TO: File: Russian River; TMDL Development and Planning

FROM: Steve Butkus

DATE: October 29, 2012

SUBJECT: SELECTION OF SAMPLING LOCATIONS FOR THE ONSITE WASTEWATER TREATMENT SYSTEMS IMPACT STUDY

The North Coast Regional Water Board staff are developing Russian River Total Maximum Daily Loads (TMDLs) for pathogen indicators to identify and control contamination impairing recreational water uses. Potential pathogen contamination has been identified in the lower and middle Russian River watershed leading to the placement of waters within these areas on the federal Clean Water Act Section 303(d) list of impaired waters. The contamination identified has been linked to impairment of the contact recreation (REC-1) and non-contact recreation (REC-2) designated beneficial uses. Health advisories for these waters have been published and posted by Sonoma County and the City of Santa Rosa authorities.

Regional Water Board staff conducted a source analysis study for the development of the Russian River Pathogen TMDL. The study was organized into four individual tasks and sampling plans to collect information which will address the identified management questions (Fadness and Butkus 2011; Butkus 2011). Task 1 evaluated the temporal and spatial variability of indicator bacteria at high use public recreation beaches. Tasks 2 and 3 evaluated the influence of land use and beach recreational use on pathogen indicator concentrations. Results of the study were documented in a report by the NCRWQCB (2012).

The assessment for the Russian River Pathogen TMDL monitoring data collected in 2011-2012 identified the need to conduct a more robust assessment of the onsite systems contribution to exceedance of pathogenic indicator bacteria criteria. Additionally, the recent adoption of the State Onsite Wastewater Treatment System Policy increases the need to explicitly identify sources of pathogens from onsite systems.

Areas that drain from catchments were assessed using both the parcel density with on-site wastewater treatment (OWTS) systems and the risk of bacterial transport from these systems. The risk of bacterial transport from OWTS systems was assessed using a spatial data model (Fortescue 2012). The OWTS system risk spatial data model was developed using factors selected from the Basin Plan's *Policy on the Control of Water Quality with Respect to On-Site Waste Treatment and Disposal Practices* (NCRWQCB 2007). The model provides an index score for the risk of bacterial transport from OWTS systems with a minimum value of 4 representing low risk areas and a maximum value of 20 for high risk areas. A risk score of 12 indicates the mid-range of the index. The total risk score was calculated from the four model inputs. Each model input was assigned a ranking based on relative risk to water quality as quantified by the Basin Plan's *Policy*. The four factors addressed in the OWTS system risk spatial data model were:

1) Hill Slope
2) Soil Classification
3) Soil Depth
4) Setbacks from surface water bodies

Parcel density was also used to select sampling locations to assess possible water quality impacts from OWTS systems. The assumption was that higher concentrations of bacteria will be found from catchments that drain areas with a higher number of residences with OWTS systems. A nationwide assessment of onsite septic systems found a failure rate of 10.2% (Knowles 1998). Onsite septic systems were considered failing for three reasons:

1. Systems that fail by the discharge of sewage to surface water, groundwater, zones of seasonal saturation, drain tiles, or zones of bedrock.
2. Systems that fail by discharge of sewage to the surface of the ground.
3. Systems that fail by causing the back up of sewage into the structure served.

Most of the continuing onsite septic system failures are caused by the first reason listed simply because they are often go unnoticed. Property owners are more likely to repair onsite septic systems that are malfunctioning for the last two reasons.

Three sample locations were selected to represent each of the following four categories, for a total of twelve sites:

1) High parcel-density with a high risk of bacterial transport from OWTS systems.
2) High parcel-density with a low risk of bacterial transport from OWTS systems
3) Low parcel-density with a high risk of bacterial transport from OWTS systems.
4) Low parcel-density with a low risk of bacterial transport from OWTS systems

In addition, three additional sample locations were selected representing catchments that drain areas of concern for OWTS impacts. Additional sampling locations were selected from areas catchments from the Fitch Mountain area near Healdsburg, downtown Monte Rio and Camp Meeker. These areas have high parcel density on OWTS that are near a stream.

Landscape analysis of spatial data was conducted to select sampling locations that best represent the identified parcel density-transport risk categories. The software ArcGIS version 10.1 was used to analyze the spatial data. The following analysis steps were conducted in order:

1. The *Data Management Tools-Raster-Raster Processing-Clip* tool was used to extract National Elevation Model (2006) spatial data to the boundaries of the Lower and Middle Russian River Basins (i.e., Hydrologic Units 114.10 and 114.20).
2. The *Spatial Analyst Tools-Hydrology-Fill* tool was used to condition the random sinks in the National Elevation Model (2006).
3. The *Spatial Analyst Tools-Hydrology-Flow Direction* tool was used to derive the direction of the steepest decent for each raster grid cell.
4. The *Spatial Analyst Tools-Hydrology-Flow Accumulation* tool was used to calculate the accumulated number of raster grid cells upstream of each cell.
5. The *Spatial Analyst Tools-Conditional-Set Null* tool was applied to identify stream flow channels from the flow accumulation raster file (i.e., expression: VALUE <= 50; constant value: 1).
6. The *ConversionTools-From Raster-Raster to Polyline* tool was applied to the resulting raster from the *Flow Accumulation* tool to generate a vector-based stream flow polyline shape file.
7. The *Analysis Tools-Overlay-Intersect* tool was applied to the stream flow poly line shape file and spatial data of Sonoma County roads to generate a point shape file of possible sampling locations.
8. The *Spatial Analyst Tools-Hydrology-Watershed* tool was applied to the point shape file of possible sampling locations to generate polygon shape files of the catchments draining to possible sampling locations.
9. A new double-precision accuracy field was added to the attribute table of the resulting catchment polygon shape file.
10. The *Calculate Geometry* tool was applied the new attribute table field to derive the watershed area in acres.
11. The *ConversionTools-From Raster-Raster to Polyline* tool was applied to the OWTS system risk spatial data model (Fortescue 2012) to generate a vector-based polygon shape file
12. The *Calculate Geometry* tool was applied to the new attribute table field to derive the watershed area in acres.
13. The *Analysis Tools-Overlay-Intersect* tool was applied to the catchment and OWTS system risk polygon shape files.
14. Area-weighted OWTS system risk was derived for each catchment using Microsoft Excel on the shape *.dbf files.
15. The *Data Management Tools-Features-feature to Point* tool was used with the Sonoma County parcel polygon shape layer to generate a point shape file representing the centroid location of each parcel.

16. The *Analysis Tools-Overlay-Intersect* tool was applied to the catchment polygon and parcel centroid point shape files to generate a point shape file containing only those parcel centroids that were within the boundaries of a catchment.
17. Parcel density for each catchment was derived from the area and the parcel centroid counts.
18. Catchments were ranked into each of the four assessment categories based on the parcel density and risk of bacterial transport from OWTS systems.

Follow-up reconnaissance was conducted at potential sampling locations that were accessible and safe to sample during wet weather. Local drainage systems at potential sampling locations were visually compared to catchment boundaries derived from the National Elevation Model spatial data. Potential sampling locations and catchment boundaries were modified based on the field reconnaissance. Spatial data analysis steps 13-18 were conducted again using the modified catchment boundaries.

The three (3) highest-ranked, safely-accessible sampling locations were selected for each of the four (4) categories. Table 1 presents the selected sample locations. Table 2 shows the estimated parcel density and relative risk of bacterial transport from OWTS systems. Figures 1-15 show the selected sampling locations, catchment boundaries, parcel centroids, and stormwater stream flow paths that were derived from the National Elevation Model.

These sampling locations will be used to develop the Quality Assurance Project Plan. Monitoring of the runoff at the selected sampling locations is expected to be conducted during the wet weather period form October 2012 through May 2013.

CITATIONS

Butkus, S. 2011. Russian River Pathogen Indicator Bacteria TMDL – Supplemental Sampling Plan - Quality Assurance Project Plan. Dated November 16, 2011. North Coast Regional Water Quality Control Board, Santa Rosa, CA.

Fadness, R. and S. Butkus. 2011. Russian River Pathogen Indicator Bacteria TMDL – Quality Assurance Project Plan. Dated May 19, 2011. North Coast Regional Water Quality Control Board, Santa Rosa, CA.

Fortescue, F. 2012. GIS Model Development for Assessing Risks from Septic Systems. Memorandum to the File: Russian River Pathogen Indicator; TMDL Development & Planning dated August 9, 2012. Santa Rosa, CA.

Knowles 1998. SepticStats: An Overview. West Virginia University Research Corporation. Morgantown, WV.

