Pseudo-Replication, No Replication, and a Complete Lack of Control (In Praise of Dirty Data for Weed Managers)

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Marin Municipal Water District
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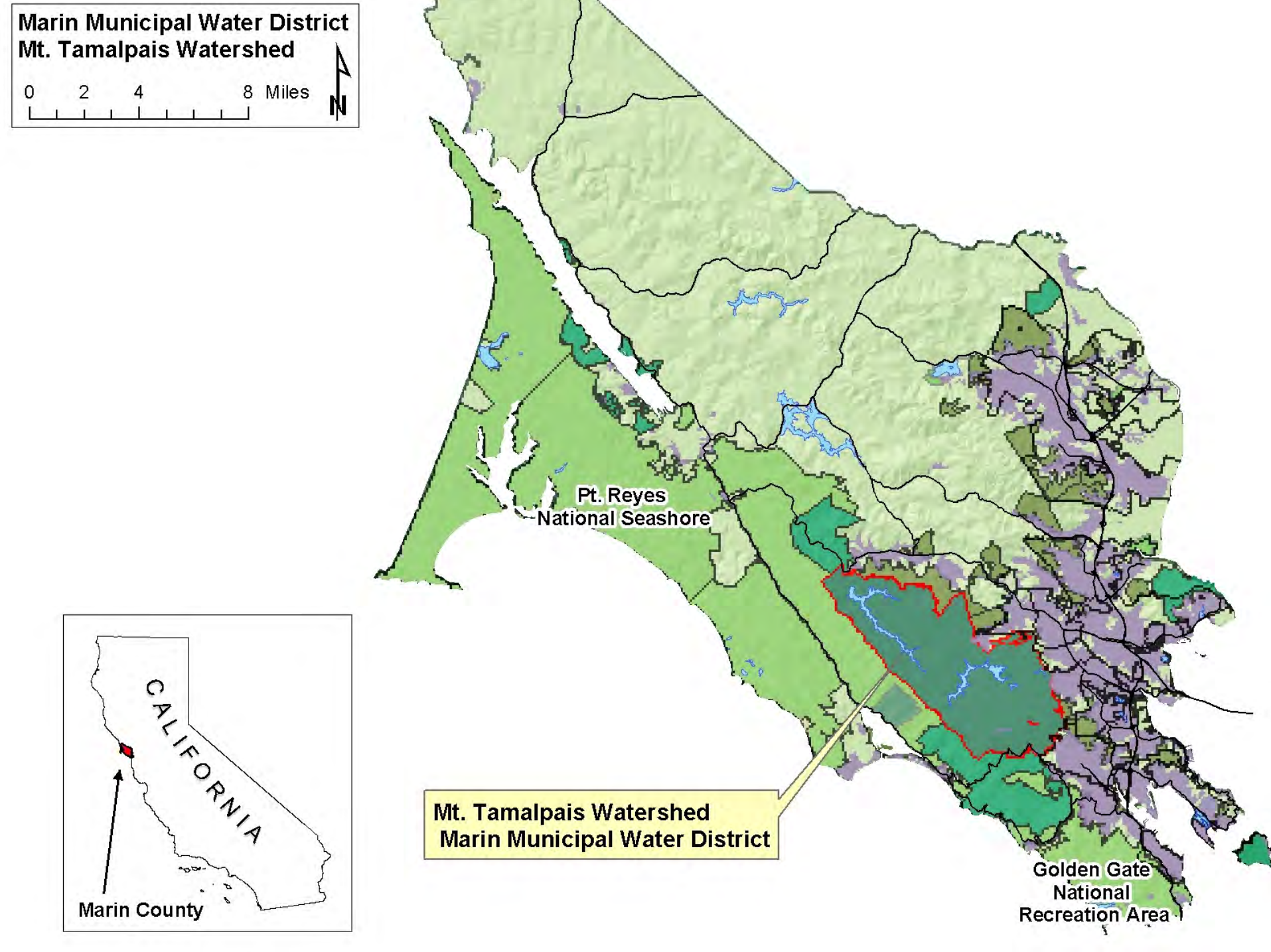
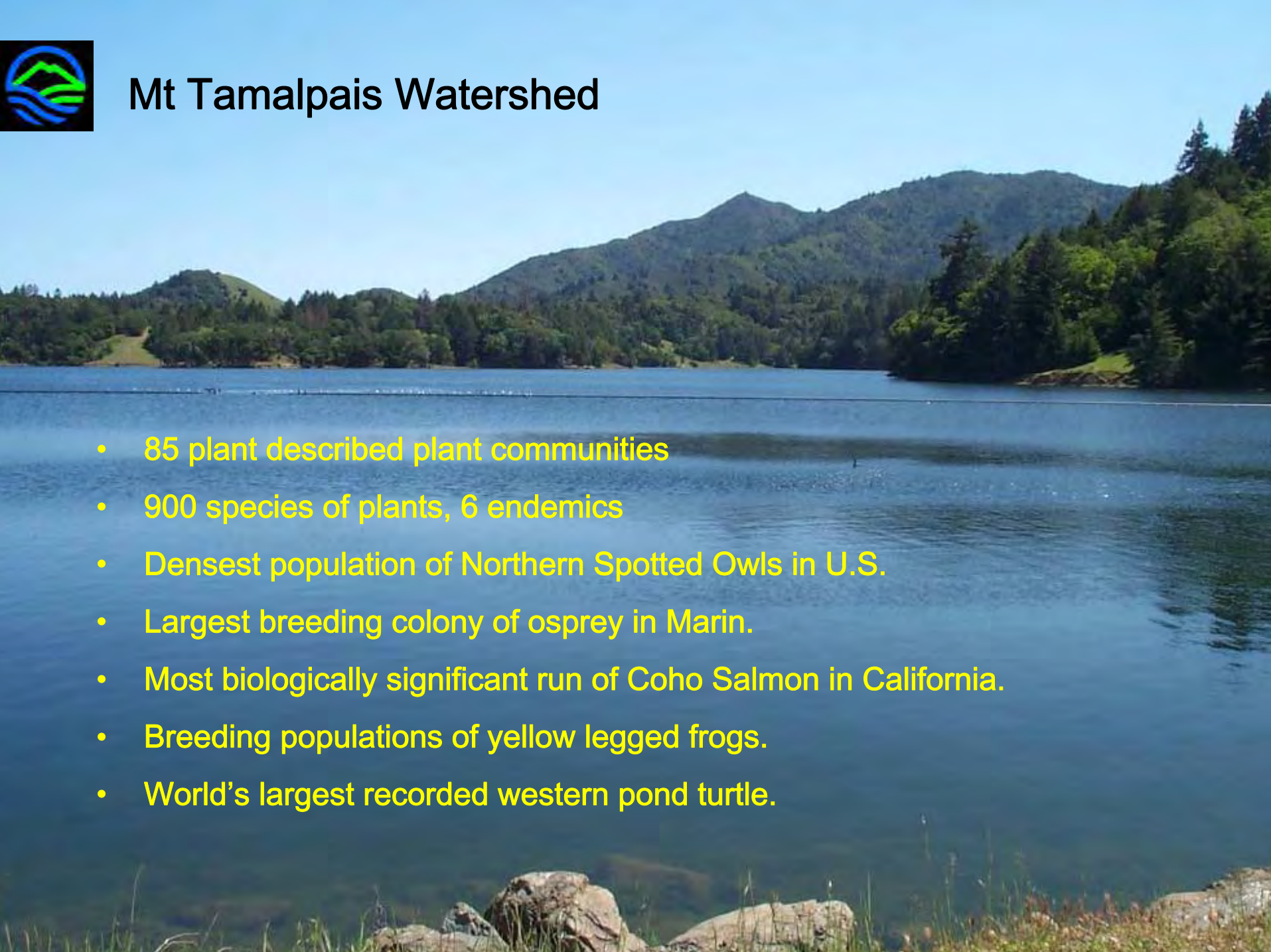

