Geosyntec Consultants, April 2, 2010, Memorandum regarding LID Equivalency Evaluation for the Newhall Ranch RMDP/SCP EIS/EIR Analysis Region

Geosyntec consultants

475 14th Street, Suite 400
Oakland, California 94612
PH 510.836.3034
FAX 510.836.3036
www.geosyntec.com

Memorandum

Date:	02 April 2010
To:	Matt Carpenter, Newhall Land
From:	Lisa Austin, Aaron Poresky and Will Lewis, Geosyntec Consultants
Subject:	LID Equivalency Evaluation for the Newhall Ranch RMDP/SCP EIR/EIS Analysis Region

INTRODUCTION

The Los Angeles County Low Impact Development (LID) Ordinance (Chapter 12.84 of the municipal code) establishes standards for the incorporation of LID into development projects. To implement the provisions of this ordinance, Los Angeles County Department of Public Works (LACDPW) has developed a LID Standards Manual that outlines stormwater runoff quantity and quality control development principles, technologies, and design standards for achieving the LID Standards of Chapter 12.84.

The Newhall Ranch Specific Plan Sub-Regional Stormwater Mitigation Plan (NRSP Sub-Regional SWMP) establishes performance standards for BMPs implemented within the Newhall Ranch Resource Development Plan (RMDP) and Spineflower Conservation Plan (SCP) EIS/EIR Analysis Region (the Project).

The purpose of this memorandum is to demonstrate that the performance standards contained in the NRSP Sub-Regional SWMP are equivalent to or exceed the LID goals and requirements of the LACDPW LID Standards Manual when applied to the Project.

BACKGROUND

Chapter 12.84 of the Los Angeles municipal code requires the use of low impact development ("LID") standards in development projects. This chapter applies to all development within the unincorporated area of the County after January 1, 2009, except for those developments that filed a complete discretionary or non-discretionary permit application with the Los Angeles County Department of Regional Planning, Public Works, or any County-controlled design control board, prior to January 1, 2009. The LID Ordinance states the purpose of LID as:

1) Replenishing groundwater supplies,

2) Improving the quality of surface water runoff,

3) Stabilizing natural stream characteristics,

4) Preserving natural site characteristics, and

5) Minimizing downstream impacts.

Chapter 12.84 requires that applicable development projects:

1) Mimic undeveloped stormwater and urban runoff rates and volumes in any storm event up to and including the "50-year capital design storm event," as defined by Public Works;

2) Prevent pollutants of concern from leaving the development site in stormwater as the result of storms, up to and including a water quality design storm event; and

3) Minimize hydromodification impacts to natural drainage systems.

LID Standards Manual Requirements

LACDPW has developed a LID Standards Manual that outlines stormwater runoff quantity and quality control development principles, technologies, and design standards for achieving the LID Standards of Chapter 12.84. The LID Standards Manual requires that large scale residential and nonresidential development projects prioritize the selection of BMPs to treat stormwater pollutants, reduce stormwater runoff volume, and promote groundwater infiltration and stormwater reuse in an integrated approach to protecting water quality and managing water resources. The volumetric criterion associated with this requirement is the excess volume (ΔV), defined as the post-developed runoff volume minus the pre-developed runoff volume for the 85th percentile storm event (0.75 inches for Los Angeles County).

The Manual states that BMPs should be implemented in the following order of preference:

- BMPs that promote infiltration.

- BMPs that store and beneficially use stormwater runoff.

- BMPs that utilize the runoff for other water conservation uses including, but not limited to, BMPs that incorporate vegetation to promote pollutant removal and runoff volume reduction and integrate multiple uses, and BMPs that percolate runoff through engineered soil and allow it to discharge downstream slowly.

If compliance with the above LID requirements is technically infeasible, in whole or in part, the project must incorporate design features demonstrating compliance with the LID requirements to the maximum extent practicable. The LID goals of increasing groundwater recharge, enhancing water quality, and preventing degradation to downstream natural drainage courses will be considered by DPW in the determination of infeasibility. The LID Standards Manual outlines site conditions where infiltration may not be possible:

- Locations where seasonal high groundwater is within 10 feet of the surface.
- Within 100 feet of a groundwater well used for drinking water.
- Brownfield development sites or other locations where pollutant mobilization is a documented concern.
- Locations with potential geotechnical hazards as outlined in a report prepared and stamped by a licensed geotechnical engineer.
- Locations with natural, undisturbed soil infiltration rates of less than 0.5 inches per hour that do not support infiltration-based BMPs.
- Locations where infiltration could cause adverse impacts to biological resources.
- Development projects in which the use of infiltration BMPs would conflict with local, State or Federal ordinances or building codes.
- Locations where infiltration would cause health and safety concerns.

The LID Standards Manual outlines where storage and reuse of the ΔV may not be possible:

- Projects that would not provide sufficient irrigation or (where permitted) domestic grey water demand for use of stored runoff due to limited landscaping or extensive use of low water use plant palettes in landscaped areas.
- Projects that are required to use reclaimed water for irrigation of landscaping.
- Development projects in which the storage and reuse of stormwater runoff would conflict with local, State or Federal ordinances or building codes.
- Locations where storage facilities would cause potential geotechnical hazards as outlined in a report prepared and stamped by a licensed geotechnical engineer.

- Locations where storage facilities would cause health and safety concerns.

Section 22.84.440.C sets forth the LID standards that must be met to comply with the goals of Chapter 12.84 of the Los Angeles County Code, and section 12.84.450 requires the County Department of Regional Planning and the Director of the Department of Public Works to conduct a review to determine compliance with those standards.