North Coast Regional Water Quality Control Board (NCRWQCB). 2007. *Water Quality Control Plan for the North Coast Region*. North Coast Regional Water Quality Control Board, Santa Rosa, CA. Available at http://www.swrcb.ca.gov/northcoast/water_issues/programs/basin_plan/083105-bp/05_implemention_plans.pdf

National Elevation Dataset (NED) 2006. *NED Data Dictionary*, U. S. Geological Survey, Available at http://ned.usgs.gov/ned/downloads/documents/

TABLES

Table 1. Selected Sampling Locations

Category	Site ID	SWAMP ID	Latitude	Longitude	Location Description
High Parcel Density High Risk	Site 1	114DFMR68	38.6131	-122.8410	1740 Fitch Mtn Road - west of Villa Anna (Healdsburg)
	Site 2	114C01EDR	38.4776	-122.9762	River Road - culvert 100' east of Duncan Road (Monte Rio)
	Site 3	114C02SPR	38.5063	-121.0735	River Drive at Summerhome Park Road (Forestville)
High Parcel Density Low Risk	Site 4	114C03OMR	38.4781	-121.0018	19375 Old Monte Rio Road (across street from Northwood golf course)
	Site 5	114CO4TRF	38.4903	-121.1022	8612 Trenton Road (Forestville)
	Site 6	114DDRC59	38.4978	-121.0979	Along west shoulder of Del Rio Court (Forestville)
Low Parcel Density High Risk	Site 7	114C05MNS	38.4581	-122.9891	9632 Main Street (Monte Rio)
	Site 8	114C06VRG	38.5059	-121.0423	12656 River Road at Von Renner Grading (near Rio Nido)
	Site 9	114C07MRC	38.4575	-122.9531	Moscow Road box culvert - 100' west of 'Right Curve' sign (near Cassini Campgound)
Low Parcel Density Low Risk	Site 10	114CO8FRS	38.6561	-121.1264	Fredson Road south of Salvation Army driveway (Healdsburg)
	Site 11	114C09WDC	38.6467	-121.0805	3654 West Dry Creek Road (Healdsburg)
	Site 12	114C10AVR	38.6509	-121.1316	148 Alexander Valley Road (Healdsburg)
Areas of Concern	Site 13	114C11RDH	38.6238	-122.8452	West end of Redwood Drive (Healdsburg)
	Site 14	114C12FSM	38.4702	-122.9850	9632 Main Street (Monte Rio)
	Site 15	114C13LSA	38.4252	-121.0399	Lakeside Ave at Market Street (Camp Meeker)

Table 2. Characteristics of Catchments for the Selected Sampling Locations

Category	Site ID	SWAMP ID	Catchment Area (acres)	Parcel Density (parcels per acre)	OWTS System Risk Index
High Parcel Density High Risk	Site 1	114DFMR68	34.7	2.25	12.4
	Site 2	114C01EDR	4.6	3.88	11.0
	Site 3	114C02SPR	45.3	1.90	10.0
High Parcel Density Low Risk	Site 4	114C03OMR	74	3.37	8.7
	Site 5	114CO4TRF	167	0.76	7.9
	Site 6	114DDRC59	90.6	2.91	9.6
Low Parcel Density High Risk	Site 7	114C05MNS	82.6	0.01	10.8
	Site 8	114C06VRG	43.0	0.02	10.9
	Site 9	114C07MRC	16.4	0.06	10.6
Low Parcel Density Low Risk	Site 10	114CO8FRS	108.8	0.04	6.4
	Site 11	114C09WDC	113.5	0.05	7.3
	Site 12	114C10AVR	36.8	0.11	8.2
Areas of Concern	Site 13	114C11RDH	30.9	0.39	10.2
	Site 14	114C12FSM	7.7	3.87	7.0
	Site 15	114C13LSA	6.3	7.84	10.2