Marin Municipal Water District
Mt. Tamalpais Watershed
0 2 4 8 Miles
N
Pt. Reyes
National Seashore
CALIFORNIA
Marin County
Mt. Tamalpais Watershed
Marin Municipal Water District
Golden Gate
National
Recreation Area

Mt Tamalpais Watershed

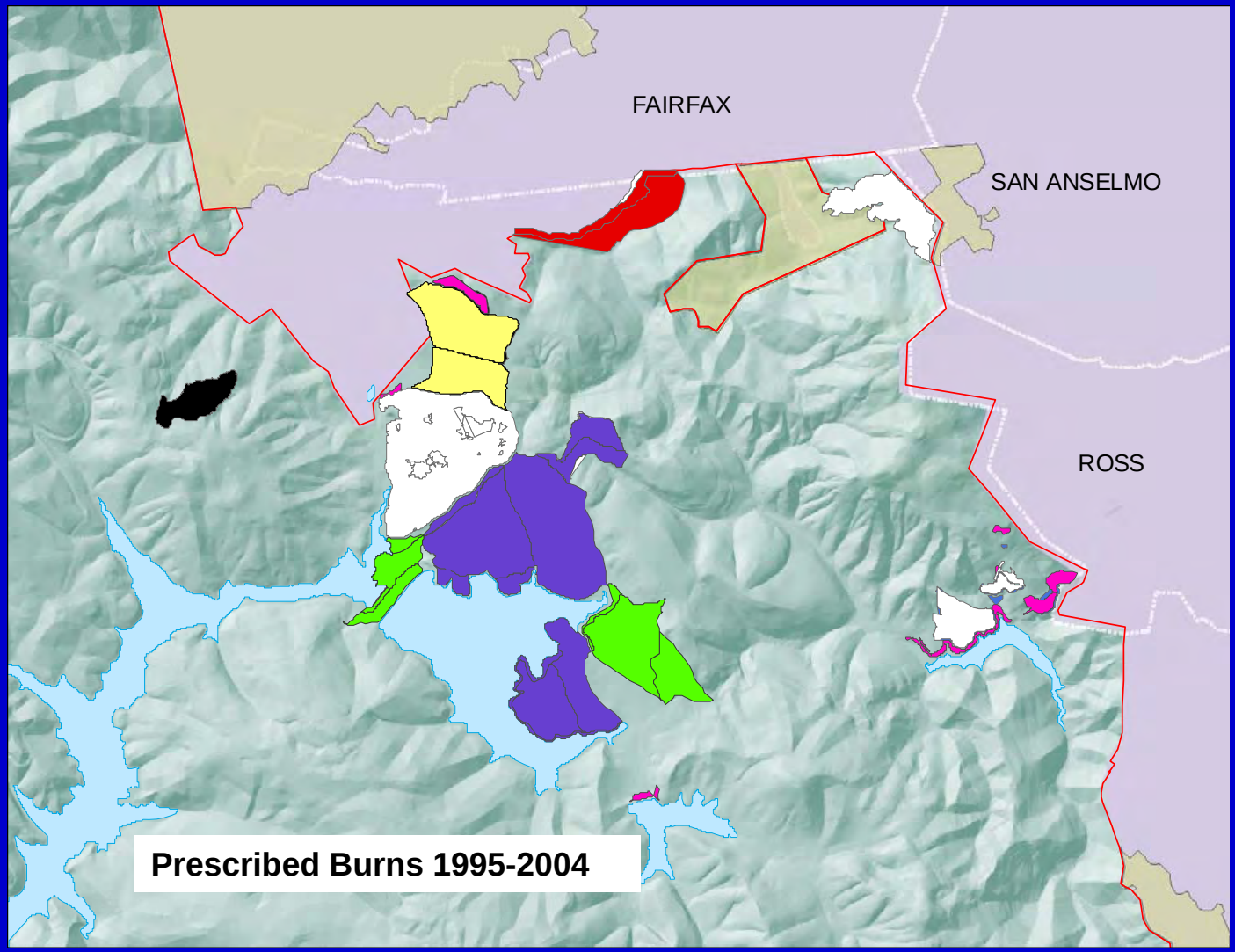


- 85 plant described plant communities
- 900 species of plants, 6 endemics
- Densest population of Northern Spotted Owls in U.S.
- Largest breeding colony of osprey in Marin.
- Most biologically significant run of Coho Salmon in California.
- Breeding populations of yellow legged frogs.
- World's largest recorded western pond turtle.

Estimated 900-1000 acres of *Genista monspessulana* (French broom)

Factors Limiting Research: Institutional focus is elsewhere

Factors Limiting Research: Complex and under-documented historic management



