Vegetation Management Policy
Policy Implementation Plan
Effectiveness Monitoring Plan

Version 1.2

Contents

Executive Summary

In this document, we describe the policy, implementation, and monitoring plan for all vegetation management activities on Mendocino and Humboldt Redwood Companies (Companies) timberland. The Companies define vegetation management as all activities initiated during stand development to move the targeted stand towards the desired future condition. These activities may take a variety of forms such as manually cutting brush with chainsaws; thinning precommercial trees in dense stands; planting trees in sites with low residual stocking; and utilizing chemical herbicides to reduce competing vegetation. More importantly, this document defines the desired future stand condition the Companies are working to achieve on our forested stands. In general, this stand is a mature, uneven-aged stand comprised of overstory trees 60 years or older that can be harvested via the selection silviculture system and not require the application of additional vegetation management activities. In concept, this is a simple transition, in practice it is quite complex.

This document provides the roadmap for transitioning our current stands to the desired future condition. We describe common methods that may be used to achieve meaningful progress in our lifetimes towards our desired future stand condition. We describe common conditions found on our lands where vegetation management activities are likely to take place along with the likely method to address those conditions. Finally, we describe our priorities for treatment of the various conditions described.

Many questions remain unanswered regarding the number of vegetation management entries it will take for a particular stand to reach the desired stand condition. Nevertheless, we understand that many of our existing young or even-aged forest stands will require multiple entries to transition to the desired stand condition.

Vegetation Management Policy

This policy has been developed to guide our forest management staff in all vegetation management activities on Companies' forestlands. We define vegetation management as all vegetation altering activities during stand development (planting, pre-commercial thinning, masticating, use of herbicides, etc.) to move the targeted stand towards the desired stand condition. In this section of the document, we review the characteristics of the desired stand condition and address the use of herbicides on the forestlands.

Desired Stand Condition

The objective of this policy is to promote the development of the current forest stand structure to the desired stand condition. Our desired stand condition is made up of the following attributes:

- Conifer dominated forest comprised of the most ecologically appropriate species for the site, with uneven-aged structure in redwood and mixed-conifer stands.
- Contains forest structural elements such as old growth trees, snags, large woody debris, legacy hardwood trees and wildlife trees.
- Protects the beneficial uses of water and promotes vitality of soils.
- Committed to the maximum sustained production of high-quality forest products where growth rates are predictable and regular (outside of special protection zones)
- Understory vegetation does not inhibit growth and development of conifer trees.

Companies may utilize mechanical, manual, or chemical treatment methods to achieve the objective of promoting development to the desired stand condition. The decision to conduct vegetation management activities will consider environmental, social, and economic factors to determine the most appropriate method to achieve this objective. Factors to consider include:

Effectiveness	Community Concerns	Water Quality
Feasibility	Visual Impacts	Soils
Availability	Neighbors	Flora & Fauna
Cost	Regulatory Requirements	Fire and Fuels

Use of Herbicides

Though the use of herbicide is only one tool in the vegetation management toolbox; we cover its use specifically here due to the public concern related to its use. Our goal is to reduce and, where possible, avoid herbicide usage on our forestlands. Where herbicides may be applied, we expect a reduction in their usage over time by transitioning stands to the desired stand condition described above. Our forestlands are impacted by a history of intensive harvest resulting in over dominance of brush and hardwood species. Additionally, the treatments required to make this transition requires opening forested stands to more light. This in turn enables dramatic growth of brush and early seral species, adding further difficulty to the work of transitioning stands to the desired stand condition.

Species composition on these forestlands was greatly impacted by previous harvest activities which led to an increase and eventual dominance of hardwood and brush in many stands. Both companies have worked hard to reduce tanoak and brush dominance and increase conifer dominance, intending this transition to occur with one vegetation management treatment. However, in northern coastal California, opening a forest stand to more light enables growth of brush and early seral species. In some cases, our attempt to transition stands from hardwood to conifer dominance resulted in stands becoming dominated by brush despite the planting of conifers. Over time we have learned transitioning our forested stands to the desired condition will likely take multiple applications of herbicide, depending on the original stand conditions, slope position, aspect, and soil type. Even with conifers in the overstory, it is sometimes necessary to utilize an herbicide treatment to reduce competition with hardwoods in order to ensure adequate growth in the forested stand.

We are committed to:

(1) Continuing to investigate alternatives to herbicide use that are economically feasible and efficient to reduce and, if practical, replace herbicide use;
(2) Continuing to monitor and assess the effectiveness of our treatments;
(3) Ensuring, on a site-by-site basis, the vegetation management entry fits our policy;
(4) Reducing our herbicide usage on the forest over the long term; and
(5) Reporting annually on our vegetation management activities on our publicly available website (www.mrc.com and www.hrcllc.com).

In the future, the annual herbicide use for both these forestlands will vary dependent on the level of and type of silviculture applied and whether herbicide is the most appropriate vegetation management treatment. The trend is a reduction in herbicide use over the long term. In the short term, many acres need treatment to be put on a trajectory to reach the desired future stand condition which may result in a temporary increase in herbicide use. An increase in herbicide usage may occur from time to time to address short term site-specific conditions as we transition these stands to our desired stand condition. In the sections below, we detail new policies we have put in place to reduce the number of acres that would have otherwise been treated and the expected timing of herbicide usage reduction.

Policies to reduce herbicide use – near term

We have implemented two policy changes to our vegetation management policy to reduce our short-term herbicide usage. The addition of these policies to our pre-existing requirements illustrates the Companies' desire to adhere to the FSC-US standards (particularly 6.6, including intent language); within the limitations of adhering to the California Forest Practice Rules (912.7(d)) which specifically require that, "The site occupancy provided by Group A species shall not be reduced relative to Group B species." (California Forest Practice Rules, 2018 page

33). For the coastal region of California, redwood, Douglas-fir, and grand fir are considered Group A species while tanoak, madrone, Monterey pine, California black oak, and Oregon white oak are considered Group B species (California Forest Practice Rules, 2018 page 8).

The first policy change is shifting our standard retention within Variable Retention silviculture to aggregate retention; beginning with harvest plans submitted in 2019. The policy shift will result in a reduction of acres that would otherwise require herbicide treatments; therefore, reducing the volume of chemicals that would have been used. In addition, the use of aggregate retention areas will allow Companies to retain areas representative of existing hardwood patches. Use of herbicide within these aggregate retention areas will be prohibited until the next harvest entry. While typically aggregate retention will be used; site specific conditions may warrant the use of dispersed retention (i.e., view shed issues). In these cases, the need for dispersed retention will be justified in the timber harvest plan by the forester. While the typical focus of aggregate retention areas will be hardwood retention; aggregate retention areas may also be used to protect other structural elements such as old growth trees, snags, geological features, and large downed logs.

The second policy change is a new requirement for foresters to assess all areas with potential for herbicide treatment to maintain ecologically viable hardwood areas that function to maintain or enhance plant species composition, distribution, and frequency of occurrence similar to those that would naturally occur on site. Companies have established a minimum contiguous area of dominant species to qualify for this protection: ten acres for tanoaks and five acres for madrone or chinquapin. The minimum area sizes were determined by Companies' best judgment on size and function of hardwood species areas observed on the landscape and will be reviewed and revised if further information or research indicates a need for revision. The intention of this policy shift is to identify and retain areas of native hardwoods that did not result from previous management actions. If the areas meet the additional criteria listed below; they will remain untreated for the life of the stand.

Additional criteria:

(a) Hardwoods are greater than 80% in the tree canopy.
(b) Evidence of successful regeneration of hardwoods exists.
(c) Conifer cover is less than 20% of the tree canopy.
(d) Brush species in the shrub layer are less than 20% cover.
(e) Absence of previous management for conifer timber production or (ii) assessment that fire exclusion is the main cause of current stand conditions.

The above policy changes are in addition to Companies' already existing policy of maintaining 10% of pre-existing hardwoods by basal area within treatment areas. Both additional requirements of area retention can count towards the 10% retention requirement; and may meet the entire requirement for a unit. The above policy changes are substantial changes and represent Companies' best efforts to reduce chemical usage in the short term.

Expected timing of herbicide reduction

To better understand the future projected use of herbicides, we used long term sustained yield models for Companies to predict annual herbicide usage. We assessed historical herbicide use by silviculture per acre to predict future use (for instance, variable retention harvest has greater per acre herbicide use than selection). Future use was assessed by acres of each silviculture modeled in the planning period using our sustainable growth model and then applying average herbicide use per acre.

