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February 5, 2013

Mr. Michael Adackapara, Supervising WRCE
California Regional Water Quality Control Board/Santa Ana Region
3737 Main Street, Suite 500
Riverside, CA 92501-3348

Subject: Model Water Quality Management Plan and Technical Guidance Document Errata; Order No. R8-2009-0030

Dear Mr. Adackapara:

A Model Water Quality Management Plan (Model WQMP) and companion Technical Guidance Document (TGD) were developed and submitted to the Santa Ana Regional Board on March 22, 2011. On May 19, 2011, the Executive Officer approved the March 22, 2011 Model WQMP, TGD and supporting documents as modified by an errata sheet dated May 17, 2011. The Permittees commenced implementation of the new land development requirements based on the requirements detailed in the Model WQMP and TGD on August 17, 2011.

As a result of training sessions and "help desk" feedback, areas requiring a number of updates and corrections have been identified within the TGD. These changes have been compiled in the attached errata sheet (Technical Guidance Document Errata #2, February 4, 2013), which is submitted for your approval.

Contact me at (714) 955-0630 with any questions, or Richard Boon at (714) 955-0670.

Very truly yours,

Chris Crompton, Manager
Environmental Resources

Attachments: Technical Guidance Document Errata #2, February 5, 2013

C: NPDES TAC/PAC
Permittees

TECHNICAL GUIDANCE DOCUMENT ERRATA SHEET #2
FEBRUARY 5, 2013

This errata sheet provides a compilation of changes detailed in the attached pages from the Technical Guidance Document (TGD). The narrative below includes italicized redline/strikeout text of the recommended changes to be made to the TGD and the purpose for the change.

Attachment 1 – TGD Section 2, Tables 2.2 and 2.3
Approval of 2010 303(d) list

This erratum updates the summary of approved 303(d) listed waterbodies and associated pollutants of concern. When the TGD was first submitted for approval, the current approved 303(d) list was the 2006 list with proposed segments included in the 2010 Integrated Report. The 2010 303(d) list was approved on October 11, 2011 and is now the current list at the time of this errata.

Table 2.2 Title (Page 2-18):

Table 2.2: Summary of the Approved ~~2006 and Tentative~~ 2010 303(d) Listed Water Bodies and Associated Pollutants of Concern for North Orange County.

Table 2.3 Title (Page 2-19):

Table 2.3: Summary of the Approved ~~2006 and Tentative~~ 2010 303(d) Listed Water Bodies and Associated Pollutants of Concern for South Orange County.

Footnote on Tables 2.2 and 2.3:

~~Note at the time of publication~~ On October 11, 2011 the 2010 303(d) list ~~had been~~ was approved by ~~the State Water Resources Control Board, but has not been approved by~~ USEPA Region 9. ~~Modifications may be made prior to approval by EPA.~~ Project proponents should consult the most recent 303(d) list located on the State Water Resources Control Board website.[6]

Attachment 1 also provides an update to the TGD Table of Contents to reflect the updated Table titles.

Attachment 2 – TGD Section 2, Table 2.4
Addition of Coyote Creek/San Gabriel River Metals TMDL

This erratum corrects an omission regarding TMDL status in Region 8.

Table 2-4 (Page 2-20):

Region	*Waterbody*	*Pollutant*				
		Bacteria	*Metals*	*Nutrients*	*Pesticides*	*Turbidity*
Region 8 – Santa Ana	*Coyote Creek/San Gabriel River*		*Technical TMDLs*[1]			

Add a footnote to Table 2-4:

[1]This TMDL was adopted by the Los Angeles Regional Water Quality Control Board (Region 4), however it applies to the areas of Orange County that drain to Coyote Creek and San Gabriel River.

Attachment 3 – TGD Appendix III
Use of Simple Runoff Coefficient Method for 2-year Design Storm

This erratum corrects an inconsistency in the TGD and associated appendices. For small projects, the simple runoff coefficient method is an appropriate option for calculating the runoff volume for the 2 year storm.

Appendix III.1 (Page III-1):

These methods are ~~not~~ applicable for hydrologic analysis of the 2-year design storm for small projects, as allowed per limitations in Appendix VI.

Appendix III.1.1 (Page III-1):

~~*This method shall not be used for calculating the runoff volume from the 2-year design storm.*~~

Attachment 4 – TGD Appendix III – Worksheet B, Appendix VII, Appendix VII – Worksheet H, and Appendix VIII
Infiltration Rates and Factor of Safety

This set of errata corrects and clarifies guidance and criteria related to infiltration rates and factors of safety.

The following criteria are intended:

$K_{observed}$ is the vertical saturated infiltration rate observed from field testing. If field testing methods return a measurement other than vertical saturated infiltration rate, then an adjustment is needed to estimate the $K_{observed}$.

$K_{measured}$ is the value that should be compared to the 0.3 in/hr feasibility criterion. This value should be the $K_{observed}$ adjusted by a mandatory factor of safety of 2.0 to account for uncertainty in field measurements and potential for long term clogging. Setting the factor of safety for $K_{measured}$ to a mandatory value of 2.0 prevents a project proponent from artificially increasing the factor of safety (S) to demonstrate infeasibility.

K_{design} is the value that should be used for design. K_{design} may be the same as $K_{measured}$ (using S = 2.0), but may need to be higher to provide higher confidence in the design.

Worksheet B (Page III-16):

Step 3a: Determine design infiltration rate				
1	*Enter measured infiltration rate,* $K_{observed}$~~$_{measured}$~~[1] *(in/hr) (Appendix VIII)*	$K_{observed}$~~$_{measured}$~~ =		*in/hr*
2	*Enter combined safety factor from Worksheet H,* S_{total}~~$_{final}$~~ *(unitless)*	S_{total}~~$_{final}$~~ =		
3	*Calculate design infiltration rate,* K_{design} = $K_{observed}$~~$_{measured}$~~ / S_{total}~~$_{final}$~~	K_{design} =		*in/hr*

Add footnote to Worksheet B:

[1] - $K_{observed}$ is the vertical infiltration measured in the field, before applying a factor of safety. If field testing measures a rate that is different than the vertical infiltration rate (for example, three-dimensional borehole percolation rate), then this rate must be adjusted by an acceptable method (for example, Porchet method) to yield the field estimate of vertical infiltration rate, $K_{observed}$. See Appendix VII.

Appendix VII-2 (Pages VII-4-5):

This section describes methods that shall be used, as applicable, to determine whether soils are potentially feasible for infiltration, and where potentially feasible soils exist. Soils would be considered potentially feasible for infiltration if the measured infiltration rate obtained from field testing or obtained by applying professional judgment to available data taken within the project vicinity is greater than 0.3 inches per hour. Measured rates ($K_{measured}$) shall account for uncertainty in field measurements and potential for long term clogging by applying a factor of safety of 2.0 to testing results ($K_{observed}$).

The measured infiltration rate ($K_{measured}$) calculated for the purpose of infiltration infeasibility screening (TGD Section 2.4.2.4) shall be based on a factor of safety of 2.0 applied to the rates obtained from the infiltration test results ($K_{observed}$). No adjustments from this value are permitted. The factor of safety used to compute the design infiltration rate (K_{design}) shall not be less than 2.0, but may be higher at the discretion of the design engineer and acceptance of the plan reviewer, per the considerations described in Section VII.4. The following definitions are intended to clarify these criteria:

$K_{observed}$ - the observed saturated infiltration rate in the vertical direction measured directly from field testing. If the testing method requires adjustment to estimate vertical K_{sat}, then this adjustment should be made as part of computing $K_{observed}$.

$K_{measured} = K_{observed}/2.0$. $K_{measured}$ value is used in comparing against the 0.3 in/hr feasibility screening criterion. The calculation of $K_{measured}$ includes a mandatory factor of safety of 2.0 applied to $K_{observed}$ to account for uncertainty in observed data and potential for long term clogging.

$K_{design} = K_{observed}/S_{Total}$. This is the value used for design calculations. The factor of safety (S) must be at least 2.0, but may be higher at the discretion of the designer and reviewer to provide additional assurance or account for systems with higher risk of failure.

Worksheet H (Page VII-35):

Combined Safety Factor, S_{Total}~~$_{OT}$~~ = S_A x S_B	
~~Measured~~ Observed Infiltration Rate, inch/hr, $K_{observed}$~~$_{M}$~~ (corrected for test-specific bias)	
Design Infiltration Rate, in/hr, KDesign = ~~S_{TOT}~~ x $K_{Observed}$~~$_{M}$~~ / S_{Total}	

Appendix VIII.2 (Page VIII-4):

- *The horizontal hydraulic conductivity should be set to 10 times the ~~measured~~ observed infiltration rate of the soil to account for typical anisotropy of natural soils (ratio of* *horizontal to vertical hydraulic conductivity). Note the ~~measured~~ observed infiltration rate will generally be greater than or equal to 2 times the design infiltration rate.*

Given:
~~Measured~~ Observed soil infiltration rate: 0.2 to 4 inches per hour

Attachment 5 – TGD Appendix VII
Porchet Method Equations

This erratum corrects errors in equations in Appendix VII of the TGD.