FIGURES

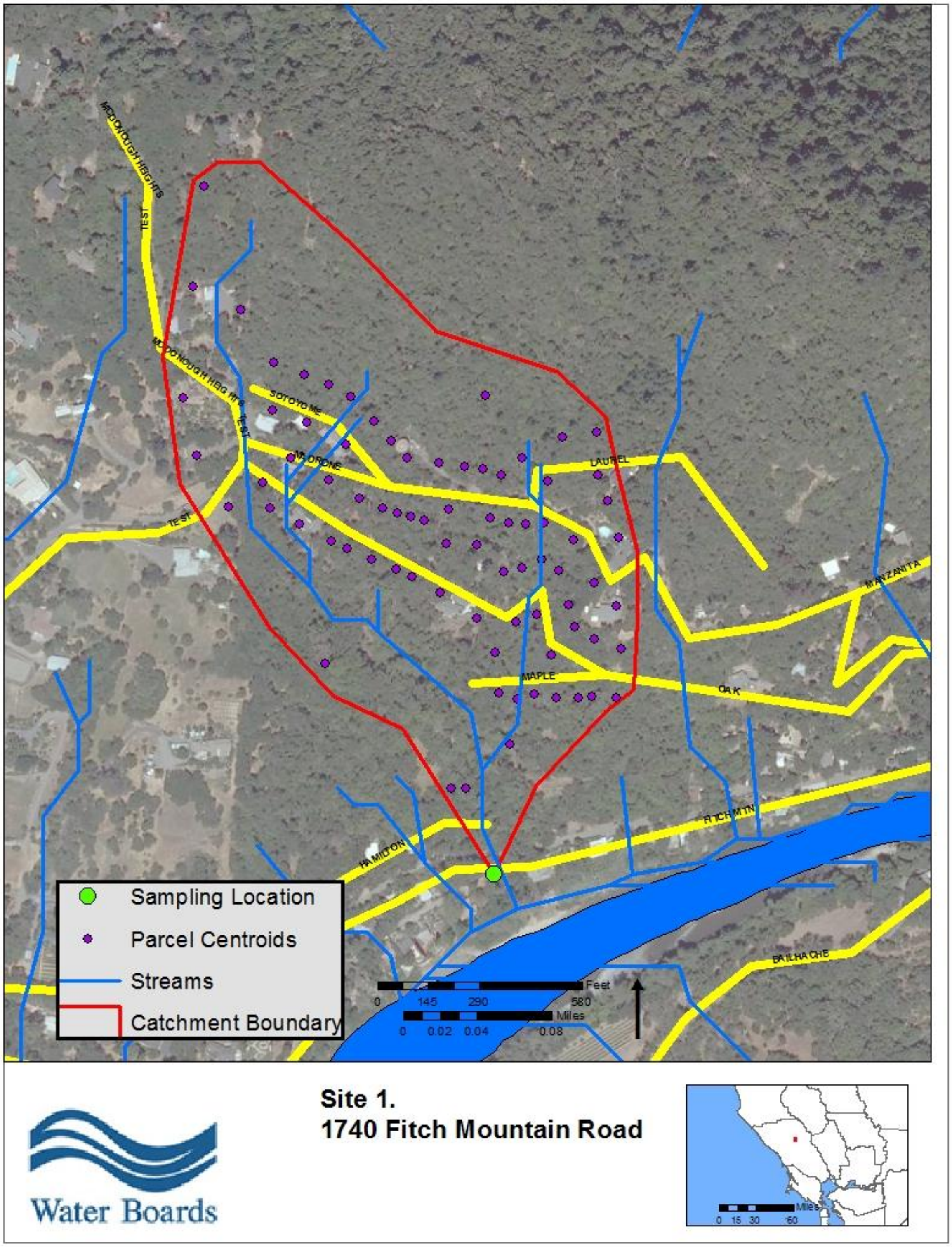

Figure 1. Sampling Location for Site 1 near 1740 Fitch Mountain Road, Healdsburg

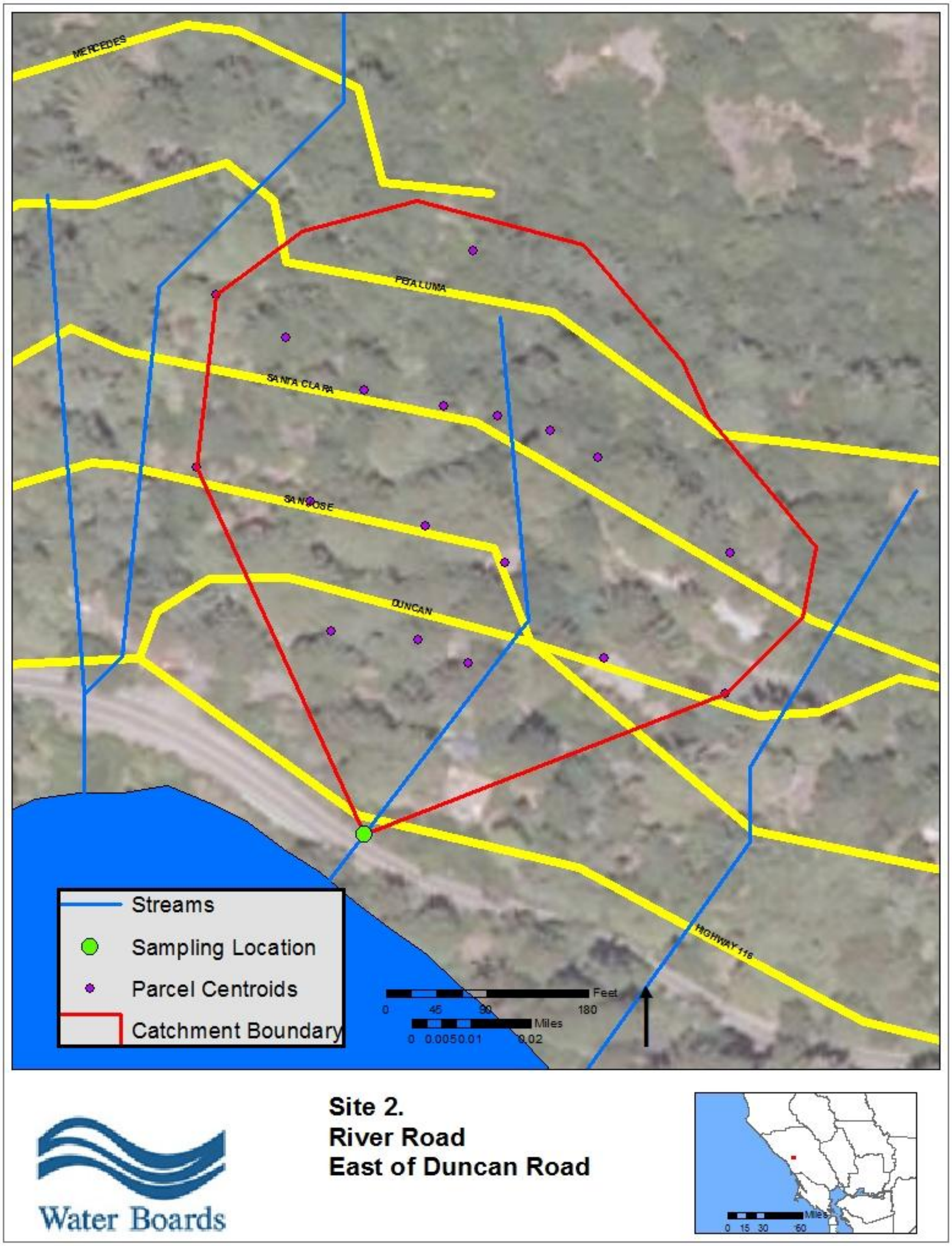

Figure 2. Sampling Location for Site 2 near River Road and Duncan Road, Monte Rio

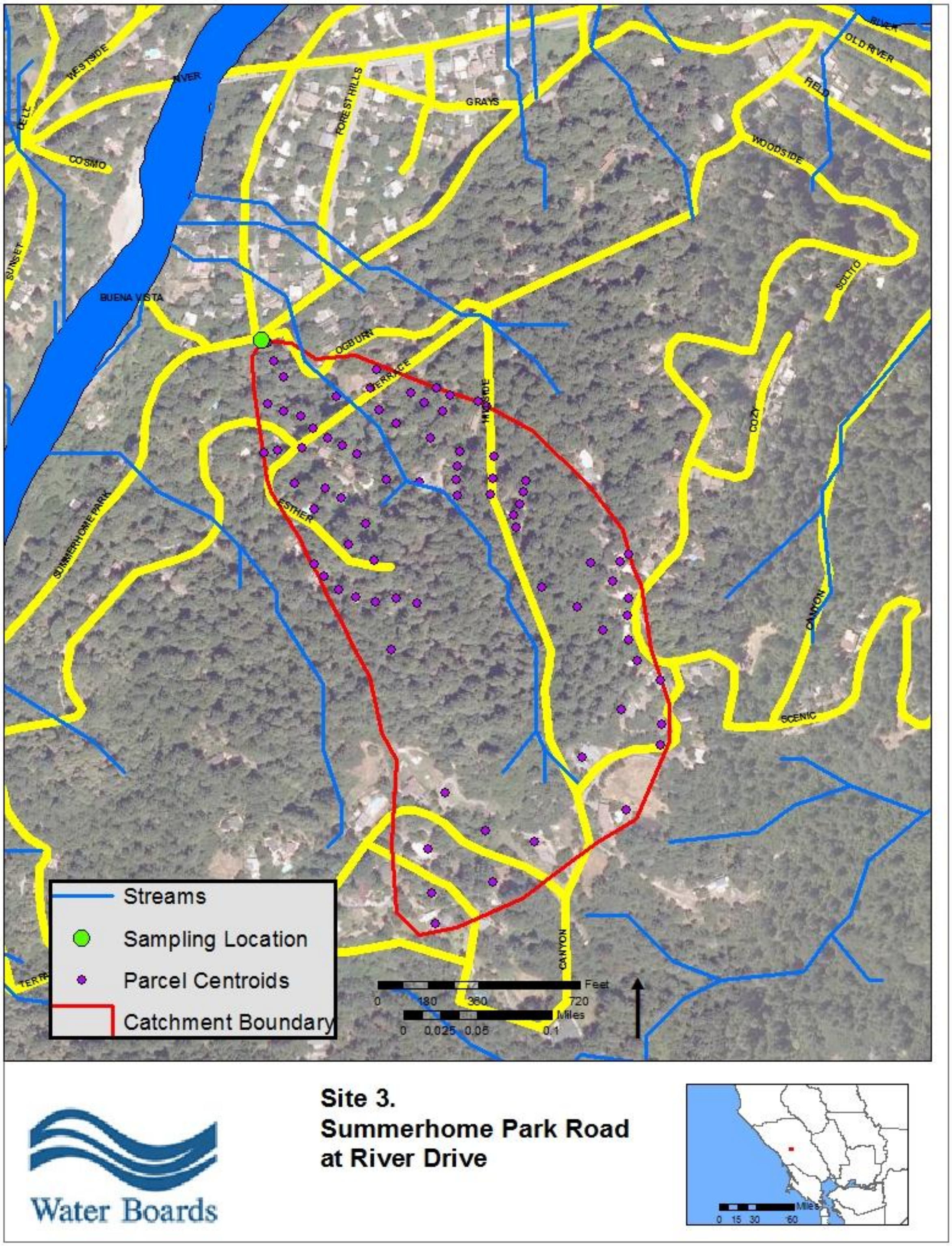

Figure 3. Sampling Location for Site 3 near Summerhome Park Road and River Drive, Forestville

