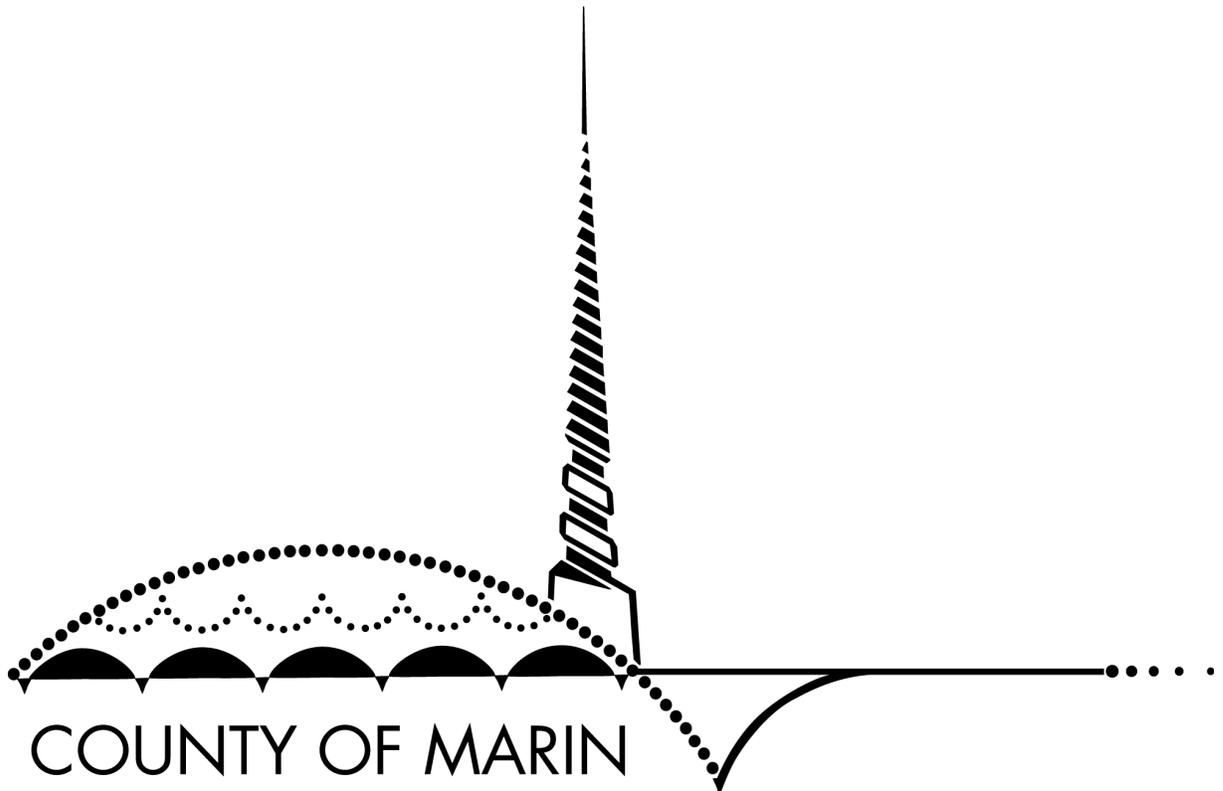
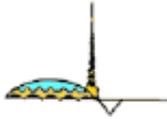

2012/2013 MARIN COUNTY CIVIL GRAND JURY

Marin on Fire Redux

Report Date - March 19, 2013
Public Release Date - March 25, 2013





Marin on Fire Redux



SUMMARY

Southern Marin residents are exposed to increased fire risk due to a dramatic increase of the fuel load on the Mt. Tamalpais Watershed. This conclusion is based on interviews with a broad cross section of fire professionals, emergency service personnel, County supervisors, and Marin Municipal Water District (MMWD) directors, as well as on research, and observations.

Previous Marin County Civil Grand Jury reports (2002-2003: Wild Fires, Partners in Prevention, and 2007-2008: Marin on Fire), address the need for increased enforcement of vegetation management codes. These codes include the creation and maintenance of defensible space.

Far more significant dangers loom. The Mt. Tamalpais Watershed borders 11 communities containing 13,200 structures within one mile of the Watershed boundary. Of these, 300 structures are on or within 300 feet of the boundary. These 13,200 structures are in imminent danger of a devastating wild fire similar to the 1991 Oakland Hills firestorm, which destroyed 2,900 structures and killed 25 people. The Watershed is rated high or very high for fire risk by the California Department of Forestry.

The Watershed is home to numerous invasive non-native plant species. The most aggressive of these is French Broom (*Genista monspessulana*). French Broom poses a significant threat to the Watershed's biodiversity and wildfire risk reduction goals. Broom infests over 1,200 acres of the Watershed, and is currently spreading at a rate of at least 30 acres per year. MMWD has found that control methods recommended in the 1995 Vegetation Management Plan (VMP) are ineffective for controlling the Broom. Despite years of effort, the Broom population continues to expand on the Watershed.

The MMWD has developed a new plan, *Wildfire Protection and Habitat Improvement Program (WPHIP)*. This plan offers two approaches to control Broom and other invasive plant species. Approach 1 calls for a manual solution with a cost of \$5.6 million annually for full implementation. Approach 2 recommends using a combination of manual efforts and the controlled use of the herbicide, Glyphosate, at a much lower cost of \$1.6 million annually. This is an annual savings of \$4 million to achieve the same results. Glyphosate is currently used in the Marin County park system and on Marin's open space as part of an integrated pest management system to control Broom. The Marin County Board of Supervisors approved the use of this herbicide in 2009.

The Grand Jury strongly believes that the high risk of wildfires far exceeds the very low risk associated with the controlled use of herbicides. We recommend that the MMWD Board approve Approach 2, which is the more effective and less expensive process for controlling Broom.

BACKGROUND

The manager of the County Office of Emergency Services has stated that the most significant danger to Marin County residents and property is an earthquake. A close second dangerous threat is a wildfire.

Wildfire in California is an ever-present danger. As populations increase so does construction at the very edge of the Wildland-Unban Interface (WUI) This intensifies the danger of wildfires. Much of Marin County is susceptible to wildfire risk due to heavily wooded areas and uneven vegetation management.

Here is a short history of Marin County wildfires

- 1881 6,500 acres burned
- 1891 12,000 acres burned
- 1894 Mill Valley to the Pacific Ocean burned
- 1904 Fairfax to Stinson Beach burned
- 1923 Ignacio to Fairfax burned
- 1929 Mill Valley to the top of Mt. Tam burned
- 1945 Kent Lake to Bolinas burned
- 1995 Mt. Vision – 12,000 acres and 48 homes burned

In 2003 the Mill Valley Fire Department indicated that if a fire similar in scope to the 1929 fire occurred it would destroy 850 homes. This is primarily due to the massive increase in the fuel load and, of course, the urbanization of Mill Valley since that fire.