<u>Example VII.1 (Page VII-29):</u>

"H_f" is the final height of water at the selected time interval.

$H_f = D_T -$ ~~D_o~~$D_f = 60 - 13.75 = 46.25$ *inches*

"H_{avg}" is the average head height over the time interval.

$H_{avg} = (H_o + H_f)/2 = 47.75 + 46.25)/2 = 47.0$ *inches*

Note: in the H_{avg} equation, the plusses replaced minuses.

Attachment 6 – TGD Appendix X
Harvested Water Demand Calculations

This erratum corrects language that was inconsistent with the intent of this calculation.

<u>Worksheet J (Page X-13):</u>

	For projects with multiple types of demand (~~both~~ toilet flushing, ~~and~~ indoor demand and/or other demand)		
8	*What is the minimum use required for partial capture? (Table X.6)*		*gpd*
9	*What is the project estimated ~~minimum~~ wet season total daily use?*		*gpd*

Attachment 7 – TGD Appendix I
BMP Fact Sheets

This erratum corrects a missing category in the listing of BMP Fact Sheets. The BMP Fact Sheets were included in the original TGD submittal, just the category was missing from the listing.

<u>Appendix I (Page I.1):</u>

Miscellaneous BMP Design Element Fact Sheets (MISC)
- *MISC-1: Planting/Storage Media*
- *MISC-2: Amended Soils*

TECHNICAL GUIDANCE DOCUMENT ERRATA SHEET #2
FEBRUARY 5, 2013

Attachment 8 – TGD Appendix XVI
North Orange County Hydromodification Susceptibility Maps

This erratum updates the Hydromodification Susceptibility Maps. Since the original submittal, the urban drainage area was further delineated using aerial imaging to update channel segments that were Earthen—Unstable to Earthen—Stable.

Attachment 8 includes a list of changed segments for each watershed, the original map exhibit (for comparison), and the updated map exhibit.

ATTACHMENT 1
TGD Section 2, Tables 2.2 and 2.3

TABLES

FIGURES

Table 2.2: Summary of the Approved ~~2006 and Tentative~~ 2010 303(d) Listed Water Bodies and Associated Pollutants of Concern for North Orange County

Region	Water Body	Pollutant																			
		Bacteria Indicators/ Pathogens		Metals		Nutrients		Pesticides		Toxicity		Trash		Salinity/ TDS/ Chlorides		Turbidity		Other Organics	
		~~2006 List~~	2010 List	~~2006 List~~	2010 List	~~2006 List~~	2010 List	~~2006 List~~	2010 List	~~2006 List~~	2010 List	~~2006 List~~	2010 List	~~2006 List~~	2010 List	~~2006 List~~	2010 List	~~2006 List~~	2010 List
Region 8 Santa Ana	Anaheim Bay			X	X			X	X	X	X							X	X
	Bolsa Chica Channel			X	X														
	Buck Gully Creek	X	X																
	Coyote Creek	X	X	X		X	X	X	X	X	X								
	Huntington Beach State Park	X																X	X
	Huntington Harbor	X	X	X	X			X	X	X	X							X	X
	Los Trancos Creek (Crystal Cove Creek)	X	X																
	Newport Bay, Lower			X		X		X		X	X							X	X
	Newport Bay, Upper (Ecological Reserve)			X		X		X		X	X					X		X	X
	San Diego Creek, Reach 1	X	X	X		X		X											
	San Diego Creek, Reach 2			X															
	San Gabriel River, Reach 1	X	X	X															
	Seal Beach	X	X															X	X
	Silverado Creek	X	X											X	X				

~~Note a the time of publication,~~ On October 11, 2011, the 2010 303(d) lists ~~had been~~ was approved by ~~the State Water Resources Control Board, but had not been approved~~ by USEPA Region 9. ~~Modifications may be made prior to approval by EPA.~~ Project proponents should consult the most recent 303(d) list located on the State Water Resources Control Board website[6].

[6] http://www.swrcb.ca.gov/water_issues/programs/#wqassessment

Table 2.3: Summary of the Approved ~~2006 and Tentative~~ 2010 303(d) Listed Water Bodies and Associated Pollutants of Concern for South Orange County

Region	Water Body	Pollutant																	
		Bacteria Indicators/ Pathogens		Metals		Nutrients		Pesticides		Toxicity		Trash		Salinity/ TDS/ Chlorides		Turbidity		Other Organics	
		~~2006 List~~	2010 List	~~2006 List~~	2010 List	~~2006 List~~	2010 List	~~2006 List~~	2010 List	~~2006 List~~	2010 List	~~2006 List~~	2010 List	~~2006 List~~	2010 List	~~2006 List~~	2010 List	~~2006 List~~	2010 List
Region 9 San Diego	Aliso Creek (Mouth)	X	X																
	Aliso Creek (20 Miles)	X				X	X			X	X								
	Dana Point Harbor	X	X		X						X								
	Pacific Ocean Shoreline, Aliso Beach HSA	X																	
	Pacific Ocean Shoreline, Dana Point HSA	X																	
	Pacific Ocean Shoreline, Laguna Beach HSAs	X																	
	Pacific Ocean Shoreline, Lower San Juan HSA	X	X																
	Pacific Ocean Shoreline, San Clemente HA at San Clemente City Beach, North Beach	X	X																
	Pacific Ocean Shoreline, Other San Clemente and San Joaquin Hills HAs	X																	
	Pacific Ocean Shoreline, San Mateo Canyon HAs		X																
	Prima Deshecha Creek				X	X	X									X	X		
	San Juan Creek	X			X		X	X			X								
	Segunda Deshecha Creek					X	X				X					X	X		

~~Note a the time of publication,~~On October 11, 2011, the 2010 303(d) lists ~~had been approved by the State Water Resources Control Board, but had not been~~was approved by USEPA Region 9. ~~Modifications may be made prior to approval by EPA.~~ Project proponents should consult the most recent 303(d) list located on the State Water Resources Control Board website[7].

[7] http://www.swrcb.ca.gov/water_issues/programs/#wqassessment

ATTACHMENT 2
TGD Section 2, Table 2.4

Table 2.4: Summary of the Status of TMDLs for Waterbodies in Regions 8 and 9

Region	Water Body	Pollutant				
		Bacteria Indicators/ Pathogens	Metals	Nutrients	Pesticides	Turbidity/ Siltation
Region 8 Santa Ana	Newport Bay, Lower	Implementation Phase	Technical TMDLs	Implementation Phase	Technical TMDLs	Implementation Phase
	Newport Bay, Upper (Ecological Reserve)	Implementation Phase	Technical TMDLs	Implementation Phase	Technical TMDLs	Implementation Phase
	San Diego Creek, Reach 1		Technical TMDLs	Implementation Phase	Technical TMDLs and Implementation Phase	Implementation Phase
	San Diego Creek, Reach 2		Technical TMDLs	Implementation Phase		Implementation Phase
	Coyote Creek/San Gabriel River		Technical TMDLs[1]			
Region 9 San Diego	Aliso Creek (20 Miles) Pacific Ocean Shoreline, Laguna Beach HSAs	Implementation Phase				
	Dana Point Harbor Pacific Ocean Shoreline HSAs	Implementation Phase or In Progress				
	Pacific Ocean Shoreline, San Clemente HA	In Progress				
	San Juan Creek (mouth)	Implementation Phase				

[1]This TMDL was adopted by the Los Angeles Regional Water Quality Control Board (Region 4), however it applies to the areas of Orange County that drain to Coyote Creek and San Gabriel River.

ATTACHMENT 3
TGD Appendix III

APPENDIX III. HYDROLOGIC CALCULATIONS AND SIZING METHODS FOR LID BMPS

III.1. Hydrologic Methods for Design Capture Storm

This section describes the hydrologic methods that shall be used to compute the design runoff volume or flowrate resulting from a given precipitation depth or intensity and a given imperviousness fraction. These methods are applicable to the Design Capture Storm (85th percentile, 24-hour) as well as the water quality design storm and water quality design intensity. These methods are ~~not~~ applicable for hydrologic analysis of the 2-year design storm for small projects, as allowed per limitations in Appendix VI.

