Richardson Grove Operational Improvement Project

HUMBOLDT COUNTY, CALIFORNIA DISTRICT 1 – HUM – 101, PM 1.1/2.2
464800

Supplement to the Final Environmental Assessment

Prepared by the
State of California Department of Transportation

September 2013

The environmental review, consultation, and any other action required in accordance with applicable Federal laws for this project is being, or has been, carried out by Caltrans under its assumption of responsibility pursuant to 23 U.S.C. 327.

General Information about This Document

What's in this document?
The Department of Transportation (Department) as assigned by Federal Highway Administration (FHWA), has prepared this Supplement to the Final Environmental Assessment (Final EA) for the proposed Richardson Grove Operational Improvement Project on U.S. Highway (US) 101 (PM 1.1/2.2) through Richardson Grove State Park in Humboldt County, California, to present the results of a revised assessment of potential project impacts to old growth redwood trees. This document also presents information on proposed minor modifications to the existing barrier rail, the results of surveys for the marbled murrelet, as well as updated information on the smaller-diameter trees to be removed.

What you should do:

- Please read this Supplement to the Final EA. Additional copies of this document and the original 2010 Final Environmental Assessment are available for review at the Caltrans District Office, 1656 Union Street, Eureka, CA, and the Humboldt County Library Branches in Eureka and Garberville. Both this supplement and the 2010 original Final Environmental Assessment may be downloaded at the following website (http://www.dot.ca.gov/dist1/d1projects/richardson_grove/).
- We welcome your comments on the Supplement to the Final EA. Send your written comments to the Department by the deadline.
- Submit comments via postal mail to Richardson Grove Improvement Project, PO Box 3700, Eureka, CA 95502.
- Submit comments via email to: RichardsonGroveImprovement@dot.ca.gov.
- Submit comments by the deadline: October 21, 2013.

What happens next?
The Department, as assigned by FHWA, will review and address any substantive comments pertaining to the information in the Supplement to the Final EA that are received from the public and reviewing agencies, and may (1) determine that the approved Finding of No Significant Impact (FONSI) for the Final EA remains valid; or (2) undertake additional environmental studies. If the FONSI is determined to be valid, the project can proceed to final design and construction.

For individuals with sensory disabilities, this document can be made available in Braille, large print, on audiocassette, or on computer disk. To obtain a copy in one of these alternate formats, please call or write to Department of Transportation, Attn: Scott Burger, 1656 Union Street, Eureka, CA 95501; (707) 445-5320 Voice, or use the California Relay Service 1-800-735-2929 (TTY to Voice), 1-800-735-2922 (Voice to TTY) or 711.

FHWA Highway ID No 464800

01-HUM-101-PM 1.1/2.2

Richardson Grove Operational Improvement Project

SUPPLEMENT TO THE FINAL ENVIRONMENTAL ASSESSMENT

Submitted Pursuant to:
(Federal) 42 USC 4332(2)(C)

THE STATE OF CALIFORNIA
Department of Transportation

9-18-13
Date of Approval

Cindy Anderson, North Region Environmental Division Chief
North Region Environmental Management
(530) 741-4277

The following person may be contacted for additional information concerning this document:

Valerie Gizinski
PO Box 3700, Eureka, CA 95502
(707) 445-5320

Summary

The Department of Transportation (Department) proposes to construct minor adjustments to the roadway alignment on U.S. Highway (US) 101 between post miles (PM) 1.1 and 2.2 in Humboldt County (Figures 1 and 2). The project, which runs through Richardson Grove State Park, would allow access by industry standard-sized trucks that conform to the Surface Transportation Assistance Act (STAA). STAA trucks are currently restricted north of Leggett, a community located approximately 15 miles south of the project area. Based on the Final Environmental Assessment (Final EA) for the project, dated May 18, 2010, the Department issued a Finding of No Significant Impact (FONSI), which stated that, “the preferred alternative will have no significant impact on the human environment.”