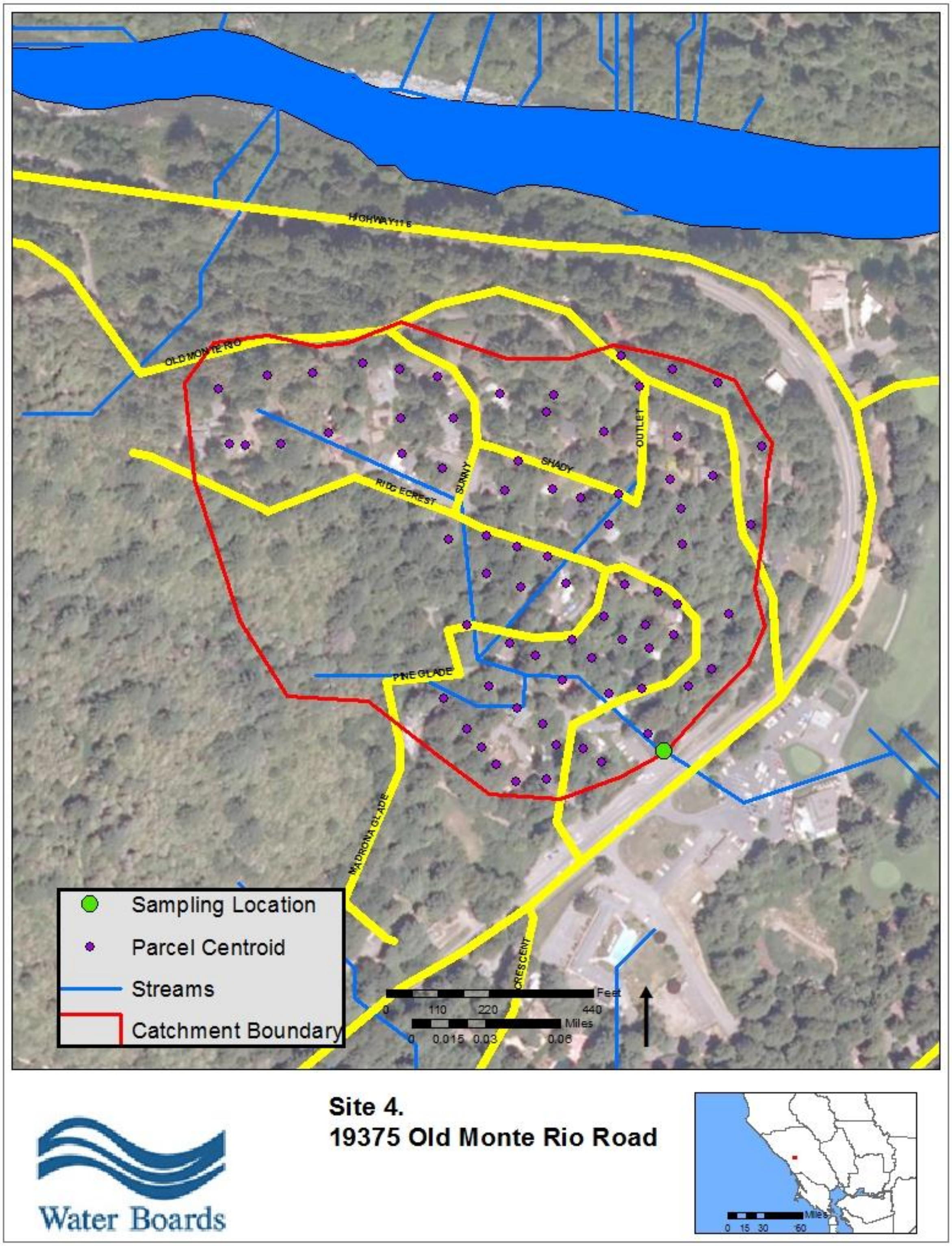

Figure 4. Sampling Location for Site 4 near 19375 Old Monte Rio Road, Monte Rio

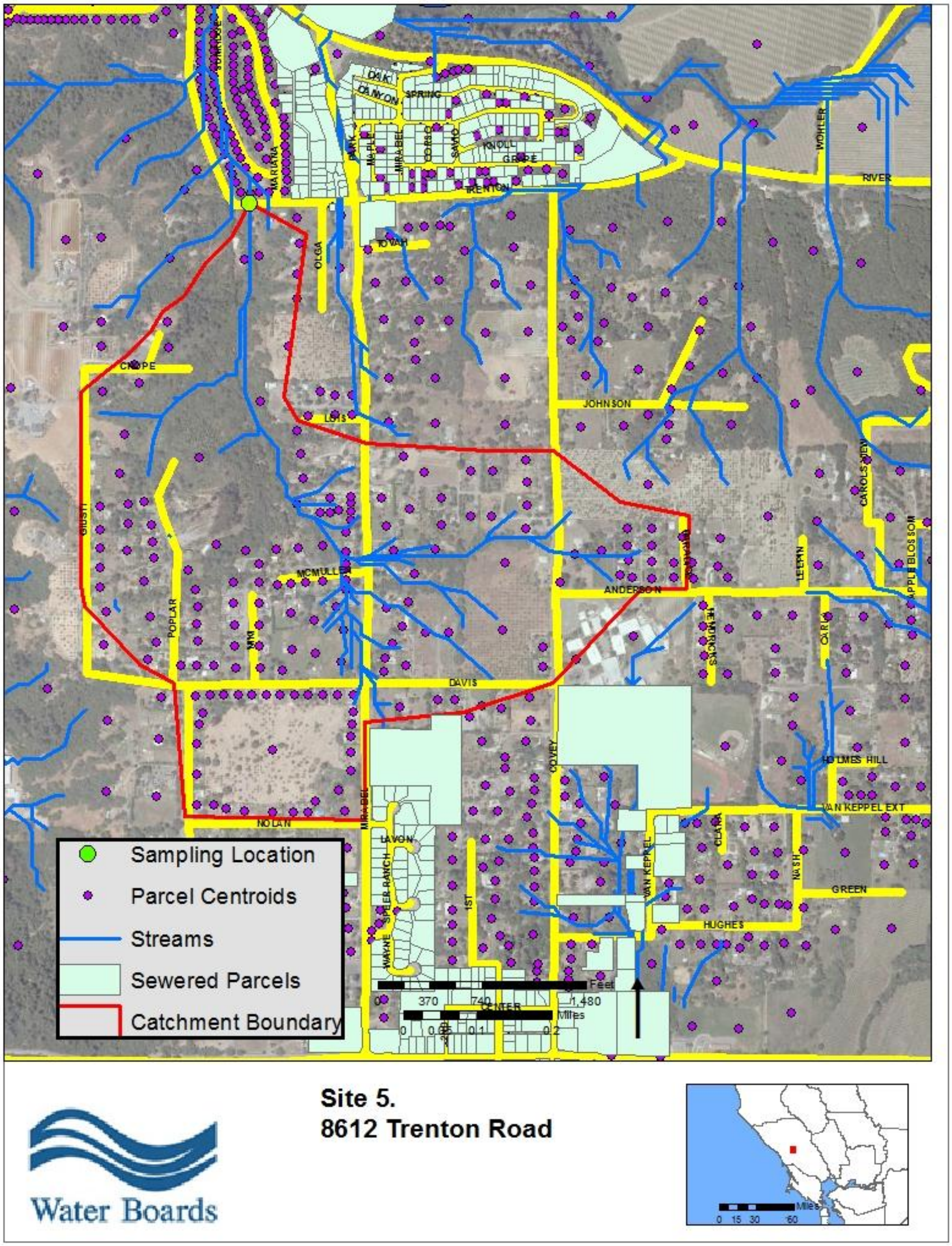

Figure 5. Sampling Location for Site 5 near 8612 Trenton Road, Forestville

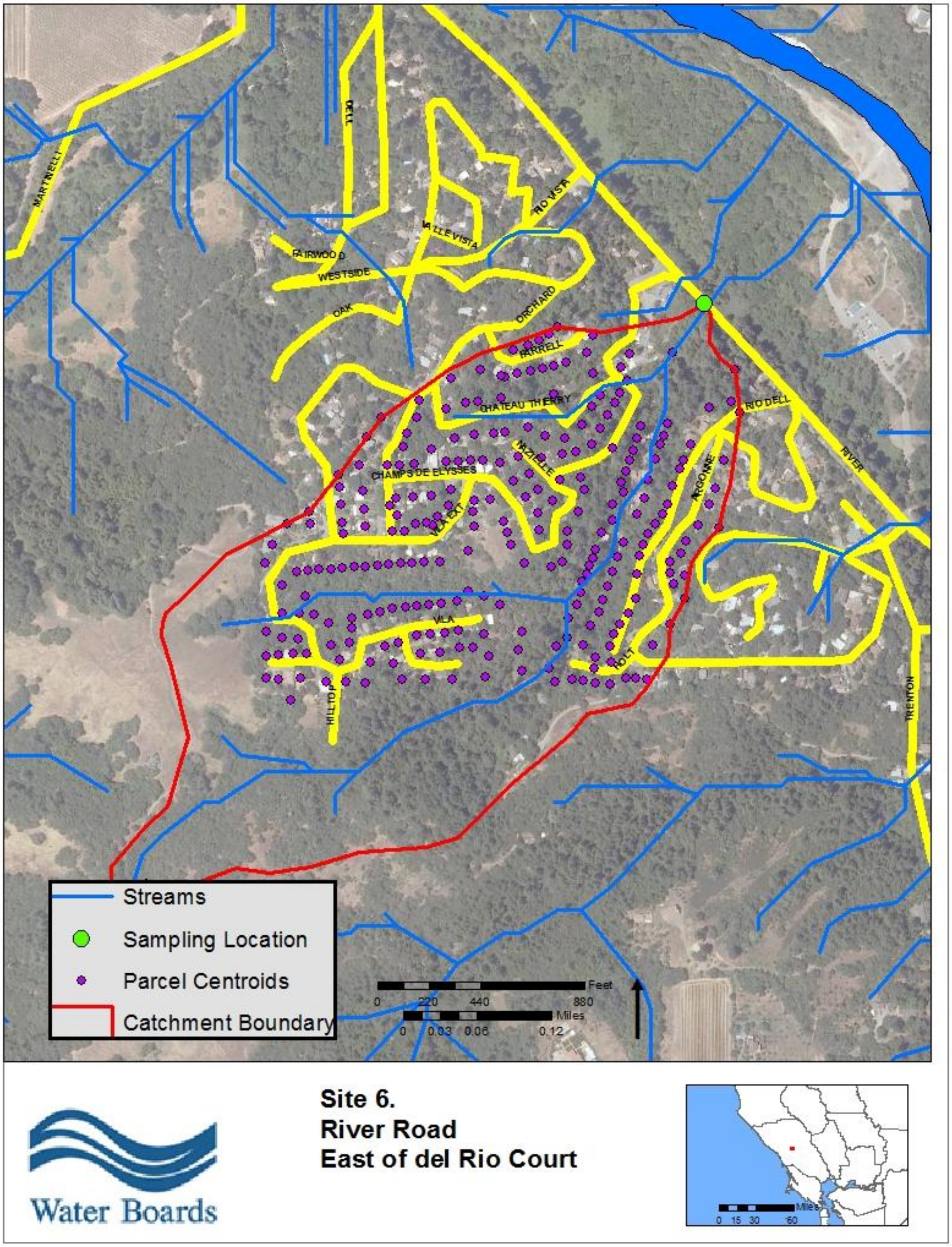

Figure 6. Sampling Location for Site 6 near River Road and del Rio Court, Forestville