III.1.1. Simple Method Runoff Coefficient for Volume-Based BMP Sizing

This hydrologic method shall be used to calculate the runoff volume associated with LID and water quality design storms. The runoff volume shall be calculated as:

$$V = C \times d \times A \times 43560\ sf/ac \times 1/12\ in/ft$$ Equation **III.1**

Where:

V = runoff volume during the design storm event, cu-ft
C = runoff coefficient = $(0.75 \times imp + 0.15)$
imp = impervious fraction of drainage area (ranges from 0 to 1)
d = storm depth (inches)
A = tributary area (acres)

Note: the tributary area includes the portions of the drainage area within the project and any run-on from off-site areas that comingles with project runoff.

An example of this calculation is provided in **Example III.1**. ~~This method shall not be used for calculating the runoff volume from the 2-year design storm.~~

ATTACHMENT 4
TGD Appendix III – Worksheet B, Appendix VII, Appendix VII – Worksheet H, and Appendix VIII

Worksheet B: Simple Design Capture Volume Sizing Method

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=		inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=		inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=		inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=		acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=		
3	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=		
4	Calculate runoff volume, V_{design}= *(C x* $d_{remainder}$ *x A x 43560 x (1/12))*	V_{design}=		cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, ~~$K_{measured}$~~ $K_{observed}$[1] (in/hr) (**Appendix VII**)	$K_{observed}$~~me asured~~=		In/hr
2	Enter combined safety factor from Worksheet H, S_{total}~~final~~ (unitless)	S~~final~~total=		
3	Calculate design infiltration rate, K_{design} = ~~$K_{measured}$~~ $K_{observed}$ / ~~x S_{final}~~ S_{total}	K_{design}=		In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=		Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), D_{max} = K_{design} *x T x (1/12)*	D_{max}=		feet
6	Calculate minimum area required for BMP (sq-ft), A_{min} = V_{design}/ d_{max}	A_{min}=		sq-ft

1 - $K_{observed}$ is the vertical infiltration measured in the field, before applying a factor of safety. If field testing measures a rate that is different than the vertical infiltration rate (for example, three-dimensional borehole percolation rate), then this rate must be adjusted by an acceptable method (for example, Porchet method) to yield the field estimate of vertical infiltration rate, $K_{observed}$. See Appendix VII.

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1)USBR 7300-89, "Procedure for Performing field Permeability Testing by the Well Permeameter Method" (Section **VII.3.7** below). Note that this result must be converted to an infiltration rate.
2) The percolation test (Section **VII.3.8** below). Note that this result must be converted to an infiltration rate.

I.1.3. Fill Condition

If the bottom of a BMP (infiltration surface) is in a fill location, the infiltration surface may not exist prior to grading. How then can the infiltration rate be determined? For example, if a proposed infiltration BMP is to be located in 12 feet of fill, how could one reasonably establish an infiltration rate prior to the fill being placed?

Unfortunately, no reliable assumptions can be made about the in-situ properties of fill soil. As such, the bottom, or rather the infiltration surface of the BMP, must extend into natural soil. The natural soil shall be tested at the design elevation prior to the fill being placed.

For shallow fill depths, fill material can be selectively graded to provide reliable infiltration properties. However, in some cases, due to considerable fill depth, the extension of the BMP down to natural soil and selective grading of fill material may prove infeasible. In that case, because of the uncertainty of fill parameters as described above, an infiltration BMP may not be feasible.

I.2. Methods for Identifying Areas Potentially Feasible for Infiltration

This section describes methods that shall be used, as applicable, to determine whether soils are potentially feasible for infiltration~~, and where potentially feasible soils exist~~. Soils would be considered potentially feasible for infiltration if the *measured infiltration rate* obtained from field-testing or obtained by applying professional judgment to available data taken within the Project vicinity is greater than 0.3 inches per hour. *Measured* rates ($K_{measured}$) shall account for uncertainty and bias in measurement methods by applying a factor of safety of 2.0 to testing results ($K_{observed}$).

The *measured infiltration rate* ($K_{measured}$) calculated for the purpose of infiltration infeasibility screening (**TGD Section 2.4.2.4**) shall be based on a factor of safety of 2.0 applied to the rates obtained from the infiltration test results ($K_{observed}$). No adjustments from this value are permitted. The factor of safety used to compute the *design infiltration rate*(K_{design}) shall not be less than 2.0, but may be higher at the discretion of the design engineer and acceptance of the plan reviewer, per the considerations described in Section **VII.4**. The following definitions are intended to clarify these criteria:

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$K_{observed}$ - the observed saturated infiltration rate in the vertical direction measured directly from field testing. If the testing method requires adjustment to estimate vertical K_{sat}, then this adjustment should be made as part of computing $K_{observed}$.

$K_{measured} = K_{observed}/2.0$. The $K_{measured}$ value is used in comparing against the 0.3 in/hr feasibility screening criterion. The calculation of $K_{measured}$ includes a mandatory factor of safety of 2.0 applied to $K_{observed}$ to account for uncertainty in observed data and potential for long term clogging.

$K_{design} = K_{observed}/S_{total}$. This is the value used for design calculations. The factor of safety (S_{total}) must be at least 2.0, but may be higher at the discretion of the designer and reviewer to provide additional assurance or account for systems with higher risk of failure.

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I.2.1. Use of Regional Maps and "Available Data"

This section describes a method that satisfies the requirements for infiltration screening of small projects as defined by the TGDInfeasibility Screening Criteria (**TGD Section 2.4.2.4**). This method uses regionally mapped data coupled with all applicable data available through other site investigations to identify locations not potentially feasible for infiltration as a result of low infiltration rate or high groundwater table.

Via this method, areas of a project identified as having D soils or identified as having depth to first groundwater less than 5 feet are considered infeasible for infiltration if available data confirm these determinations.

Infiltration constraint maps are available in **Appendix XVI** and will be refined as part of the development of Watershed Hydromodification and Infiltration Management Plans.These maps identify constraints, including hydrologic soil group (A,B,C,D), and depth to first groundwater, which should be confirmed through review of available data.

"Available data" is defined as data collected by the project or otherwise available that provides information about infiltration rates and/or groundwater depths. Applicable data is expected to be available as part of nearly all projects subject to New Development and Significant Redevelopment stormwater management requirements in Orange County. Data sources may include:

- Geotechnical investigations
- Due diligence site investigations
- Other CEQA investigations
- Investigations performed on adjacent sites with applicability to the project site

Worksheet H: Factor of Safety and Design Infiltration Rate and Worksheet

Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = w x v
A	Suitability Assessment	Soil assessment methods	0.25		
		Predominant soil texture	0.25		
		Site soil variability	0.25		
		Depth to groundwater / impervious layer	0.25		
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			
B	Design	Tributary area size	0.25		
		Level of pretreatment/ expected sediment loads	0.25		
		Redundancy	0.25		
		Compaction during construction	0.25		
		Design Safety Factor, $S_B = \Sigma p$			

Combined Safety Factor, S_{Total}~~$_{OT}$~~= S_A x S_B	
~~Measured~~ Observed Infiltration Rate, inch/hr, $K_{observed}$~~$_M$~~ (corrected for test-specific bias)	
Design Infiltration Rate, in/hr, K_{DESIGN} = ~~S_{TOT} x~~ $K_{Observed}$~~$_M$~~ / S_{Total}	
Supporting Data	
Briefly describe infiltration test and provide reference to test forms:	

Note: The minimum combined adjustment factor shall not be less than 2.0 and the maximum combined adjustment factor shall not exceed 9.0.

- Recharge rate should be set to the design infiltration rate of the stormwater BMP, assuming that the BMP operates at its design infiltration rate throughout the critical period for groundwater mounding.
- The horizontal hydraulic conductivity should be set to 10 times the ~~measured~~ observed infiltration rate of the soil to account for typical anisotropy of natural soils (ratio of horizontal to vertical hydraulic conductivity). Note the ~~measured~~ observed infiltration rate will generally be greater than or equal to 2 times the design infiltration rate.
- The period of simulation should be set to 10 days. Applying the design infiltration rate continuously over 10 days generally results in 3-5 times the DCV infiltrated over this period considering typical BMP drawdown times.
- The specific yield should be set to 0.2.
- The saturated zone thickness should be set to 20 feet.

An example using the USGS tool is included in Example VIII.1 below.