Factors Limiting Research:
Work Ethic and Culture—Speed and Efficiency

Factors Limiting Research:
Weed Management Objective--Eradication

Factors Limiting Research: Successful Staff, Volunteer and Public Education

Rogue Weeder Finds a Control Plot

Factors Limiting Research: Resources are limited.

Fundamental Information Needs Of the Marin Municipal Water District Weed Management Program

- How bad is the problem, really?
- How long will it take to fix?
- What works?
- What does it cost?

Who Needs This Information?

- MMWD Resource Management Staff
- MMWD Board of Directors (purse string holders and policy setters)
- Adjacent Land Managers
- Fire Community
- General Public

Who's available to get the information?

Quick and Dirty Data

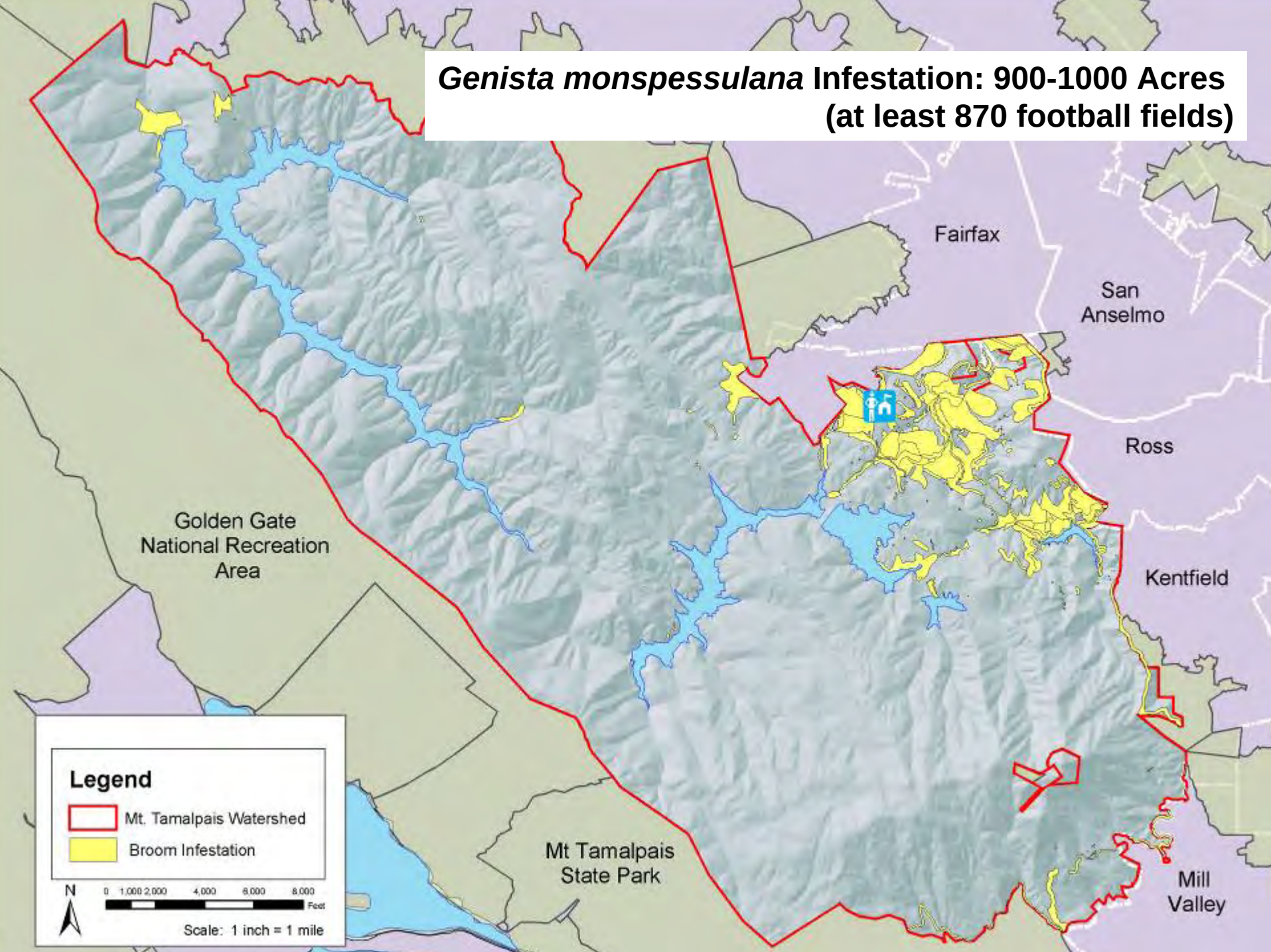
How bad is the problem, really?