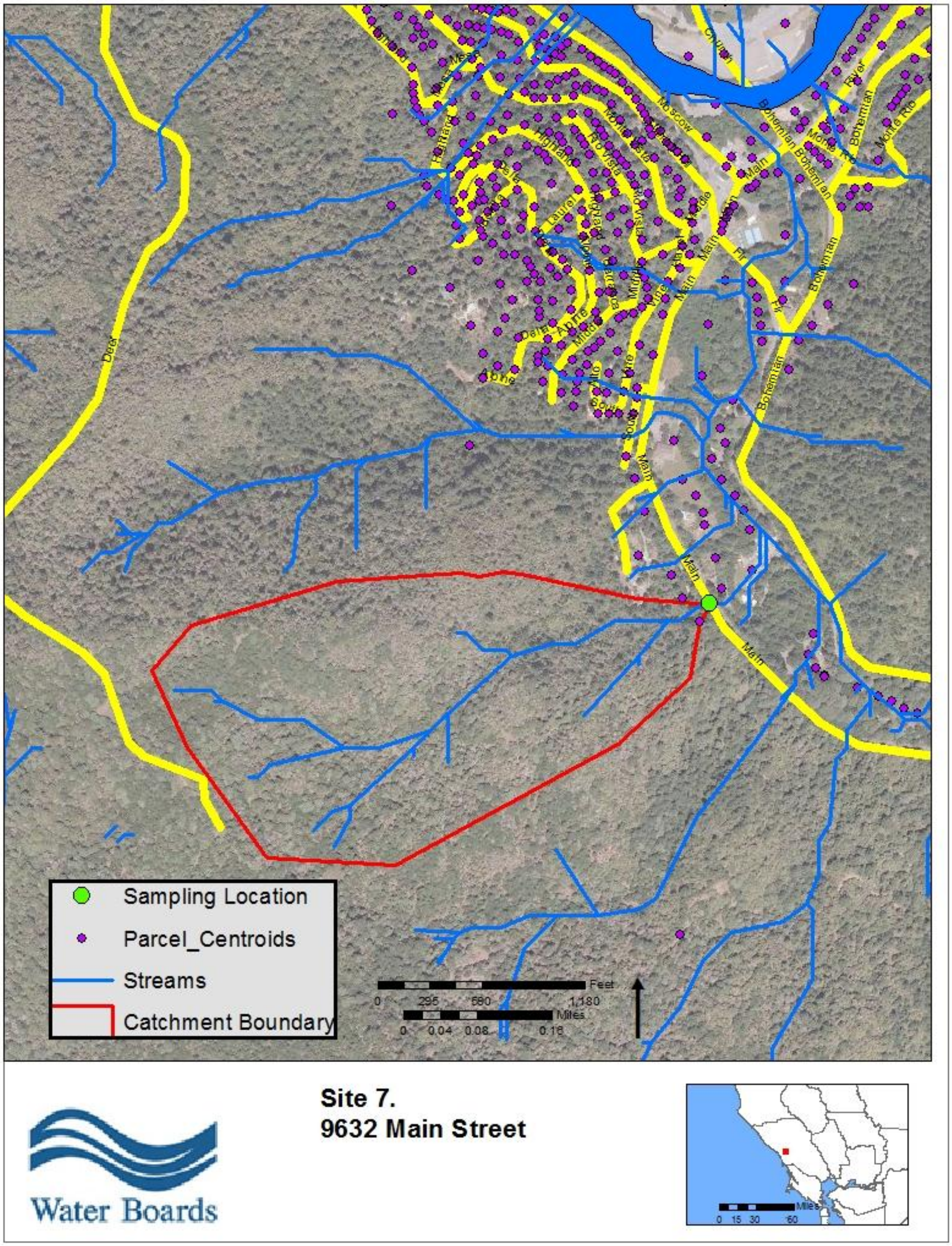

Figure 7. Sampling Location for Site 7 near 9632 Main Street, Monte Rio

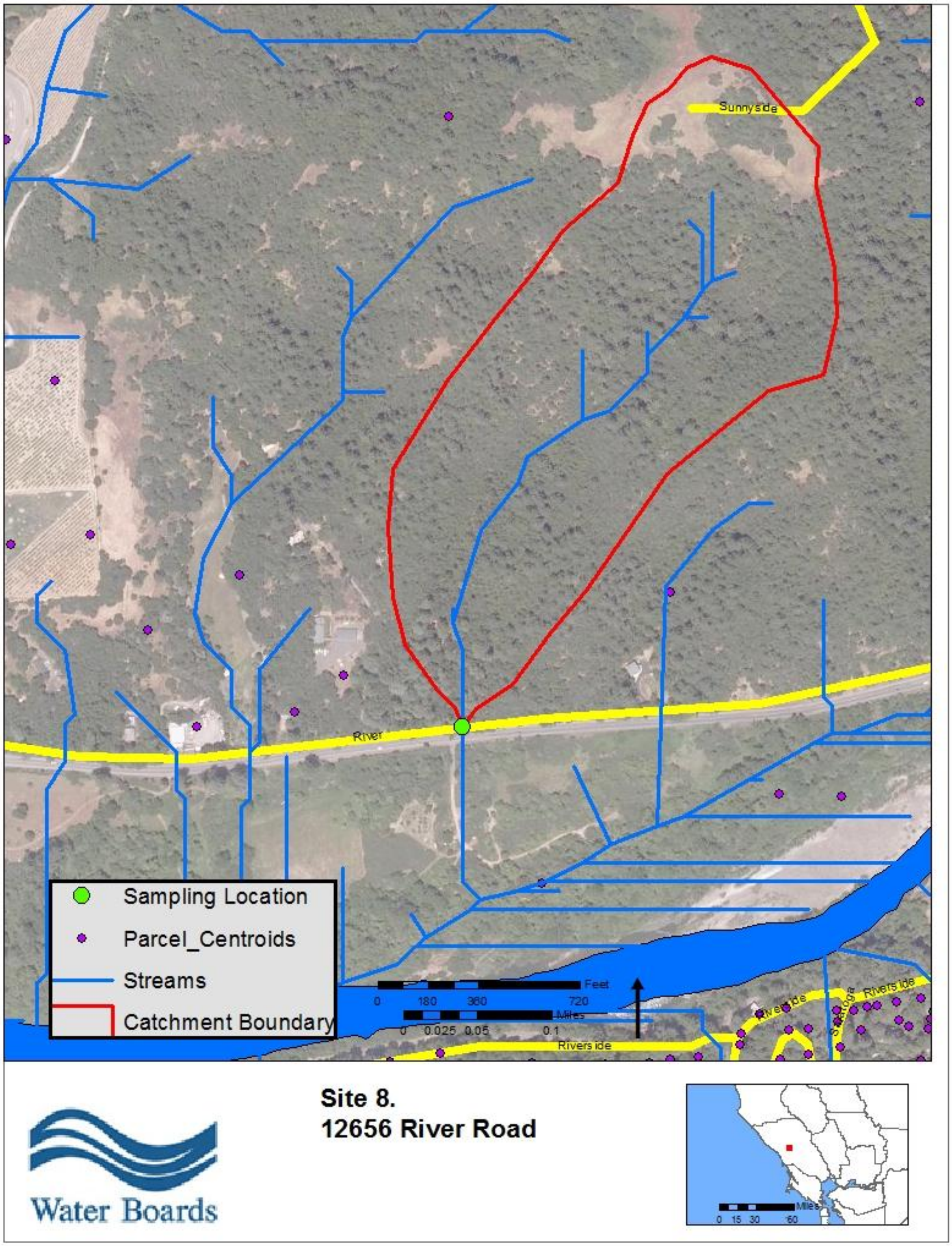

Figure 8. Sampling Location for Site 8 near 12656 River Road, Rio Nido

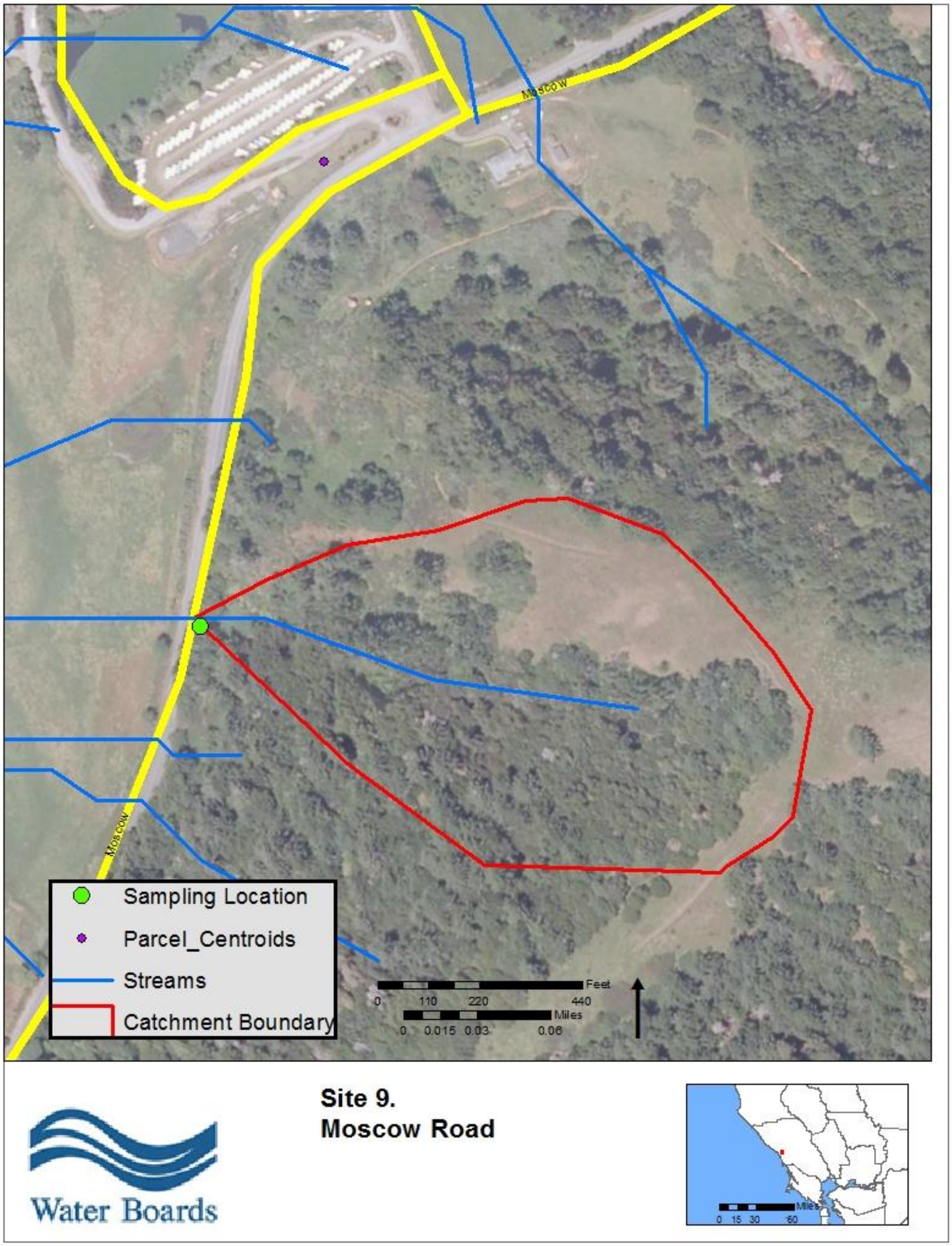