Example VIII.1: Application of USGS Groundwater Mounding Tool Using a Hypothetical Range of Infiltration Scenarios

Given:

- ~~Measured~~ Observed soil infiltration rate: 0.2 to 4 inches per hour
- Design infiltration rate: 0.1 to 2 inches per hour (Factor of Safety = 2.0)
- Horizontal Hydraulic Conductivity: 2 to 40 inches per hour (Anisotropy: 10:1 (H:V) applied to measured infiltration rate)
- Facility footprint: 500 to 4,000 sq-ft
- *System aspect ratio*: 1:1 (square) and 5:1
- Period of simulation: 10 days (total infiltrated depth =24 to 480 inches)
- Saturated zone thickness: 20 feet
- Specific yield: 0.2

Required:

- Compute maximum mounding heights using USGS tool

Solution:

Maximum mounding heights calculated with the USGS tool are given in Figure VIII.1. While these results reflect a relatively conservative case, they indicate that system size and design infiltration rate both influence the potential for mounding. In addition, a linear geometry reduces the magnitude of mounding somewhat compared to a square geometry with the same footprint.

ATTACHMENT 5
TGD Appendix VII

Example VII.1: Percolation Rate Conversion Example

(Porchet Method, aka Inverse Borehole Method):

The bottom of a proposed infiltration basin would be at 5.0 feet below natural grade. Percolation tests are performed within the boundaries of the proposed basin location with the depth of the test hole set at the infiltration surface level (bottom of the basin). The Percolation Test Data Sheet (Table 5) is prepared as the test is being performed. After the minimum required number of testing intervals, the test is complete. The data collected at the final interval is as follows:

Time interval, Δt = 10 minutes
Initial Depth to Water, D_0 = 12.25 inches
Final Depth to Water, D_f = 13.75 inches
Total Depth of Test Hole, D_T = 60 inches
[13]Test Hole Radius, r = 4 inches

The conversion equation is used:

$$I_t = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$$

"H_o" is the initial height of water at the selected time interval.

$H_o = D_T - D_0 = 60 – 12.25 = 47.75$ inches

"H_f" is the final height of water at the selected time interval.

$H_f = D_T$ - ~~D_0~~ D_f = 60 - 13.75 = 46.25 inches

"ΔH" is the change in height over the time interval.

$\Delta H = \Delta D = H_o - H_f = 47.75 – 46.25 = 1.5$ inches

"H_{avg}" is the average head height over the time interval.

$H_{avg} = (H_o + H_f)/2 = (47.75 + 46.25)/2 = 47.0$ inches

"I_t" is the tested infiltration rate.

$$I_t = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})} = \frac{(1.5\ in)(\frac{60\ min}{hr})(4\ in)}{(10\ \text{min})((4\ in) + 2(47\ in))} = 0.37\ in/hr$$

[13] Where a rectangular test hole is used, an equivalent radius should be determined based on the actual area of the rectangular test hole (i.e., $r = (A/\pi)^{0.5}$).

ATTACHMENT 6
TGD Appendix X

Table X.8: Minimum Irrigated Area for Potential Partial Capture Feasibility

General Landscape Type	Conservation Design: $K_L = 0.35$			Active Turf Areas: $K_L = 0.7$		
Closest ET Station	*Irvine*	*Santa Ana*	*Laguna*	*Irvine*	*Santa Ana*	*Laguna*
Design Capture Storm Depth, inches	**Minimum Required Irrigated Area per Tributary Impervious Acre for Potential Partial Capture, ac/ac**					
0.60	0.66	0.68	0.72	0.33	0.34	0.36
0.65	0.72	0.73	0.78	0.36	0.37	0.39
0.70	0.77	0.79	0.84	0.39	0.39	0.42
0.75	0.83	0.84	0.90	0.41	0.42	0.45
0.80	0.88	0.90	0.96	0.44	0.45	0.48
0.85	0.93	0.95	1.02	0.47	0.48	0.51
0.90	0.99	1.01	1.08	0.49	0.51	0.54
0.95	1.04	1.07	1.14	0.52	0.53	0.57
1.00	1.10	1.12	1.20	0.55	0.56	0.60

Worksheet J: Summary of Harvested Water Demand and Feasibility

1	What demands for harvested water exist in the tributary area (check all that apply):			
2	Toilet and urinal flushing		◻	
3	Landscape irrigation		◻	
4	Other:____		◻	
5	What is the design capture storm depth? (**Figure III.1**)	d		inches
6	What is the project size?	A		ac
7	What is the acreage of impervious area?	IA		ac
	For projects with ~~multiple types of demand (~~ ~~both~~ toilet flushing, ~~and~~ indoor demand, and/or other demand)			
8	What is the minimum use required for partial capture? (**Table X.6**)			gpd
9	What is the project estimated ~~minimum~~ wet season total daily use?			gpd
10	Is partial capture potentially feasible? (Line 9 > Line 8?)			
	For projects with only toilet flushing demand			
11	What is the minimum TUTIA for partial capture? (**Table X.7**)			
12	What is the project estimated TUTIA?			

ATTACHMENT 7
TGD Appendix I

APPENDIX I. BMP FACT SHEETS

This appendix contains BMP fact sheets for the following BMP categories:

ATTACHMENT 8
TGD Appendix XVI

XVI.3. North Orange County Hydromodification Susceptibility Maps

Figure XVI.3: North Orange County Hydromodification Susceptibility Maps

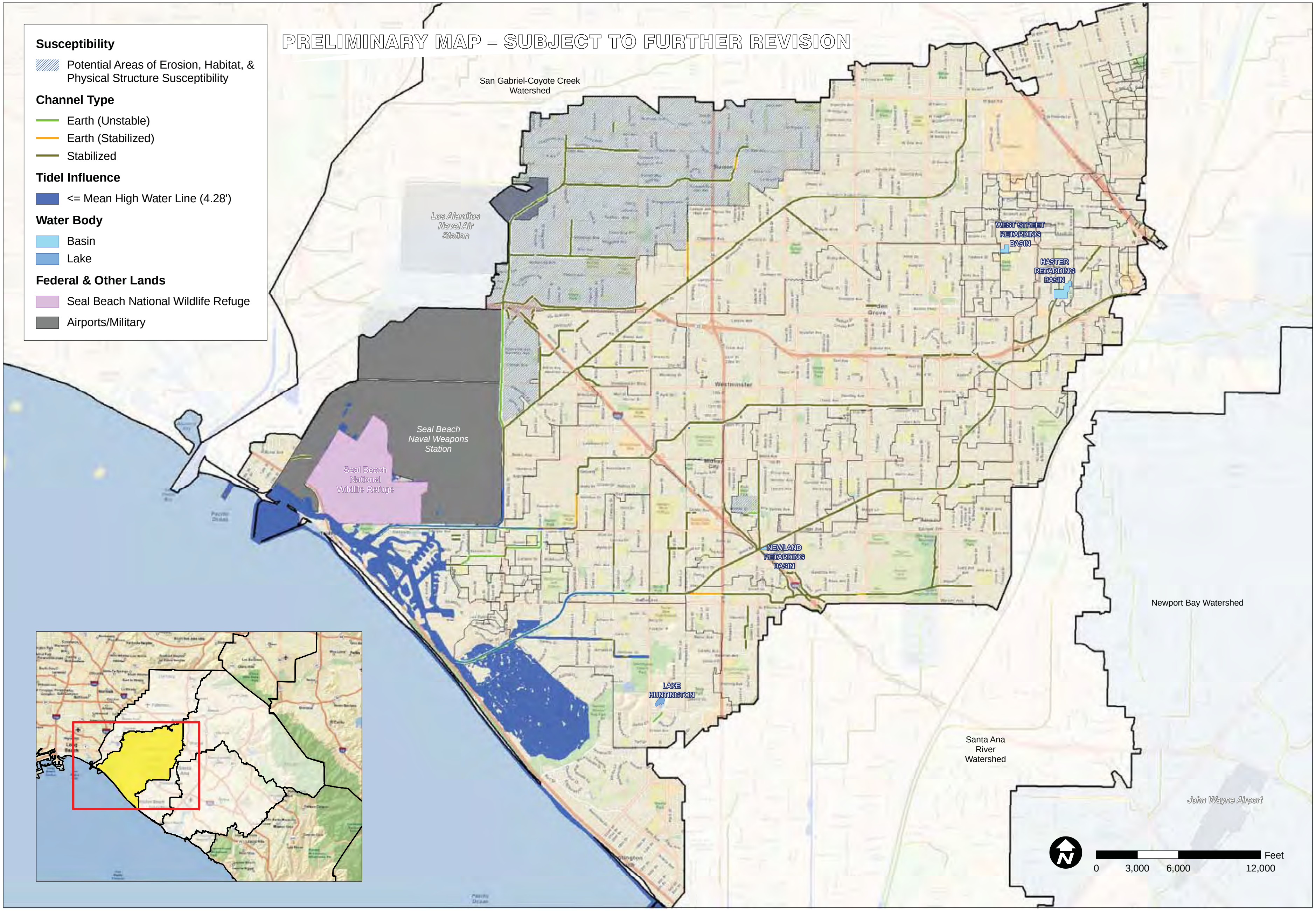
Exhibits start on following page

Map Title: SUSCEPTIBILITY ANALYIS ANAHEIM BAY- HUNTINGTON HARBOR

Changes:

- A total of 9,612 linear feet of channel changed from Earth (Unstable) to Earth (Stabilized)
- Channels:
    - OCEAN VIEW CHANNEL = 1,358 ft.
    - EAST GARDEN GROVE-WINTERSBURG CHANNEL = 2,684 ft.
    - BOLSA CHICA CHANNEL = 2,249 ft.
    - SLATER STORM CHANNEL = 304 ft.
    - STANTON STORM CHANNEL = 175 ft.
    - WESTMINSTER CHANNEL = 1,517 ft.
    - SUNSET CHANNEL = 597 ft.
    - NEWLAND STORM CHANNEL = 119 ft.
    - Unnamed Channels = 609 ft.

