydrologic conditions.

The excavation requirements for this alternative are minimal. Instead, the existing surface is re-graded to remove roads and drainage canals, to create local topography that defines seasonal wetlands within the coastal prairie, and to expand the existing wetland habitats into the project area.

Examples of backdune, non-tidal salt marsh, and brackish marsh already exist on the project site. These habitats can be expanded with minimal change to the existing hydrologic conditions, as described below:

- *Backdune habitat* is supported by coastal wind and wave processes shaping the land surface immediately landward of the beach and dunes. Currently, only a small portion of backdune remains within the project area, to the southeast of the power plant <Ref need WRA BA?>, since much of the region immediately behind the dunes has been impacted by development. However, the healthy beach and foredune system should be capable of supporting a more extensive backdune habitat.
- *Non-tidal salt marsh* would replicate and expand existing, on-site examples of this habitat located at the end of Arnold Road and northeast of the power plant. This habitat is supported by direct rainfall and seasonal fluctuations in the groundwater table, with occasional wave overtopping during ocean storm events.
- *Brackish marsh* exists along the surface drains and the J Street Lagoon where fresh water from the watershed mingles with salt from the ocean to create fluctuating intermediate salinity levels.

Landward of the regions directly influenced by coastal processes, the habitat transitions to coastal prairie. The transitional portion of the coastal prairie represents the land area that would be susceptible to coastal flooding during extreme storm events.

Existing hydrologic conditions would be changed to the least extent possible. Surface drains flowing into the site would be nearly unchanged except for the addition of treatment wetlands to buffer the project site from watershed pollutants. The existing Oxnard Drainage Ditch #3 (ODD #3), which currently cuts across the project area and drains to the southeast, will instead end at the project boundary. A large subsurface drain which delivers water to ODD #3 within the project area will be re-routed parallel to Arnold Road and re-connected with ODD #3 south of the channel block.

Unconstrained (Alternative 3A)

The expansion of existing habitat, the creation of coastal prairie, and minimal hydrologic modifications, as described above, are readily applied to the unconstrained project area, as shown in Figure 8.

The duck ponds at VCGP would be abandoned and largely converted to coastal prairie with seasonal wetland depressions. A portion of existing salt marsh in the southeast corner of the preserve would be maintained. Tidal flows to this salt marsh would be supplied by the existing channel and culvert connection with Mugu Lagoon. Between the salt marsh and coastal prairie, the existing patches of salt grass habitat would be expanded.

Constrained (Alternative 3B)

The topographic and hydrologic gradients are minimal in Alternative 3. Therefore, the habitats can be laid out in the constrained variant identically to the unconstrained variant, but with no action on the excluded parcels. The resulting habitat configuration is shown in Figure 9.