This Supplement to the Final EA (Supplement) presents the results of two years of surveys for the marbled murrelet, a species listed as threatened (federal) and endangered (state), which was found not to be present in the project area. This document also presents a re-assessment of potential project impacts to old growth redwood trees (*Sequoia sempervirens*) based on updated tree data, updates to the numbers and species of trees to be removed and minor changes to the design of existing and proposed barrier rail end treatments. Using the results of the revised tree mapping and measuring, the Department has determined that an additional two trees would be removed, a small redwood and a small alder, both smaller than 20 inches in diameter. No old growth redwoods would be removed for the project, and the Department has evaluated the potential for project impacts to their roots. In consultation with State Parks, the Department defines “old growth redwood trees” for this project as redwood trees with a diameter of 30 inches or larger, measured at breast height (54 inches above the ground).

The Department evaluated every old growth redwood tree that is a distance of five times its diameter or less from project construction limits (an area defined as the root health zone) to determine how it would be affected by the project. The evaluation considered the condition of the tree; the environmental setting; the type and extent of work that would take place within the root health zone; and the proposed impact avoidance and minimization measures. Incorporated into this supplement is an Individual Tree Analysis (Analysis) (Attachment B), which is a description and analysis of potential project impacts to each old growth redwood tree with a root health zone overlapping the area of project construction.

At the end of the public review period, the Supplement to the Final EA will be finalized.

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Chapter 1. Introduction

1.1 Type of Environmental Document

This document is a supplement to the May 2010 Final Environmental Assessment (Final EA) for the proposed Richardson Grove Operational Improvement Project (project). The scope of the proposed project is essentially unchanged from the Final EA. This supplement was prepared in compliance with the court's order of April 4, 2012 (Bair v. California State Department of Transportation, U.S. District Court for the Northern District of California, No. C 10-04360 (Order)) to prepare updated old growth redwood tree maps and analysis. This document contains the updated information and analysis requested by the Order.

1.2 About the Project

The Department proposes to make minor adjustments to a one-mile section of US Highway 101 (US 101) located one mile north of the Mendocino/Humboldt County line and approximately eight miles south of the community of Garberville. A portion of the proposed modifications would take place on the roadway within the boundaries of Richardson Grove State Park. Maps of the location and vicinity of the project are shown in Figures 1 and 2. The purpose of the proposed project is to adjust the roadway alignment to allow access by industry standard-sized trucks conforming to the Surface Transportation Assistance Act (STAA). STAA vehicles are defined as having either a 48 foot trailer, or as having a 53 foot trailer with a limit of 40 foot distance from kingpin of the cab to the rear axle of the trailer. STAA trucks have been restricted from this section of US Route 101 because the tight radius curves between the large redwood trees make it difficult for the longer trucks to stay within the travel lane without using part of the opposing lane of traffic ("off-tracking") or traveling off the roadway and using unpaved shoulders. The proposed roadway adjustments to accommodate industry standard-sized trucks would improve goods movement and the operation of US 101.