SUSCEPTIBILITY MAP - ORIGINAL SUBMITTAL (MAY 2011)



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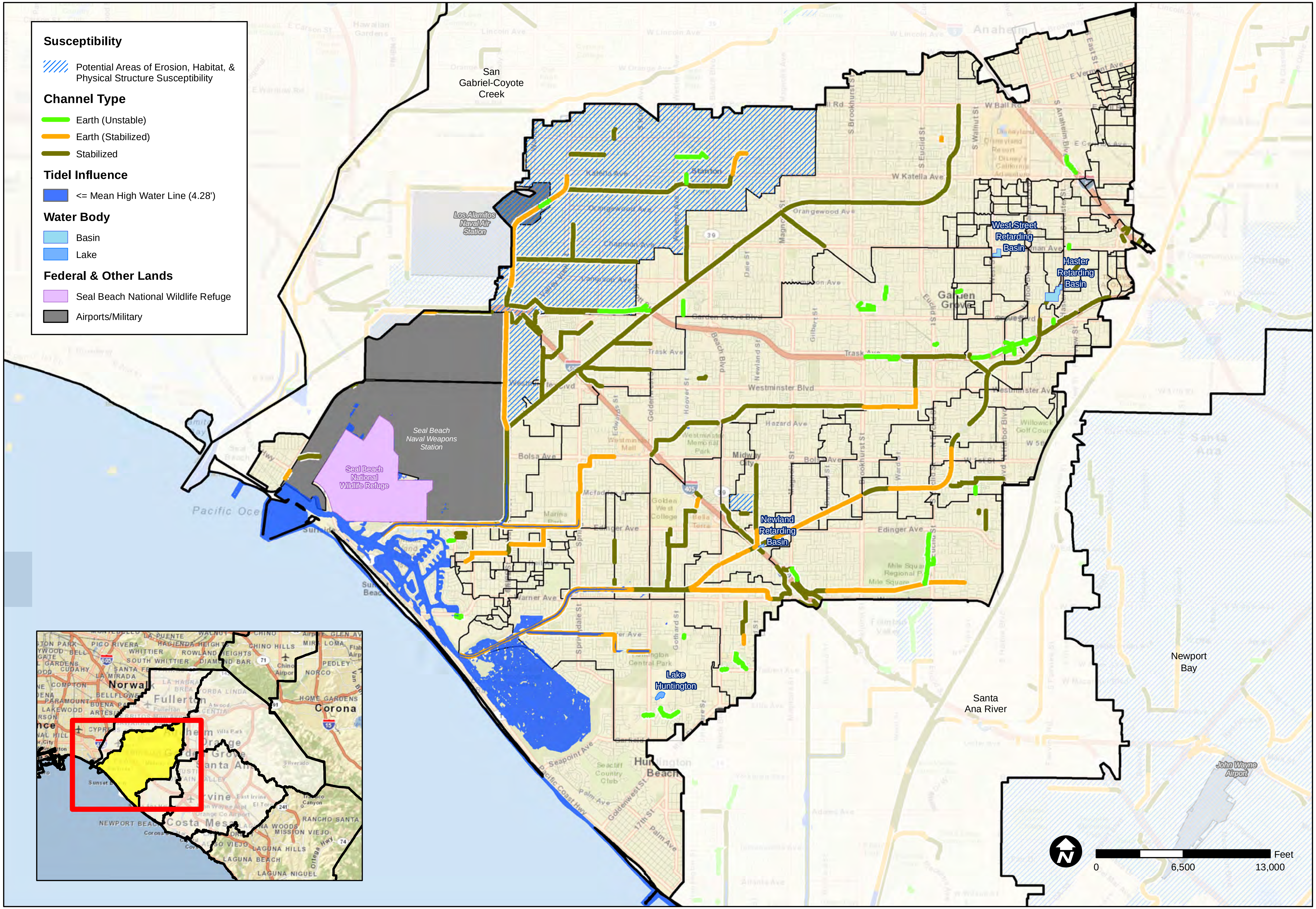
TITLE
SUSCEPTIBILITY ANALYIS
ANAHEIM BAY-
HUNTINGTON HARBOR

JOB
ORANGE COUNTY
WATERSHED
MASTER PLANNING
ORANGE CO. CA

SCALE 1" = 3000'
DESIGNED TH
DRAWING TH
CHECKED BMP
DATE 04/22/10
JOB NO. 9526-E

PACE Advanced Water Engineering

FIGURE
XVI-3b



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TITLE
SUSCEPTIBILITY ANALYIS
ANAHEIM BAY-
HUNTINGTON HARBOR

JOB
ORANGE COUNTY
WATERSHED
MASTER PLANNING
ORANGE CO. CA

SCALE	1" = 6500'
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/22/10
JOB NO.	9526-E

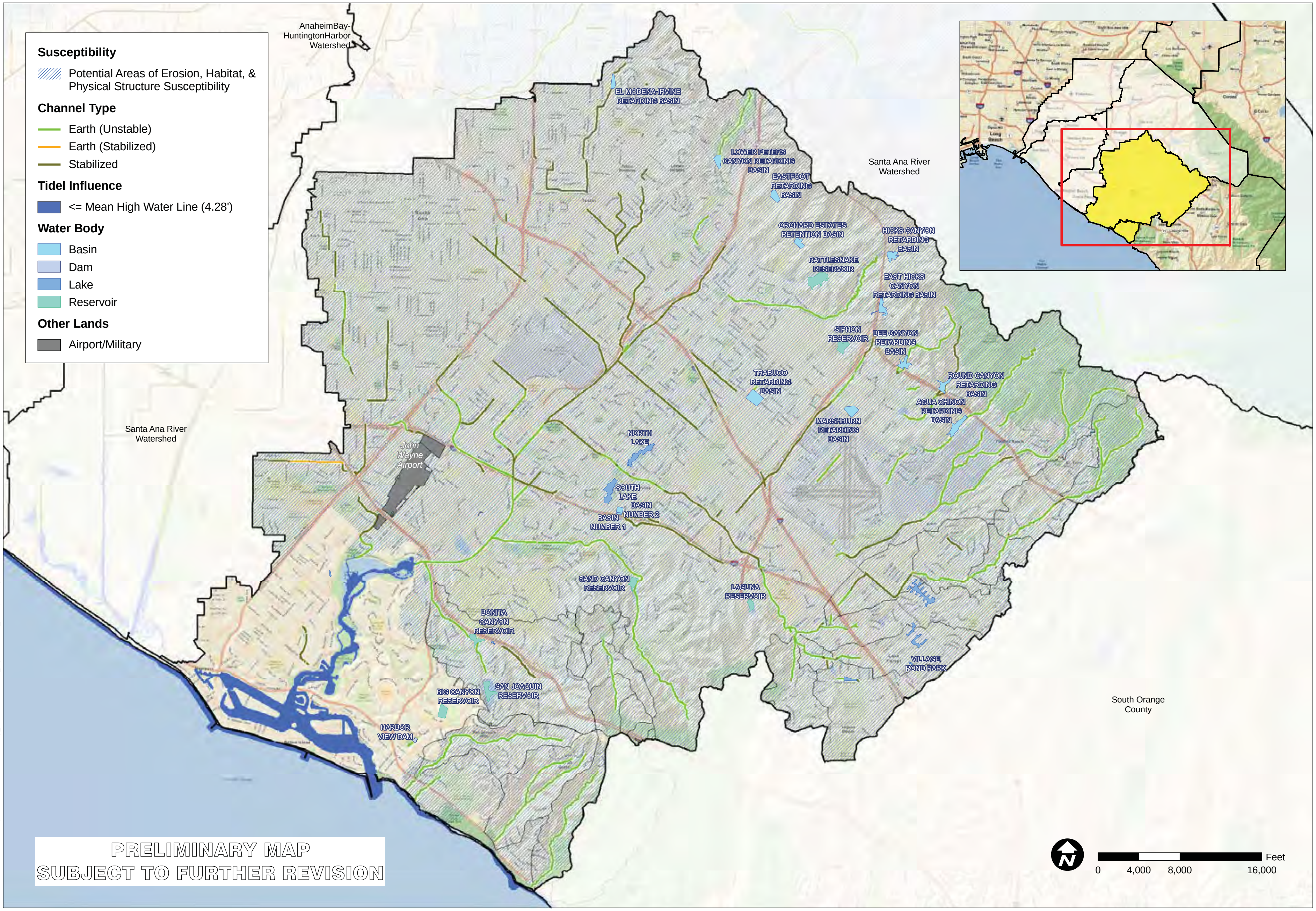
PACE
Advanced Water Engineering

FIGURE
2

Map Title: SUSCEPTIBILITY ANALYSIS NEWPORT BAY-NEW PORT COASTAL STREAMS

Changes:

- A total of 14,416 linear feet of channel changed from Earth (Unstable) to Earth (Stabilized)
- Channels:
  - BORREGO CANYON CHANNEL = 242 ft.
  - SANTA ANA-SANTA FE CHANNEL = 971 ft.
  - PETERS CANYON CHANNEL = 845 ft.
  - CENTRAL IRVINE CHANNEL = 445 ft.
  - SAN DIEGO CREEK CHANNEL = 2,275 ft.
  - PAULARINO CHANNEL = 361 ft.
  - LA COLINA-REDHILL STORM DRAIN = 137 ft.
  - EL MODENA-IRVINE CHANNEL = 650 ft.
  - REDHILL CHANNEL = 50 ft.
  - COMO STORM CHANNEL = 812 ft.
  - LANE CHANNEL = 870 ft.
  - CANADA CHANNEL = 274 ft.
  - ARMSTRONG STORM CHANNEL = 325 ft.
  - BARRANCA CHANNEL = 975 ft.
  - BEE CANYON CHANNEL = 975 ft.
  - SAN JOAQUIN CHANNEL = 260 ft.
  - AGUA CHINON CHANNEL = 49 ft.
  - VEEH STORM CHANNEL = 20 ft.
  - AIRPORT STORM CHANNEL = 154 ft.
  - SANTA ANA-DELHI CHANNEL = 739 ft.
  - SANTA ANA GARDEN CHANNEL = 864 ft.
  - VALENCIA STORM CHANNEL = 149 ft.
  - Unnamed Channels = 1,974 ft.



TITLE
SUSCEPTIBILITY ANALYIS
NEWPORT BAY-
NEWPORT COASTAL STREAMS

JOB
ORANGE COUNTY
WATERSHED
MASTER PLANNING
ORANGE CO.
CA

SCALE	DESIGNED	DRAWING	CHECKED	DATE	JOB NO.
1" = 4000'	TH	TH	BMP	04/30/10	9526-E

PACE
Advanced Water Engineering

FIGURE
XVI-3d

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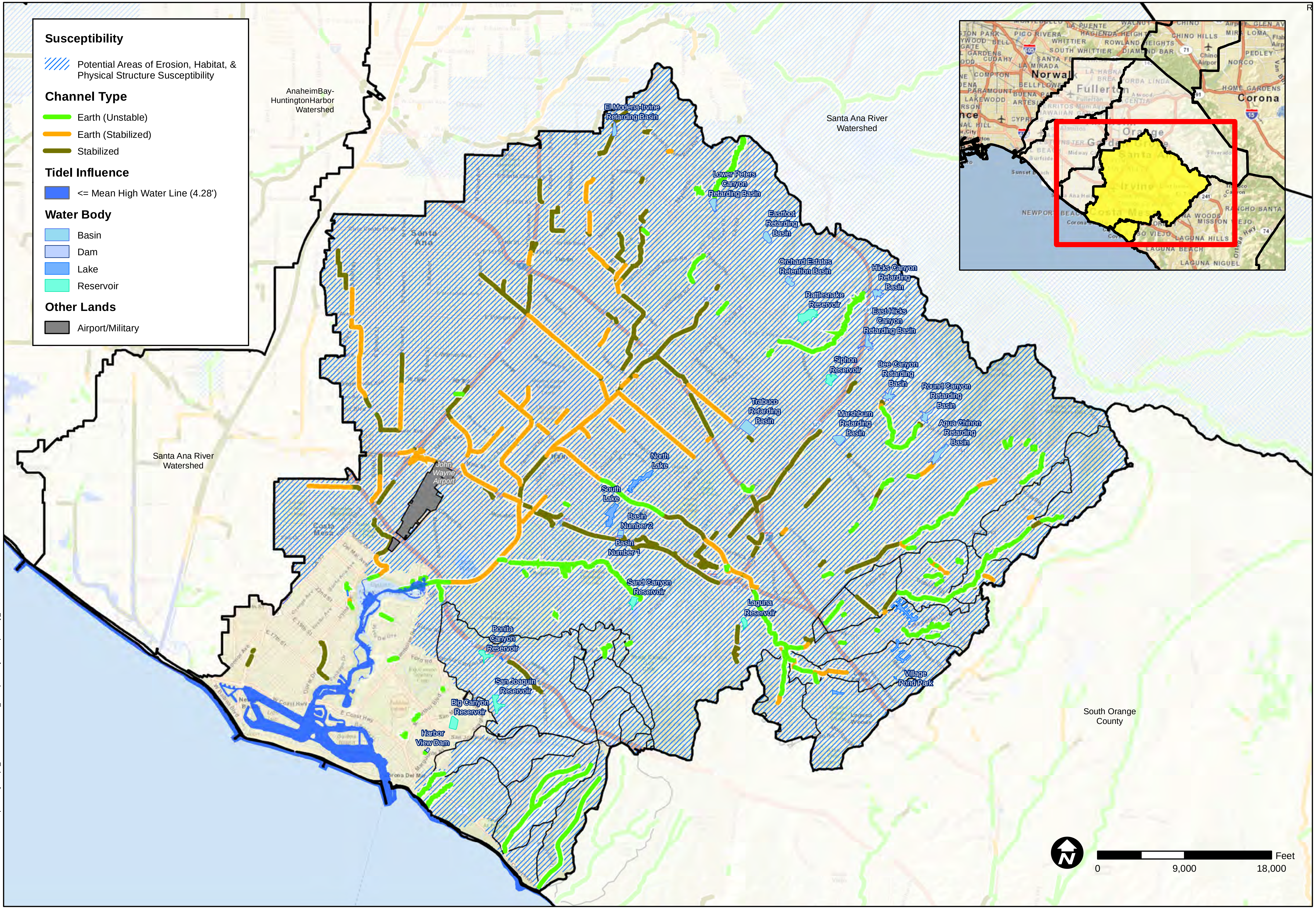

SUSCEPTIBILITY ANALYIS
NEWPORT BAY-
NEWPORT COASTAL STREAMS

ORANGE COUNTY
WATERSHED
MASTER PLANNING

ORANGE CO. CA

SCALE	1" = 12000'
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/30/10
JOB NO.	9526-E