Looking at wildfires from the broader perspective of the State of California tells a similar story. The consequences of the largest wildfires as measured by structures destroyed are sobering. According to the California Department of Forestry and Fire Protection (CAL FIRE), the largest twenty wildfires in state history have taken 70 lives, destroyed 15,840 properties, and burned 1,161,668 acres. Over the past five years the damage cost has averaged over \$100 million per annum.

The Oakland Hills 1991 Fire was one of Northern California's largest firestorms. That fire destroyed 2,900 structures and cost 25 lives. The difficult terrain, limited access, and lack of vegetation control, are quite similar to many Marin County neighborhoods.

Many actions have resulted from these fires in an attempt to reduce risks:

- A higher degree of cooperation among fire jurisdictions
- Stronger rules for new construction within the WUI areas
- Development of vegetation management codes
- Implementation of defensible space requirements
- More vigorous enforcement of fire codes

Previous Marin County Civil Grand Juries have reported on these dangers from different perspectives. All of these reports dating back to the early 1990s have acknowledged the danger to property and life. The 1991 Report, "Controlled Burning on Mt. Tamalpais," recommended a return to the highly controversial method of vegetation management through burning as part of the overall fire prevention program.

The 2002-2003 Report, "Partners in Prevention" recommended a much more aggressive approach to vegetation management and the reduction of the fuel load. It recommended that fire jurisdictions form cooperative groups to implement best practices in the areas of vegetation management, fire code enforcement, public education, and implementation of defensible space.

This report focuses on the Mt. Tam Watershed. The Watershed consists of 18,900 acres and borders 11 communities. These communities are: Lagunitas, Forest Knolls, San Geronimo, San Anselmo, Ross, Fairfax, Kentfield, Mill Valley, Larkspur, Corte Madera, and Woodacre. These communities contain 13,200 structures within one mile of the Watershed boundary. Of these, 300 structures are on or within 300 feet of the Watershed boundary. The Watershed has CAL FIRE Fire Hazard Ratings of High and Very High.

HISTORICAL PERSPECTIVE

Vegetation management has evolved over the last six hundred years. Miwok and Pomo Indian tribes once inhabited Marin County. These tribes were hunter/gatherers and knew the value of managing the heavy fuel load. They would periodically set wildfires to create open space for deer, elk, and other game. This practice also facilitated access to acorns and stimulated the growth of grasses and forbs. These seeds and bulbs were regular food sources.

In the 1800s, Spaniards, and Mexican immigrants also recognized the value of fire as a successful tool for clearing land for cattle and dairy ranching.

Modern methods of vegetation management (a combination of mowing, prescribed burning, and manual removal) have not been successful on the Watershed. Two new issues threaten the Watershed. The first is the invasive species of noxious weeds, the subject of this report. The other is Sudden Oak Death. Sudden Oak Death was first discovered in 1995, and by 2009 the MMWD estimated that at least 1,300 acres had been infested. This pathogen poses a significant long-term risk to the Watershed bio-diversity. Almost 100% of the Tan Oak trees have been destroyed. These losses as well as other tree losses also increase the fire hazard.

LIKELY IMPACTS DUE TO CLIMATE CHANGE

Scientists generally agree climate change will result in larger and more frequent wildfires in central and western California. Some models forecast a 4 to 6 degree Fahrenheit increase in temperature over the next fifty years. This would cause an increase in fast spreading grass fires and a moderate increase in brush fires. These predicted climate change effects will also reduce fuel moisture and increase wind speed as well as cause fires to burn over larger areas with higher intensity.

METHODOLOGY

- Conducted interviews with Fire Officials, MMWD, Office of Emergency Services, County Department of Parks and Open Space, and other county organizations.

- Conducted research to determine the effectiveness and safety of the use of herbicides, such as glyphosate.
- Researched pathogens causing Sudden Oak Death disease.
- Reviewed MMWD's WPHIP Report.

DISCUSSION

BROOM

The major types of invasive weed species found growing on Mt Tamalpais Watershed property are:

- 1) French Broom (*Genista monspessulana*)



- 2) Scotch Broom (*Cytisus scoparius*)



3) Spanish Broom (*Spartium junceum*)



4) Portuguese Broom (*Cytisus striatus*)



All four species are upright shrubs that grow 3 to 10 feet tall. They generally produce bright yellow, pea shaped flowers on green stems from April to June. The Scotch and Portuguese species produce their flowers in the leaf axils, while the French and Spanish have flowers found at the branch tips. Broom is a member of the pea family, and like all

peas, shelter bacteria in its roots that "fix nitrogen" in the soil. In farming, this is highly desirable, but within California open space, high levels of nitrogen in the soil can give an advantage to non-native species.

Broom infests over 1,200 acres on the Mt. Tamalpais Watershed and spreads at a rate of 30 acres per year. It is a highly combustible weed that during a firestorm will spread the fire to the tree canopy and lead to potentially larger and more frequent fires.

In 2005 the MMWD Board of Directors agreed to a moratorium on the use of herbicides to control Broom and other noxious weeds. Since the moratorium, the Broom infestation has continued to expand at a rate of approximately 30 acres per year (to a total exceeding 210 acres; or approximately the equivalent of 210 football fields). As shown on the following map, MMWD has prioritized within the Watershed, five distinct vegetation management zones for the purpose of controlling the Broom population.