As expected, when conifer stocking levels increase, the need for herbicide treatments reduces. Table 1 shows predicted total herbicide usage in pounds of active ingredient per year over multiple model planning periods. Herbicide usage on the Companies forestlands is projected to decrease by 50% in the next modelled harvest period (Period 4). As time goes on, predicted herbicide usage continues to decline until it reaches a somewhat consistent level. Barring new technologies or treatment methods, we expect the need for herbicide treatment to continue as part of our forest management but are wholly committed to continuing to investigate alternatives and investigate creative ways to reduce total usage. It is important to note that these assessments are based on models and as such are speculative – a further discussion of the speculative nature of models is found in the section below regarding other information about herbicides.

Table 1. Projected herbicide use on Companies' timberlands

MRC Model period	HRC Model period	Years	Average annual pounds herbicide applied	Percent change from previous period
3	1	2016-2020	12,991	NA
4	2	2021-2025	5,360	-59%
5	3	2026-2030	1,533	-71%
6	4	2031-2035	1,214	-21%
7	5	2036-2040	1,316	+8%
8	6	2041-2045	1,216	-8%
9	7	2046-2050	1,231	+1%
10	8	2051-2055	1,317	+7%

Other Information about Herbicides

Herbicides that might possibly be used in reforestation have been the subjects of extensive testing and research. A certified regulatory program under CEQA administered by the Department of Pesticide Regulation (DPR) regulates their application. The DPR regulatory program is a functional equivalent of an Environmental Impact Report (EIR) certified by the California Secretary of Resources pursuant to PRC Section 21080.5. The DPR regulatory program is designed to study and test pesticides, and to mitigate potential environmental effects by the totality of the registration, label, and commercial application control processes. These processes include the US EPA label (which is a binding legal document) that prescribes limitations on use and mitigations for proper use. California may add additional restrictions beyond the EPA label and does so through the classification of an EPA labeled pesticide as a California "Restricted Use" pesticide. California's DPR process also requires additional site-specific analysis, before any commercial application of pesticides (including herbicides). The analysis takes the form of a written recommendation for herbicide use prepared by a licensed Pest Control Advisor (PCA). Finally, this program requires that the application of any pesticides be supervised by licensed Qualified Applicators. We work with all contractors to ensure applications are conducted in a professional manner that strictly follows all regulatory and licensing requirements. Licensed Qualified Applicators are required to attend 20 hours of continuing education every 2 years to maintain their licenses. Pest Control Advisors are required to attend 40 hours of continuing education every 2 years.

When a pesticide is registered in California, it has been determined through detailed testing and analysis (building upon the US EPA testing) that if applied according to the label restrictions there will not be significant adverse impacts upon the environment. The term label is misleading, since labels are booklets of 30 to 50 pages in length. The testing and research includes an evaluation of conditions under which the herbicides may be applied for various uses including forestry, agricultural field crops, orchards, vineyards, pastures, and rights-of-ways. The active ingredient of a given herbicide can be registered and labeled for use under one or more of these categories. Herbicide use on our forested property requires a written recommendation by a licensed Pest Control Advisor (PCA) and application by a licensed Pest Control Operator (PCO).

Pesticides tested for both EPA label and DPR registration undergo a number of tests and evaluations of risk. These analyses and mitigations were designed to provide protection for human health and the environment and were developed under assumed use in urban and semi- urban/agricultural environments. Each pesticide has a label that describes possible environmental hazards associated with the use of the product. The label prohibits any use that is *dangerous to the environment* and describes mitigation measures to minimize any adverse environmental effects. All pesticide handlers must, by law, undergo annual training in the safe and effective use of all pesticides they utilize. They are required to read those pesticide labels before use. This training also includes the use of personal protective equipment (PPE), and procedures for emergency medical treatment and spill cleanup. A Pest Control Advisor must certify, in a written recommendation, that alternatives and mitigation measures that would substantially lessen any significant adverse impact on the environment, have been considered and if feasible, adopted.

Licensed Pest Control Operators must also read and follow any additional restrictions and/or mitigation measures listed on the PCA recommendation. Both PCAs and PCOs must maintain copies of all recommendations for one year following the date of the recommendation.

The DPR registration process establishes how materials may be applied and used (through EPA label restrictions), and whether the label is adequate for human and environmental protection. If DPR finds the label lacking or finds some other issue of concern, it can change the status of the pesticide to a restricted class and add additional mitigations through that status. Representatives from several state agencies participate in this review to assist DPR. These agencies include Air Quality, Water Quality, Fish and Wildlife, and the Office of Environmental Health Hazard Assessment.
Notices of the "Decision to Register" for each pesticide are posted for at least 30 days for public comment before such pesticide is finally licensed for use in the state. After a pesticide is registered for use in this state, DPR has an ongoing obligation to review new information received about the pesticide that might show new problems beyond those identified in the registration process. Where new problems come to light, DPR is required to reopen and reexamine the registration.

The County's Agricultural Commissioner oversees portions of the DPR's functional equivalent program and is designated as a state agency for the purposes of certification (3 CCR 6100(a)(7)). Detailed records are kept on any pesticide application. This information is tracked by DPR and is available to the public. The labels usually require that non-protected contact with herbicides be avoided until the applied herbicides are dry. Most permitted or adjacent landowner access is by vehicle on company-controlled roads and thus contact with herbicides during the 12-24 hour drying period after application is unlikely. Our employees and contractors spend little or no time in areas that are treated during the drying period. Thus, even in the most heavily traveled or accessible areas on our property, the likelihood of such contact is low enough to be considered insignificant in regard to adverse impacts.

The need for forest application of herbicides will be reassessed at each site entry with consideration of factors such as site index, species and density on site, and trajectory towards desired stand condition. Application of herbicides is not intended to eliminate entire populations of the targeted species. We encourage a healthy understory as a beneficial environment for the varied species of plant and animals that utilize our forests. There are fundamental differences in how herbicides are used in reforestation applications that provide added measures of protection and lower risk for its use. Herbicide applications to specific areas within a forested watershed also do not create a substantial or potentially substantial adverse change in the environment. Impacts to target plants are short lived. Site occupancy/re-occupancy by invading vegetation or vegetation on site is rapid. Potentially significant, adverse, cumulative impacts are not expected from herbicide application with the longer intervals between applications on any acre in a forestry environment. In addition to the long interval between re-use, when forest uses interface with water, such water is normally free flowing therefore, while highly improbable, any herbicide that does reach such waters would dilute rather than concentrate. While unlikely, this possibility is only raised, to place into context that even in a worst-case scenario, the potential for significant adverse effects is extremely remote.

At the present time, it is not possible to predict (without speculation) which herbicide, in which area, in which concentration, at which time will be used, or whether applied prior to harvest or after trees are removed from a given area. Harvest scheduling is often a very fluid process both from year to year and during any single operating season, thus it is impossible and infeasible to speculate which herbicide will be needed to produce the desired result. In addition, the availability of timber from other private landowners and/or public land often influences where and when timber harvests from company lands are carried out. Other variables include the availability and timing of new products, techniques, and technology. In any case, current technology provides no way to know which brush or weed seeds are lying dormant in the soil, and it is impossible to predict which and when any particular combination of future environmental conditions will cause various brush and weed species to sprout post-harvest. In any given area of harvest, dramatic differences in weed and brush growth may be exhibited from year to year. No models exist which provide any reliable prediction as to the type, species, and conditions of future competing vegetation. The reason such prediction is unreliable is the suite of environmental variables that allow for the germination or vigorous re-growth of existing vegetation depend on far too many conditions that are individually unpredictable and cumulatively impossible to predict with any certainty. These variables include the seasonal timing of when any particular acre is logged; the effectiveness of a myriad of postharvest site preparations; weather and climate impacts on germination or production of seed; and the combination of all of the above conditions.

We can state the following:

1. In past reforestation efforts, we have applied ground applications of imazapyr, triclopyr, glyphosate, sulfometuron methyl, clopyralid, and aminopyralid each at varying rates of application, and in full compliance with label requirements.

2. Decisions about site prep or conifer release herbicide application are made postharvest based on conditions on the ground. These conditions include the amount of competing vegetation present and its future growth potential, level of moisture retention capability in the soil, survival and success rates of planted conifers, and other factors that are not known until after harvest. Possible alternatives to herbicide treatments are evaluated in a similar manner considering these same biotic and abiotic factors. However, in the case of a pre-harvest herbicide treatment, this evaluation takes place at some point prior to harvest. This evaluation is dependent on the existing species mix prior to harvest to allow more control of the postharvest species mix to produce a more conducive environment for later planting.

