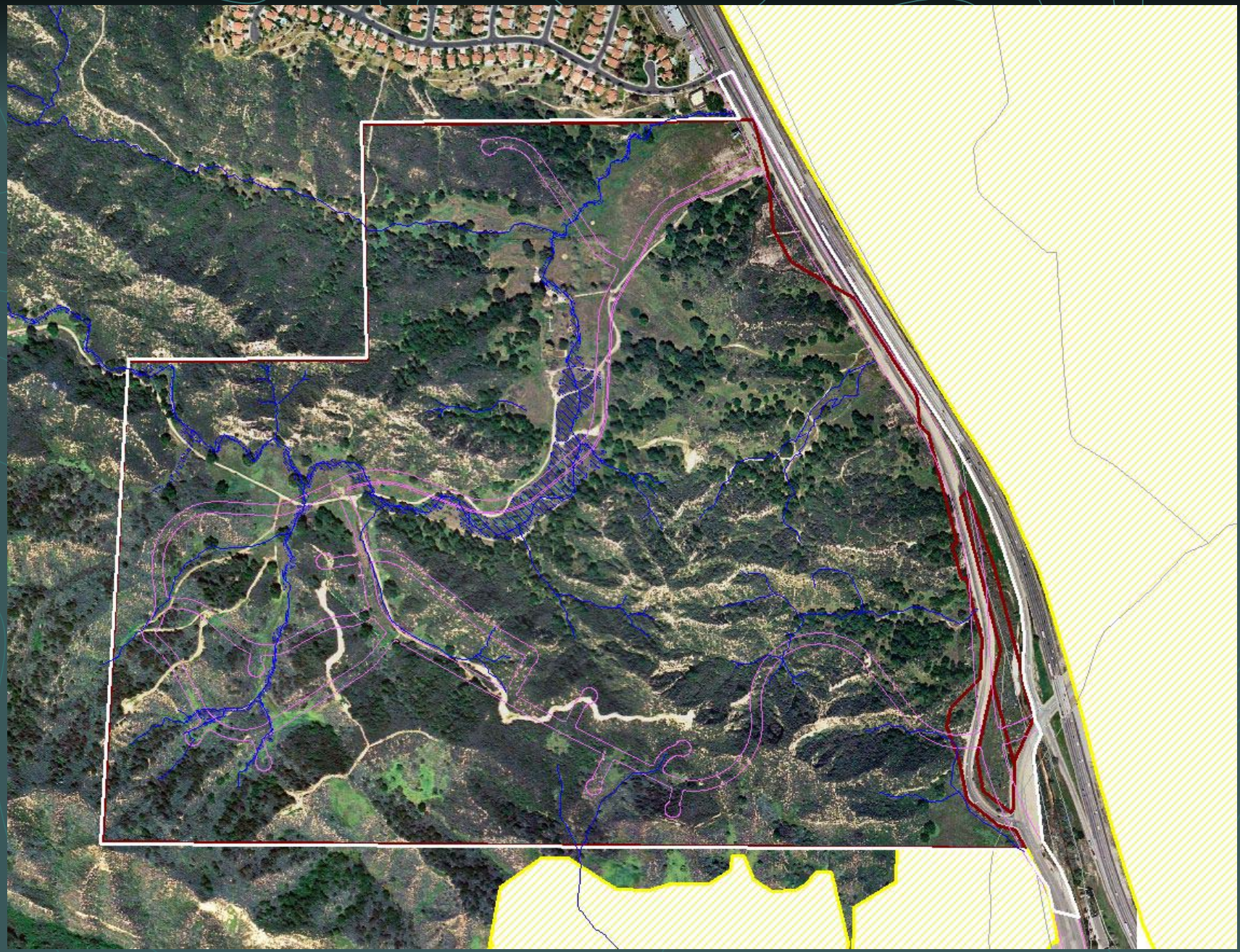
Oak Tree Data Assessment Solutions Using GIS

David Magney
and
Ken Niessen

David Magney Environmental Consulting

Project Purpose

- Western Pacific [Housing] Series development proposal environmental assessment of Lyons Canyon Ranch
- Identify location & type of all oak trees to satisfy City of Santa Clarita requirements
- Determine which trees will be impacted
- Allow analysis of impacts to existing oak trees related to proposed project



Project Participants

- Western Pacific Housing
- Daly Owens Group
- City of Santa Clarita
- Diamond West Engineering
- Trees, Etc. (Richard Ibarra)
- David Magney Environmental Consulting
  - David Magney
  - Ken Niessen
  - Cher Batchelor
  - Dan Brenner