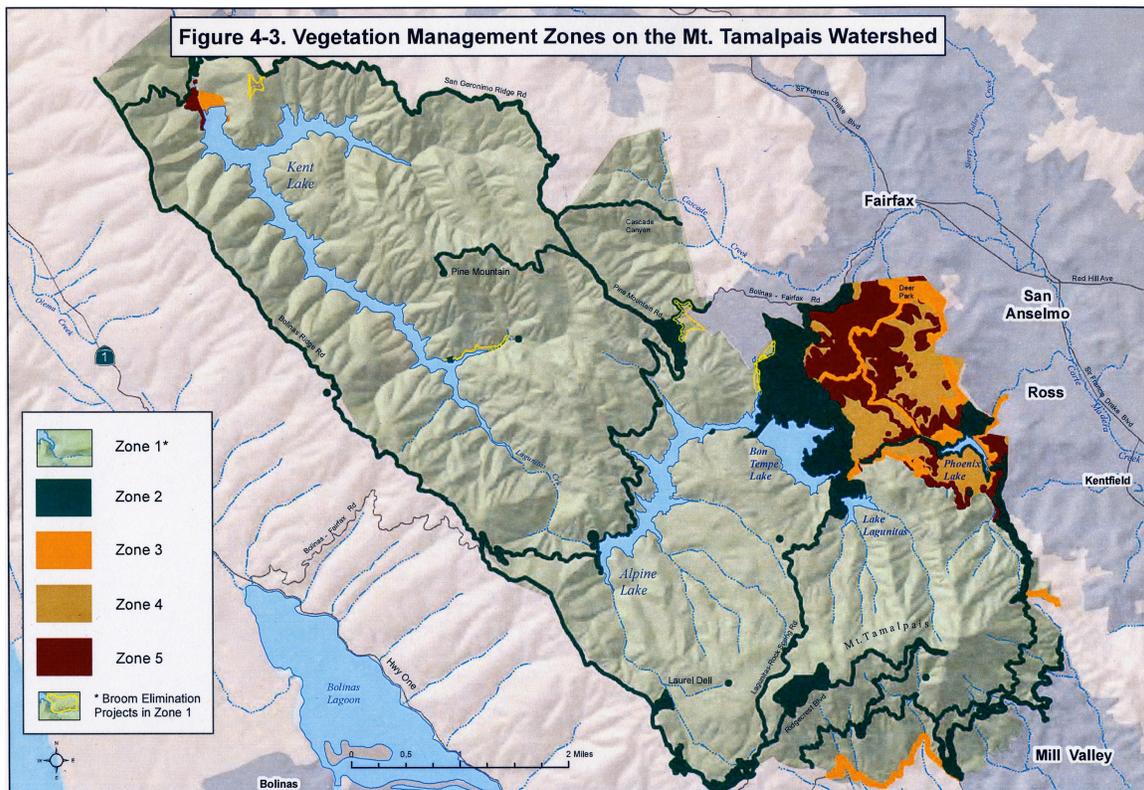


Figure 4-3. Vegetation management objectives prioritize weed elimination, Early Detection/Rapid Response (EDRR), and habitat restoration in Zones 1 and 2. Vegetation management objectives in Zone 3 focus on fuelbreak maintenance. Vegetation management in Zone 4 and Zone 5 is limited to EDRR and highly localized habitat restoration. See Section 6.6 for more information.

Note that Zone 5 borders the areas of the highest density of homes.

Zone 1 (Refugium Zone) represents 90% of the Mt. Tamalpais Watershed and is characterized by large expanses of high-quality habitat with a minimal degree of human disturbance and weed invasion. This zone is considered the most vital to protect. The recommended actions

taken by MMWD include the complete elimination of four known isolated Broom populations and enactment of an Early Detection Rapid Response (EDRR) program designed to stop the weed colonies before they can expand and spread.

Zone 2 (Infrastructure-Fuels Reduction and Weed Elimination Zone) is comprised of relatively weed-free fuel breaks and service road corridors that transect Zone 1. The recommended action is the elimination of Broom that could spread to Zone 1.

Zone 3 (Infrastructure-Fuel Reduction Zone) is also comprised of fuel breaks and service road corridors. The difference from Zone 2 is that weed populations in Zone 3 are both extensive and bounded by other established weed stands. The recommended action is that MMWD will work to control any additional expansion of Broom within Zone 3 but not try to remove the Broom entirely from this zone.

Zone 4 (Control Weed Spread) is similar to Zone 1 in that it is relatively free of management activities and weeds. However, because it is completely surrounded by extensive weed populations, it is vulnerable to rapid weed encroachment. The recommended action here is to maintain the status quo through EDRR and limited weed management.

Zone 5 (Limited Action Zone) is characterized by poor habitat quality and extensive stands of Broom. The recommendation is to limit weed control to actions that would prevent spread to Zone 4.

CONTROL OF BROOM

Multiple approaches are used to control the common Broom types discussed in the preceding section. The combination of mechanical removal followed by herbicide treatment produce the most successful results. MMWD has identified those populated land areas that are adjacent to extensive Broom infestations as the areas most at risk in a wildfire and areas where efforts at Broom control will be focused.

Manual Control: These processes involve hand pulling or mechanical grubbing by employing combined uses of shovels, picks and Weed Wrenches™ to physically remove Broom infestations. This is best done in the fall or early spring when the soil is moist and it is easier to remove the roots. Based on information obtained from the Department of Civil and Environmental Engineering, University of California, Davis, other methods of mechanical removal have not proven to be successful. Brush rakes and bulldozers often leave pieces of rootstalks that readily resprout. Mowing has poor results since the plants have underground rootstalks that rapidly recover from mowing, and if the mowing occurs when the seedpods are present, disperse millions of seeds.

During its investigation of this report, the Grand Jury visited a site within the MMWD Watershed that had been used in a multiple year effort by school children to physically

remove the Broom. The initial results looked very promising, and the site was revisited each year to clear new Broom growth. However, the end result was that the Broom won. The underground root stalks and the millions of seeds released by the seedpods proved to be overwhelming. Today the site is a Broom paradise. The MMWD has discontinued the program owing to its ineffectiveness.

MMWD estimates that the annual costs to control Broom within MMWD Zone 5 using only mechanical methods are \$3.9 million.

Burning: Burning is not an effective method of control. Although the initial results may appear to be successful, the burning process removes competitive plant populations, releases nutrients into the soil, and stimulates that growth of the Broom seeds remaining in the soil.

Goats: MMWD performed a trial of using goats to eat the Broom but the results were not satisfactory. The goats were hard to transport into the often-steep terrain and they stripped the Broom plant of foliage but did not kill the Broom. Additionally, since much of MMWD lands have considerable Madrone groves and goats consider Madrone to be a special treat, it was almost impossible to have the goats focus on the Broom plants.

HERBICIDES

Herbicides, also known as weed killers, are used to kill unwanted plants. Some herbicides kill a specific weed leaving other surrounding plants unharmed. Some inhibit growth of the plant, and others kill all plant material with which they may come into contact.

The Approach 2 Approved Herbicide Plan in the MMWD's WPHIP includes using the following herbicides, surfactants, and dyes for management of Broom and other invasive weeds.

(Refer to the Glossary for detailed definitions of these terms.)

Conventional Herbicides

- 1) Aquamaster™
- 2) Garlon 4 Ultra™ Triclopyr
- 3) Transline™

Organic Herbicides

- 1) Scythe™
- 2) Matran™
- 3) Acetic Acid (Vinegar)

Surfactants

- 1) Competitor™
- 2) Sylgard 309™

Dye: Blazon Blue™ Dye

Refer to Appendix C for the tools and techniques proposed by weed management in the WPHIP.