Figure 9. Sampling Location for Site 9 on Moscow Road, Duncan Mills

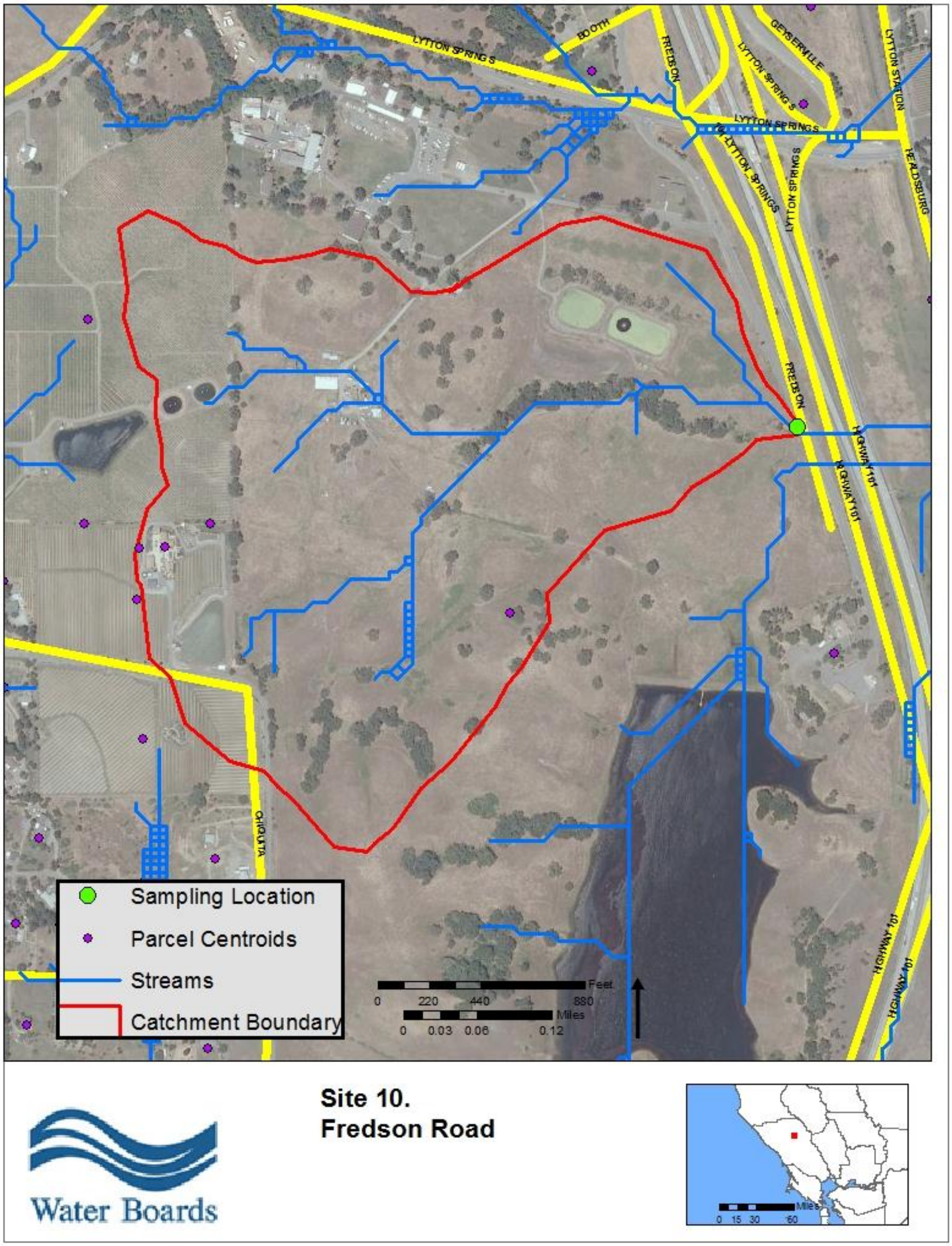

Figure 10. Sampling Location for Site 10 on Fredson Road, Healdsburg

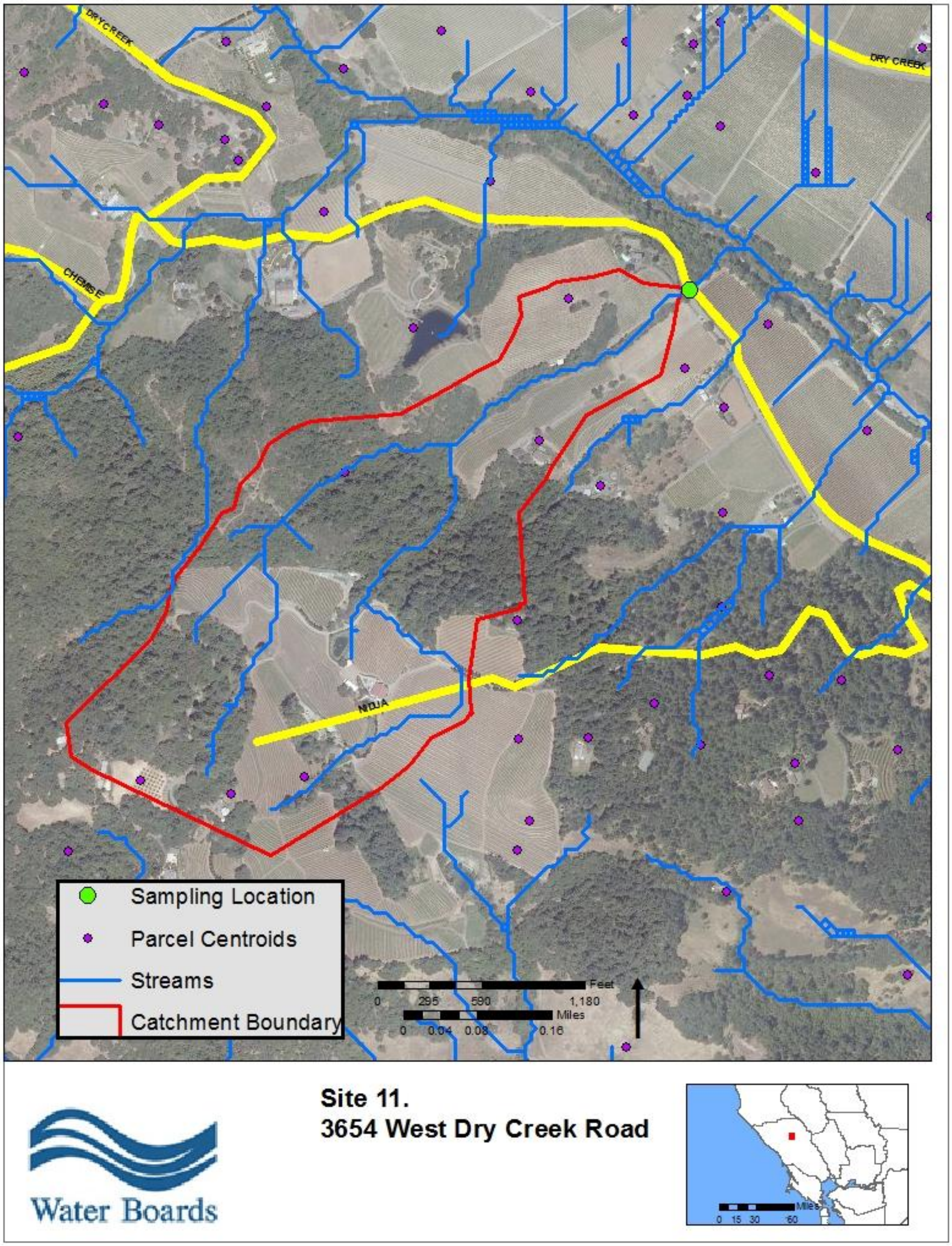