PACE Advanced Water Engineering

FIGURE 4

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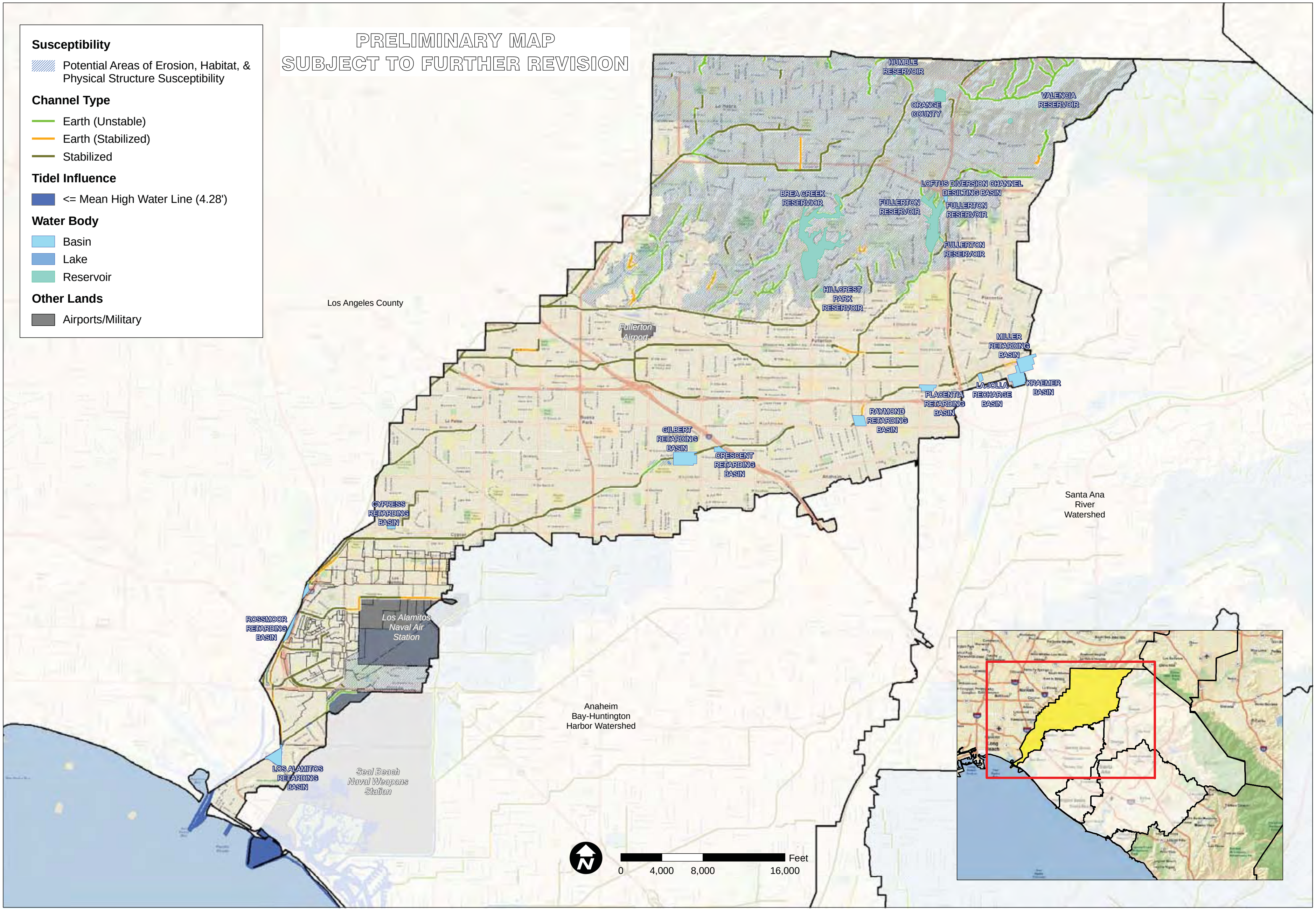
Map Title: SUSCEPTIBILITY ANALYSIS SAN GABRIEL-COYOTE CREEK

- Changes: A total of 8,879 linear feet of channel changed from Earth (Unstable) to Earth (Stabilized)
- Channels:
  - LOFTUS DIVERSION CHANNEL = 783 ft.
  - BUENA PARK STORM CHANNEL = 166 ft.
  - CARBON CREEK CHANNEL = 4,235 ft.
  - MONITECITO STORM CHANNEL = 125 ft.
  - ROSSMOOR STORM CHANNEL = 425 ft.
  - LOS ALAMITOS CHANNEL = 768 ft.
  - COYOTE CREEK CHANNEL = 400 ft.
  - BREA CANYON CHANNEL = 588 ft.
  - IMPERIAL CHANNEL = 627 ft.
  - FULLERTON CREEK CHANNEL = 182 ft.
  - FEDERAL STORM CHANNEL = 315 ft.
  - EAST LA HABRA STORM DRAIN = 44 ft.
  - BREA CREEK CHANNEL = 221 ft.



SUSCEPTIBILITY ANALYSIS
SAN GABRIEL-COYOTE CREEK

ORANGE COUNTY WATERSHED MASTER PLANNING

ORANGE CO. CA

SCALE	DESIGNED	DRAWING	CHECKED	DATE	JOB NO.
1" = 4000'	TH	TH	BMP	04/22/10	9526-E

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FIGURE

XVI-3a

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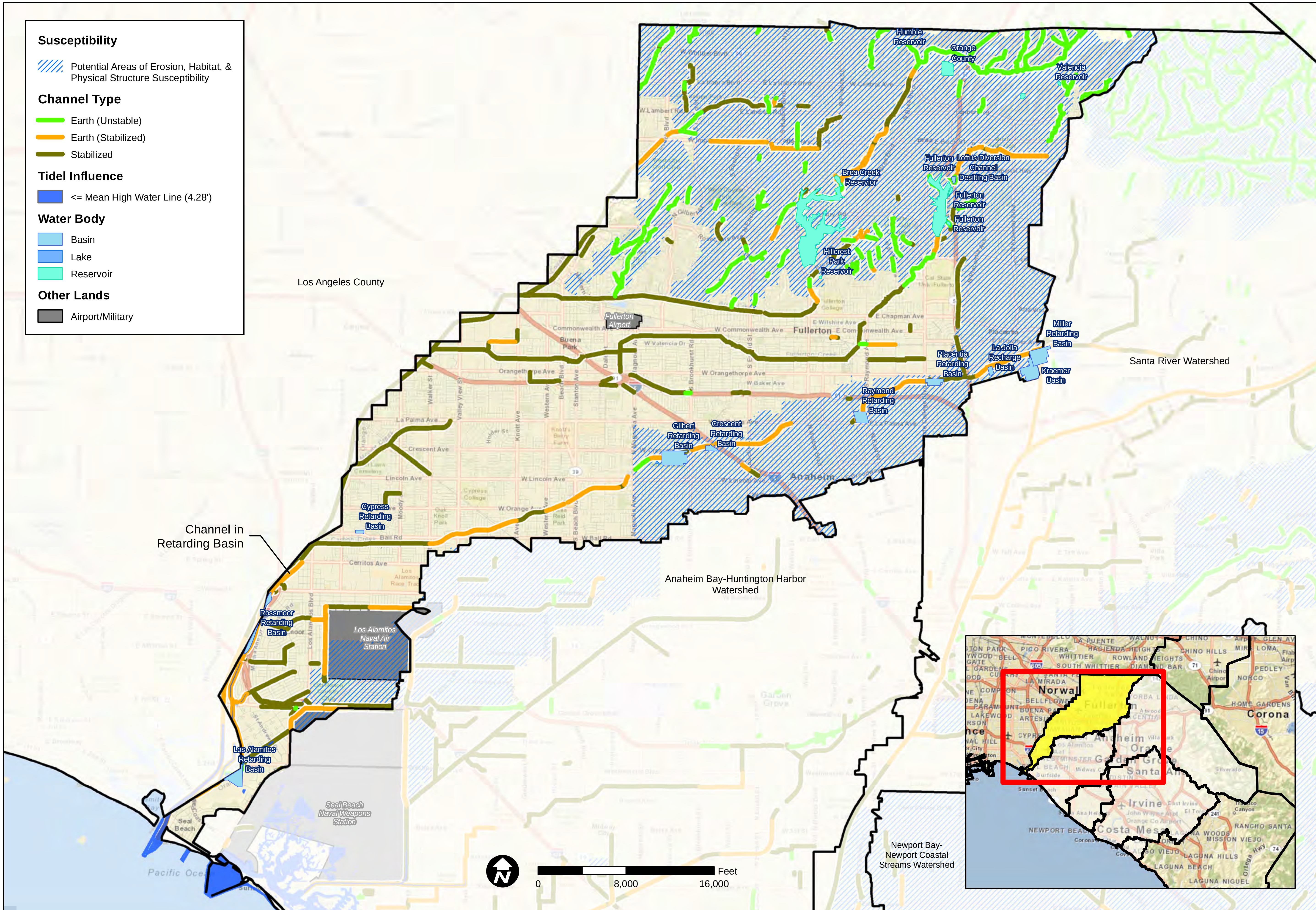


SUSCEPTIBILITY ANALYIS
SAN GABRIEL-COYOTE CREEK

ORANGE COUNTY WATERSHED MASTER PLANNING

ORANGE CO. CA

SCALE	1" = 8000'
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/30/10
JOB NO.	9526-E