(or how much broom is out there and why is this plant different from all other plants?)

Quick and Dirty Distribution Mapping

Emphasis is on characterizing static "vegetation management units" rather than delineating population boundaries which continually change.

- **Cover (<1%, 1-10%, 10-35%, 35-65%, 65-90%, >90%)**
- **Distribution pattern (isolated patch, scattered, clustered, continuous)**
- **Evidence of past management (stumps, burn scars, piles)**


Genista monspessulana Infestation: 900-1000 Acres
(at least 870 football fields)
Fairfax
San Anselmo
Ross
Kentfield
Golden Gate National Recreation Area
Mt Tamalpais State Park
Mill Valley
Legend
Mt. Tamalpais Watershed
Broom Infestation
N
0 1,000 2,000 4,000 6,000 8,000
Feet
Scale: 1 inch = 1 mile

Quick and Dirty Population Density Estimates

- Density is easy to replicate and easy to understand.
- Density relates directly to hand pulling and cut-stump treatment costs.

Population Density Sampling:

- Stratified random placement by predefined Weed Management Units
- Minimum of 20 samples per unit—goal of 30 for 80% confidence interval
- Quadrat size 0.5 meters x 5 meters
- Sampling interval dependent on planned management actions and availability of labor
- Time needed: 2-3 hours
- Typical labor source: surly teenagers

Population Density Estimates

Abundance	Estimated Stems per Acre	Acreage
Sparse (<10% cover)	5,000-20,000	95
Low (10 to 35% cover)	20,000-40,000	295
Medium (36 to 65 % cover)	40,000-80,000	185
High (66 to 90% cover)	80,000-130,000	125
unquantified		200

Estimated Minimum of
24 – 44 Million
Broom Plants On The Watershed

Quick and Dirty: Why is this plant different from (and worse than) all other plants?

Quick and Dirty Quantification of Fuel Loading

Heights of 100 broom and 100 native species measured 6 months after mowing.
Time needed: 45 minutes.

How Long Will It Take To Fix The Problem?

(Or how many person hours per acre per method used?)

Quick and Dirty Staff / Contractor Labor Statistics:

- Tied to vegetation management units
- Accuracy limited by map accuracy and details provided by crews
- Tracked through a work order system
- Averaged over multiple years and over 60 project sites

Quick and Dirty Volunteer Productivity Calculation:

- Individuals count number of stems pulled in 5 minutes.
- Data combined with stem density data.
- Averaged over multiple years, thousands of volunteers, and 15 project sites.

Handpulling Rate and Capacity:

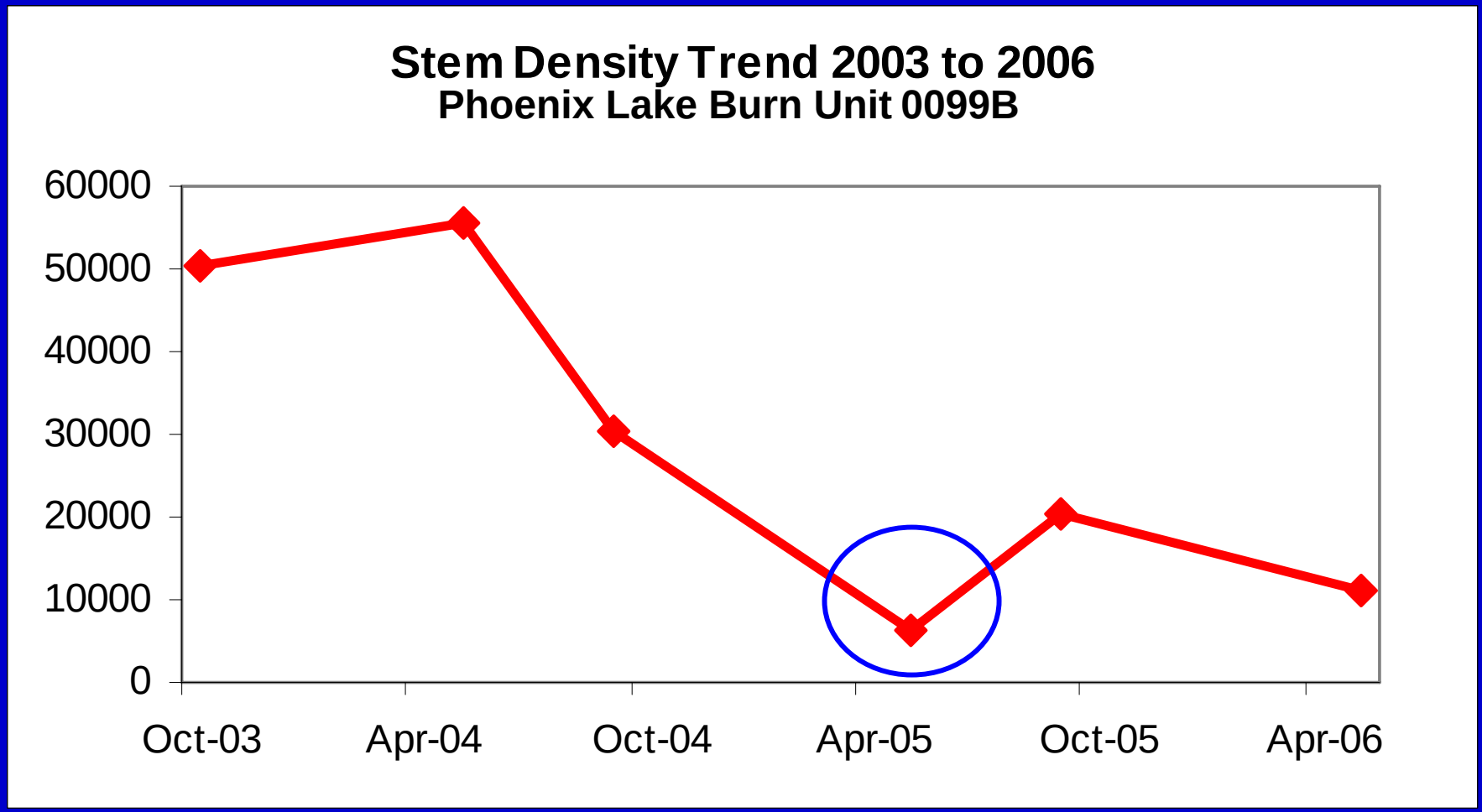
	Volunteers / Adult Offenders	Contract Crews
Person Hours Per Acre	400	50
Maximum Acres per Year (existing program)	30	60
*** Years to Clear Watershed**	**30**	**15**