Oak Tree Assessment Task

- City required maps and data on each and every tree present on project site
- Compile oak tree data from three separate arborists
- Calculate project-related impacts to onsite oak trees (direct, indirect, and encroachment)
- Create accurate maps for use by City inspectors and planners

9 May 2005

GIS Tasks

- Georeference CAD data
- Convert CAD files to shapefiles
- Clean up new shapefiles
- Create tree canopy polygons
- Identify/map each tree's protected zone
- Determine effect of earth moving (grading) on existing trees

Data Needs

- Obtain georectified aerial photograph
- Obtain oak tree assessment data
- Obtain oak tree locations
- Obtain project site boundaries
  - Project site bounds
  - Parcels
  - Grading limits
  - Project planning units

GIS Methods

- Build GIS project
- Convert CAD files into shapefiles
- Re-project CAD files from ether space to real world coordinates
- Heads-up digitize paper maps into shapefiles
- Build oak tree attributes database
- Create polygons for each tree's canopy

Challenges

- Little data were available digitally
- Oak tree inventories overlapped (same identification tag #s used for 2 or more trees)
- Not all trees were located by land surveyors (hundreds of trees were "missing")
- Land surveyors did not use real world coordinates
- Canopies for every tree needed to be shown
- Entire site burned in October 2003 Simi Fire
- First two arborists had been "fired" and not available for interrogation

Solutions

- GIS project was developed using ESRI's ArcView 3.3
- Recent (2002) georectified aerial photography was purchased from AirPhotoUSA
- Project boundary and parcel lines were drawn over the aerial photograph
- CAD files were converted and reprojected using ArcMap 8.2

Dealing with CAD Files

CAD drawings were available for:

- Property line
- Grading limits
- About half the oak tree locations

CAD files lacked geographic coordinates

- Required us to project the unprojected graphics CAD files

Dealing with CAD Files (cont)

Luckily:

- North orientation was correct
- Units were in feet
- Site was relatively small; potential projection problems were minimal
- Some CAD features existed on the ground to provide on-the-ground coordinates (a billboard)

Used a single coordinate to write the world file

- Lacking correct north orientation would have required at least 2 known geographic coordinates to properly reorient and project the CAD files

Converting CAD to Shapefiles

- Biggest problem: separating CAD layers to create useable shapefiles
- ArcView 8.2 worked much better with CAD files than ArcView 3.3
- File Cleanup Shapefiles from CAD layers:
  - Contained hanging chads (stray lines, etc.)
  - Often contained gaps
  - Gaps filled by drawing, snapping and using the union tool

Oak Tree Data Solutions

- Worked with engineer and arborist to get good point location for each tree on site
  - went from 50% to 0.5% trees with unknown location
- Needed to develop polygons for each tree's canopy and tie them to the tree database
- Needed to identify protected zone for each tree

Oak Tree Data Solutions (cont)

- GPS was used to locate and verify selected oak trees onsite (Garmin eTrex)
- Oak tree data mostly in hardcopy format: Excel data entry
- Obtained ArcView extension written by Jenness Enterprises (www.jennessent.com) to develop "concave hull" polygons from numeric canopy data ("Polyline-to-Polygon" extension

Tree Canopy Creation Problems

- Many trees had been destroyed or damaged in Simi Fire
- Available data: hardcopy dimensions (distance in feet) in 8 cardinal and subcardinal compass directions
- Some canopy data lacking for a number of trees

Canopy Solutions Details

- Used Excel to create table of tree trunk coordinates
- Calculate x,y distances of canopy edge vertices from center point
- Added/subtracted vertex distances from trunk coordinates to obtain coordinates for each canopy vertex point
- Assigned sequential #s to each vertex point (N=1, NE=2, … NW=8, starting at North and working clockwise)

Canopy Solutions Details(cont)

- Converted Excel spreadsheet to dbf table, then to point shapefiles, and then merged point shapefiles
- Connected vertex points to form closed-line shapefile using "Points-to-Lines or Polylines" extension
- Converted closed polyline canopy shape edge line to polygons of the canopy footprints using the Jenness "Polyline to Polygon" extension

Creating Canopy Buffers

- Created 15-ft buffers for tree points & 5-ft buffers for each canopy edge
  - Used non-ESRI extension ("Buffer Theme Builder")
- Merged canopy polygons and buffers into one shapefile
- Dissolved the canopies and buffers by tree id number using the GeoProcessing Wizard

Assessing Grading Impacts

Need - Determine which trees would be impacted or avoided by project grading, including:

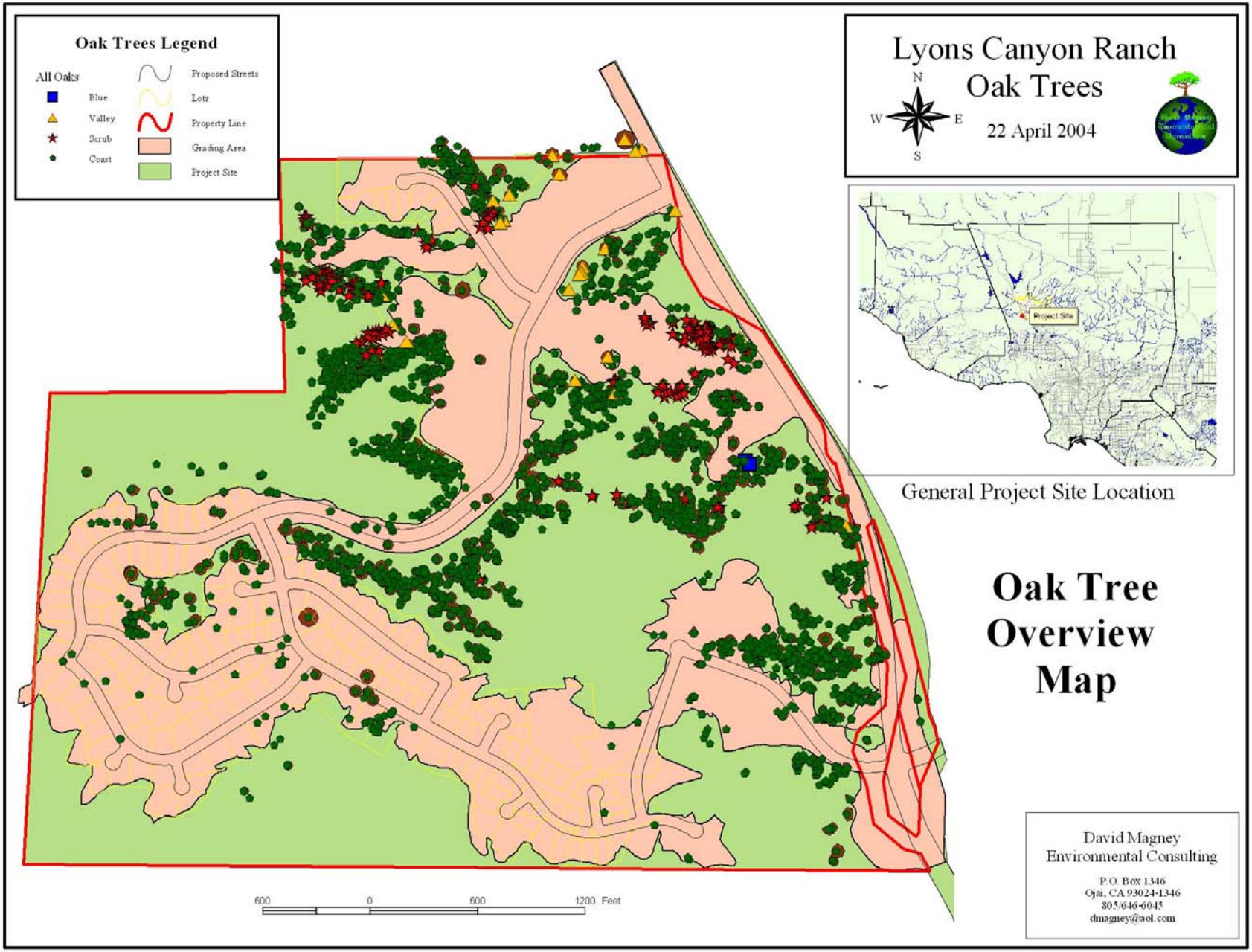
- Destroyed trees
- Encroached trees dripline (protected zone)
- Avoided (protected and preserved)
- Determine monetary value of lost, encroached, impacted, protected, and preserved

Assessing Grading Impacts GIS

- Used spatial select to identify trees in categories
- Created map(s) depicting all categories

Results

- Maps for each type of oak tree were created (20 maps were created)
- Oak tree data were compiled into readable tables and included in a summary report
- City of Santa Clarita stated that the maps and report were "the best they had every received".