NRSP Sub-Regional SWMP Performance Standards

The NRSP Sub-Regional SWMP contains a variety of commitments to stormwater management. Critical among these are the commitment to integrate site design/low impact development principles at the project and site-scale and the commitment to capture and treat, in a well designed BMP, 80 percent of the average annual runoff volume from the Project.

EQUIVALENCY ANALYSIS

NRSP Sub-Regional SWMP performance standard applied to the Project is compared to the LID Standards Manual requirements through a two tiered analysis. The first tier of analysis involves spatial data processing to divide the Project area into analysis regions based on the proposed developed condition and infeasibility criteria listed above. The second tier involves calculating the LID Standards Manual volumetric mitigation requirements for these areas, calculating the volumetric performance of Project BMPs, and comparing these values.

TIER ONE ANALYSIS METHODOLOGY

Tier One analysis utilizes spatial datasets and Geographic Information System (GIS) processing to divide the project into analysis regions based on the infeasibility criteria listed above. The steps in Tier One analysis are described below.

Establishing Areas with a $\Delta V>0$

Proposed land use datasets were queried for areas that will undergo development. Areas that will remain as open space will inherently have a ΔV of 0 and are not considered further in this equivalency analysis. Figure 1 shows the results of this screening.

Subdividing Areas with a $\Delta V>0$ by Treatment Feasibility

Developed land uses were subdivided into the following feasibility categories:

1. Infiltration is potentially feasible; none of the infiltration screening factors apply.
2. Infiltration is infeasible or unadvisable based on the criteria listed above but storage and reuse may be feasible.

3. Both infiltration and storage and reuse are infeasible or unadvisable based on the criteria listed above.

A series of spatial analyses were performed to identify areas within the Project boundary that meet the numeric or narrative infeasibility criteria, as described below.

Establishing Areas Infeasible for Infiltration

Areas With Seasonally High Groundwater:

Spatial datasets representing contours of depth to seasonally high groundwater less than or equal to 10 feet were provided by the Project's geotechnical consultant (Seward, 2009). This surface was intersected with developed areas within the Project boundary to yield the developed acreage where infiltration is infeasible due to seasonally high groundwater. Figure 2 shows the results of this screening.

Areas Within 100 feet of a Drinking Water Supply Well:

Infiltration infeasibility due to proximity to water supply wells in the Project area was not considered in analysis. This assumption has the effect of making more area available for infiltration than would actually be available if drinking water wells were considered.

Brownfield Development Sites Where Pollutant Mobilization is a Concern:

There are no known contaminated soils or groundwater areas within the Newhall Sub-region. Unless such a site is identified by the Newhall Land project team, infiltration feasibility due to the presence of brownfields does not apply to Newhall Land projects and was not incorporated into spatial processing for the Project.

Areas Where Geotechnical Hazards Are Outlined by a Licensed Geotechnical Engineer:

Spatial datasets representing identified geotechnical hazards were prepared by the Project geotechnical consultant (Seward, 2009). The geotechnical hazards considered in this screening included mapped landslides immediately adjacent to proposed development that will be left partially or entirely in place after remedial grading.

In addition, it was assumed that a geotechnical hazard would potentially arise from infiltration of water into deep fill areas. For the purposes of this analysis, areas with fill depth exceeding 25 feet in depth were assumed to be infeasible for infiltration. Proposed cut and fill data based on rough grading plans was used to generate contours of approximate cut and fill depths. The resulting contour dataset was then queried for expected fill depths greater than 25 feet to yield areas of geotechnical concern due to the depth of fill.

Landslide areas identified by Seward (2009) and areas with greater than 25 feet of anticipated fill were intersected with areas to be developed within the Project boundary to yield the development acreage where infiltration is assumed to be infeasible due to geotechnical concerns. Figure 3 shows the results of this screening.

Areas Where Natural Soil Infiltration Rates are Less Than 0.5 inches per hour:
Based on a review of geologic formations and available permeability testing data Seward (2009) divided the Project areas into three categories:

1. Areas where permeability testing at limited at limited locations indicates that the native soils have a permeability rate of greater than 0.5 inches per hour,
2. Areas that have not been tested where geologic conditions indicate that native soils may have a permeability of greater than 0.5 inches per hour, and
3. Areas where permeability testing at limited locations and geologic conditions indicates that native undisturbed soils likely have permeability rate less than 0.5 inches per hour.

The first two of these categories were assumed to be feasible for infiltration. The third category was intersected with areas to be developed within the Project boundary to yield the acreage where infiltration is infeasible due to an undisturbed soil infiltration rate likely less than 0.5 inches per hour. Figure 4 shows the results of this screening.

Where Infiltration May Cause Adverse Impacts to Biological Resources:
Infiltrating the excess volume (ΔV) in some areas may lead to the creation of springs or seeps and/or unseasonal flows in ephemeral tributaries to the Santa Clara River. Spring/seeps and/or unseasonal flows may adversely impact ecosystems adapted to episodic precipitation and event-driven ephemeral flows. For this analysis, infiltration infeasibility due to adverse impacts to biological resources was not considered. This assumption has the effect of making more area feasible for infiltration than if impacts to biological resources were considered.

Areas Where the Use of Infiltration BMPS May Conflict with Building Codes:
Current County guidance on setbacks for infiltration facilities includes:

- Property lines & Public Right of Way: 5 ft
- Any foundation: minimum of 15 ft or within a 1:1 plane drawn up from the bottom of foundation
- Face of any slope H/2, 5 ft minimum (H is height of slope), unless otherwise recommended by a Soils Engineer and approved by Geotechnical and Materials Engineering Division.