3. When herbicides are used, they will be applied according to the laws and regulations covering pesticide use at that time in California. We will only use herbicides registered by the California Department of Pesticide Regulation (CDPR).

We will obtain any permits required for pesticide use from the Agricultural Commissioner for each County in which we operate.

We can say that it is likely; as a pre-harvest treatment, part of site preparation, or later as competing vegetation control, that herbicides will be applied to some portion of regeneration acres of this forestland. This use will be mitigated as follows:

1. A written recommendation will be made by a state licensed Pest Control Advisor (PCA).

2. Application will be made by a state licensed Pest Control Operator (PCO) contracted and supervised by Companies reforestation foresters.

3. Herbicide(s) used will provide both contact and residual control of grasses, weeds, and woody plants.

4. Site preparation application is normally made in the fall following the completion of logging and mechanical site preparation but may be utilized in the following spring and summer. Herbicide application for release from competing vegetation; pre-harvest herbicide applications; or hand applied directed sprays; are typically completed in the fall, spring, or summer. Weather patterns including temperature, wind speed, relative humidity, and rainfall will affect application decisions and prescriptions. Discussing the various possibilities is futile because they depend on the conditions at the time and because the number of variables makes analysis apart from site-specific facts uninformative. However, there are certain minimum requirements set forth on the label which would include limits during the time of application on wind speed, rainfall, weather conditions, etc.

5. If we use herbicides, those herbicides will only be applied from ground-based equipment or by ground crews. The factors affecting choice of application method include cost, worker safety, the kind of herbicides to be applied and regulatory constraints thereof, and the target species. Discussing the various possibilities is not productive because it is speculative with respect to the site-specific conditions because the number of variables makes analysis apart from site-specific facts uninformative.

6. If present or found by subsequent survey, special interest plants (including listed plant species) are protected from herbicides by site-specific application of plant protection measures detailed under the biological resources section of the THP.

7. All required buffers near watercourses and wetlands will be avoided.

Public comment in the past has raised the issue of additives to herbicides used by Companies. We have attempted to identify each additive (commonly called adjuvants) added to a spray solution to enhance or modify its performance. A subset of adjuvants is surfactants, which are added by the applicator and mixed with the herbicide at the time of application. Surfactants are specialized additives, formulated to improve the emulsifying, spreading, sticking, and absorbing properties of liquids. There are five surfactant classes: nonionic surfactants, crop oil concentrates, nitrogen-surfactant blends, esterified seed oils and organo-silicone surfactants. The use of a surfactant tends to reduce the amount of herbicide needed per square meter of application area, because they allow the herbicide to spread more evenly, with a thinner coat and they also cause the active ingredient to stick to leaf surfaces. We also add dye to mixes when hand applying herbicides to enable applicators to avoid repeat sprays and ensure proper spray coverage. Those additives commonly used by Companies in reforestation efforts include: Hasten, Syl-Tac, Rainier EA, MOC/MSO (both methylated, non-ionic, esterified vegetable oils), crop oil concentrate, and Colorfast Purple or Hi-Light Blue (dye). Surfactants and additives are usually inert, detergents, vegetable oils, crop oils or petroleum distillates. The actual quantity of additives that are dispersed into the environment is very limited in this application. These additives break down quickly in the forest environment and repeat applications are minimal. The PCA is required to include any adjuvants used in each prescription and the PCO is required to report to the county agriculture commissioner herbicide application including adjuvants.

Vegetation Management Implementation Plan

This section identifies site conditions where a vegetation management entry is warranted; identifies and describes available entry options; provides guidance on treatment priorities; defines requirements for each vegetation management entry; assesses when a vegetation management entry may be considered completed; and identifies common concerns associated with vegetation management activities. This information will be used by forest managers to determine the most appropriate entry for each site. This analysis will be documented in a project level vegetation management assessment for each project prior to treatment, see Appendix B.

Site Conditions

Evaluations to assess the need for vegetation management include: assessment of the current species composition, site potential and planned harvest activity. When any of these factors indicate a delay in reaching the desired stand condition, vegetation management treatments may be warranted.

Common examples of these conditions include:

- Significantly increased hardwood stocking from previous management activities.
- Significant amounts of postharvest hardwood sprouts or brush impacting regeneration.
- Postharvest stocking is insufficient to capture site potential.
- Existing conifer stocking that negatively affects conifer diameter growth (stands are too dense).
- Grass and weeds resulting in negative impacts on seedling survival and growth.
- Control of most wanted[1] invasive species with a high priority on highly utilized roads or populations likely to spread into forest management units.
- Areas with increased fuel loading and increased fire ignition risk.
- Road right of ways at risk of being overgrown.

Vegetation Management Options

The companies rely on the Registered Professional Forester (RPF) who prepared the Timber Harvest Plan (THP) to assess each silviculture unit and determine if site conditions may delay or prevent the desired stand condition from being attained. When warranted, the Reforestation Forester will visit the unit to assess the conditions and prescribe a treatment to ensure a trajectory towards the desired future stand condition. In the sections below, we discuss the potential treatments and treatment hierarchy based on the conditions at the site. If the preferred treatment is unavailable, the

[1] Scotch broom, French broom, jubata/pampas grass, yellow star thistle, and gorse.

Reforestation Forester must choose an alternative option or forgo treatment. This will be completed prior to initiation of any vegetation management option.

Here, we present the most common vegetation management options for these forestlands, including a description of common triggers and potential impacts for these options.

Planting

Planting is necessary unless the desired stand conditions can be achieved after harvest with adequate natural regeneration. The goal is to plant within one growing season after the completion of harvest. Often, planting will occur within the same year of harvest. Planting will use redwood seedlings or cultivars[2], and Douglas-fir seedlings.

The target seedling survival after three growing seasons is 85%. Planting density will depend upon the stocking levels of retained trees, saplings, seedlings, and anticipated sprouts. The planting density may vary between 100-275 trees per acre and will always result in meeting the minimum conservation standards of the California Forest Practice Rules (14 CCR 912.7).

The cost of planting is one of the highest vegetation management treatment costs incurred occurring early in the history of the stand. Some wildlife that prefer early seral vegetation stages will be affected by the rapid establishment of a young conifer stand, though planting is generally considered a positive impact on a forest stand.

Pre-commercial thinning (PCT)

This density-management treatment is performed on younger stands that have not reached merchantable size. The purpose is to reduce the number of conifer stems so that remaining trees grow faster. Hardwood stems and large brush may also be cut or removed during PCT. These stems will vigorously re-sprout after cutting, but the reduction in their cover will provide a short-term response in conifer growth. PCT treatments may be carried out with chainsaws or with the frill herbicide method when the trees are too large to be efficiently cut down.

The efficacy of a PCT treatment is based on how soon the stand may be entered for a harvest after treatment. When an average stand diameter at breast height (DBH) of 16 inches is attained, the stand is available for harvest. A PCT entry may allow an entry 15-30 years earlier than a non-treated stand. Typically, a PCT treatment will occur on a stand that was planted prior to Companies management – our expectation is to plant appropriate densities of conifers when planting is required.

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[2] In this case, a cultivar is a young redwood tree propagated from the genetic material of a selected tree with superior characteristics for the site.

There is a short-term increase in surface fuels after a PCT treatment occurs. Once this material decomposes, the risk of fire in the stand decreases since the continuous ladder fuels are reduced. Bear damage in redwood and Douglas-fir stands may occur after PCT treatment.

Mastication

Mastication is mainly used as a forest fuel reduction treatment, especially along public roads, where residences are nearby, or to develop fuel breaks. Mastication reduces fuel loading by grinding existing brush and trees into mulch or chips. This treatment is typically limited to more gentle slopes. The mastication method could be used instead of herbicides to treat sprouting hardwoods and brush; however, it is more expensive and there is an increased risk of conifer damage.

Mastication is an effective method to reduce fuels when the amount of material to be treated is moderate. This treatment is limited to dry soil conditions to avoid soil compaction. Habitat for some species of wildlife may be negatively affected since slash accumulations are reduced. Hardwoods and brush species that are capable of re-sprouting may require an additional treatment.