Oak Trees Legend
All Oaks
Blue
Valley
Scrub
Coast
Proposed Streets
Lots
Property Line
Grading Area
Project Site
Lyons Canyon Ranch
Oak Trees
N
W
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S
22 April 2004
Project Site
General Project Site Location
Oak Tree
Overview
Map
600
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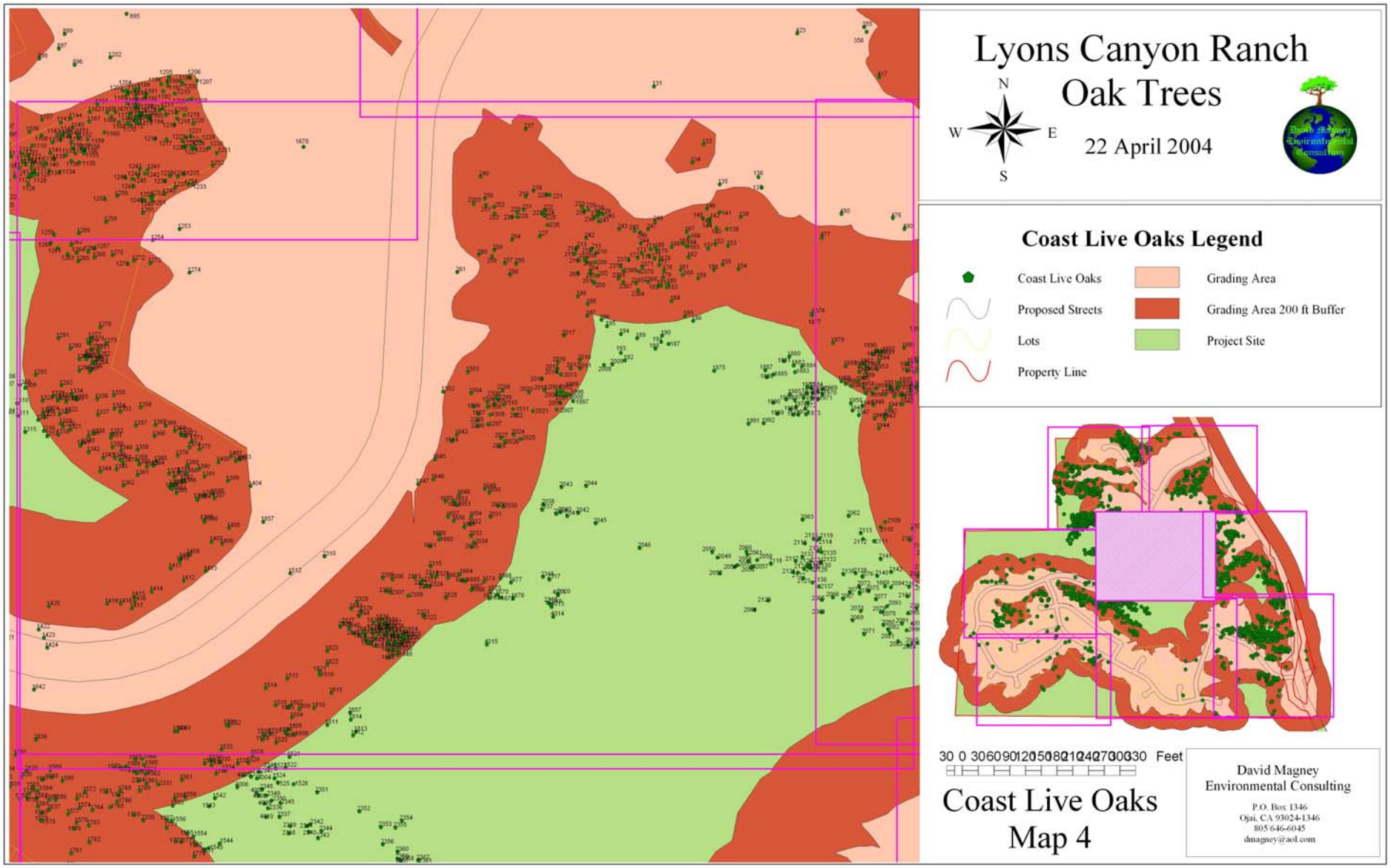
600
1200 Feet
David Magney
Environmental Consulting
P.O. Box 1346
Ojai, CA 93024-1346
805/646-6045
dmagney@aol.com