It is anticipated that complete retention of the excess volume (ΔV) would not be feasible in some land uses due to these considerations. However, for this analysis, infiltration infeasibility due to potential conflict with building codes was not incorporated into spatial processing due to lack of detail in proposed development spatial data layers. It is expected that conflicts with building codes would be evaluated at the tract map level. This assumption has the effect of making more area feasible for infiltration in the analysis than if conflicts with building codes were considered.

Areas Where Infiltration May Cause Health or Safety Concerns

At this time, the Newhall consultant team has not identified local, State, or Federal ordinances or statutes that may limit the feasibility of infiltration due to health and safety concerns. Therefore, infiltration inadvisability due to health and safety was not considered in this analysis. This assumption has the effect of making more area feasible for infiltration than if health and safety concerns were considered.

Merging and Subtracting to Establish Areas Where Infiltration is Infeasible and Feasible

All spatial datasets representing areas where infiltration is infeasible were merged and dissolved to represent a single surface. Merging accounts for any overlapping areas and ensures that double counting does not occur when an area of infiltration feasibility or infeasibility within the developed areas of the Project is established. The area for which infiltration of ΔV is the applicable standard was calculated by subtracting the areas where one may claim infiltration is infeasible from the developed areas within the Project. Figure 5 shows the combined results of screening for each of the factors discussed above.

Establishing Areas with Storage and Reuse Infeasibility

Where infiltration is infeasible, the next priority is to store and use ΔV (rainwater harvesting). The Project is required to use reclaimed water for irrigation of landscaping, therefore storage and reuse are not considered feasible.

LID Where Infiltration and Retention and Storage Are Infeasible

Where both infiltration and harvesting are not feasible, ΔV must be treated in vegetated BMPs. The remaining water quality design volume may be treated in a non-vegetated BMP if necessary. Media filters or equivalent have been specified in the NRSP Sub-Regional SWMP as the last alternative when vegetated BMPs are not feasible.

TIER TWO ANALYSIS METHODOLOGY

Tier Two analysis sets a performance standard for the Project and compares the performance of project design features to this performance standard. The performance standard is set based on

the estimated long term performance of properly designed LID BMPs per the LID Standards Manual, considering the feasibility criteria contained in this manual.

LID Standards Manual Mitigation Volume Requirements Calculation

The LID Standards Manual prescribes the following six step method for computing the excess volume:

Step 1: Determine hydrologic parameters:

A) Establish the area that will be disturbed and what areas will be left as open space.

B) Determine the length of flow path and calculate an average slope.

C) Identify soil type

Step 2: Establish a design storm:

A) Identify the 85th percentile 24-hour runoff event.

Step 3: Calculate undeveloped runoff volume for area to be disturbed:

A) Estimated using the LACDPW T_c Calculator based on area, proportion of impervious area, soil type, associated rainfall isohyet, and flow path length and slope as inputs.

Step 4: Calculate developed runoff volume for area to be disturbed:

A) Estimated using the LACDPW T_c Calculator based on area, proportion of impervious area, soil type, associated rainfall isohyet, and flow path length and slope as inputs.

Step 5: Calculate excess runoff volume (ΔV):

A) Subtract undeveloped runoff volume from the developed runoff volume to establish (ΔV).

Step 6: Determine water quality treatment volume or flow rate:

A) Infiltrate, capture and reuse, or treat and release (ΔV) depending on feasibility criteria.

Proposed Alternate LID Mitigation Volume Requirements Approach

The approach described above relies on values (i.e., length of flow path, slope, drainage patterns, etc.) that are not commonly available at the programmatic level. Therefore, a simplified approach utilizing runoff coefficients was employed for this stage of development planning as an alternative to the approach described above. Establishing runoff coefficients that would likely underestimate undeveloped runoff volume and overestimate developed runoff conditions would yield a ΔV greater than what would be established using the more site-specific LACDPW T_c calculator.

A runoff coefficient of 0.1, the minimum runoff coefficient presented for undeveloped areas in Chapter 6 of the LACDPW Hydrology Manual, was selected for the calculation of runoff in the pre-development condition (LACDPW, 2006). LACDPW Hydrology Manual equation 6.3.2 for determining developed runoff coefficients was simplified by setting the undeveloped runoff coefficient to 0.10 and will be determined by the following function:

LACDPW Hydrology Manual: $C_d = (0.9 * Imp) + (1 - Imp) * C_u$ (Eqn. 1)

Simplified equation where C_u=0.10 $C_d = (0.8 * Imp + 0.10)$ (Eqn. 2)

Where:

(C_d) = Developed runoff coefficient

(C_u) = Undeveloped runoff coefficient

Imp = Percent impervious

The existing condition of the Project was assumed to be entirely undeveloped. While some development does exist within the Project, this assumption has the effect of increasing the LID Standards Manual performance standard and is therefore conservative. The resulting excess runoff volume for the Project can be calculated as:

$\Delta V = V_{proposed} - V_{existing}$

$= d*A*[(0.8*Imp + 0.1)] - d*A*(0.1) = d*A*0.8*Imp$ (Eqn. 3)

Where,

d = design storm depth = 0.75 inches

A = tributary area (acres)

Imp = impervious fraction (ranges from 0 to 1)

This equation reduces to:

ΔV (ac-ft) = 0.05*A*imp (Eqn. 4)

Calculating Performance Associated with LID Standards Manual Mitigation Volume Requirements

To provide a basis for establishing equivalency, the performance of BMPs designed per the requirements of the LID Standards Manual has been estimated. Performance was estimated using a three-part process:

1. Estimate total runoff from developed regions of the Project,

2. Divide this volume between areas where infiltration is feasible and infiltration is not feasible,

3. Compute average annual volume reductions that would be expected for BMPs designed to the standards of the LID Standards Manual and apply these reductions to the total runoff volumes computed in (2).