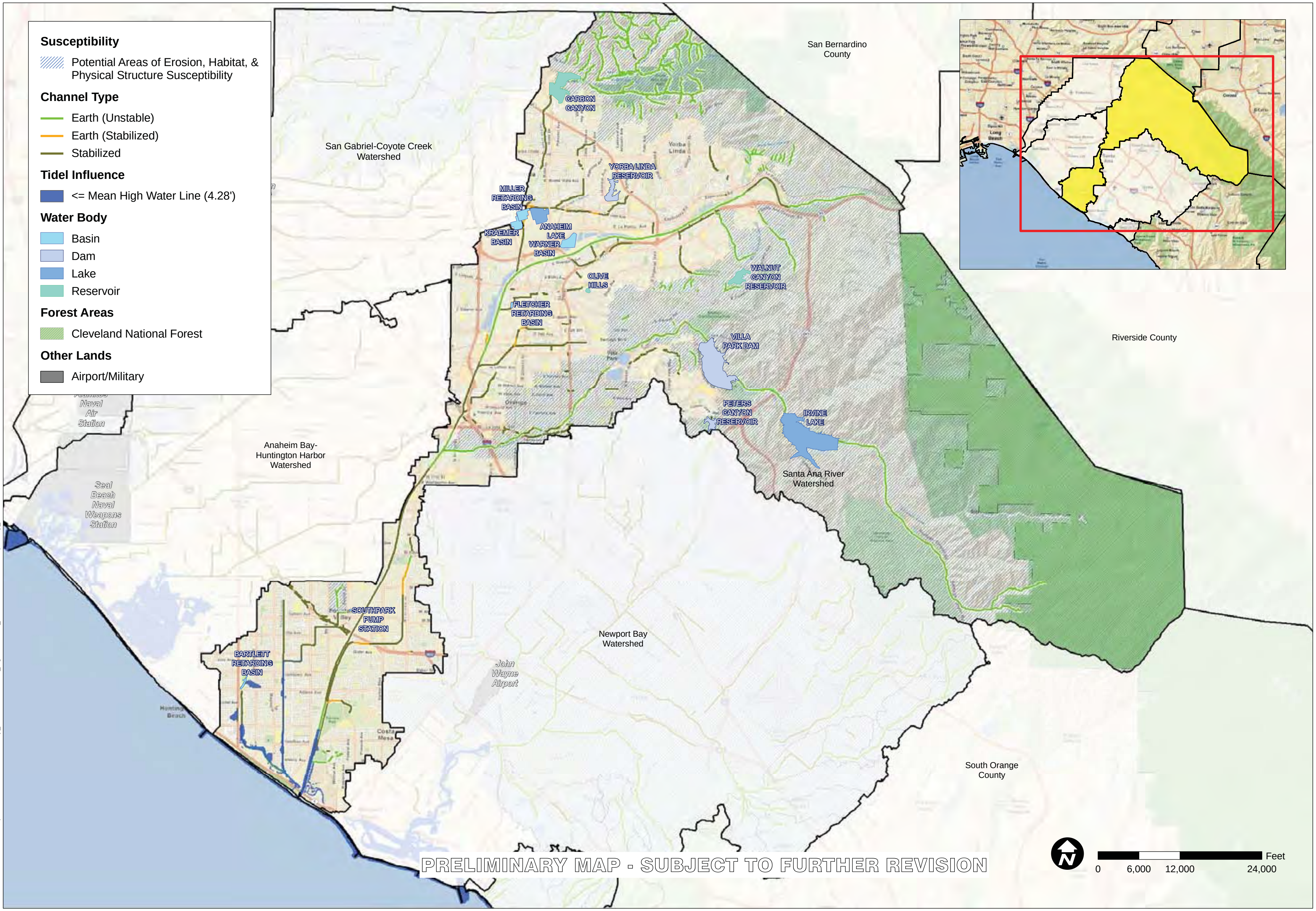
PACE Advanced Water Engineering

1

Map Title: SUSCEPTIBILITY ANALYSIS SANTA ANA RIVER

Changes:

- A total of 13,574 linear feet of channel changed from Earth (Unstable) to Earth (Stabilized)
- Channels:
  - CARBON CANYON CHANNEL = 26 ft.
  - SOUTHEAST ANAHEIM CHANNEL = 99 ft.
  - COLLINS CHANNEL = 690 ft.
  - SANTA ANA RIVER CHANNEL = 6,797 ft.
  - ATWOOD CHANNEL = 346 ft.
  - GREENVILLE-BANNING CHANNEL = 1,259 ft.
  - FOUNTAIN VALLEY CHANNEL = 764 ft.
  - TALBERT CHANNEL = 313 ft.
  - FLETCHER CHANNEL = 97 ft.
  - WALNUT STORM CHANNEL = 48 ft.
  - CARBON CREEK DIVERSION CHANNEL = 209 ft.
  - HANDY CREEK STORM CHANNEL = 206 ft.
  - SANTIAGO CREEK CHANNEL = 810 ft.
  - FAIRVIEW CHANNEL = 216 ft.
  - CARBON CREEK DIVERSION CHANNEL = 695 ft.
  - GISLER STORM CHANNEL = 205 ft.
  - Unnamed Channels = 794 ft.



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TITLE
SUSCEPTIBILITY ANALYSIS
SANTA ANA RIVER

JOB
ORANGE COUNTY
WATERSHED
MASTER PLANNING
ORANGE CO. CA

SCALE	1" = 6000'
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/30/10
JOB NO.	9526-E

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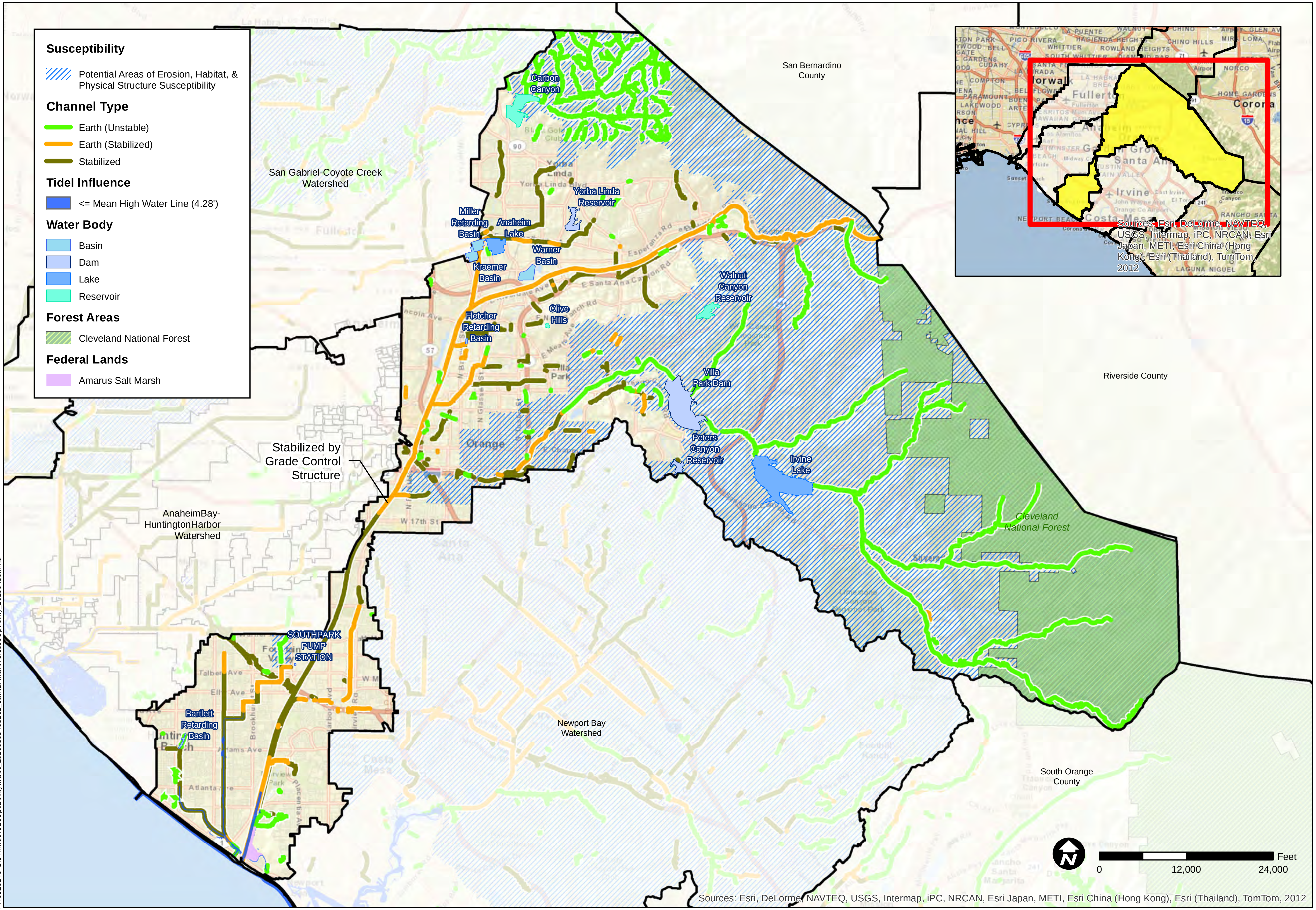
FIGURE
XVI-3c



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TITLE: SUSCEPTIBILITY ANALYIS SANTA ANA RIVER

JOB: ORANGE COUNTY WATERSHED MASTER PLANNING

ORANGE CO. CA

SCALE	1" = 12000'
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/30/10
JOB NO.	9526-E

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FIGURE 3