Prescribed burning

Prescribed burning may be used to control competing vegetation in preparation for additional vegetation management activities (i.e., planting) or to reduce fuel loading in areas of concern. Specifically, the Companies may utilize burning to either burn logging slash that has been piled in areas considered safe for burning in the winter or in a broadcast application to reduce fuel loading, as site preparation, or to enhance habitat. The primary concern when burning is avoiding an escape from fire lines. All piles are constructed to protect against the risk of spread. All broadcast burn activities are accompanied by a burn plan that includes specifications for conditions under which the burn may be conducted.

Herbicide

Herbicide use is strictly regulated in California by the Department of Pesticide Regulation (DPR). Each herbicide is authorized for use by both the application method and target species. A licensed Pest Control Advisor (PCA) must sign a site-specific authorization before pesticides may be used in commercial applications. Four application types may be used on these forestlands:

(1) **Frilling** – This treatment involves cutting a small notch through the bark to expose the cambium layer. Herbicide is then applied to the exposed cambium. Imazapyr is the chemical typically used for this application, as it effectively controls tanoak, other hardwood species, and tall brush species such as blueblossom. Glyphosate can be used to control conifers

such as Douglas-fir and grand fir. Triclopyr amine can be used to control madrone, but it is less effective on tanoak.

(2) **Foliar Sprays** -- This treatment involves hand spraying a dilute concentration of herbicide directly onto the leaves of the target species. Chemicals used include triclopyr (amine and ester forms), imazapyr, glyphosate, and clopyralid. The spray treatment can be a site preparation spray, applied either pre-harvest or within one year of harvest before the unit is planted. The other type of treatment is a release spray, when vegetation that threatens the survival and growth of young seedlings is treated. The ideal time to carry out a release spray is when the target vegetation is 2-3 feet tall. Vegetation up to six feet tall can be treated, but labor and chemical costs are increased.

(3) **Pre-Emergent Sprays** -- This treatment applies a soil active herbicide with the objective of controlling germination of grasses, weeds, and some herbaceous plants. Chemicals used include sulfometuron methyl, clopyralid, hexazinone and aminopyralid.

(4) **Basal Bark Application**. --This treatment applies a mixed combination of triclopyr ester and methylated seed oil (MSO) on the lower bark surface of hardwood or woody brush stems. The MSO penetrates through the bark and carries the herbicide along with it. This method is uncommon.

Herbicide treatments are the preferred treatment option for the control of competing vegetation. Numerous studies from western North America (Boe 1971, Piirto et al 1996, and DiTomaso et al 1999) have demonstrated their superiority in controlling vegetation. Other methods are more expensive, have greater negative impacts, and are less effective. We have tested and will continue to test alternatives to the use of herbicides (see Appendix A).

The main impact of herbicide application is the creation of dead and dying fuels. It is commonly accepted that the additional material results in an elevated fire hazard for a short term, until leaves fall and fine branches decompose. The fire hazard of treated stands is then reduced since the ladder fuels from the shrub layer are reduced. Additionally, the tree canopy bulk density is reduced by treatment of hardwood trees. Under these conditions, a fire that enters the stand is more likely to be a surface fire than a crown fire.

Goats, sheep, and cattle

Some agencies and timberland owners have utilized domestic animals in an attempt to control competing vegetation. This method is likely suitable for controlling weeds that have encroached upon native grasslands or chaparral brush land but less suitable for controlling vegetation in young forests due to potential damage to seedlings from feeding and trampling. This method may be used to control grass and weeds on un-forested road rights of way or where reduction of fine fuels is needed to reduce fire hazard.

Manual Slashing

This treatment involves a crew with chainsaws cutting competing hardwoods and brush. The downed material then must be lopped and scattered to reduce large accumulations of slash and get it closer to the ground so that decomposition occurs faster. This is the preferred method when use of herbicides is prohibited.

In coastal California, most hardwood and brush species that compete with conifers are capable of re-sprouting after being cut. This method provides short term release from competition. Thus, repeated treatments are necessary resulting in infeasibly high treatment costs.

Special care must be taken to avoid damage to the conifers caused by accidental cutting, damage from falling slash, and smaller seedlings being buried under slash. Worker safety must remain a priority in these operations as using chainsaws on units with logging slash and high brush cover increases the safety risks to the workers (Dost 2003).

Hand Grubbing

This treatment involves the use of hand tools to remove competing vegetation. Typically, the competing vegetation including the roots is removed from a radius of 2-4 feet from the seedling. This is an additional herbicide alternative method, but it is more expensive than the manual cutting method.

This method provides short term relief from competition. The cleared area is rapidly invaded from adjacent roots, rhizomes, or seeds. Repeated treatments are often necessary. This method may disturb mycorrhizal networks that benefit conifers.

Commonly Encountered Site Conditions and Treatments

The following section provides greater detail on specific and commonly encountered conditions that warrant vegetation management and the recommended vegetation management treatment to apply to those conditions.

1. **Condition:** A proposed harvest unit that has a significant basal area component of hardwoods (greater than 30 square feet per acre).
   Challenge: Growth reductions in conifer volume and inhibited seedling and redwood stump sprout growth.
   Treatment: Pre-harvest frill with imazapyr concentrate.
   Expected application rate: 0.6 pounds per acre.
2. **Condition:** A proposed harvest unit that has existing cover of 25% or more of established evergreen brush species such as tanoak sprouts, evergreen huckleberry, or manzanita.

Challenge: Brush cover will expand after harvesting negatively affecting natural conifer regeneration and planted seedlings. The brush will reduce seedling survival and height growth.
Treatment: Spring pre-harvest foliar application with an imazapyr product and methylated seed oil (MSO). Glyphosate and triclopyr ester may also be used for control of other species.
Expected application rate: 1.5-2.0 pounds per acre.

3. **Condition:** A proposed harvest unit with already established grass and herbaceous species or with those species expected to become established after harvesting.
   Challenge: Many studies in the Pacific Northwest and California have documented that grass and weeds are effective at removing available soil moisture from the upper soil layer where planted seedlings have their roots (Roy 1953, Baron 1962, and Reitveld 1975). The seedlings cannot compete effectively with grass and weeds until they are older and able to establish their roots deeper. The result of established grasses and herbaceous species is high mortality and poor seedling performance.
   Treatment: Springtime foliar spray with glyphosate, clopyralid and sulfometuron methyl.
   Expected application rate: 1.5 pounds per acre.
4. **Condition:** A planted unit with brush species such as ceanothus, blackberry, coyote brush, and manzanita beginning to establish. It can also include resprouting hardwood species including tanoak, madrone, and maples.
   Challenge: These species compete with planted conifers causing reduced growth and increased mortality.
   Treatment: Directed release spray when the conifers are most dormant (August-October) to minimize damage from spray drift. Herbicides used are triclopyr (amine and ester forms), glyphosate, or imazapyr.
   Expected application rate: 1.5 to 1.75 pounds per acre.
5. **Condition:** Group selection or transition units that are five to eight years old with tanoak stump sprouts increasing in coverage resulting from cutting of tanoaks during the harvest. Often, these units have not been planted but are stocked with a combination of redwood stump sprouts and Douglas-fir natural regeneration.
   Challenge: Tanoak stump sprouts will continue to increase in cover and reduce growth of the conifers.
   Treatment: Directed release spray with imazapyr or triclopyr ester when the tanoak sprouts are 3 to 4 feet in height.
   Expected application rate: 1.5 pounds per acre.
6. **Condition:** Clear-cut or rehabilitation units with a cover of 30% or more tall brush species such as tanoak sprouts or Ceanothus that are too tall to be sprayed effectively. These units were often harvested from1995 to 2005.
   Challenge: The 30% cover of brush species is the level at which Companies have anecdotally observed a negative impact on growth of planted seedlings.
   Treatment: Frill release with imazapyr concentrate.
   Expected application rate: 0.8 pounds per acre.
7. **Condition:** Large seed tree or shelter wood units with a minimum hardwood basal area of 50 square feet per acre. These units were harvested from 1983 to 2000. The hardwood component was not treated during this time.
   Challenge: This level of competition affects conifer diameter growth which will delay the development of the desired stand condition.

Treatment: Frill release with imazapyr concentrate.
Expected application rate: 0.6 to 0.8 pounds per acre.