Land use acreages, imperviousness and infeasibility categories tabulated in Tier One analysis were used to complete the first two steps. The simplified runoff coefficient equations described above were used with an approximate annual average rainfall depth of 18 inches per year (full analysis contained in NRSP Sub-Regional SWMP, Appendix B) to calculate average annual runoff volumes for developed areas of the Project.

In order to estimate the performance of BMPs designed per the requirements of the LID Standards Manual, continuous simulation of a hypothetical catchment was conducted. First, a hypothetical BMP was sized to the LID Standards Manual requirements (Eqn. 4) for a hypothetical developed catchment. Then USEPA Stormwater Management Model (SWMM) was used to simulate the performance of this BMP over 40 years of historic hourly precipitation records (described in NRSP Sub-Regional SWMP Appendix B). This analysis assumed a 48-hour drawdown time of stored volume, which is consistent with the Los Angeles County BMP Manual (LACDPW, 2009). Table 1 provides SWMM inputs used for this simulation.

Table 1: SWMM Simulation Inputs

SWMM Parameters	Units	Values
Wet time step	seconds	600
Wet/dry time step	seconds	600
Dry time step	seconds	14,400
Precipitation	inches	733 (Patched Newhall Gage, COOP 046162, 1968-2008)
Impervious Manning's n		0.012
Hypothetical drainage area	acres	1

SWMM Parameters	Units	Values
Shape		Rectangular, 250 ft flow path length
Impervious fraction modeled		100%
Slope	ft/ft	0.03
Evaporation	in / mo	60% of reference ET values for CIMIS Zone 14
Depression storage, impervious	inches	0.02, based on Table 5-14 in SWMM manual (James and James, 2000)
BMP Storage Volume	ac-ft	0.05 = 1 ac*0.05*100%imp (Eqn. 4)
BMP Storage Volume	cu-ft	2,178
Drawdown Rate	cfs	0.0126 = 2,178 cu-ft/(48 hrs * 3600 sec/hr)

The resulting capture efficiency (i.e., the fraction of average annual runoff that is captured and not immediately bypassed by the BMP) was estimated to be approximately 48 percent based on this hypothetical scenario. The assumed impervious fraction of 100 percent is not important for this analysis because both runoff volume and modeled BMP volume have approximately linear dependency on impervious fraction.

Of the volume "captured," a portion is expected to be retained and a portion is expected to be released to the downstream conveyance system. For infiltration BMPs, captured water is expected to be fully retained up to the design storm event, therefore the total average annual reduction of runoff volume will be equal to the capture efficiency. In areas where infiltration is infeasible, vegetated treatment BMPs may still achieve incidental volume reductions through soil soaking and drying processes (i.e. evapotranspiration) and slower infiltration (unless facilities have an impermeable liner). An analysis of the International BMP Database (Strecker et al., 2004) found that detention basins and biofilters (swale and filter strips) achieved average volume reductions of 30 to 38 percent of captured volume, respectively. This analysis likely included studies of BMPs underlain by highly infiltrative soils. For areas of the Project where infiltration is not feasible, it is likely that incidental volume reduction achieved by vegetated BMPs would be significantly less than indicated by the Strecker et al. (2004) study. Therefore, for areas of the Project where infiltration is not feasible, it is assumed that 20 percent of the volume captured in vegetated BMPs in areas is retained and lost to either evapotranspiration or incidental infiltration. The remaining 80 percent of captured volume is assumed to be treated and released. These values are multiplied by the average annual capture efficiency to yield the total reduction in average annual runoff volume. Capture efficiency and volume reduction estimates are contained in Table 3.

Calculating Performance of Project PDFs

The NRSP Sub-Regional SWMP requires that BMPs be designed to capture and treat 80 percent of average annual runoff volume. Of this captured volume, the fraction retained in BMPs and lost to evapotranspiration and/or incidental infiltration is assumed to be 20 percent on average. This is the same assumption used in establishing the LID Standards Manual performance standard (see previous section).

TIER ONE ANALYSIS RESULTS

Table 2 and Figure 5 (attached) present the results of Tier 1 infiltration screening for the Project. Assumptions of imperviousness by land use are consistent with those used for the NRSP Sub-Regional SWMP.

Table 2: Project Area Breakdown

Infiltration Feasibility Screening Criteria	Area (acre)	Composite Imperviousness based on Land Uses in Each Area
Open Space	7,475	NA
Infiltration Infeasible	818	51%
Infiltration Feasible	4,436	61%

TIER TWO ANALYSIS RESULTS

Tables 3 presents the results of Tier Two calculations described above.

Table 3: LID Equivalency Calculations

Feasibility Category	Infiltration Feasible	Infiltration Infeasible	Total
Total Area, ac	818	4,436	5,254
Composite Imperviousness[1]	61%	51%	
Average Annual Runoff Volume, ac-ft/yr	725	3,396	
Average Annual Capture Efficiency of BMPs Designed per LID Standards Manual[2]	48%	48%	
Average Annual Volume Reduction of Captured Water for Vegetated BMPs[3]	100%	20%	
Performance Standard Average Annual Volume Reduction, ac-ft/yr	348	326	674
NRSP Sub-Regional SWMP Average Annual Capture Efficiency	80%	80%	
NRSP Sub-Regional SWMP Average Annual Volume Reduction of Captured Water	20%	20%	
Project Achieved Average Annual Volume Reduction[4], ac-ft/yr	116	543	659
Project Surplus/Deficit Average Annual Volume Reduction[5], ac-ft			-15
Additional Volume Reduction to be Achieved at the Tract Map (Village) Level			≥15

Note: NRSP developments are required to use reclaimed water for irrigation of landscaping. Therefore, storage and reuse are not considered feasible and are not included in this table.