*** Assumes no spread, no seedbank, and no re-infestation**

How long until we rid a single site of broom?

Restoration Threshold: 5000 stems per acre

Using that Quick and Dirty Density Data:



What Works?

Quick and Dirty Treatment Assessments: Focus on Logistics and Management Goals

- Cost per acre: initial treatment and 10 year projection
- Re-treatment interval needed to achieve zero seed set
- Time to restoration (stem density below 5000 per acre)
- Logistical limitations
- Wildfire risk reduction
- Ecological protection
- Invasive species spread control

Failure can sometimes be determined without replicates or controls.

Goat Trial:

Carefully planned broom mortality study

Grazing rate slower than expected; <50% of monitoring plots grazed.

Quick and Dirty Data:

Madrone mortality
(oops, no controls!)

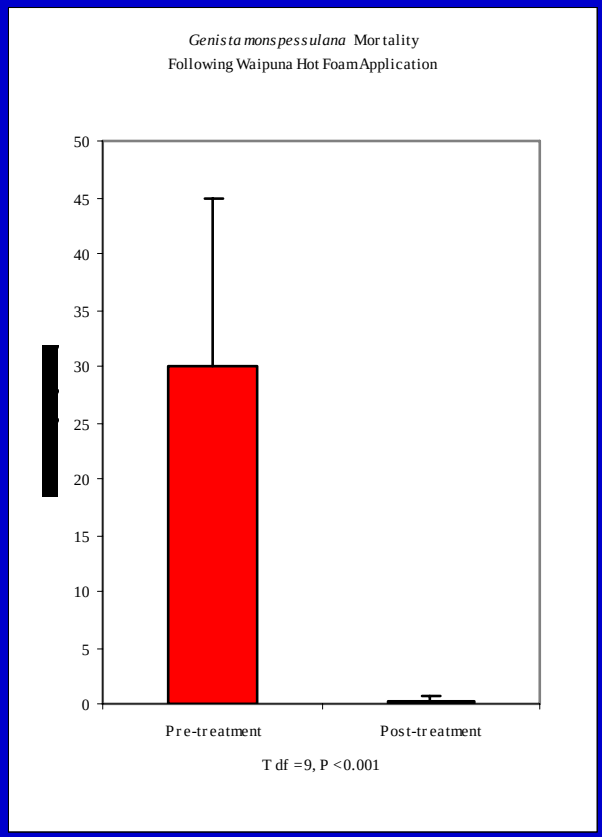
2006 Waipuna Hot Foam Trial

- Formal study initiated
- Controls and replicates
- Study components
  - Broom mortality
  - Broom seed bank
  - Native seed bank
  - Soil macro nutrients
  - Soil microbial activity
  - Cost
  - Water usage

Cost proved to be prohibitively high.

All components of study discontinued, with the exception of broom mortality.

2003 Waipuna Demonstration Results

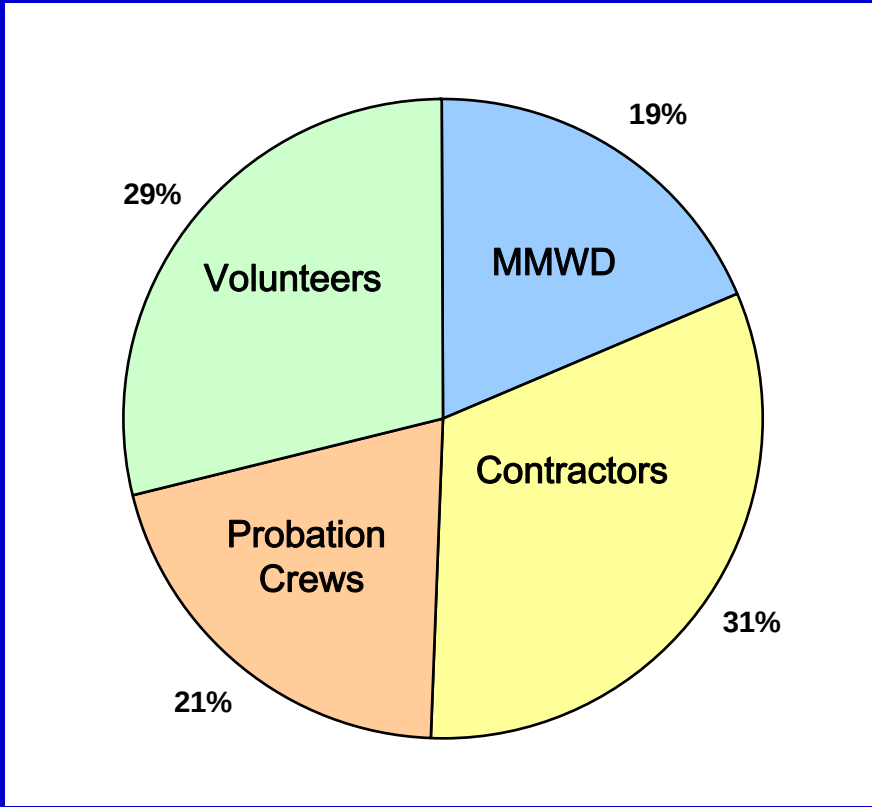


100% kill rate in 7 out of 10 plots and >90% in the remaining 3 plots.