Lyons Canyon Ranch
Oak Trees
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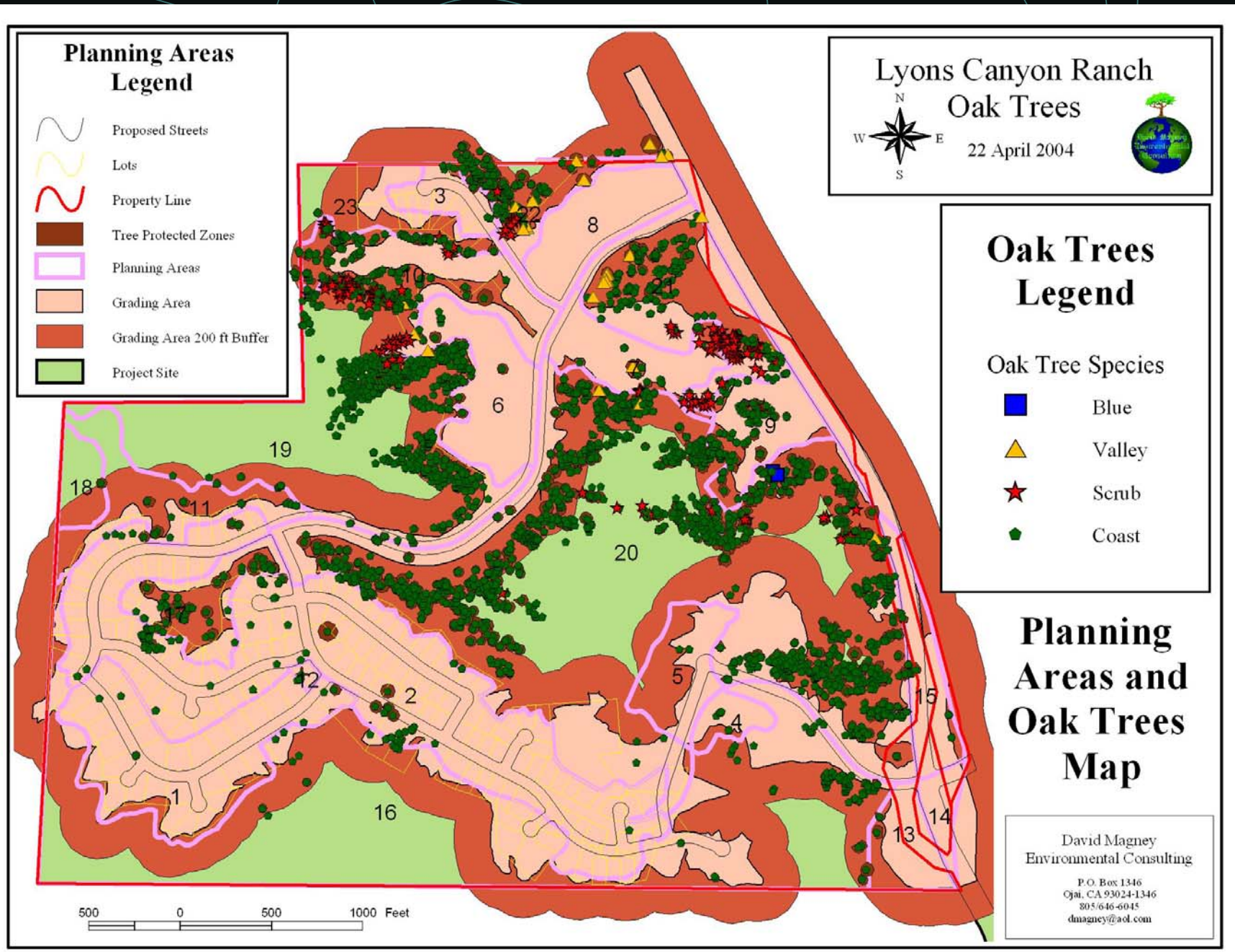
22 April 2004
Coast Live Oaks Legend
Coast Live Oaks
Proposed Streets
Lots
Property Line
Grading Area
Grading Area 200 ft Buffer
Project Site
30 0 30 60 90 120 150 180 210 240 270 300 330 Feet
Coast Live Oaks
Map 4
David Magney
Environmental Consulting
P.O. Box 1346
Ojai, CA 93024-1346
805 646-6045
dmagney@aol.com


Planning Areas Legend
Proposed Streets
Lots
Property Line
Tree Protected Zones
Planning Areas
Grading Area
Grading Area 200 ft Buffer
Project Site
Lyons Canyon Ranch
Oak Trees
22 April 2004
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Oak Trees Legend
Oak Tree Species
Blue
Valley
Scrub
Coast
Planning Areas and Oak Trees Map
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Environmental Consulting
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Conclusions and Recommendations

- GIS is the right tool for such projects
- Land surveyors need to include real world coordinates with all their surveys
- Oak tree data need to be gathered in a consistent manner, in electronic format
- Creating such a database greatly accelerates the ability to compare project alternatives (after the database has been developed)

Current Status

- Western Pacific Housing is considering a different road alignment for the project to avoid wetlands onsite, resulting in different trees being affected
- The existing tree GIS database was used to quickly determine how many and which trees would be impacted, and a new report was quickly generated (fewer trees impacted too!)