RISK ASSESSMENT OF HERBICIDE USE BY MMWD

The MMWD through its WPHIP is proposing the control, management, and elimination of noxious invasive weeds such as French Broom. The MMWD has stated that the Broom varieties are the top priority, with French Broom number one, because it is the most prevalent and prolific. The WPHIP describes two possible scenarios to accomplish Broom removal. They are Approach 1 - manual procedures only, and Approach 2 - manual procedures with the addition of herbicides.

This report concentrates on the differences in cost and the differences in invasive weed containment between Approach 1 and Approach 2.

The MMWD commissioned a risk assessment study on the use of herbicides for incorporation into the WPHIP. This grand jury report cites the two agencies that conducted this risk assessment. They are: The Pesticide Research Institute, and the Environmental Quality Laboratory, Dept. of Civil and Environmental Engineering, University of California, Davis. Their research findings are too lengthy to be included in this report. Please refer to this WEB link for full research findings:
<http://marinwater.org/controller?action=menuclick&id=664>

The MMWD used data from the risk assessment analysis, as well as input from other consulting team members and the public, to establish transport and application guidelines and restrictions. The WPHIP is based on a large-scale review of the literature about the health, safety, and environmental hazards and risks of using the target list of herbicides and additives. Allowed herbicide use would comply with all required state and federal guidelines as well as the more stringent restrictions and guidelines listed below. These restrictions provide considerably more protection for environmental resources and human health than required by state and federal guidelines, and hence provide further margins of safety.

Because of the potential risk, the MMWD'S WPHIP has established an Herbicide Use Guideline, which takes into consideration public health issues, and water shed integrity. The proposed guidelines are the following:

- 1) Limit projects where herbicides are to be used.
- 2) Use least toxic herbicides.
- 3) Follow the Integrated Pest Management Approach
- 4) Use only allowed application methods.
- 5) Use only allowed herbicides, application rates, and treatment targets.

In summary, while the herbicides and additives under consideration are all potentially harmful to human and other life, MMWD's proposed best-practices plan should ensure their safe application.

In May of 2007, the MMWD Board wrote a policy titled Precautionary Principle; Policy No. 47, (Appendix E). That policy in part states, "Where threats of serious or irreversible damage to people or nature exist, lack of full scientific certainty about cause and effect shall not be viewed as sufficient reason for the District to postpone cost effective

measures to prevent the degradation of the environment or protect the health of its customers. Any gaps in scientific data uncovered by the examination of alternatives will provide a guidepost for future research, but will not prevent protective action being taken by the District.” Implementation of this policy would allow the Board to make decisions based on the best information available and permit the Board to proceed with actions that are deemed by the Board to be best for protecting both their customers and the Watershed environment. Public complaints and concerns about the use of herbicides resulted in the Board forestalling implementation of Policy No. 47 in 2007. As a result, the areas infested by Broom continued to expand resulting in the loss of biodiversity within the Watershed and a greatly increased risk of devastating wildfires. The Grand Jury believes that if MMWD follows its own Policy No. 47, the best interests of the public will be served.

REASONABLE APPROACH TO BROOM CONTROL

In any community discussion regarding the use of herbicides, it is unlikely that a complete agreement regarding their use will ever be reached. However, decisions on their use should be made on the basis of the most recent scientific evidence, recommendations by subject matter experts, governmental bodies and the board members of the MMWD. As with some decisions, a decision to do nothing will also have adverse consequences. The Grand Jury strongly believes that the high risk of wildfires far exceeds the very low risk associated with the controlled use of herbicides. We recommend the course of action detailed by the MMWD’s Approach 2 as the only reasonable alternative to control the Broom infestation within the Watershed.

IMPLEMENTATION PLAN BY MMWD

Recommended actions to control invasive weeds in the MMWD Watershed over the next 15 years were determined by Leonard Charles and Associates of San Anselmo, CA. These actions are documented in Chapter 6 of the WPHIP. The actions to be implemented are listed in two scenarios, Approach 1 and Approach 2. Approach 1 is a manual action only, and Approach 2 is manual with the inclusion of the use of herbicides.

When developing the projects for implementation, the following key points were considered.

- 1) Available fiscal resources.
- 2) Available labor resources.
- 3) Techniques feasible for use at a landscape level of treatment.
- 4) Costs relative to techniques.
- 5) Risks of using techniques.
- 6) Cost estimates.

Key strategies and approaches that would be incorporated into the project implementation are shown below.

- 1) Improve Watershed resiliency.
- 2) Use an Integrated Pest Management approach.

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- 3) Collaborate with other agencies and landowners.
 - 4) Use tools for treating large areas.
 - 5) Transition to a site based approach for weed control.
 - 6) Implement the Early Detection and Rapid Response (EDRR) program.
 - 7) Implement only projects that can be sustained

Data shown in Table 6-10 in Chapter 6 of the WPHIP (Appendix A to this report) describe and demonstrate that substantially more can be accomplished if limited use of herbicides is included as a part of the initial weed control process. Far fewer projects devoted to preserving and restoring biodiversity could be completed under Approach 1. Herbicidal use, if implemented, would be used for initial control (3 to 5 consecutive years) of invasive weeds, or in emergency response to a sudden weed population growth. Herbicidal use would be phased out after the initial treatment period, when non-chemical control becomes feasible. As shown in Table 6-10, plan objectives are better met under Approach 2, and with a substantial cost reduction. Costs for fuel break maintenance would also be reduced allowing for more funds to be allocated to other Watershed projects. Data compiled in other listed Tables and Figures within Chapter 6 of the WPHIP, demonstrate that Approach 2 would be more cost effective in the control of invasive weeds than Approach 1.

For details of a zone-by-zone approach, refer to Appendix D.

Listed below are examples of predicted conditions within the District 15 years after the WPHIP is implemented.

- 1) Fuel Break Construction: Approach 2 would allow 184 additional acres of fire-break to be constructed.
- 2) Broom Control in Zone 1: Approach 2 would eliminate all Broom from Zone 1
- 3) Broom Control in Zone 2 Fuel Breaks: Approach 2 eliminates reproductive-aged Broom.
- 4) Broom Control in Zone 4: Approach 2 would maintain 95% of Zone 4 as Broom free. This would maintain the biodiversity in the zone.
- 5) Broom Control in Zone 5: Approach 2 would allow some high priority Broom habitat to be treated, but remaining areas would be at risk.
- 6) Overall Reduction of Broom: Approach 2 would reduce Broom infestation by 172 acres. Broom would become denser in untreated areas.