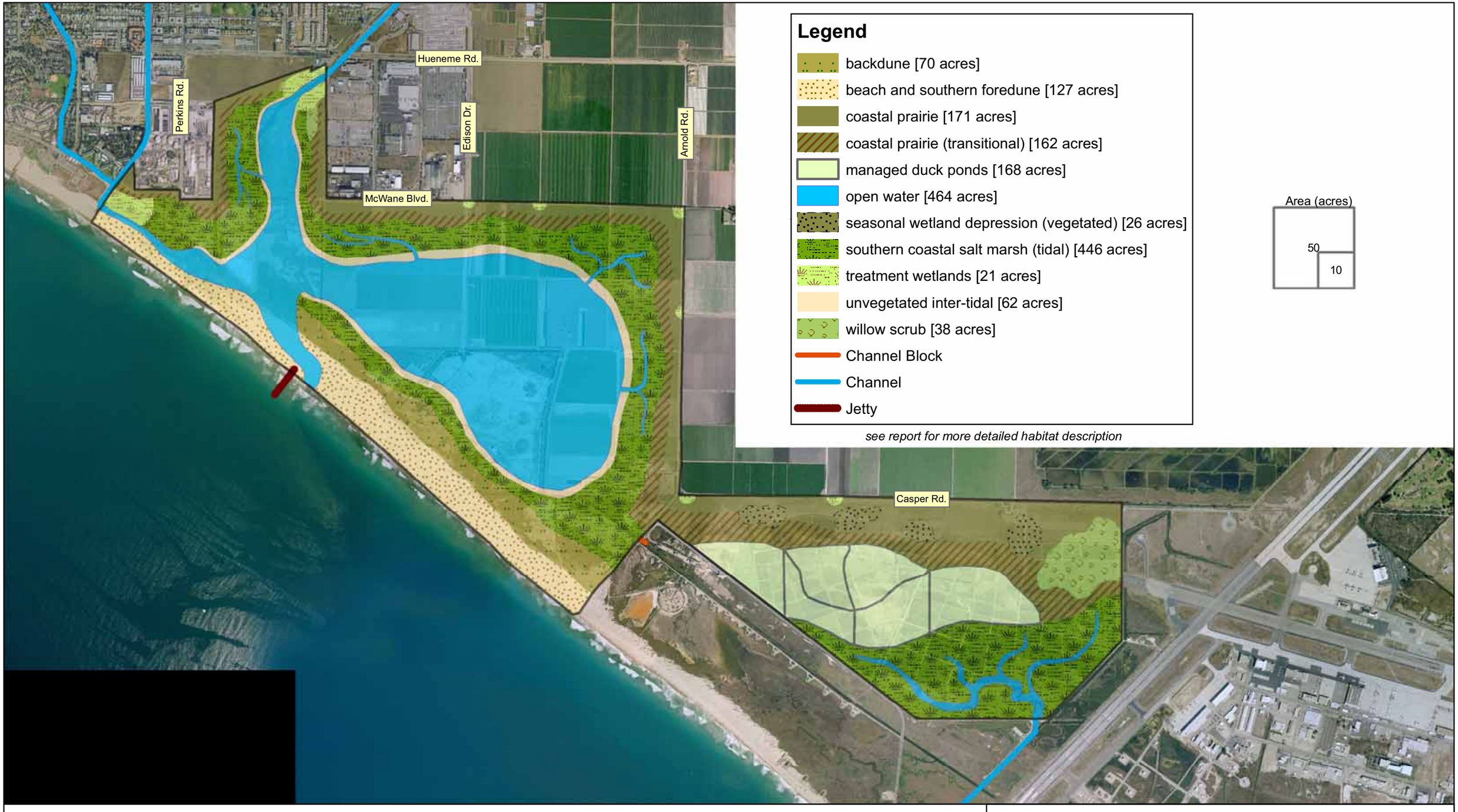
No Project Alternative (Alternative 4)

WRA w/reference to PWA's Existing Conditions section

References

Isenberg, P.L. 2008. Letter to Governor Schwarzenegger from the Chair of the Delta Blue Ribbon Task Force, State of California Resources Agency.

Figures



Legend

- backdune [70 acres]
- beach and southern foredune [127 acres]
- coastal prairie [171 acres]
- coastal prairie (transitional) [162 acres]
- managed duck ponds [168 acres]
- open water [464 acres]
- seasonal wetland depression (vegetated) [26 acres]
- southern coastal salt marsh (tidal) [446 acres]
- treatment wetlands [21 acres]
- unvegetated inter-tidal [62 acres]
- willow scrub [38 acres]
- Channel Block
- Channel
- Jetty

see report for more detailed habitat description

Area (acres)

50

10

Notes: The property boundaries depicted in this figure are for general planning purposes only. They have not been surveyed and may not coincide exactly with parcel-specific legal boundaries.