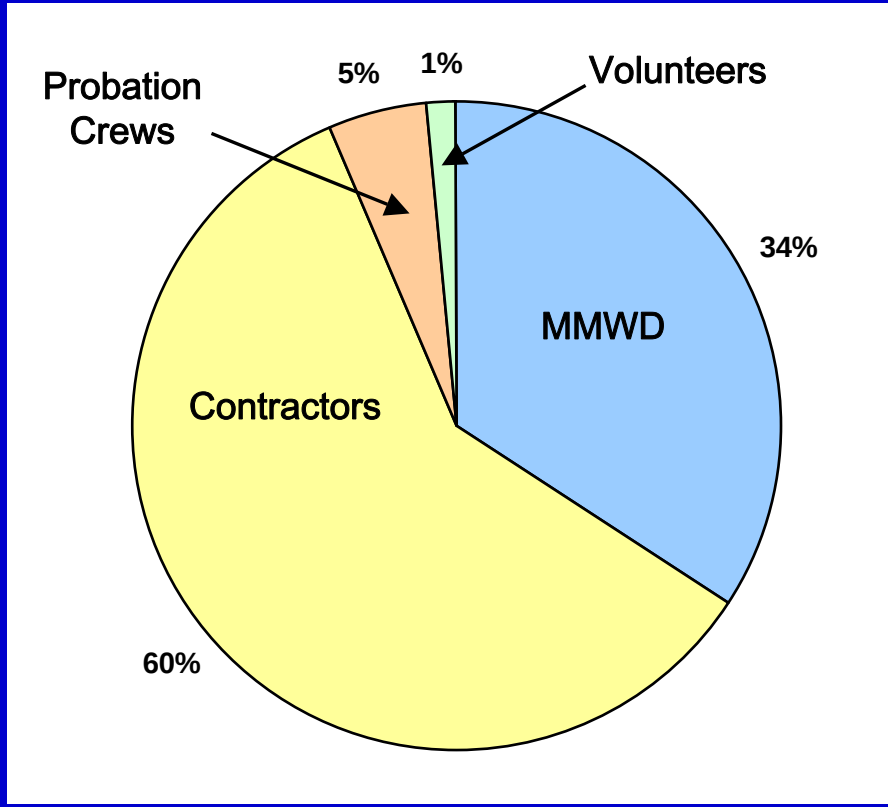
2006 mortality results expected to differ significantly from 2003 demonstration.

Larger scale, extended trial closer to the reality of daily operations.

Who Works:
Labor Sources and Productivity



Person Hours: 10,800



Acres Treated: 500

Value of a given crew is often greater than their productivity level.

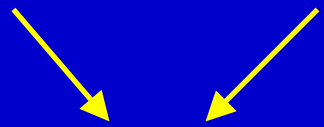
How Much Is it Costing Us?

Or how bad is the problem, really?