Exhibit 1 *excerpted from WPHIP*

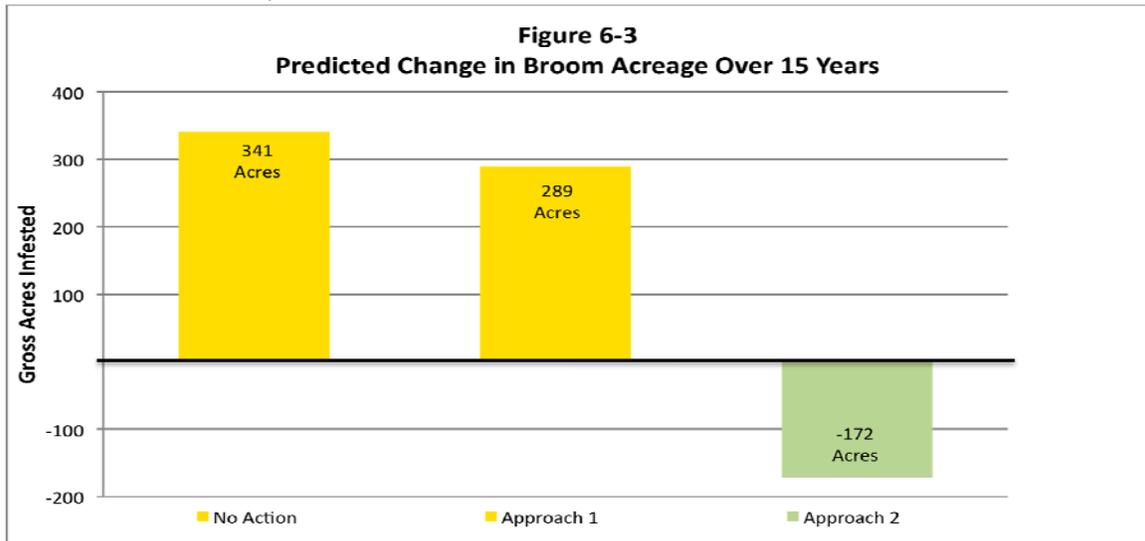
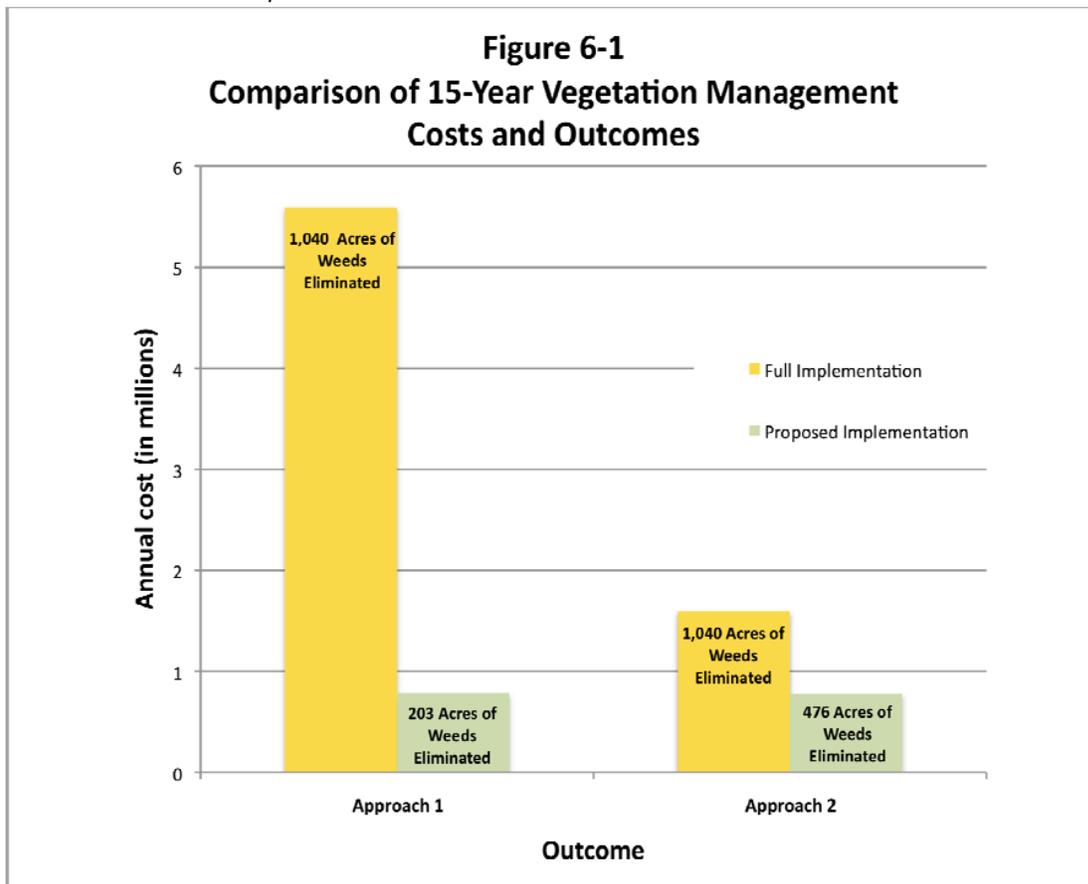


Exhibit 2 *excerpted from WPHIP*



Please refer to the additional Tables and Figures listed below, and found in the Appendices of this Grand Jury report. These data show additional information on the comparisons of Approach 1 and Approach 2.

- 1) Table 6-10: Summary of Annualized Cost of Approach 1 and Approach 2. (Appendix A)
- 2) Table 6-12: Predicted Broom Infested Areas After 15 Years. (Appendix B)

In summary, fire management objectives could be met under both approaches. However, Approach 2 would result in better control of the invasive weeds and with considerable cost savings. Some weed populations would be eliminated and maintenance costs of fuel breaks would decrease. Under Approach 1 the areas infested by Broom after 15 years of management would be about the same as would occur if no action were taken.

FINDINGS

- F1. There has been a long history of fire on Mt. Tamalpais. It is likely that wildfire will occur again.
- F2. Wildfire danger is rated very high owing to substantial fuel-load growth especially for invasive weeds, particularly various species of Broom.
- F3. Property development in areas adjacent to open space places these adjacent communities at great risk to fire and the loss of life and property.
- F4. Traditional vegetation management methods have not been effective in the control of Broom infestations.
- F5. The use of herbicides in conjunction with traditional vegetation management methods is the most effective means to eliminate Broom, and is cost effective compared to less productive alternatives
- F6. Current scientific studies indicate that the recommended application of glyphosate with a surfactant approved for use within Watershed areas pose no significant risk.
- F7. Approved glyphosate based herbicides have been certified as safe by the EPA, are used by the Marin County Parks & Open Space District and on Federal, County and State owned lands. Extending the use of glyphosates to MMWD lands to control Broom should be practical and controllable based on experiences gained from these other glyphosate applications within the county.
- F8. The MMWD Board of Directors' agreement to stop using herbicides to control Broom has resulted in over 300 additional acres in increased Broom infestation over the past 8 years. This has led to a high risk of fire, and exposes communities adjacent to the MMWD lands to the consequent loss of property and lives.
- F9. Some community activists refuse to consider any information showing that a managed application of herbicides approved by the EPA can be used in any form.