1 – Composite imperviousness based on distribution of land uses within each analysis area

2 – Capture efficiency estimated through continuous simulation modeling of 40 years of precipitation, runoff and routing for a hypothetical volume-based BMP sized per the LID Standards Manual

3 – Volume reduction in vegetated treat and release BMPs based on Strecker et al., 2004

4 – Achieved Volume Reduction = Total Runoff Volume * Capture Efficiency * Volume Reduction of Captured Water

5 – Positive value indicates exceedance of LID Standards Manual-based performance standard, negative value indicates a deficit

A slight deficit in volume reduction indicates that the Project BMPs assumed for this analysis (regional or sub-regional vegetated BMPs that capture and treat runoff and allow it to discharge downstream slowly) would provide a slightly lower average annual volume reduction than the LID Standards Manual performance standard as applied to the Project area. This deficit (approximately 15 ac-ft per year) will be addressed through the inclusion of on-site infiltration BMPs identified at the tract map level for each of the Villages using the feasibility analysis methods outlined above.

DISCUSSION

The analysis presented in this memorandum has been performed at a programmatic planning level. At this level, it is not possible to evaluate all criteria that may limit infiltration. It is also not possible to say with certainty that the areas identified as infeasible for infiltration may not be feasible upon more detailed analysis. The intent of this analysis has been to apply screening criteria such that it is more likely that the amount of area feasible for infiltration will decrease rather than increase upon detailed inspection. In this respect, the performance standard established in this analysis is believed to be biased somewhat high.

In addition, the analysis of PDFs considers only the structural treatment control provisions of the NRSP Sub-Regional SWMP and does not account for source control and site design practices intended to be implemented at the tract map, planning area, and/or parcel scale. This tends to bias the volume reductions achieved by the PDFs downward.

Finally, the continuous simulation analysis methods used to equate the event-based requirements of the LID Standards Manual to a long term volumetric performance standard are analogous to the methods described in the NRSP Sub-Regional SWMP Appendix B, which includes a discussion of the reliability of model inputs and methodology.

The combination of these factors results in a conservative assessment of whether Project BMPs meet the goals and requirements of the LID Standards Manual.

CONCLUSIONS

Based on the comparison of volumetric requirement associated with the LID Standards Manual and volumetric performance achieved by Project Design Features, the minimum provisions of the NRSP Sub-Regional SWMP as applied to the Project result in slightly lower volume reduction than would be achieved by BMPs designed per the requirements of the LID Standards Manual. Additional volume reduction will be achieved at the tract map level through the selected implementation of BMPs that promote greater infiltration where feasible. As a result, the volume reduction achieved by PDFs will be greater than or equal to the LID Standards Manual performance standard. On this basis, the Project will achieve or exceed the performance standard established in the Los Angeles County LID Standards Manual.

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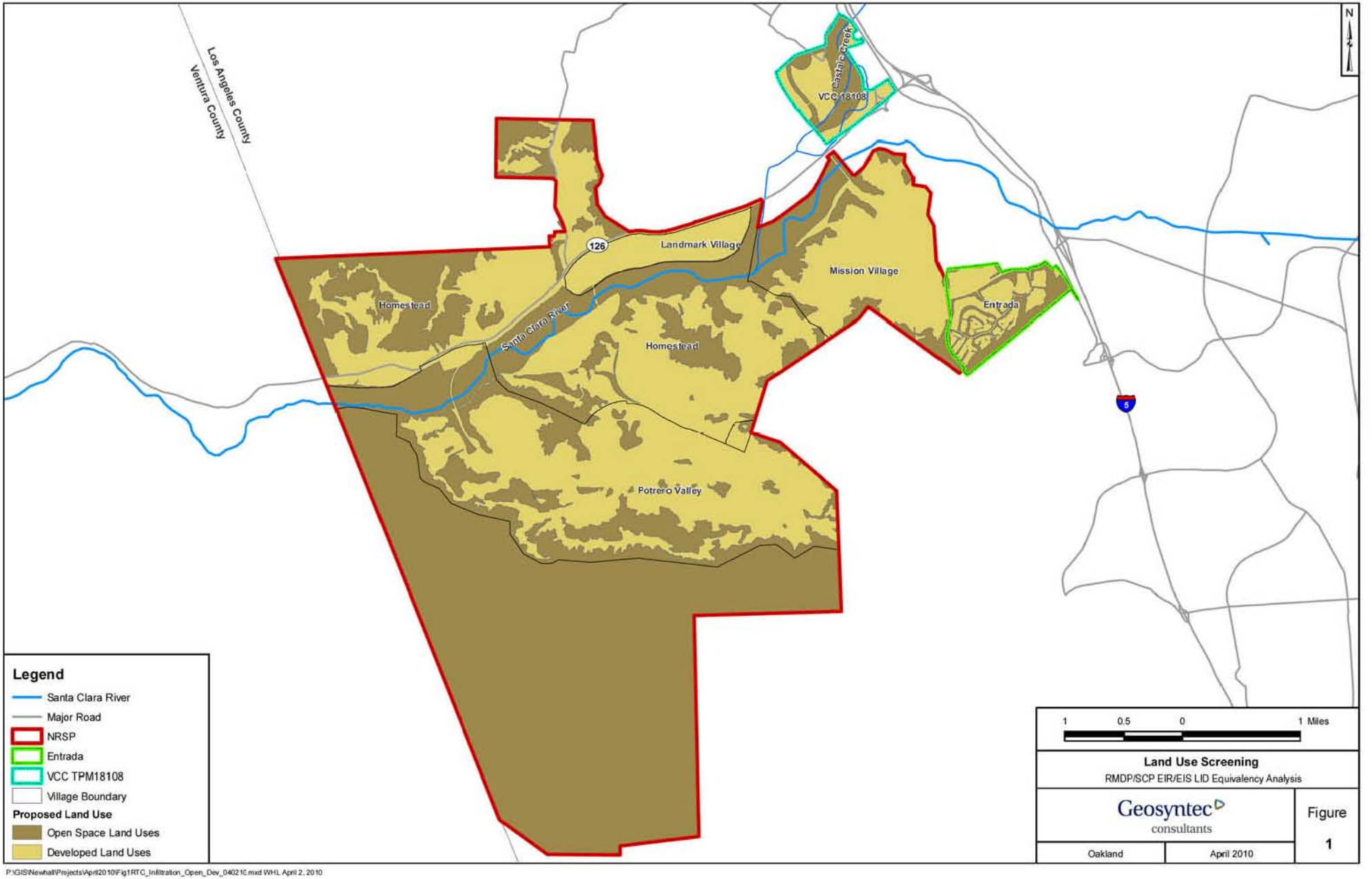