Quick and Dirty Treatment Comparisons: Cost

Work Order Statistics

Broom Density & Distribution Data



Person Hours Per Acre

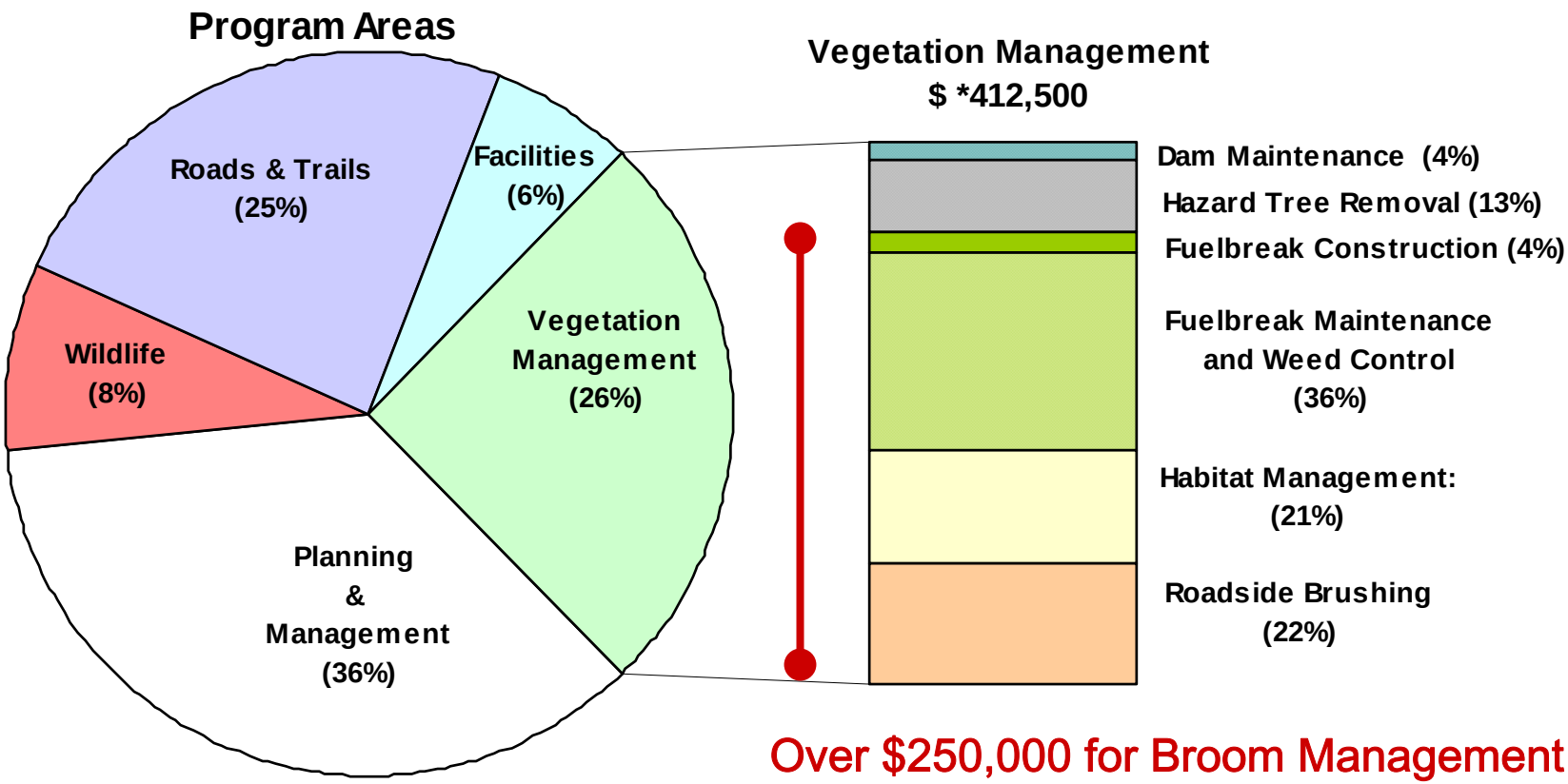
+

Crew
Vehicles
Fuel
Equipment
Chemical
Lease Fees
Additional Expenses

Treatment Assessments:
10 Year Cost Per Acre Comparison

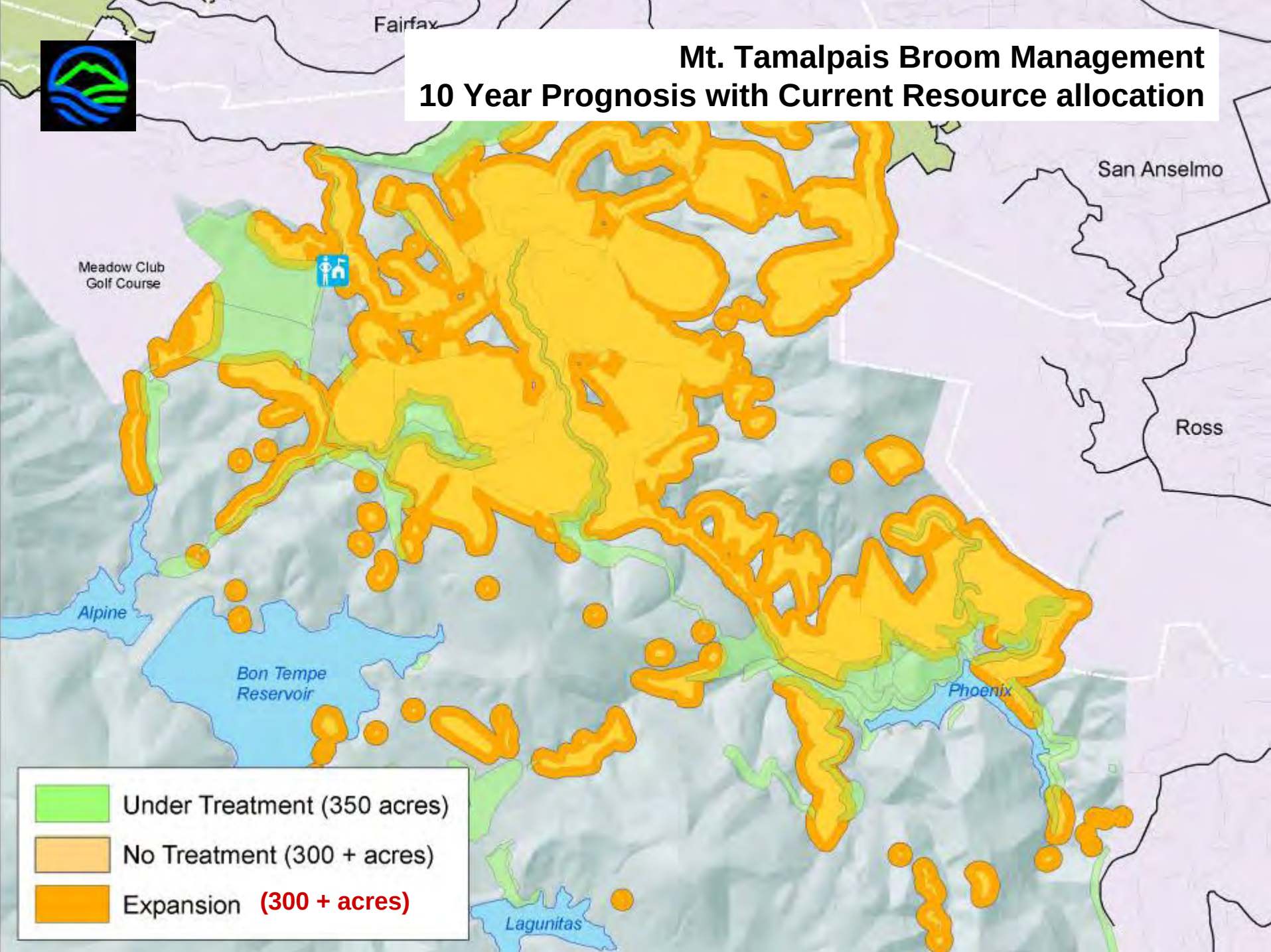
Methods	Labor Source	Person Hours an Acre	Cost Per Acre (Single Treatment)	Treatment Costs Over Ten Years
Suspended Methods				
Cut Stump Treatment	Contractor or MMWD	30	$ 750	$ 2,825
Currently Employed Methods				
Excavator / Tiger Mower	MMWD	5	$ 350	$ 3,500
Power Brushcutting	Contractor or MMWD	20	$ 500	$ 4,875
Prescription Burning	MMWD	Insufficient data	$ 1,500	$ 8,850
Mulching	MMWD	16	$ 475	$ 1,825
Propane flaming	Contractor or MMWD	75	$ 1,975	$ 6,025
Handpulling	Contractor or AWOP or Volunteer	300	$ 2,400	$ 9,850
Experimental Methods				
Terra Torch	Contractor with MMWD	7	$ 725	$ 2,775
Grazing (goats)	Contractor with MMWD	10	$ 975	$ 5,300
Waipuna Hot Foam	MMWD	110	$ 3,550	$ 6,800