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Draft

figure X

Ormond Beach Wetland Restoration

Alternative 1 - Create lagoon, unconstrained

PWA Ref # - 1738

Alt 1 - Create lagoon unconstrained v4.mxd

PWA

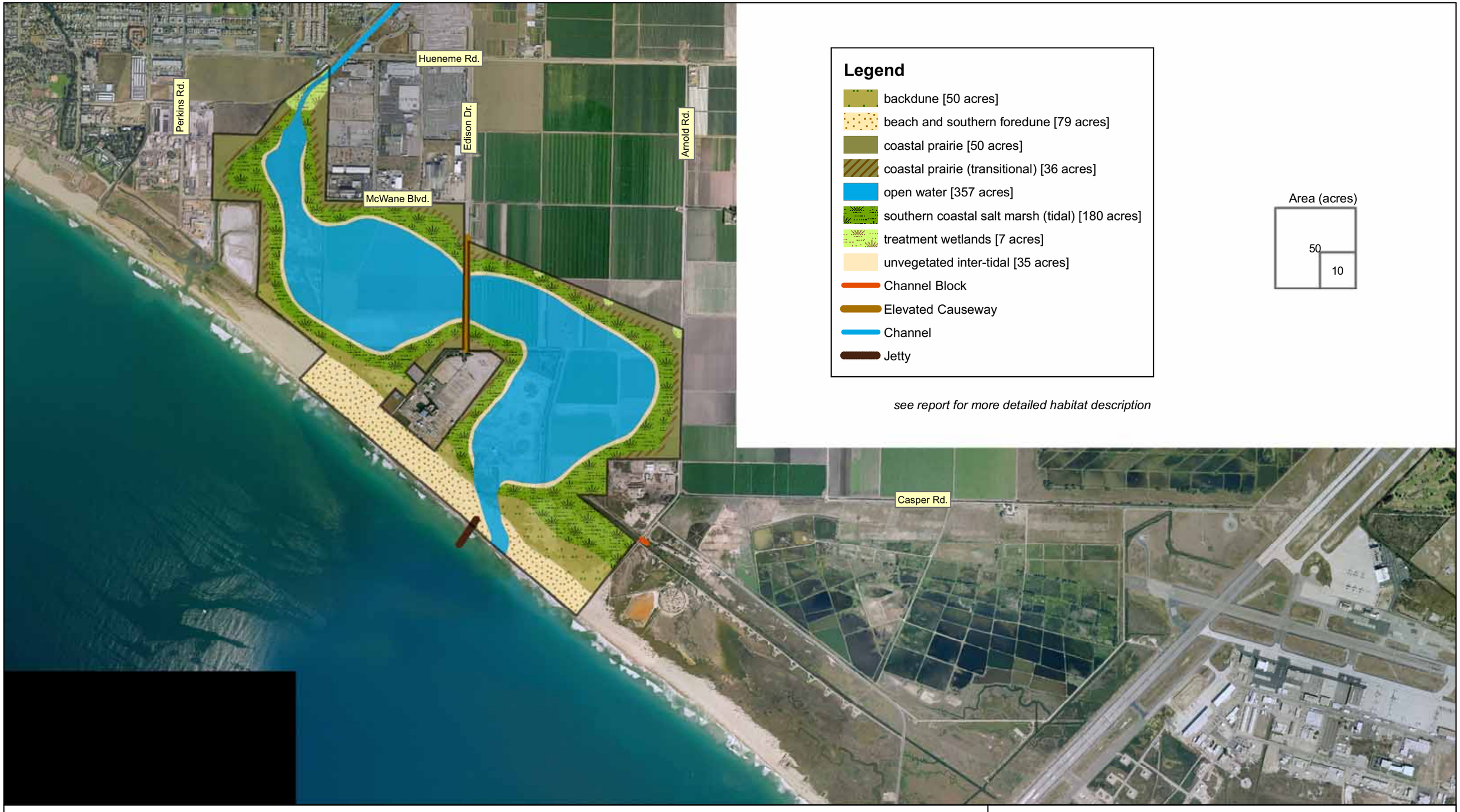

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figure X

Ormond Beach Wetland Restoration

Alternative 1 - Create lagoon, constrained

PWA Ref # - 1738

Alt 1 - Create lagoon constrained v3.mxd

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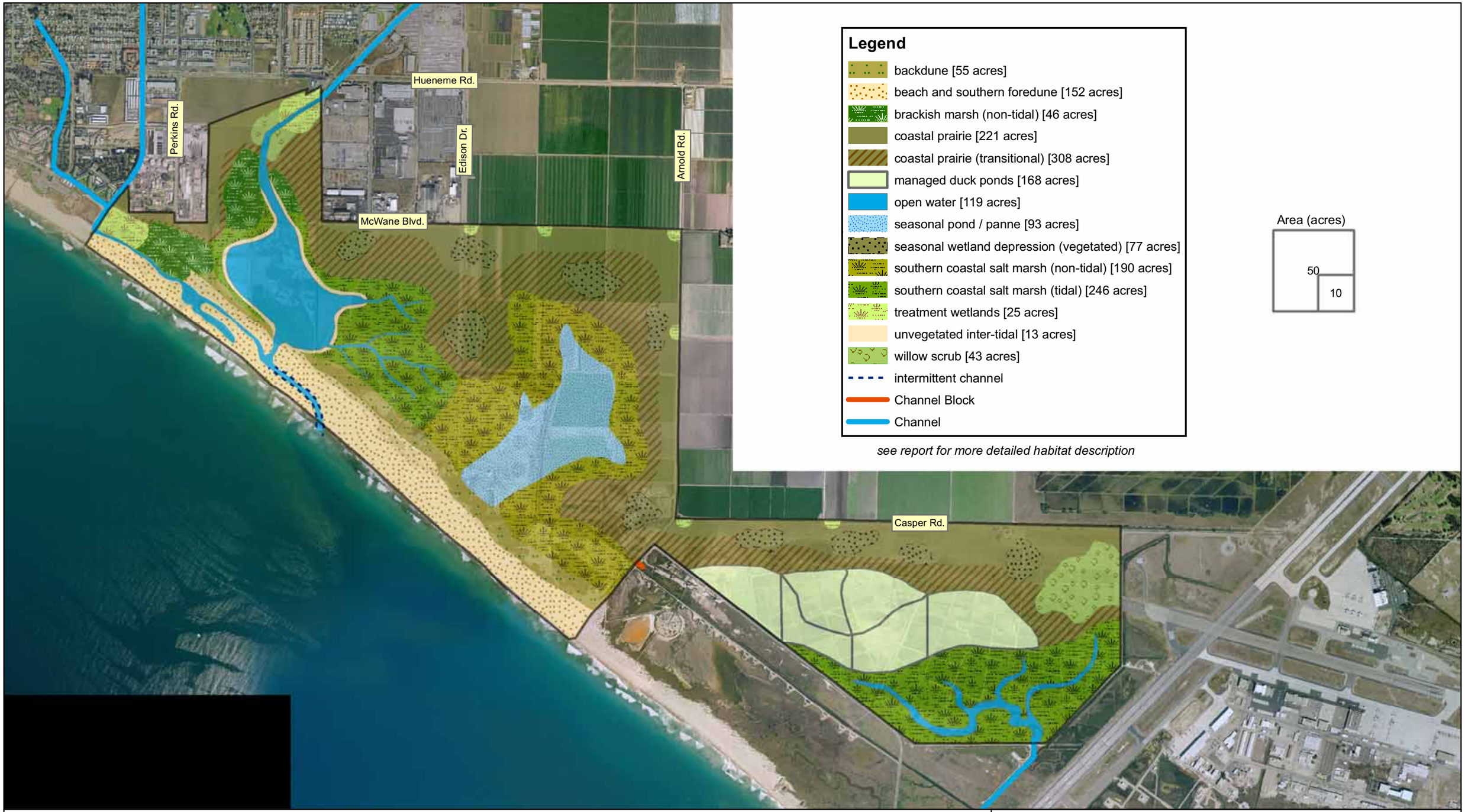

Legend

- backdune [55 acres]
- beach and southern foredune [152 acres]
- brackish marsh (non-tidal) [46 acres]
- coastal prairie [221 acres]
- coastal prairie (transitional) [308 acres]
- managed duck ponds [168 acres]
- open water [119 acres]
- seasonal pond / panne [93 acres]
- seasonal wetland depression (vegetated) [77 acres]
- southern coastal salt marsh (non-tidal) [190 acres]
- southern coastal salt marsh (tidal) [246 acres]
- treatment wetlands [25 acres]
- unvegetated inter-tidal [13 acres]
- willow scrub [43 acres]
- intermittent channel
- Channel Block
- Channel

see report for more detailed habitat description

Area (acres)