Figure 11. Sampling Location for Site 11 near 3554 West Dry Creek Road

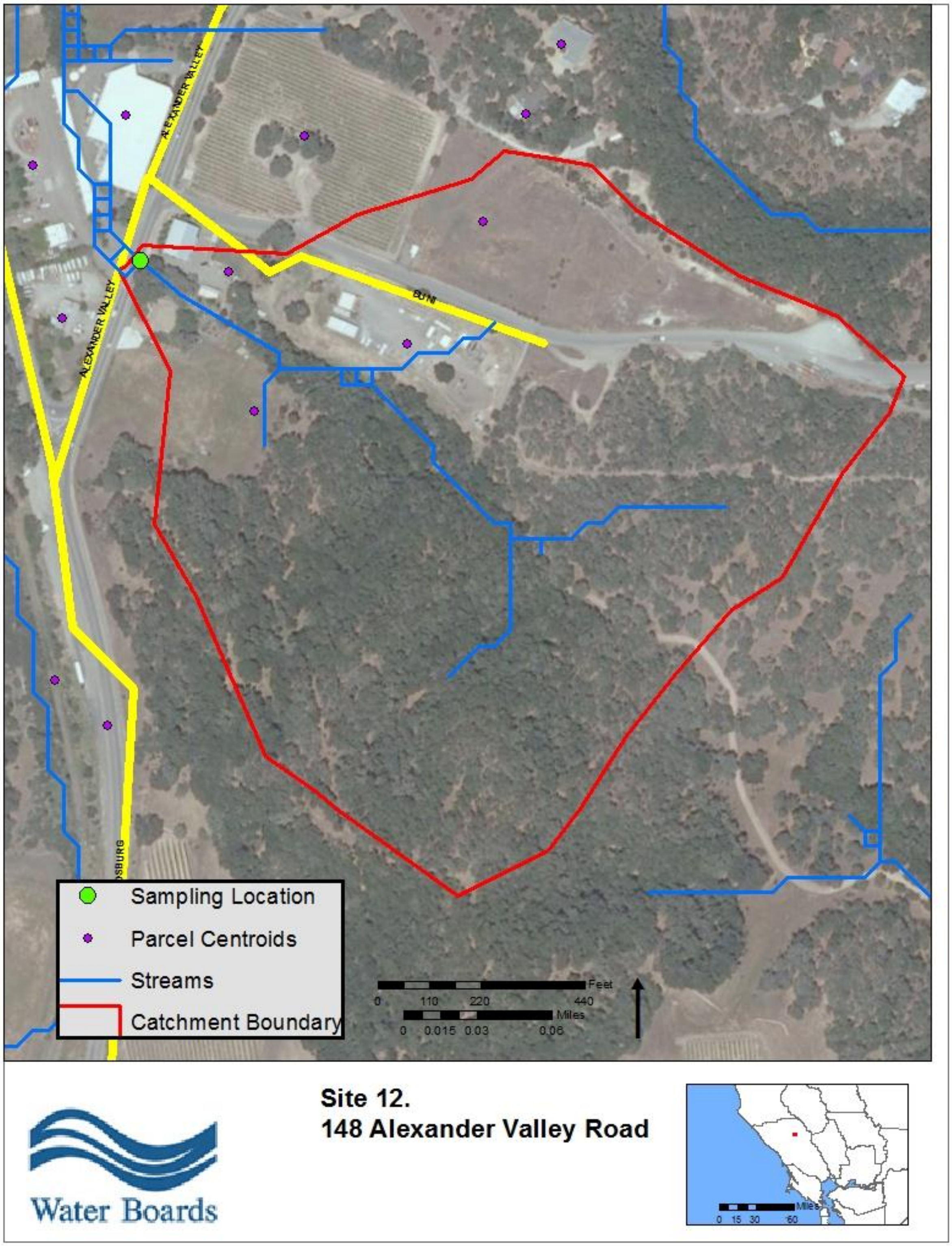

Figure 12. Sampling Location for Site 12 near 148 Alexander Valley Road

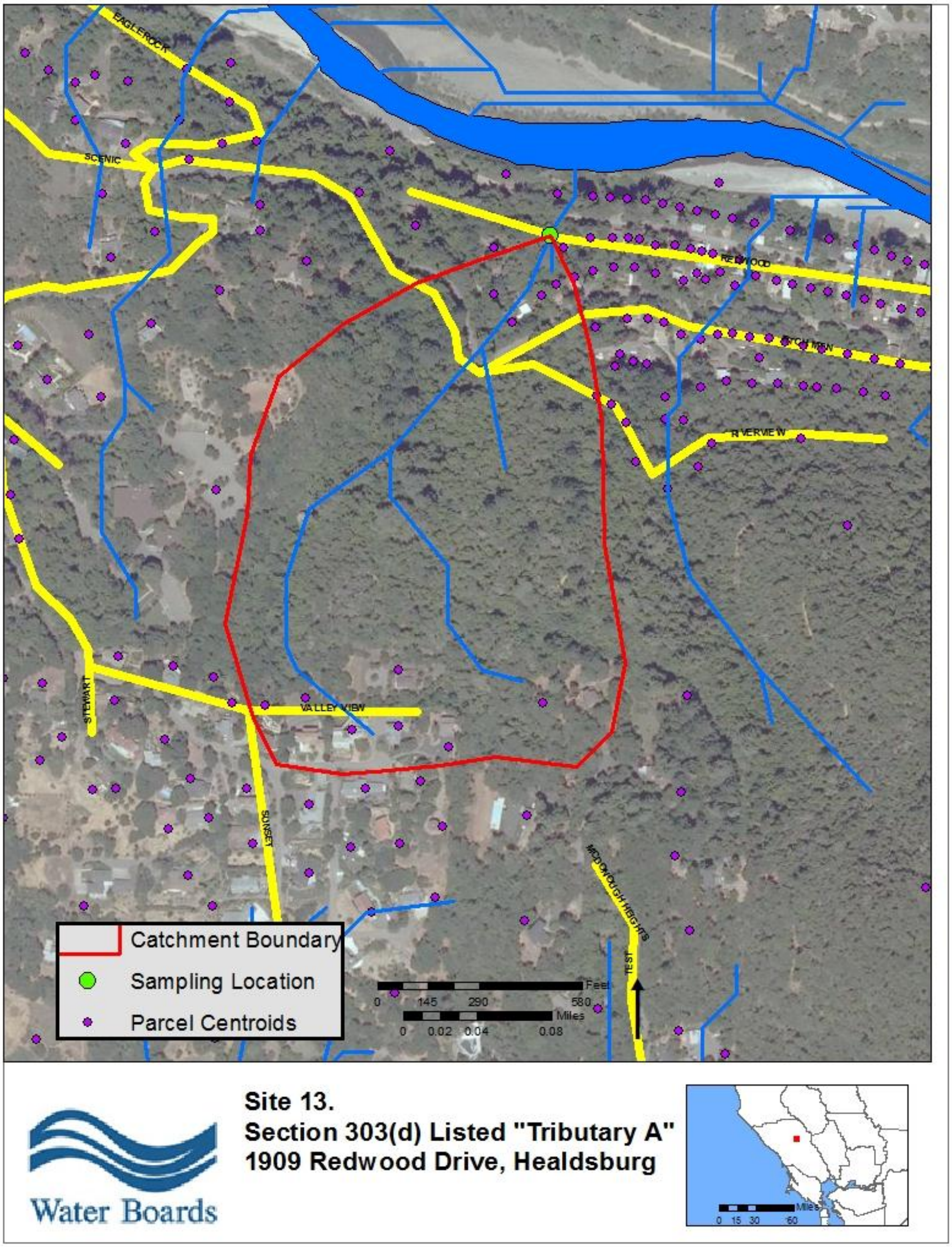

Figure 13. Sampling Location for Site 13 near 1909 Redwood Drive