8. **Condition:** Overstocked, immature conifer stands established from 1990 to 2005 withan average DBH between 4 and 8 inches and with greater than 1000 trees per acre.
   Challenge: Overstocked condition will inhibit growth of all stems and result in an even-aged stand.
   Treatment: Pre-commercial thin (PCT) with chainsaws when the crop tree heights are 20-30 feet tall. The PCT can also be accomplished by a frill treatment of the Douglas-fir and Grand fir with glyphosate and thinning redwood stems.
   Expected application rate: 1 pound per acre.
9. **Condition:** Road right of ways, landings, or rock pits with occurrences of non-native plant species such as Scotch broom, French broom, jubata grass, and Himalayan blackberry.
   Challenge: These species create a fire hazard, block the roads, and eventually spread into other areas outcompeting native species.
   Treatment: Use of herbicides or mechanical cutting. It is important to minimize soil disturbance when the cutting treatment occurs, as these species store viable seeds in soil for many years, and they can quickly colonize disturbed roadside areas.
   Expected application rate: Variable. Depends on the cover and height of the brush - rates range from 1 to 6 pounds per acre.
10. **Condition:** Localized occurrences of noxious weeds such as yellow star thistle, knapweeds, Scotch broom, and Himalaya blackberry.
    Challenge: These species create a fire hazard, block the roads, and eventually spread into to other areas outcompeting native species.
    Treatment: Use of herbicide including: triclopyr ester, imazapyr, and clopyralid. The application method is generally a directed spray with backpacks. In the case of large Scotch broom plants too tall to spray, a frill treatment using triclopyr amine is effective. Jubata grass is widely established on both properties and its eradication is not practicable. Occurrences of jubata grass along roads or landings close to newly harvested units will be treated by herbicides to prevent its spread. The preferred treatment is a foliar application of glyphosate combined with imazapyr.
    Expected application rate: Depending upon the density of the jubata grass and their size, the rates range from 4-6 pounds per acre.

Priority of Treatment Areas

Ideally, we would be able to apply vegetation management to all areas of the forestland that would benefit from such treatment; however, the Companies are limited by availability of crews and equipment, internal budgets, and the scale and large number of potential projects. In order to appropriately plan, we have developed a list of factors to define the priority of vegetation management treatments on the forestland.

Factors affecting priority:

i. **Cost and overall value of the treatment** --A fundamental economic consideration of all vegetation management treatments is the return on investment. All treatments should yield a positive return on investment (ROI). Activities with the greatest return on investment receive the highest priority. At times, environment or social factors may influence this simple tenant. Other things being equal, an expensive treatment at an early date in the management of a silviculture unit will result in a reduced return on investment. The expectation is that a vegetation management treatment will produce increased growth greater than inflation; though there will be instances where exceptional environmental or social factors require mitigation with more expensive treatments.

ii. **Site Index** -- Site index has a significant effect upon the expected Return of Investment (ROI) of a treatment. Site Class IV sites and lower Site Class III sites do not have the growth potential of Site Class I and Site Class II sites. They also take longer to become operable, whether in terms of attaining a minimum average tree diameter, or a minimum harvestable volume. Priority will be given to more productive sites over less productive sites. Site specific cases may be exceptions, such as a tract with limited mature volume to harvest in the near term.

iii. **Fire Hazard** -- The companies must consider existing and future fire hazard when deciding where to make vegetation management investments. Factors such as public road access, neighbors, adjacent fuel types that inherently have a high risk of fires, and power lines increase fire hazard. When deciding among equal treatments, priority should be given to those projects with reduced fire hazard.

iv. **Harvest opportunity from the treatment** -- Other things being equal, the treatment that resulted in an earlier harvest opportunity should be selected.

Silviculture investment priorities

During the course of financial planning a decision must be made regarding a level of commitment to vegetation management treatments. Many proposed treatments may yield a positive, but marginal, return on investment. In this case, competing operational demands dictate some vegetation management treatments with positive Return on Investment (ROI) will be foregone. In addition, a positive ROI in and of itself is not the only consideration. Alternative rates of return will be evaluated and as such, treatments with positive ROI may be foregone to achieve higher alternative rates of return, for example the acquisition of additional timber land.

All treatments necessary to meet the legal stocking requirements within five years after the completion of the timber harvest will be complete. When further funding is available, investments may be considered on discretionary treatments. Any discretionary treatments will require an assessment of ROI.

The following list of ranked treatments was developed to guide Reforestation Foresters in assessment of priority of vegetation management treatments. When explained and justified, site specific conditions may warrant a deviation from these priorities.

1. Planting of Variable Retention (VR) and Rehabilitation (REHAB) harvest units.
2. Site preparation of VR and REHAB units where the intent is to reduce brush andgrass cover to less than 35% for two years following planting.
3. Hardwood treatment of VR and REHAB units; if possible, pre-harvest treatment is preferred.
4. First release treatment on VR and REHAB units where the intent is to reduce brush and grass cover to less than 35% for two years following initial treatment (see item #2 above).
5. Hardwood treatment of Group Selection (GSEL) or Transition (TRANS) units where the hardwood basal area component is greater than 30 square feet per acre. Pre-harvest treatment is preferred.
6. A release treatment of hardwood inhibited redwood sites 10 to 15 years before the next harvest entry on Site Class I, II and III lands.
7. Pre-commercial thinning (PCT) of redwood sites on Site Class I, II or III lands.
8. PCT of Douglas-fir (DF) sites on Site Class I, II or III lands.
9. A frill release treatment of hardwood inhibited DF sites 10 to 15 years before the projected next harvest entry on Site Class I, II and III lands.
10. Rehabilitation (non-harvest plan related) of existing hardwood stands on Site Class 1 and 2 lands. This treatment is used only if the unit can be reforested with redwood and if the stand was a result of previous management activity.
11. Release of hardwood-inhibited redwood sites with a stand age of 15-25 years. These are units where large tanoak sprouts, madrone sprouts, or tall ceanothus are present and are slowing diameter growth on Site Class I, II or III lands only.
12. Release of hardwood-inhibited DF sites with a stand age of 15-25 years on Site Class I and II lands only.
13. Site preparation of discrete small group clearings in GSEL units where stocking by redwood sprouts, or DF natural regeneration can be reasonably expected and there is existing competition from re-sprouting hardwoods such as tanoak and madrone.
14. Planting of redwood in GSEL openings.

Discretionary investments on Site Class IV lands return a limited or negative return on investment. These areas will only be treated to meet stocking standards.

Requirements for each vegetation management entry

Other parts of this document have discussed general policies and guidelines for vegetation management; this section provides specific requirements for each vegetation management activity that must be followed unless a deviation is explained and described on a site-specific vegetation management assessment. The goal of these requirements is to reduce and mitigate impacts to adjacent landowners and to protect key within-stand habitat elements such as wildlife trees and large diameter hardwood trees.

a. Fuels treatment with special protection zones. All fuels within special protection zones listed below will have the following fuels treatment: (1) slash will be treated by lopping for fire hazard reduction, piling, and burning, chipping, burying, or removing from the zone; and (2) standing dead trees taller than 20 feet will removed or felled.

   Special protection zones:

   i. Within 100 feet of the edge of the traveled surface of public roads
   ii. Within 50 feet of the edge of the traveled surface of permanent private roads open for public use where permit to pass is not required
   iii. Within 200 feet of permanently located structures maintained for human habitation
   iv. Additional 200-500 feet of permanently located structures maintained for human habitation where unusual fire risk or hazard exist, as determined by the forester
   v. Within at least a tree length of power lines

b. Prohibit herbicide treatment within watercourse protection zones of Class I and II watercourses and within 25’ of a Class III stream. Herbicides rated for aquatic use may be used in these areas to treat the “most wanted” invasive species.
c. Notify all landowners in advance within 100 feet of a treatment area of plan to treat with chemical herbicides. Consult with landowner to meet both landowners’ objectives. If landowner cannot be reached; then ensure no dead trees greater than 20 feet tall are left standing within 100 feet of the boundary.
d. Any planned herbicide treatment within the boundary of an HCV or RSA area are unusual in nature and should be addressed in the vegetation management assessment to ensure it meets the requirements described in the management plan for management of these areas.
e. Retain true oak trees > 18” dbh unless removal is needed to address safety concerns.
f. Retain a minimum of 10% of the pre-harvest hardwood basal area postharvest (i.e., if pre-harvest is 100 square feet per acre, retain 10 square feet per acre); across the unit; excluding Class I and II watercourse buffers. Typically, this retention should not exceed 20% of the post-harvest basal area. This retention can include aggregate retention patches and larger retained hardwood patches.
g. Avoid treatment of marked wildlife trees.