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figure X

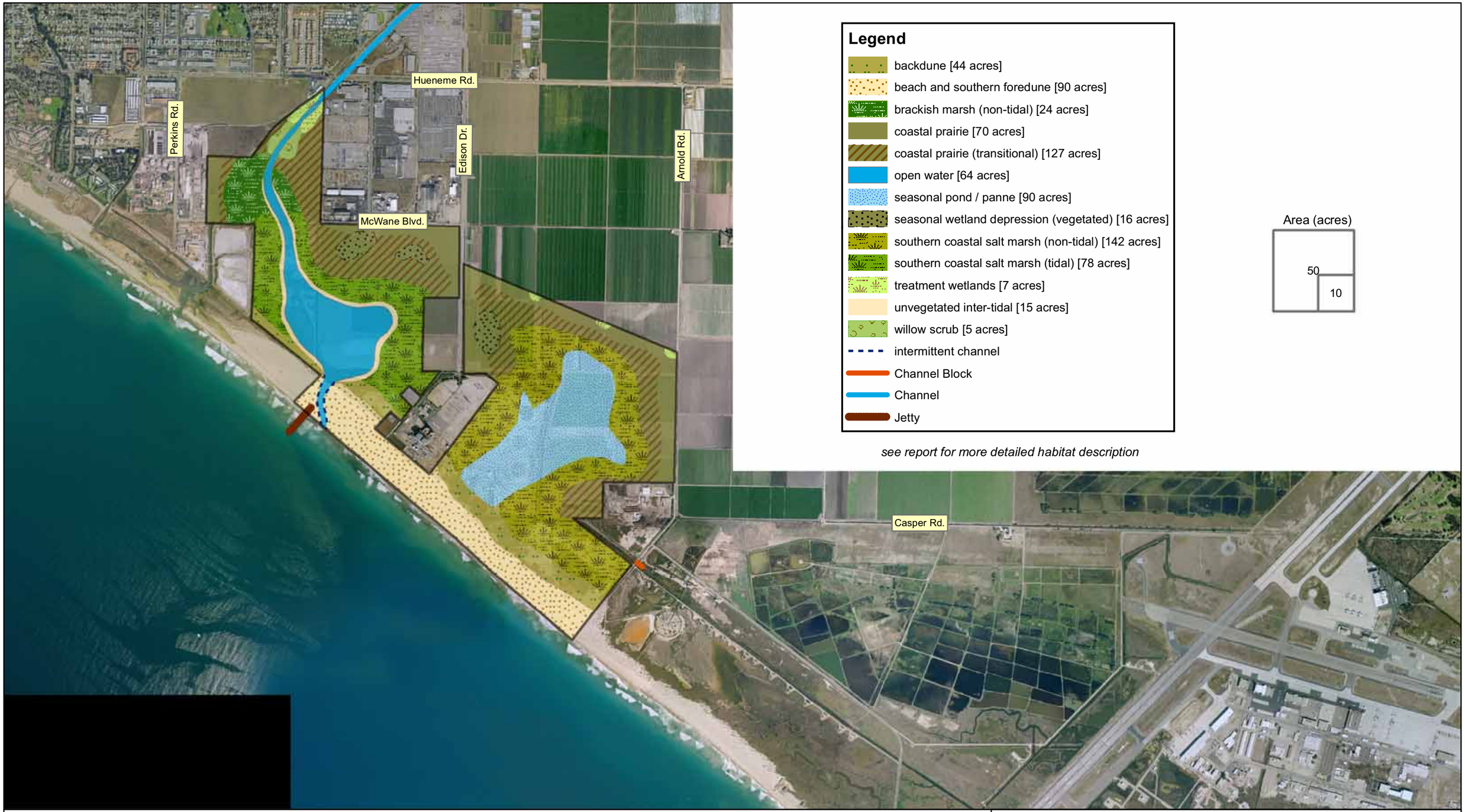
Ormond Beach Wetland Restoration

Alternative 2 - Restore seasonal ponds, unconstrained

PWA Ref # - 1738

Alt 2 - Restore ponds unconstrained v6.mxd

PWA



Legend

- backdune [44 acres]
- beach and southern foredune [90 acres]
- brackish marsh (non-tidal) [24 acres]
- coastal prairie [70 acres]
- coastal prairie (transitional) [127 acres]
- open water [64 acres]
- seasonal pond / panne [90 acres]
- seasonal wetland depression (vegetated) [16 acres]
- southern coastal salt marsh (non-tidal) [142 acres]
- southern coastal salt marsh (tidal) [78 acres]
- treatment wetlands [7 acres]
- unvegetated inter-tidal [15 acres]
- willow scrub [5 acres]
- intermittent channel
- Channel Block
- Channel
- Jetty

see report for more detailed habitat description

Area (acres)