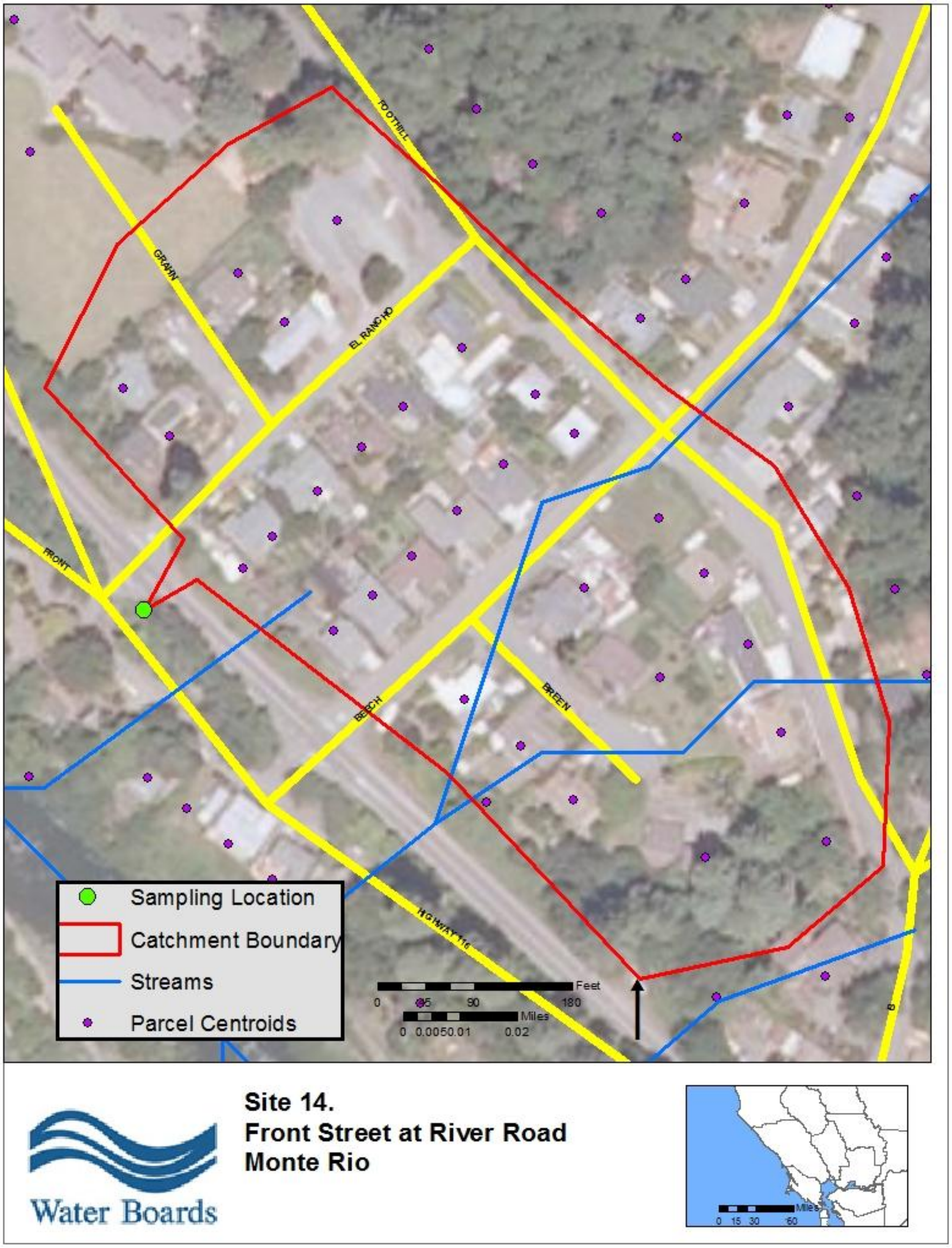

Figure 14. Sampling Location for Site 14 near Front Street and River Road

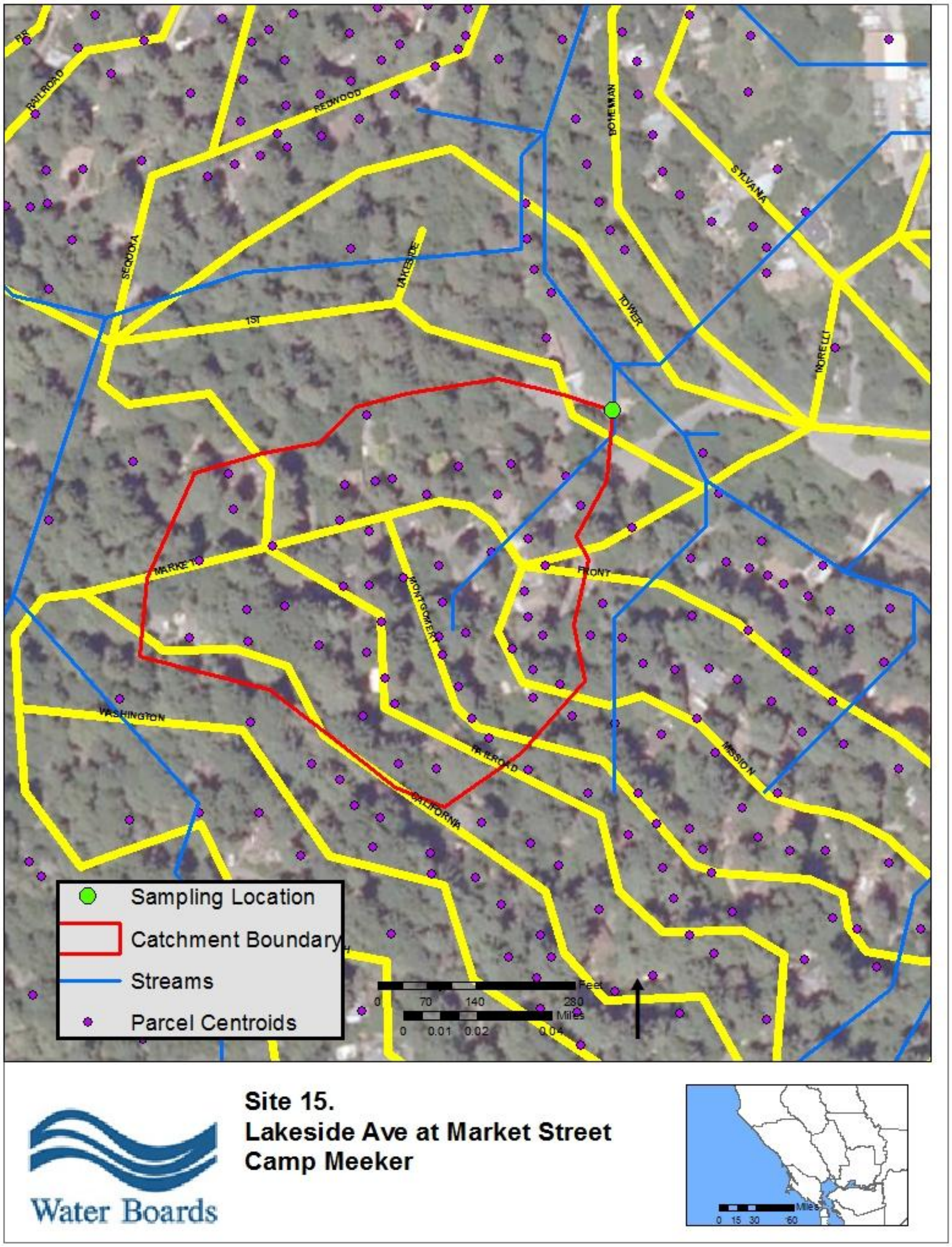

Figure 15. Sampling Location for Site 15 near Lakeside Ave and Market Street