Any deviation from these measures must be explained and justified in the vegetation management assessment for the site.

When is vegetation management complete?

A site may be considered complete when further vegetation management activities would not significantly improve the trajectory towards the desired stand condition. We will continue to depend on the professional judgement of our reforestation foresters and forest managers to make this decision based on field observations and professional judgement.

Common Concerns Associated with most Vegetation Management Activities

There are many concerns associated with vegetation management activities. The most common concerns communicated with Companies relate to the use of herbicides on the forestlands. Those concerns typically relate to toxicity of the chemicals being used; ability to bioaccumulate in the food chain; chemical contamination in the water supplies; visual impacts; and increased fire risk. These concerns are addressed below and cover the seven common chemicals used on our forestlands – glyphosate, imazapyr, triclopyr, sulfometuron methyl, clopyralid, aminopyralid, and hexazinone. To date, we have not received stakeholder concerns related to non-chemical vegetation management methods.

Toxicity

All chemicals used on our forestlands show low toxicity to humans and other animals.

(1) **Imazapyr** -- Based on lab and field studies Imazapyr is minimal risk to fish and practically non-toxic to birds and bees on an acute basis (Steven Carey et al at United States EPA, September 30, 2005). Given the scientific and toxicological information in conjunction with the DPR and EPA testing and label restrictions, Imazapyr use would not pose a significant human health hazard nor produce any significant adverse environmental impacts when used in accordance with label or other regulatory restrictions and when used in the typical manner during reforestation (EPA 2006).

(2) **Glyphosate** -- Glyphosate has no known effect on soil microorganisms (Busse et al 2001). It is slightly toxic to birds and practically non-toxic to fish, bees, and aquatic invertebrates (EPA 1993). Given the scientific and toxicological information in conjunction with the DPR and EPA testing and label restrictions, Glyphosate use would not pose a significant human health hazard nor produce any significant adverse environmental impacts when used in accordance with label or other regulatory restrictions and when used in the typical manner during reforestation (Monique M. Perron, et al United States EPA, December 12, 2017).

(3) **Triclopyr** -- It is slightly toxic to practically non-toxic to soil microorganisms (USDA Forest Service, 1996) and it is low in toxicity to fish (WDNR 2012). Triclopyr is slightly toxic to mammals (Washington State Department of Transportation 2017). Triclopyr use would not pose a significant human health hazard nor produce any significant adverse environmental impacts when used in accordance with label or other regulatory restrictions and when used in the typical manner during reforestation (EPA 1998).

(4) **Sulfometuron Methyl—**Sulfometuron methyl has a low acute toxicity for most species' tests (Category III or IV [slightly toxic or practically non-toxic]; EPA 2008).

Sulfometuron methyl use would not pose a significant human health hazard nor produce any significant adverse environmental impacts when used in accordance with label or other regulatory restrictions and when used in the typical manner during reforestation (EPA 2008).

(5) **Clopyralid—**It is practically non-toxic to mammals and birds and of low toxicity tofish (USDA Forest Service 2004). Clopyralid use would not pose a significant human health hazard nor produce any significant adverse environmental impacts when used in accordance with label or other regulatory restrictions and when used in the typical manner during reforestation (USDA Forest Service 2004).

(6) **Hexazinone--** It is practically non-toxic to birds, fish, invertebrates (EPA 1994). Hexazinone use would not pose a significant human health hazard nor produce any significant adverse environmental impacts when used in accordance with label or other regulatory restrictions and when used in the typical manner during reforestation (EPA 1994).

(7) **Aminopyralid--**It has low acute toxicity (USDA Forest Service 2007). Aminopyralid use would not pose a significant human health hazard nor produce any significant adverse environmental impacts when used in accordance with label or other regulatory restrictions and when used in the typical manner during reforestation (USDA Forest Service 2007).

Bioaccumulation in the food chain

All chemicals used on our forestlands show low risk for bioaccumulation in the food chain (EPA 2006, EPA 1993, EPA 1998, Harvey et al 1985, USDA 2004, EPA 1994, USDA 2007).

Fire hazard

We recognize that our neighbors are concerned about increased levels of dead hardwood fuels after vegetation management treatments that increase dead fuel loading. Herbicide treatments elevate surface fuels in the short term, but surface fuels typically decline 8-12 years after treatment (Valachovic et al 2011). Valachovic et al (2011) also noted that herbicide treatment does not pose as much of a problem for long-term fuels management because its effects are short-lived and manageable, whereas other fuel loading circumstances, such as sudden oak death is chronic, continuous, and somewhat random on the landscape. We have provided special zones near infrastructure where additional fuel treatments are required when implementing vegetation management activities that increase fuel load. Fire hazard is also mitigated by treating a small percentage of any given watershed in any given year.

Visual Impacts

A treated unit can be seen up to 5 miles away under optimal conditions. Typically, the treatment is noticeable from about 3 miles. The most dramatic impact occurs where a stand with a large component of hardwood trees is treated during the spring or summer. The foliage turns brown and is noticeable for two years until the leaves drop after which the visual impacts are from the dead stems and branches.

After five years, the visual impact is far less noticeable as the conifer crowns respond by increasing in size. We recognize that vegetation management treatments create a change in the visual landscape of our neighbors. In visually sensitive areas, treatments will be dispersed over space and time to mitigate the impact on visual quality.

Water Quality

Over 20 years, we have voluntarily taken several hundred water samples (N = 196) to better understand the risk of herbicide application runoff into watercourses. Water samples are collected from Class III watercourses when water begins to flow at the first major rain following treatment – this is to increase the likelihood of detection. We have detected traces of herbicide in 8 of those water samples. In order to better understand the potential implications of these detections, we compared the detection values in parts per billion to established thresholds, specifically the North Coast Basin Plan maximum threshold for glyphosate in water. We utilized this value since a basin plan threshold for Imazapyr has not yet been established and glyphosate is the most similar herbicide to Imazapyr with a basin plan threshold (Water Quality Control for the North Coast Region, May 2011; North Coast Regional Water Quality Control Board; page 3-11). Also, for comparison, the lethal concentration of