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figure X

Ormond Beach Wetland Restoration

Alternative 2 - Restore seasonal ponds, constrained

PWA Ref # - 1738

Alt 2 - Restore ponds constrained v3.mxd

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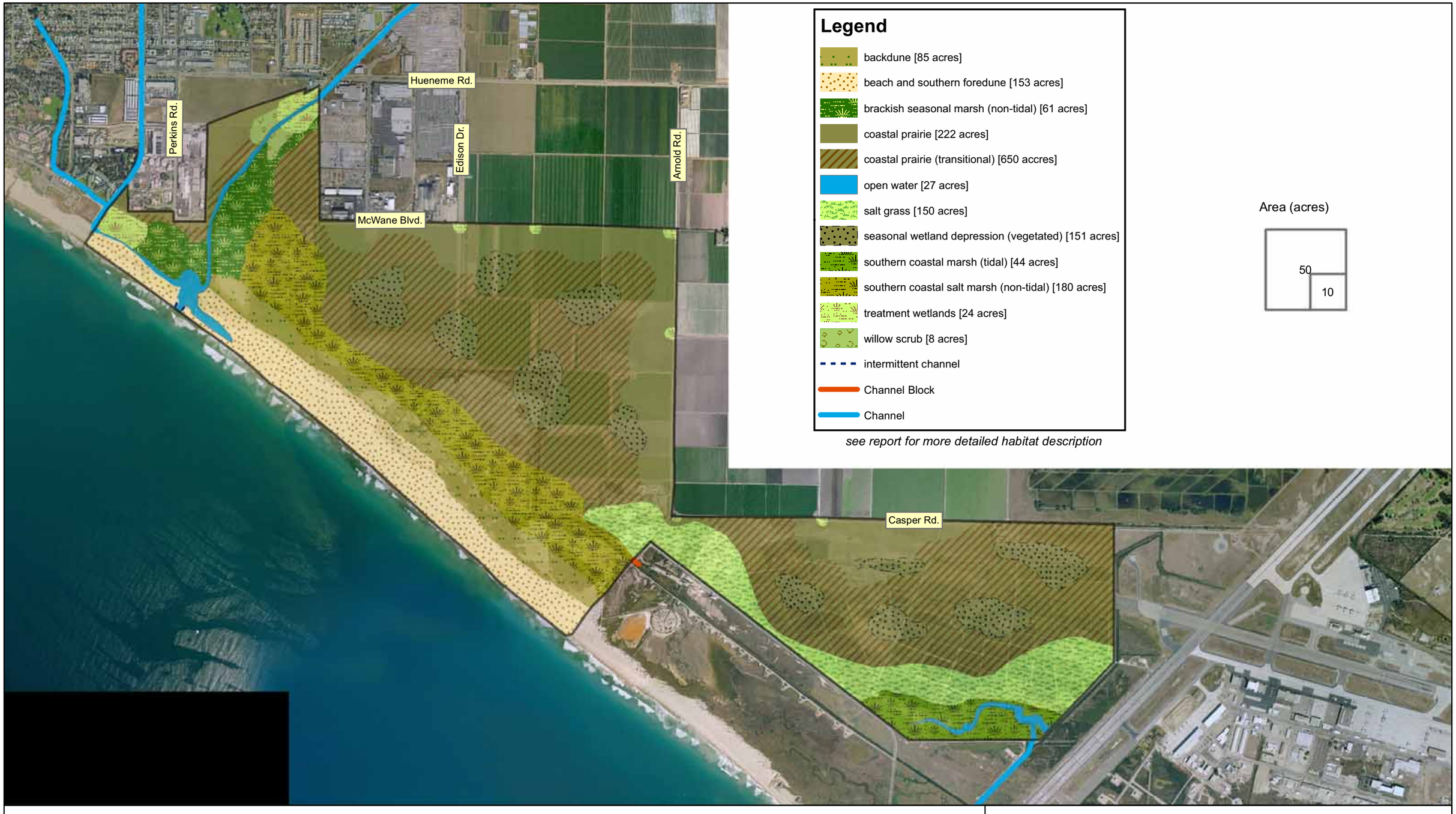

Legend

- backdune [85 acres]
- beach and southern foredune [153 acres]
- brackish seasonal marsh (non-tidal) [61 acres]
- coastal prairie [222 acres]
- coastal prairie (transitional) [650 accres]
- open water [27 acres]
- salt grass [150 acres]
- seasonal wetland depression (vegetated) [151 acres]
- southern coastal marsh (tidal) [44 acres]
- southern coastal salt marsh (non-tidal) [180 acres]
- treatment wetlands [24 acres]
- willow scrub [8 acres]
- intermittent channel
- Channel Block
- Channel

see report for more detailed habitat description

Area (acres)