Decisions concerning the use of herbicides to control fuel load on MMWD lands should be based entirely on science, economics and the broad public welfare.

RECOMMENDATIONS

The Grand Jury recommends that:

- R1. The MMWD Board adopt Approach 2 with the expectation that the findings of the EIR will support the program to control Broom using glyphosate based herbicides, an action also recommended by their own subject matter experts.
- R2. The MMWD Board act on policies that they conclude are the most effective in the control of Broom, wildfire and the effective management of the MMWD lands.
- R3. Existing codes governing defensible space and other fire regulations be rigorously enforced on MMWD and adjacent developed and open-space lands..
- R4. The Marin County Board of Supervisors go on record that control of Broom within the MMWD lands is a high priority and that the most effective means of control should be utilized. This is consistent with the Board of Supervisors existing policy for the county's open space lands.
- R5. Should a less effective approach to vegetation management be selected (Approach 1), new funding sources should be pursued by the most affected communities.

REQUEST FOR RESPONSES

Pursuant to Penal code section 933.05, the grand jury requests responses as follows:

- Board President MMWD. All Findings and Recommendations.
- Mayor, San Anselmo, CA. F1, F2, F3, F9, R3, R5.
- Mayor, Ross, CA. F1, F2, F3, F9, R3, R5.
- Mayor, Fairfax, CA. F1, F2, F3, F9, R3, R5.
- Mayor, Mill Valley, CA. F1, F2, F3, F9, R3, R5.
- Mayor, Larkspur, CA. F1, F2, F3, F9, R3, R5.
- Mayor, Corte Madera, CA. F1, F2, F3, F9, R3, R5.
- Marin County Board of Supervisors. R4.

The governing bodies indicated above should be aware that the comment or response of the governing body must be conducted subject to the notice, agenda and open meeting requirements of California's Ralph M. Brown Act.

BIBLIOGRAPHY

- California Public Resources code 4291/4299
- California Department of Forestry and Fire Protection (CAL FIRE), 2011
- California Invasive Plant Council, University of Cal UC Davis, 2011
- CAL FIRE October 2007 Defensible Building Space, 2005
- CAL FIRE Wild Land Hazard and Building Plan, Chapter 78, 2009
- Community Wild Life Protection Plan, 2012
- General Guide Lines for Defensible Space Marin County Fire, 2007
- Department Fire Management Plan Marin County Fire, 2009
- MMWD Vegetation Management Plan, 2012
- Red Books Cal Fire Activity Statistics, 2011
- San Rafael Fire Department Vegetation Management Plan 2007
- City of San Rafael Municipal Ordinance # 1856 July 2007
- Wildfire Protection and Habitat Improvement Plan 2012

Reports issued by the Civil Grand Jury do not identify individuals interviewed. Penal Code Section 929 requires that reports of the Grand Jury not contain the name of any person or facts leading to the identity of any person who provides information to the Civil Grand Jury.
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GLOSSARY

Acetic acid -- The acid constituent of vinegar; it is used for control of herbaceous weeds and Broom seedlings.

Alkyl ethoxylate -- A major class of widely-used, non-ionic surfactants.

Approach 1 -- An alternative put forth by MMWD. Within designated areas of the Mt. Tamalpais watershed, this is a totally manual solution to control broom with no use of herbicides at a cost of \$5,600,000 annually.

Approach 2 -- An alternative put forth by MMWD. Within designated areas of the Mt. Tamalpais watershed, this is a solution to control broom combining manual efforts and controlled use of an herbicide, Glyphosate, at a cost of \$875,000 annually.

Aquamaster™ -- A brand name for an aquatically approved herbicide whose active ingredient is glyphosate.

Arbutus menziesii -- *Arbutus menziesii* is the genus and species name of the Madrone tree.

Blazon Blue™ dye -- A brand of blue dye used to mark the path of the application of an herbicide.

Broom -- When used by itself in this report, refers to all Brooms as a group.

California Department of Forestry and Fire Protection -- The California agency responsible for fire protection in designated areas of California as well as the administration of the state's forests.

CAL FIRE -- Refers to the California Department of Forestry and Fire Protection.

Climate Change -- See Global Warming.

Clopyralid (3,6-dichloro-2-pyridinecarboxylic acid) -- is a selective herbicide used for control of broadleaf weeds.

Competitor™ -- A brand of non-ionic surfactant containing ethyl oleate and alkyl ethoxylate.

Cytisus scoparius -- *Cytisus scoparius* is the genus and species name of the Scotch Broom plant.

Cytisus striatus -- *Cytisus striatus* is the genus and species name of the Portuguese Broom plant.

Defensible Space -- Used in the context of wildfires, especially in the wildland-urban interface. It is the area that has been landscaped around a structure to reduce fire danger. This space reduces the risk that fire will spread to the structure, and also provides firefighters a relatively safe area in which to work while protecting the structure.

Early Detection Rapid Response -- An approach put forth by MMWD designed to stop weed colonies before they can expand and spread.

EDRR -- Refers to the Early Detection Rapid Response program.

Ethyl oleate (ethyl (Z)-octadec-9-enoate) -- An ingredient in the Competitor(T) brand of surfactant.

Firestorm -- An intense fire that creates and sustains its own wind system. The Oakland Hills fire of 1991 was an example of such a fire.

Foliar spraying -- With regard to herbicides, the application of the herbicide directly onto the leaf surface of the target plants.

Forb (sometimes spelled phorb) -- Refers to a non-grass, flowering plant in a grassland setting.

Forestry Fire Hazard Rating -- A rating system used by the CAL FIRE that considers wild land fuels, the steepness of the slopes, temperature, humidity, wind, as well as the production of burning fire embers, the distance they travel, and the receptiveness of the landing site to new fires. All areas are rated moderate, high or very high fire hazard.

French Broom -- (*Genista monspessulana*) An invasive species of plant common throughout Marin County. It is an upright, evergreen shrub, commonly growing to ten feet tall. The round stems are covered with silvery, silky hair, and the small leaves are usually arranged in groups of three.

Fuel Break -- A gap in vegetation or other combustible material that acts as a barrier to slow or stop the progress of a wildfire.

Fuel Load -- Anything burned to provide power or heat. In the outdoors, fuel load mostly refers to readily combustible vegetation.