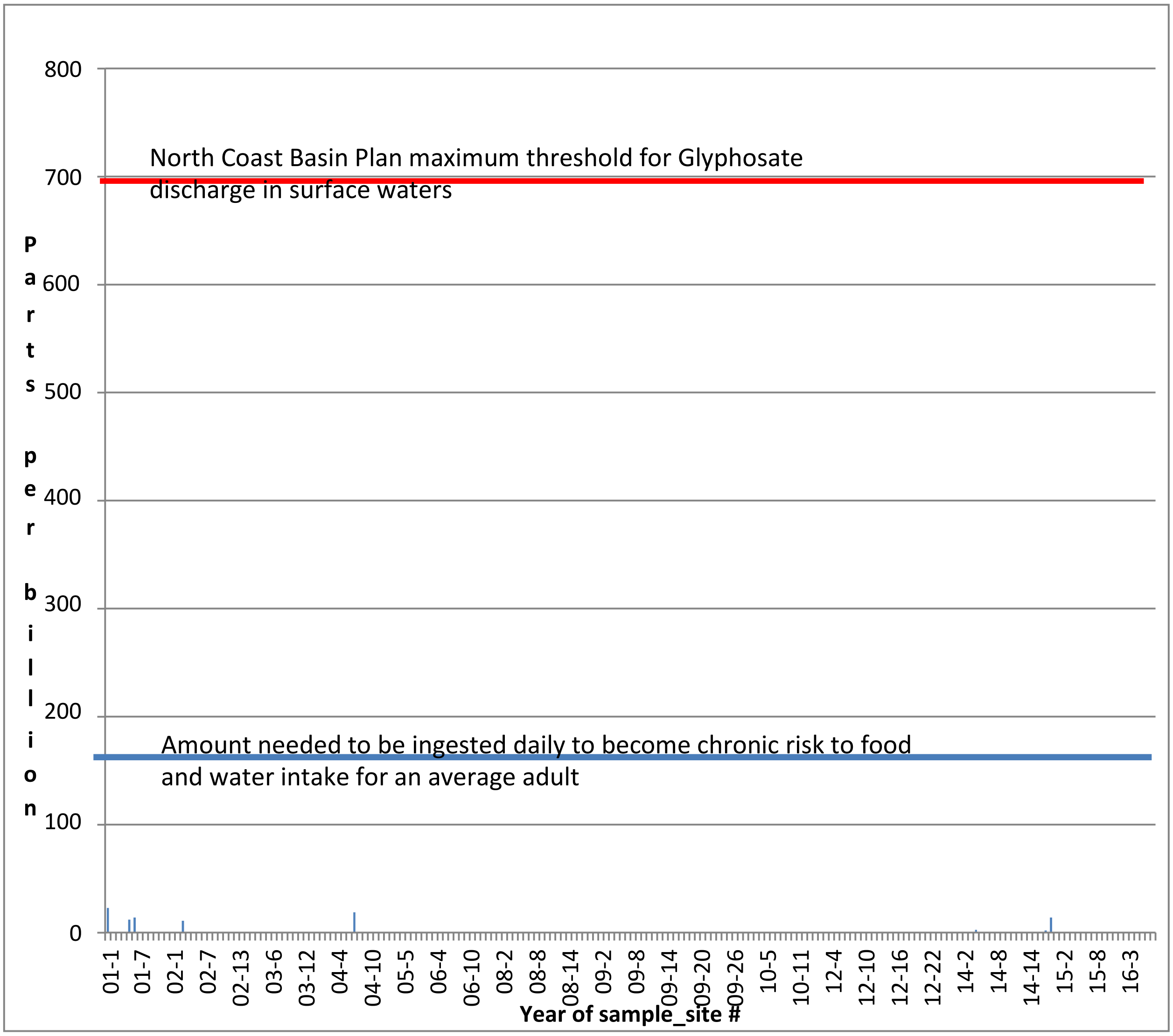

Figure 1. Water sampling results from 2001-2017 indicating that any herbicide detections were orders of magnitude lower than various drinking water standards.

Imazapyr in rainbow trout is reported as > 100 parts per million; this converts to 100,000 parts per billion. The maximum safe threshold for glyphosate in domestic water supply was listed as 700 parts per billion – see figure above for graph of our detections compared to the basin plan threshold and the established safe chronic ingestion risk.

Vegetation Management Effectiveness Monitoring Plan

Effectiveness monitoring is the practice of evaluating the outcome of vegetation management treatments to determine if changes to implementation are warranted. The goal of this monitoring is to improve effectiveness and reduce the usage of chemical pesticides; where feasible. Activities that are successful need to be identified so that they may be repeated.

Goal

The goal is to improve regeneration success and growth rates, control stand density, reduce fire risk, reduce costs, and in the case of controlling vegetation determine if effective alternatives to herbicide use are possible or if the volume of herbicides used can be reduced. Monitoring will be used to identify and promote accountability for the success of treatments and to correct ineffective treatments. Monitoring should also be considered an investment like any other vegetation management treatment. It can produce a quantifiable benefit to the vegetation management program.

Inter-Connections

Our vegetation management program is conducted within a complex physical and biological system. Many factors such as the local climate, ecology, soils, site characteristics and timing of treatments interact and determine the success of vegetation management treatments. Over time, this monitoring program will identify how the interaction of these factors affect the outcome of vegetation management treatments to create our desired future stand conditions.

Treatment Records

Companies will maintain relevant information for units where vegetation management treatments have occurred. Relevant information is information on variables that can potentially affect the outcome. They include: site condition, weather, materials (e.g., seed zone); timing, treatment method, treatment size, species, etc. For example, below is a list specifically for planting:

A. Site conditions
   i. Vegetation cover and main competing vegetation species
   ii. Site history and silviculture system
B. Weather conditions during and after planting, especially rainfall
C. Seedlings
   i. Species
   ii. Cultivar number or seed lot

iii. Stock type
iv. Nursery
v. Storage and handling notes

D. Planting Practices
i. Inter-tree distance
ii. Planting quality (excellent, average, poor)
iii. Levels of natural conifer regeneration (frequent, medium, less)

Records and data analysis

Data will be collected and stored in a database and further analyzed as needed for the monitoring effort. All data collected will be retained electronically for at least 5 years.

Vegetation management monitoring

Annually, the Companies management team will determine which monitoring programs to implement to provide the best value to the business and the resource. Annually, Companies' will include a component to monitor the effectiveness of herbicide treatments in the previous year. The monitoring plan will be completed each year by February 28th for the calendar year and circulated among forest managers. An annual monitoring plan will consider available resources; information needs; and the highest priority projects. Listed below are potential monitoring programs that could be included in a given year though this list is not exhaustive.

Potential monitoring programs:

1. Pre-submittal THP silviculture prescription

   The Reforestation Forester will provide comments to the THP plan writer on aspects of the plan that will impact vegetation management costs prior to submittal. An example would be the determination of the silviculture system, which will indicate whether artificial regeneration is needed. Another example is to determine the level of hardwood competition or an existing brush layer in units and whether post-harvest or pre-harvest vegetation control treatments are appropriate.

2. Stocking Survey

   Three years after planting, planted units will have a full survey completed. The units selected will focus units where difficulties occur. The data collected will include number of surviving and dead planted conifers as well as some indication of competition. Information gathered will then be used to determine any need for future treatments of the site.

3. Free-growing Survey

   The purpose of this survey is to determine if units are free growing eight years after harvest completion. The Companies define a free growing tree as a healthy, undamaged conifer that is 150% greater in height than competing vegetation within a 3 feet radius of the tree's leader. Information from this survey will also aid in fine tuning vegetation management prescriptions.

4. Harvesting

Aspects of harvesting that affect future vegetation management treatments will be assessed near the completion of harvest operations by the Reforestation Forester, including:

i. Permanent access levels - identify the percentage of the unit that has been taken out of growing space for permanent infrastructure (i.e., roads, landings, rock pits, etc.). Company expectation is less than 7% of the unit area is maintained in permanent infrastructure.
ii. Site occupancy by slash. Reforestation Foresters will complete ocular assessment when operations are close to finishing. The Forest Manager will be notified if the slash levels on the unit are deemed to be excessive for successful reforestation.

5. Herbicide treatment for site preparation

Units will be selected at each site prepared with herbicides to assess efficacy of herbicide treatment. The Reforestation Foresters will assess whether the competing species targeted for control were effectively controlled and whether there were any unintended effects of the treatment. This will be an experimental study to compare outcomes of areas treated versus those not treated. This will provide objective data on the effects of controlling vegetation on seedling performance.

6. Seedling Production

High quality seedlings from the nursery are important in ensuring success on planted units. Seedling samples will be tested annually by a reputable third party. The initial focus will be on those redwood cultivars that appear to be sub-standard in appearance compared to cultivars that appear to be acceptable. By tracking the performance of seedlings after they have been planted, it will be possible to determine which features are detrimental to early survival and performance.

7. Seedling Storage and Transportation

Storage and handling can have significant effects on survival and early growth of planted trees. Seedlings need to be stored at a temperature of 34-36 degrees Fahrenheit or their quality will decline. This will be assessed by placing temperature sensors in the boxes at the nursery, then tracking the temperatures the seedlings experience until they are planted. Seedlings that have been exposed to temperatures above 40 F for extended times may have reduced vigor.

8. Planting

The companies assess planting operations by establishing plots on planting units and inspecting the planting quality and determining seedling density. The planting quality inspection procedures will be developed in consultation with staff. During this process, the Reforestation Foresters will also be assessing the success of completed site preparation treatments. An assessment for future vegetation control needs will also be made at this time.

The proper storage of seedlings while they are on the planting unit is critical to ensure vigorous seedlings. Seedling temperature, moisture status of the plugs, and overall condition will be monitored and recorded. Weather information at time of planting and during the first growing season will be used to identify potential units with poor seedling performance.

9. Planted Stand Performance

Both companies desire high seedling survival and early height growth. These factors will help reduce future vegetation management treatments. To monitor early seedling performance, 100 tree survival studies will be established on a representative number of planted units each year. They will be measured at the end of the first, second, and third growing seasons. Another measurement will occur at the end of the fifth growing season if the survival percentage was below 80% after the third-year assessment.

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Appendix A – MRC and HRC analysis of options

We have analyzed the potential options for achieving desired stand conditions which include alternatives to herbicides including: (a) a study in 1999-2000 covering early alternatives including mechanical treatment; (b) a study in 2011-2012 assessing bark stripping and mushroom spores to kill standing tanoaks; (c) goats. As new options or alternatives come up, we assess the potential usage of these options and determine if they are effective and feasible. Additionally, we are participating in a hardwood management research group convened by CalFire to research possible alternatives to chemical herbicide usage for the control of tanoaks. Cal Fire has hired Humboldt State University to conduct a study to determine what impact to seedling vigor occurs by retaining various levels of hardwood canopy. The goal is to find a canopy level that can be retained while still restoring a natural level of conifer in the study areas, thereby reducing herbicide use. Data collection from JDSF and other landowners has been completed with the results anticipated in the first half of 2020.