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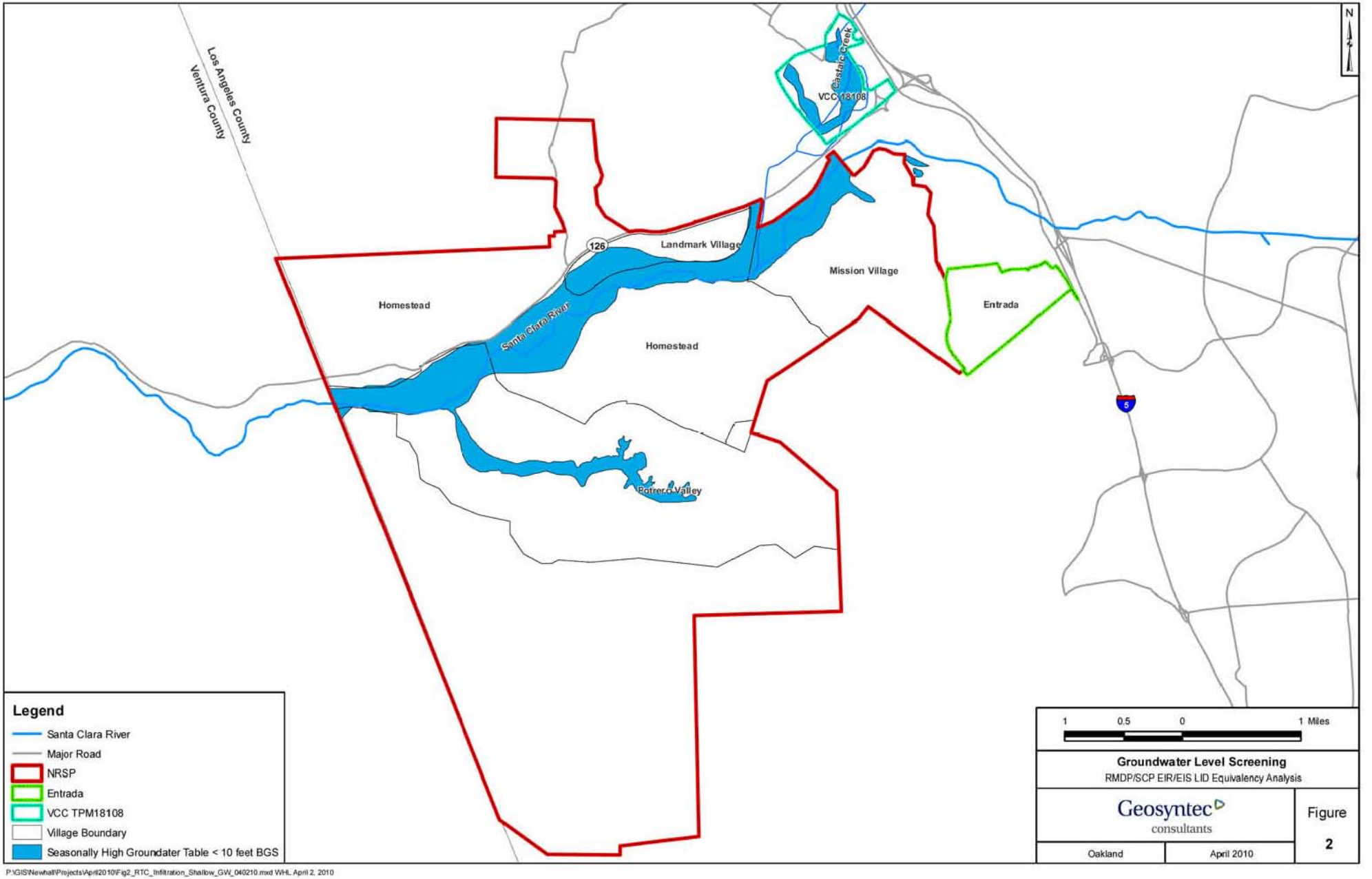