Garlon 4 Ultra™ Triclopyr -- A brand name for an herbicide whose active ingredient is triclopyr.

Genista monspessulana -- *Genista monspessulana* is the genus and species name of the French Broom plant.

Global Warming -- The gradual increase in the temperature of the earth's atmosphere, believed to be caused by increased amounts of concentrations of greenhouse gases produced by human activities such as the burning of fossil fuels and deforestation. Also referred to as "Climate Change."

Glyphosate (N-(phosphonomethyl) glycine) -- A broad-spectrum systemic herbicide used to kill weeds, especially annual broadleaf weeds and grasses known to compete with commercial crops grown around the globe. In 2007, glyphosate was the most widely used herbicide in the US agricultural sector, with 180 to 185 million pounds applied, and the second most commonly used in home and garden market, with 5 to 8 million pounds applied. Glyphosate has been approved by regulatory bodies worldwide and is widely used. Glyphosate's mode of action is to inhibit an enzyme involved in the formation of a specific essential amino acids in plants. It is absorbed through foliage, and is soluble in water.

Herbicide -- A chemical preparation or pesticide designed to kill plants, especially weeds, or to inhibit their growth.

Herbicide Use Guideline -- A set of guidelines imposed upon itself by the MMWD to control levels of pesticide use in order to support public health and water shed integrity.

Integrated Pest Management Program -- Under this program, the MMWD has identified a combination of available methods to manage weeds with the least possible hazard to people and the environment, using the most effective and economical means available.

Invasive Species -- Any species, including its seeds, eggs, or other biological material capable of propagating a species not native to that ecosystem, and whose introduction does or is likely to cause environmental harm to native species.

Isopropyl amine -- An organic compound used in glyphosate formulations.

Madrone tree -- (*Arbutus menziesii*) A tree found along the Pacific coast and recognized by its peeling red bark, tan trunk, leathery evergreen leaves, and whitish flowers with bright clusters of reddish-orange berries.

Marin Municipal Water District -- The public agency that provides drinking water to 185,000 people in a 147-square-mile area of south and central Marin County, California.

Matran™ -- A brand name for an herbicide whose active ingredient is clove oil.

Nitrogen Fixation -- Another term for nitrogen fixing.

Nitrogen Fixing -- Any natural or industrial process that causes free nitrogen, a relatively inert gas plentiful in air, to combine chemically with other elements to form more reactive nitrogen compounds such as ammonia, nitrates, or nitrites. Under ordinary conditions, nitrogen does not react with other elements. Nitrogen can be fixed, or combined in nature as nitric oxide by lightning and ultraviolet rays, but more significant amounts of nitrogen are fixed to ammonia, nitrates, and nitrites by soil microorganisms.

Non-ionic surfactant -- A surfactant whose main function is as a wetting agent.

Notholithocarpus densiflorus -- *Notholithocarpus densiflorus* is the genus and species name for the Tan Oak tree.

Organosilicon surfactant -- A surfactant whose components include silicon compounds.

Pathogen -- A biological agent that causes disease or illness to its host. The term is most often used for agents that disrupt the normal physiology of a multicellular animal or plant.

Pesticide -- A substance, or mixture of substances, intended for preventing, destroying, repelling or mitigating any pest. A pesticide is generally a chemical or biological agent that through its effect deters, incapacitates, kills or otherwise discourages pests. Pesticides are categorized into four main types: herbicides, fungicides, insecticides and bactericides.

Phorb -- See forb.

Portuguese Broom -- (*Cytisus striatus*) An invasive species of plant found in Marin County, which is similar in appearance to the French Broom.

Scotch Broom -- (*Cytisus scoparius*) An invasive species of plant found in Marin County, which is similar in appearance to the French Broom.

Scythe™ -- A brand name for a fatty acid based, non-selective, contact herbicide. The main ingredient is pelargonic acid.

Spanish Broom -- (*Spartium junceum*) An invasive species of plant found in Marin County, which is similar in appearance to the French Broom.

Spartium junceum -- *Spartium junceum* is the genus and species name of the Spanish Broom plant.

Sudden Oak Death -- A serious disease caused by the fungus *Phytophthora ramorum* that affects many tree species. It has led to the death of various species of oak in California.

Surfactants -- Any compound that lowers the surface tension of a liquid, the interfacial tension between two liquids, or between a liquid and a solid. Surfactants are added to active herbicidal ingredients to improve performance. They facilitate herbicidal activity by improving herbicide dispersal, absorption, spread, adherence and/or penetration to foliage.

Sylgard 309™ -- A brand of non-ionic organosilicone surfactant that is considered minimal risk.

Tan Oak -- (*Notholithocarpus densiflorus*) Also known as the tanoak or tanbark-oak, it is an evergreen tree in the beech family, related to the *Quercus* oaks, and is native to the western United States. Tan Oak grows as a tree or shrub. The typical variety is a medium-sized tree, usually attaining 65 to 80 feet.

Tanbark-oak -- See Tan Oak.

Tanoak -- See Tan Oak.

TranslineTM -- A brand name for a selective broad leaf conventional herbicide that provides excellent control of many tough broad-leafed invasive plants. The active ingredient is clopyralid. Application is by foliar spray.

Triclopyr -- (3,5,6-Trichloro-2-pyridinyloxyacetic acid) is a systemic herbicide for the control of broadleaf weeds.

Vegetation Management Plan of 1995 -- A plan put forth by the Marin Municipal Water District in 1995 whose control methods have been deemed ineffective in dealing with the Broom

VMP -- Refers to the Vegetation Management Plan of 1995.

Watershed -- A bounded region or area of land that drains to a common waterway, watercourse or body of water.

Wetting agent -- A compound that reduces the surface tension of water, thereby allowing easier mixing with another agent. See non-ionic surfactants.

Wildfire -- A fierce fire that spreads rapidly, especially in a wilderness area.

Wildfire Protection and Habitat Improvement Plan -- A plan put forth by the Marin Municipal Water District.

Wildland-Unban Interface -- Refers to the zone of transition between unoccupied land and human development. Lands and communities adjacent to this zone are at risk of wildfires.

WPHIP -- The Wildfire Protection and Habitat Improvement Plan.

WUI -- Wildland-Unban Interface.