The conclusion of review of these options is that currently, chemical herbicide is the most efficient, effective, and safe method to control competing species. In general, alternatives have a very high cost related to effectiveness (this is supported by additional experts attending the CalFire meeting to research possible alternatives to chemical herbicide usages for tanoak control). We will continue to participate in the CalFire work organized by JDSF as they are set up for researching these types of questions – further focus on alternatives selected by this group include thinning clumps of young tanoak and review selective treatment of tanoak with planted conifer seedlings and redwood sprouts.

1999 and 2000 - initial herbicide alternatives studies

Location: Charlie M. Timber Harvest Plan, Upper Ackerman Creek Watershed,

Methods: The herbicide trial area, consisted of fourteen adjacent 2.3-acre units (dimensions approximately 650’ by 150’), was surrounded on three sides by the Charlie M. timber harvest plan. Fourteen different herbicide or alternative treatments were applied to the trial area in two main groups: those units treated with stump applications of a solution with a sprayer, and those units treated with alternative cutting techniques but no herbicide solutions. In the nine “solution” units the harvesting procedure mimicked the AP Rehabilitation silviculture used in the surrounding Charlie M. THP, which consisted of harvesting marked conifers and merchantable (>10” DBH) tanoaks. Additionally, all smaller hardwoods were cut in the nine “solution” treatment units, while in the remainder of the THP these small hardwoods were left standing and injected with herbicide. Following are the nine “solution” treatment names and rates applied:

Treatment	Rate Applied
Accord	100%

Ammonium Sulfamate	1 kg /gallon water
Arsenal	6 oz. /gallon water
Defol. 6	100%
Eucalyptus Oil	100%
Garlon 4	100%
Neem Tree Oil	100%
Oust	1 oz. /gallon water
Vinegar	100%

Treatment application took place in July 2000. All products were applied to the cambium of cut stumps with backpack sprayers within 0.5 hours of harvesting. Target species included tanoak of all diameters and madrone less than 10 inches in diameter. The remaining five trial units were treated with alternative cutting techniques as follows:

Technique	Description
Control (no harvest)	Leave as found.
Cut All Tanoak	Cut marked conifers and all tanoaks.
Cut Merchantable Tanoak	Cut marked conifers and tanoak >10" DBH.
High Stump	Cut marked conifers, cut all tanoaks to a 4'-5' stump.
Shade	Cut marked conifers, retain strategically-located larger tanoaks for shade.

The "Cut All Tanoak" unit was harvested in the same manner as the nine "solution" units yet no herbicide solution was applied, providing a control. The unit labeled "Control (no harvest)" demonstrates planted seedling response if no rehabilitation harvest had occurred.

Data were collected in September 2002 in order to assess two-year progress of the herbicide trials. In each treatment unit, fourteen 100th-acre circular plots were measured. Variables measured for conifers and hardwoods included tree, brush, and seedling stem diameter;

height; crown size; leader length and condition; and vigor. No data collection took place prior to harvest; therefore the results given here are intended for comparison between units, not to a pre-treatment state.

Interpretation of results:

The traditional herbicides were the most effective in controlling hardwood brush cover. The Control (no harvest) and Shade units also contained low hardwood cover, but this condition could be due to less cutting of hardwood causing decreased sprouting ability. The Vinegar treatment seemed to increase brush *and* seedling growth. The Eucalyptus Oil and Defol. 6 units demonstrated similar results to each other for all variables measured. In these two units, hardwood brush cover was relatively low, yet seedling leaders were among the shortest in the study.

MRC and HRC herbicide alternative 2011/2012

The intent of this alternative assessment is to determine if either bark stripping applications or application of mushroom spores to tanoak stumps can reduce or completely eliminate tanoak sprouting. There were essentially 6 different treatments applied on two experimental sites (Rockport and Navarro West). The treatments are: (1) cut tree and strip bark; (2) girdle tree and strip bark below girdle site; (3) cut tree and apply plugs with oyster mushroom spawn; (4) cut tree and apply plugs with turkey tail spawn; (5) cut trees and apply oyster mushroom spored oil; and (5) cut trees with no application (control). Mushrooms plugs and oil were applied to the Navarro West site on December 14th, 2011 and at the Rockport site on December 5th, 2011. Bark stripping was more difficult and occurred on several different dates in spring/early summer of 2012.

TREATMENT TYPES:

(1) Strip bark (tanoak cut at operational height, strip bark from cut stump to base of tree)

(2) Girdle and strip bark (tanoak left standing, girdled at 4 feet, strip bark from girdle site to base of tree).

(3) and (4) Mushroom plugs – cut the tree. Insert mushroom plugs into holes drilled into the top of the stump and the side of the stump.

(5) Spored mushroom oil application – cut the tree, apply oil on tree stump (can be applied with a backpack sprayer, similar to foliar spray application).

Outcomes were assessed in August of 2013. Mushroom spore application areas were not assessed since there were no noticeable fruiting bodies on the tanoak stumps and trees treated.

Across all locations (Navarro West, South Coast, and Rockport) a total of 14% (51 of 361) bark stripped tanoak trees died. Most of these dead tanoaks did sprout from the base or the stump in the case of cut trees. There were signs of early senescence in some additional tanoaks – in very limited cases, bark stripping of standing tanoaks may be a viable alternative to chemical herbicide use, i.e., when trying to get mid-canopy conifers above an overstory of tanoaks or to temporarily reduce tanoak competition. However, this method is time-consuming, expensive, and requires near perfect timing to strip the bark from the oaks at just the right time. This method should be limited to infrequent cases where strong concern occurs from neighbors, but there is a definite need to treat trees within 100 feet of the property boundary.

Goats

In 2015, several stakeholders suggested that we investigate the use of goats to browse and control tanoak sprouts. The participants at the JDSF meeting did not support this as a viable alternative based on existing information, the following is excerpted from John Andersen's report of the meeting, "when goats were discussed Lynn mentioned any potential project needs to be at least potentially cost effective to a point landowners will use the research. She asked what the group knows about the cost effectiveness of goats. Linwood stated he got a quote from an individual who rents goats: $1500/acre. I mentioned repeated treatments would likely be needed given what we saw at Tom Madden's property (after three years of grazing oak sprouts were still growing)." We do not believe goats could be considered at this time.

Conclusion

We have yet to find a non-chemical alternative to the use of herbicides for moving forest stands to our desired stand condition and control of invasive species that is effective and feasible. We will continue to assess if and when mechanical treatment or other options can be utilized when we are within 100' of nonindustrial neighbors.

Appendix B – Vegetation Management Assessment

Date:

Project Name:

THP:

Project Location:

Project Type & Size:

Assessment Areas

Adjacent Landowners: *Are there neighbors within 100 feet of the treatment unit? Have they been contacted? What was the outcome?*

Stream Protection Zones: *Are there Class 1, 2, or 3 streams present within or directly adjacent to the treatment area?*

Sensitive Plants: *Are there sensitive plants present on the unit? Has the Botanist cleared the unit or identified plant sites with protection measures?*

Special Protection Zones; *Is the treatment unit within any of the following categories?*

1. *Within 100 feet of the edge of the traveled surface of a public road.*
2. *Within 50 feet of the edge of the traveled surface of permanent private roads open for public use where a permit to pass is not required.*
3. *Within 200 feet of permanently located structures maintained for human habitation.*
4. *Within 200-500 feet of permanently located structures maintained for human habitation were unusual fire risk or hazard exists, as determined by the forester.*
5. *Within at least a tree length of power lines.*

Describe the measures that will be undertaken to treat fuels created by vegetation management treatments.

Visuals: *Will the unit be visible from a public road.*

True Oaks Present?

Fuels Assessment: *Identify expected changes to post treatment fuel loading and if mitigations are needed and how they will be implemented.*

Prior Treatments: *Identify prior treatments to the area. If this project is immediately adjacent to previous treatments wherein the effective result is one large continuous treatment identify and mitigate if necessary.*

Community Concerns: *Identify existing and likely to arise concerns regarding the project. Identify measures taken to address concerns.*