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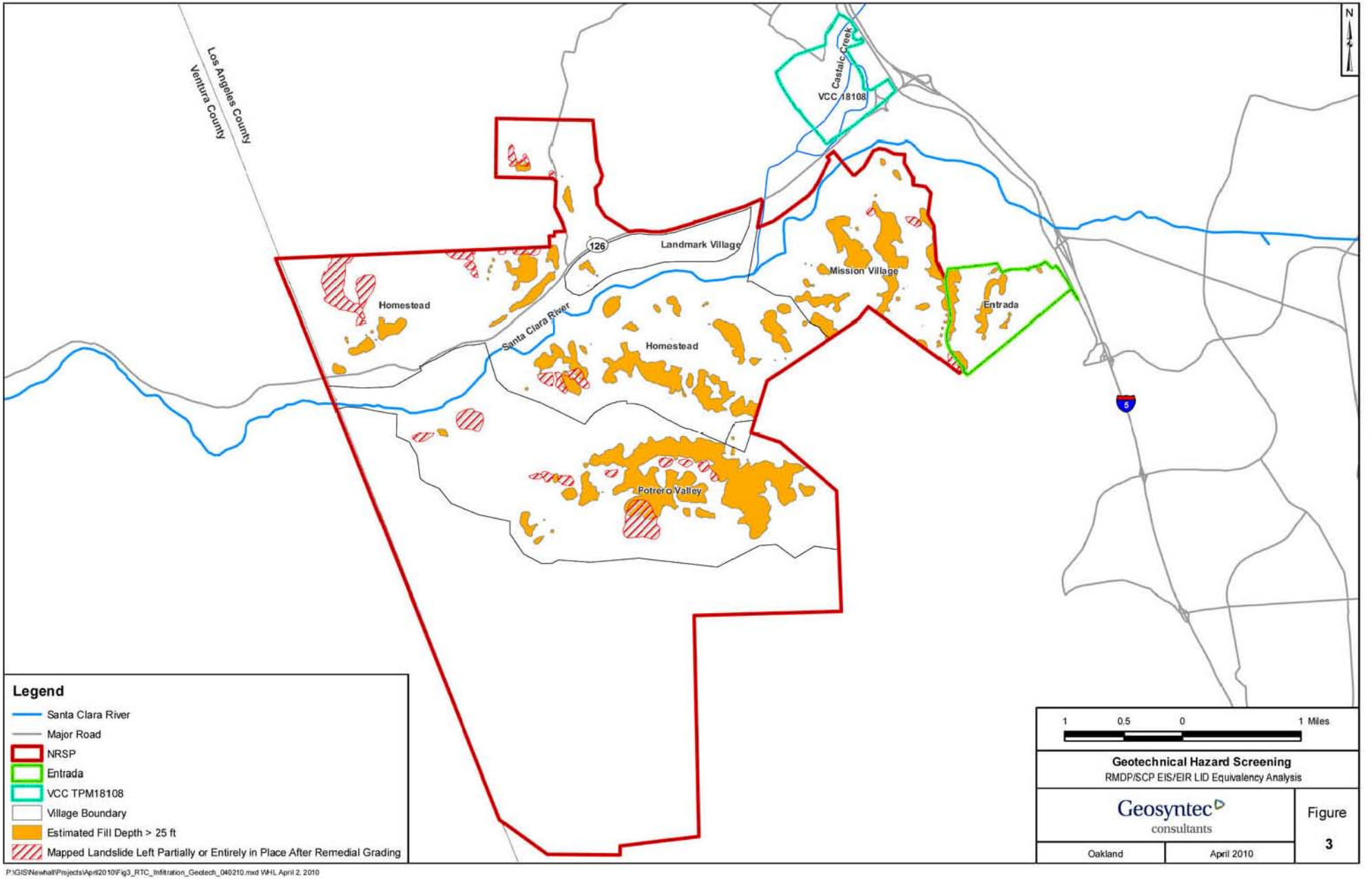

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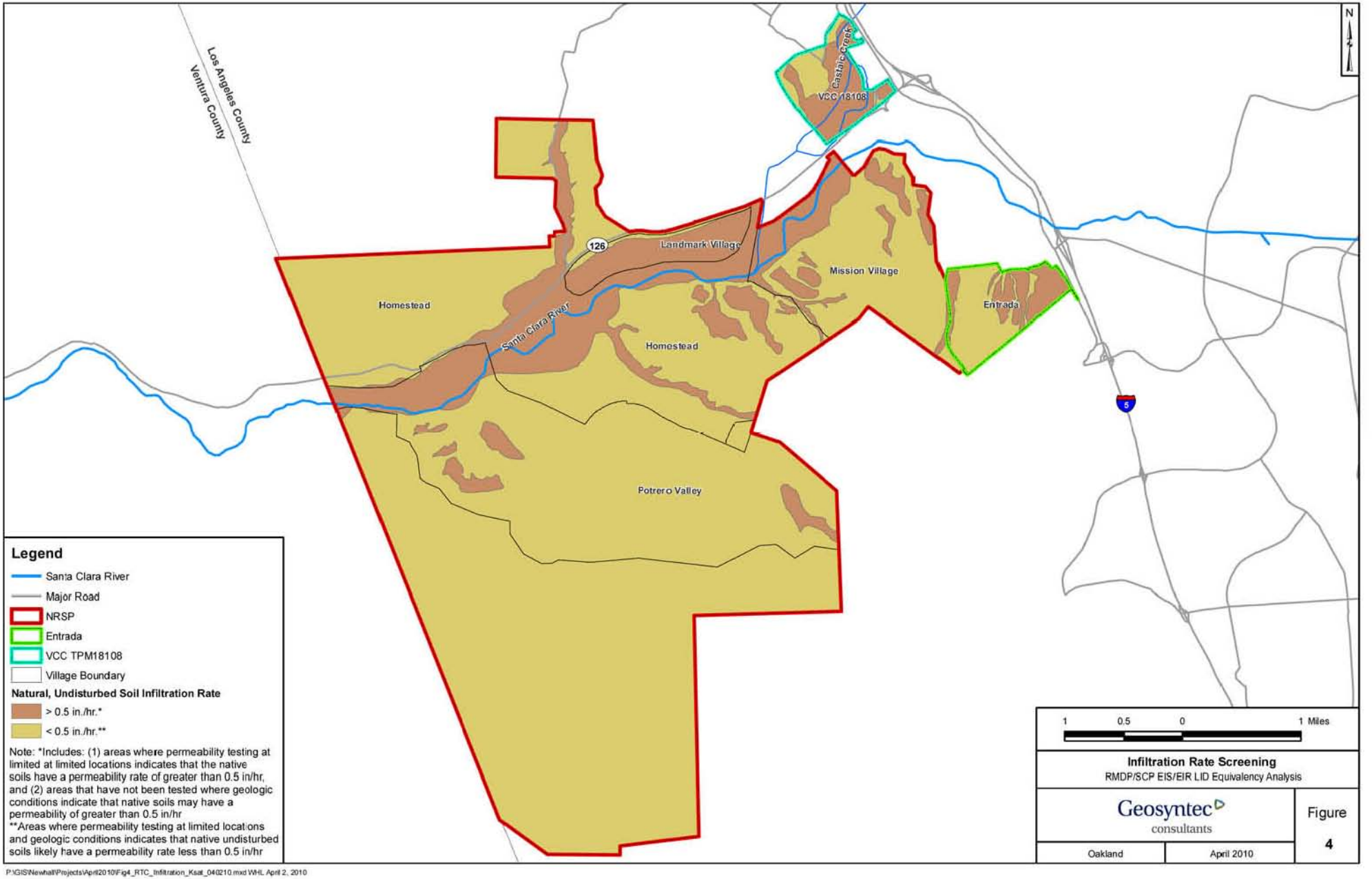