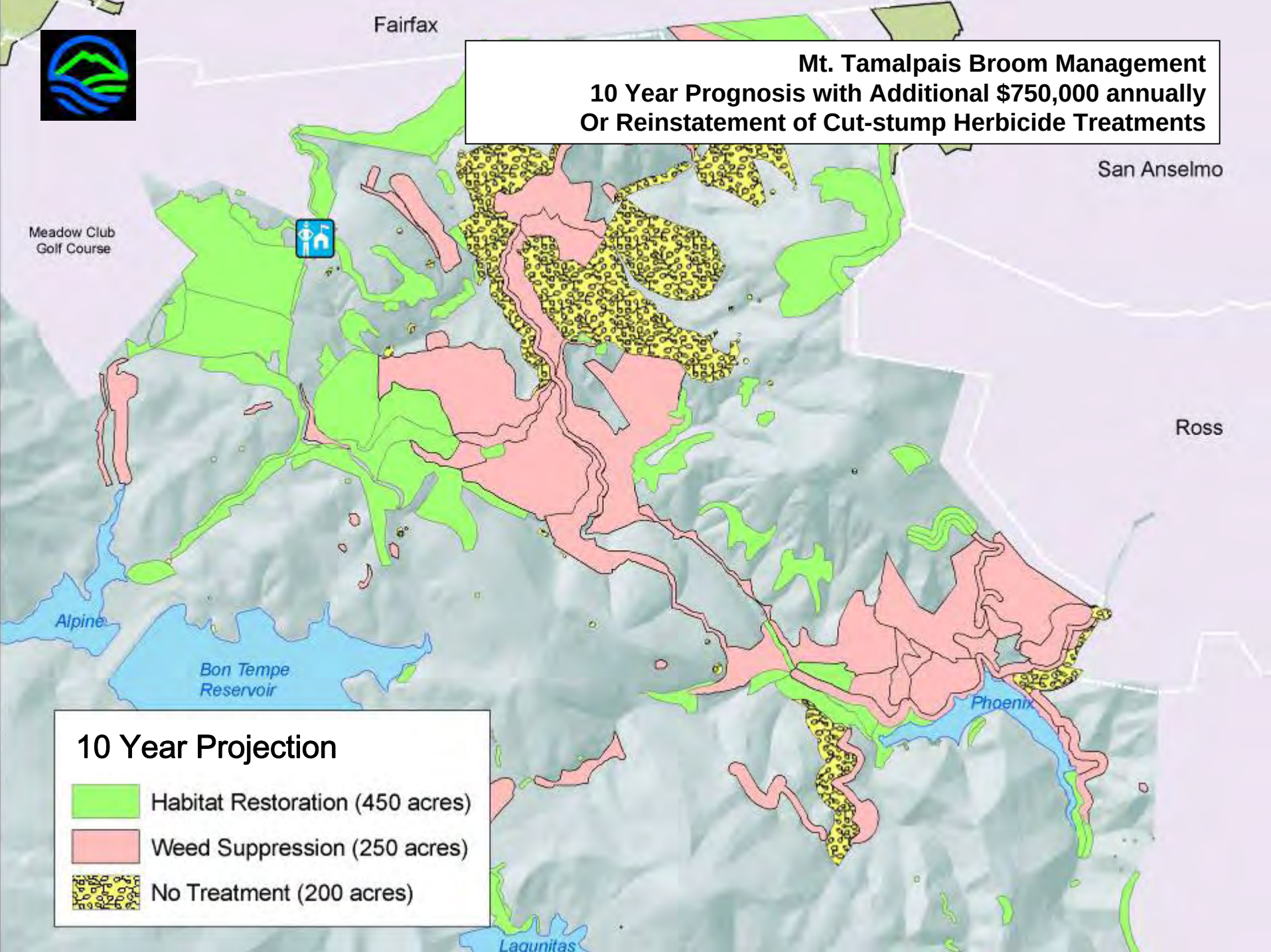
Watershed Resource Program Budget
Fiscal Year 2005/2006
$1,606,000,000



Over $250,000 for Broom Management

Mt. Tamalpais Broom Management
10 Year Prognosis with Current Resource allocation




Mt. Tamalpais Broom Management
10 Year Prognosis with Additional $750,000 annually
Or Reinstatement of Cut-stump Herbicide Treatments
Fairfax
San Anselmo
Ross
Meadow Club
Golf Course
Alpine
Bon Tempe
Reservoir
Phoenix
Lagunitas
10 Year Projection
Habitat Restoration (450 acres)
Weed Suppression (250 acres)
No Treatment (200 acres)

Thanks to the many interns and volunteers who have stooped and counted and counted again.

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