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Ormond Beach Wetland Restoration

Alternative 3 - Enhance existing conditions, unconstrained

PWA Ref # - 1738

Alt 3 - Enhance existing unconstrained v4.mxd

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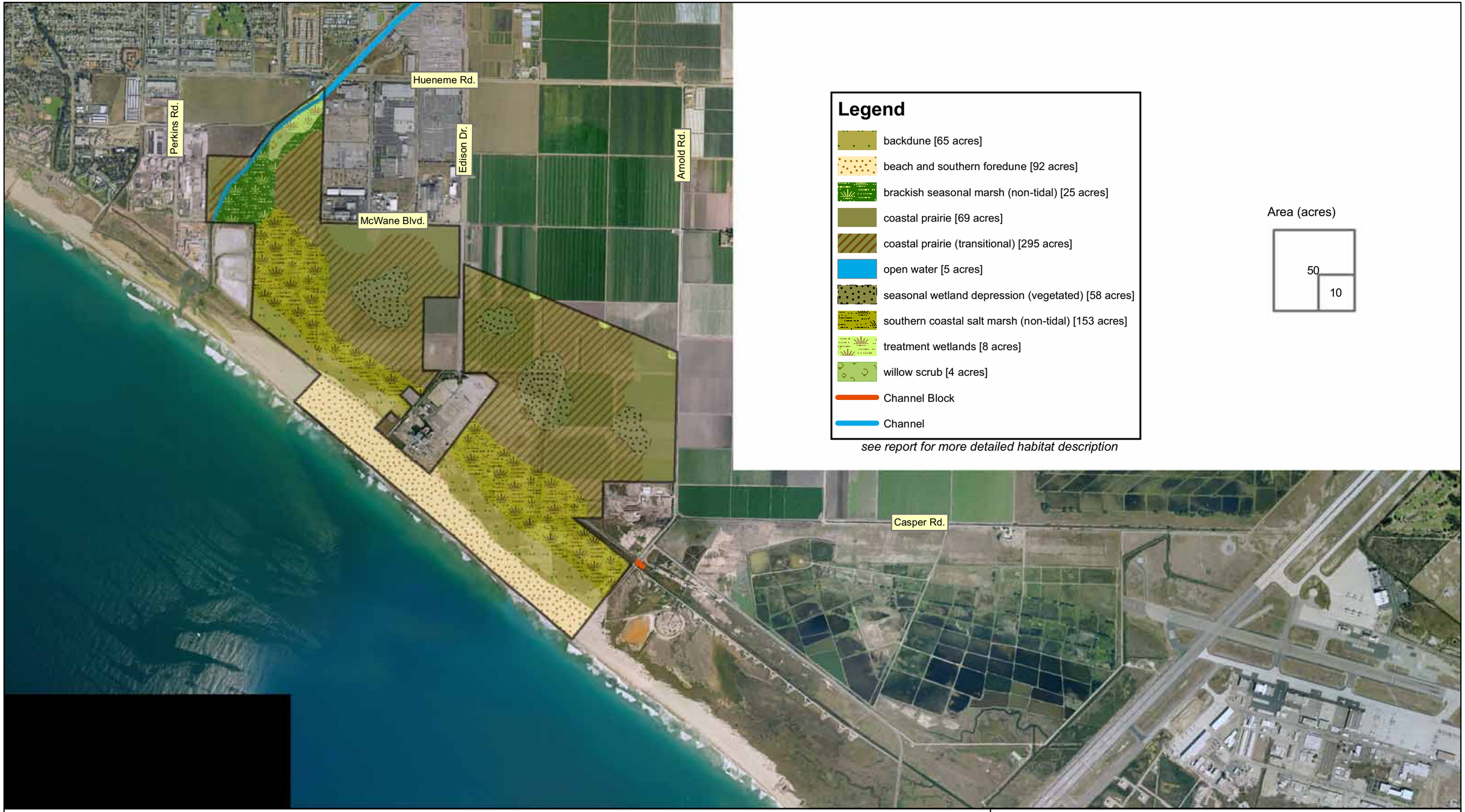

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figure X

Ormond Beach Wetland Restoration

Alternative 3 - Enhance existing conditions, constrained

PWA Ref # - 1738

Alt 3 - Enhance existing constrained v3.mxd

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