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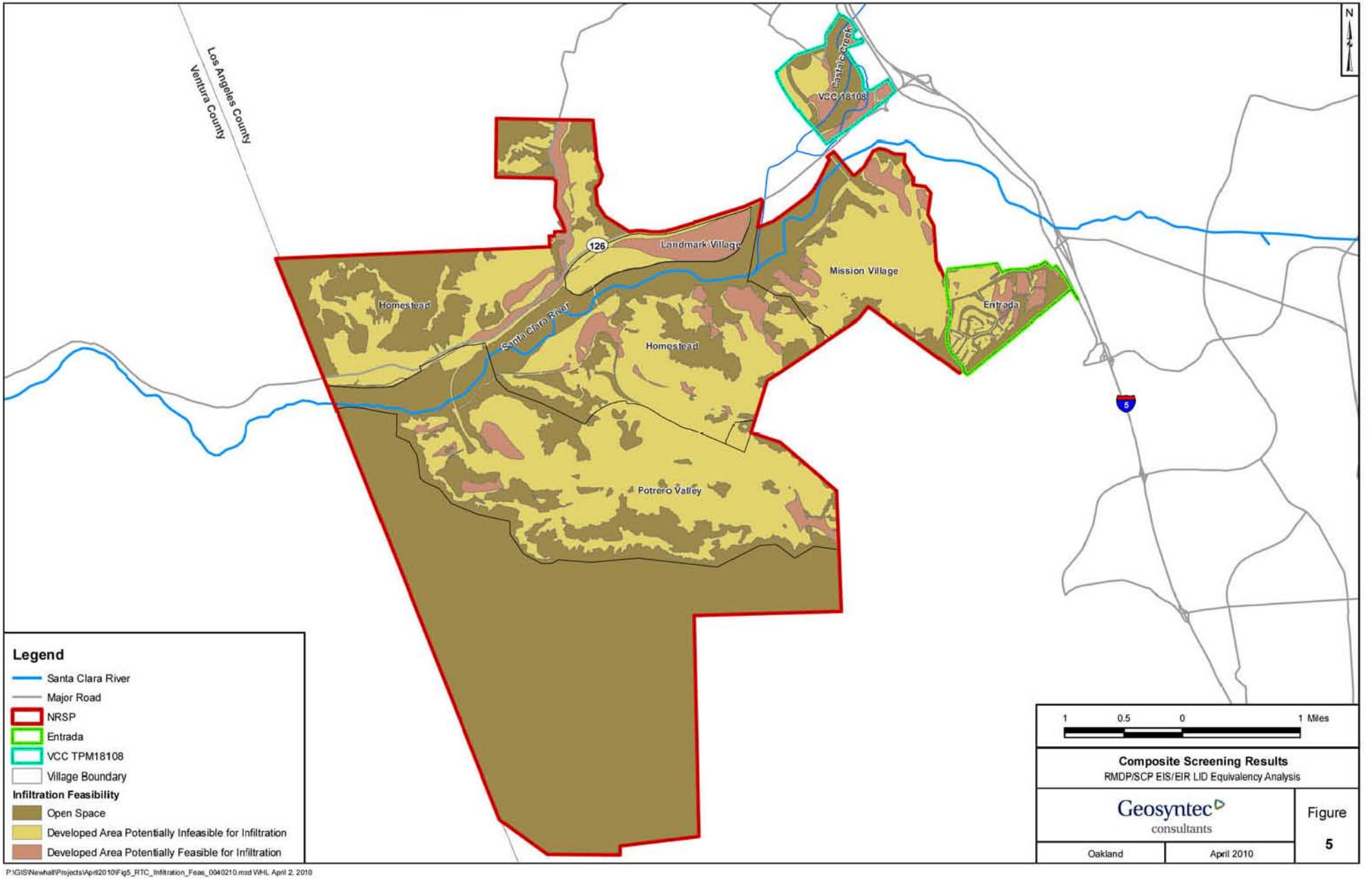

Composite Screening Results
RMDP/SCP EIS/EIR LID Equivalency Analysis

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Figure 5

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