APPENDIX A – Table 6-10 from MMWD WPHIP

Note: FHR = Fire Hazard Reduction / BP = Biodiversity Protection

Management Action	Approach 1 (No Conventional Herbicides)		Approach 2 (Conventional Herbicides Possible for Initial Weed Control)	
	Annualized Cost to Fully Implement	Projects Recommended for Implementation	Annualized Cost to Fully Implement	Projects Recommended for Implementation
FHR-1 – Perform cyclical maintenance throughout fuelbreak system with sufficient frequency to maintain design standards.	\$258,500	\$258,500	\$242,000	\$242,100
FHR-2 – Construct the remainder of the fuelbreak system.	\$113,100	\$102,700	\$113,100	\$113,100
FHR-3 – Eliminate broom and other perennial invasive species in Zone 2 fuelbreaks.	\$926,100	\$289,100	\$256,200	\$256,200
BP-11 – Expand the Early Detection-Rapid Response (EDRR) Program to identify, report and treat new invasions.	\$55,000	\$55,000	\$55,000	\$55,000
BP-12 – Extirpate goatgrass from the Mt. Tamalpais Watershed.	\$10,000	\$10,000	\$10,000	\$10,000
BP-13 – Eliminate broom from Vegetation Management Zone 1.	\$178,900	\$38,300	\$60,300	\$60,300
BP-15 – Manage broom in Weed Management Zone 5.	\$3,915,500	\$0	\$845,100	\$12,600
BP-16 – Eliminate yellow star-thistle on the Mt. Tamalpais Watershed.	\$135,500	\$24,600	\$29,300	\$29,300
Total Annualized Cost	\$5,592,600	\$778,200	\$1,611,000.00	\$778,600

Note: Gray-shaded boxes show costs for actions that would not be fully implemented. All costs are annualized.
The costs for Actions BP-14 and BP-17 are included in the costs for Action BP-11.

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APPENDIX B – Table 6-12 from MMWD WPHIP

Table 6-12					
Predicted Broom Infested Acres After 15 Years					
	Zone 1	Zone 2	Zone 3	Zones 4 and 5	Total
Baseline (2011)	56	324	178	578	1136
No Action (2024)	73	421	231	752	1477
Approach 1 (2024)	66	376	231	752	1425
Approach 2 (2024)	0	0	221	743	964
<p><i>Note: Zones 4 and 5 are combined in this table because as Broom expands in Zone 4, those areas become Zone 5. As a result, it is difficult to calculate the spread independently for the two zones.</i></p>					

APPENDIX C - Tools and techniques for proposed weed management from MMWD WPHIP

Whether Approach 1 or Approach 2 is adopted after final WPHIP approval, the invasive weeds would be managed in accordance with MMWD’s existing Integrated Pest Management (IPM) program. MMWD’s IPM Program, and its IPM Program Handbook describe how, when, and under what circumstances MMWD has applied herbicides and other pesticides. The introduction to the IPM Handbook states:

“Integrated Pest Management is the blending of effective, economical, and environmentally sound pest control methods into a single but flexible approach to manage pest populations within acceptable limits. Those who practice IPM begin by analyzing the nature and the source of the pest problem. They then rely on a range of preventative and treatment strategies that can be a combination of cultural, physical, mechanical, or biological treatments. Only the least-toxic chemical pesticides should be used, and always as a last resort.”

The MMWD is currently using or considering the following treatments for the control of invasive weeds. These techniques and tools would remain the same for Approach 1 or Approach 2.

1. Category 1: Landscape-Scale Treatments (Over 5 Acres)
2. Category 2: Small-Scale Treatments.

3. Category 3: Techniques Infrequently Used.

(Detailed explanation of categories found in Chapter 7, Section 7.3 of the WPHIP)

In addition to the above mentioned treatments, Approach 2 would allow the addition of 3 conventional herbicides.(See Allowed Herbicide Section) to be used on a limited basis.

Approach 1 would allow formulated organic herbicides limited to small stands of invasive weeds.

Application methods for herbicide treatment are as follows:

1. A low volume foliar application, which is direct spraying of the target plants.
2. A low volume basal bark application, which targets the lower 11 to 12 inches of the trunk or stem of the target plant.
3. Cut stump application which directly sponges, wicks, or sprays the herbicide on the freshly cut stump.

APPENDIX D – Predicted conditions in 15 years after implementation of MMWD WPHIP

Listed below are examples of predicted conditions within the District in 15 years after the WPHIP is implemented.

- 1) Fuel Break Construction: Approach 2 would allow 184 additional acres to be constructed.
- 2) Broom Control in Zone 1: Approach 2 would eliminate all Broom from Zone 1 (Refer to Appendix B for table)
- 3) Broom Control in Zone 2 Fuel Breaks: Approach 2 eliminates reproductive-aged Broom. (Refer to Appendix C for table)
- 4) Broom Control in Zone 4: Approach 2 would maintain 95% of Zone 4 as Broom free. This would maintain the biodiversity in the zone.
- 5) Broom Control in Zone 5: Approach 2 would allow some high priority Broom habitat to be treated, but remaining areas would be at risk.

Overall Reduction of Broom: Approach 2 would decline Broom infestation by 172 acres. Broom would become denser in untreated areas. (Refer to Exhibit 1 on page 13)

APPENDIX E – Precautionary Principle – MMWD Board Policy No. 47. Date: 5/16/2007

The Precautionary Principle requires a thorough exploration and a careful analysis of a wide range of alternatives. Based on the best available science, the Precautionary Principle requires the selection of the alternative that presents the least potential threat to human health and the environment. Public participation and an open and transparent decision making process are critical to finding and selecting alternatives.

Where threats of serious or irreversible damage to people or nature exist, lack of full scientific certainty about cause and effect shall not be viewed as sufficient reason for the District to postpone cost effective measures to prevent the degradation of the environment or protect the health of its customers. Any gaps in scientific data uncovered by the examination of alternatives will provide a guidepost for future research, but will not prevent protective action being taken by the District. As new scientific data become available, the District will review its decisions and make adjustments when warranted. Where there are reasonable grounds for concern, the precautionary approach to decision making is meant to help reduce harm by triggering a process to select the least potential threat. The essential elements of the Precautionary Principle approach to decision-making include:

1. **Anticipatory Action:** There is a duty to take anticipatory action to prevent harm. Government, business, and community groups, as well as the general public, share this responsibility.
2. **Right to Know:** The community has a right to know complete and accurate information on potential human health and environmental impacts associated with the selection of products, services, operations or plans. The burden to supply this information lies with the proponent, not with the general public.
3. **Alternatives Assessment:** An obligation exists to examine a full range of alternatives and select the alternative with the least potential impact on human health and the environment including the alternative of doing nothing.
4. **Full Cost Accounting:** When evaluating potential alternatives, there is a duty to consider all the reasonably foreseeable costs, including raw materials, manufacturing, transportation, use, cleanup, eventual disposal, and health costs even if such costs are not reflected in the initial price. Short-and long-term benefits and time thresholds should be considered when making decisions.
5. **Participatory Decision Process:** Decisions applying the Precautionary Principle must be transparent, participatory, and informed by the best available information.