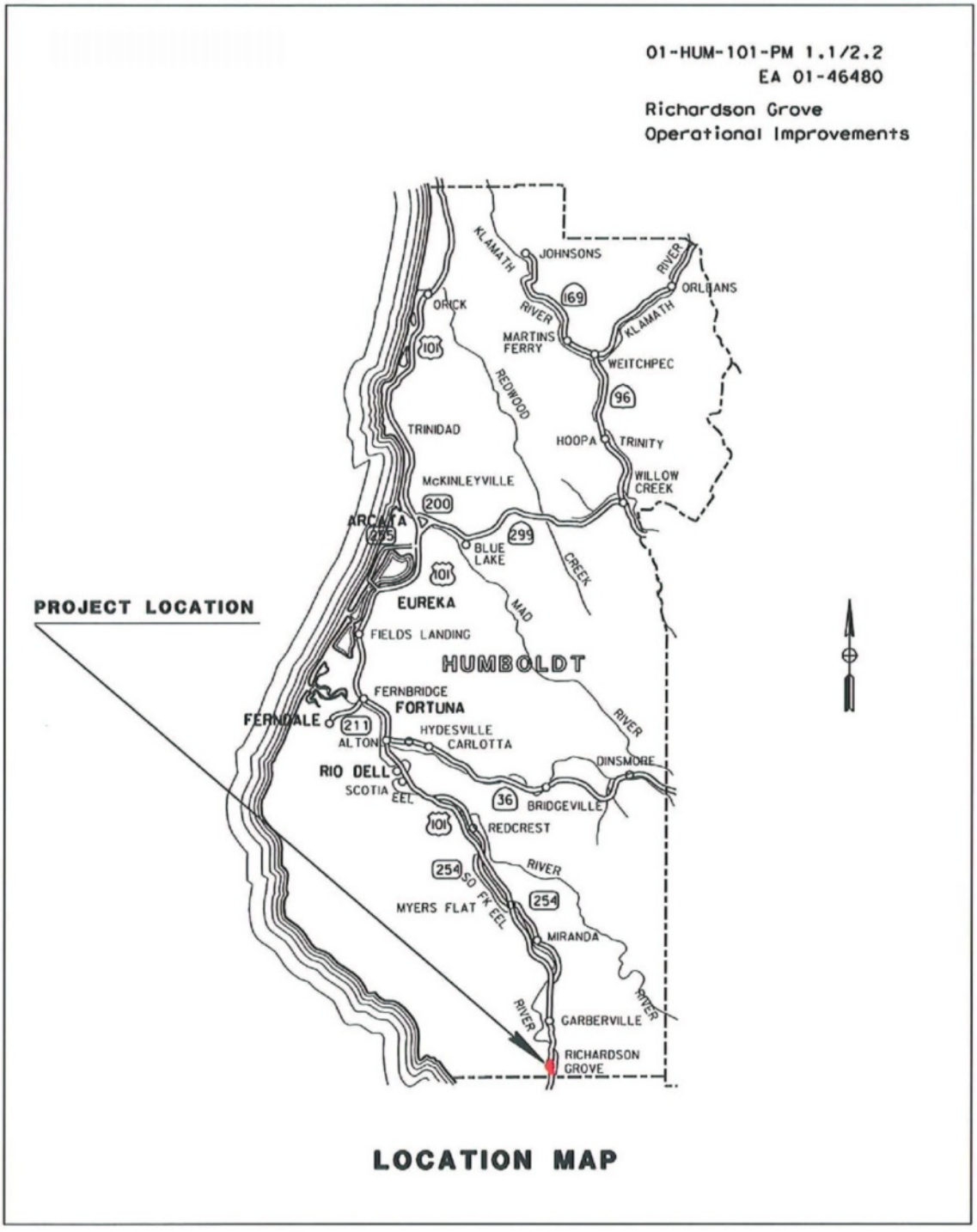
1.3 Incorporation by Reference

This Supplement to the Final EA revises a portion of Chapter 2 of the original document, presenting results of subsequent surveys for marbled murrelets and analyzing potential tree impacts based on revised tree data and new proposed barrier rail modifications. Except for the following minor change to the project description which revises Chapter 1, all other information and chapters in the original Final EA remain accurate.

Addition to the Project Description
The proposed project includes modifying the ends of the existing barrier rail at each of the four corners of the Richardson Grove Undercrossing at postmile (PM) 1.61 (near Durphy Creek), and extending the concrete barrier at the end of the proposed retaining wall at PM 2.14. Recent changes to federal standards require that the barrier end system at the bridge be upgraded. The modifications would improve the performance of the barriers in a collision. The locations of the proposed barrier rail improvements are depicted on Sheets 10, 11 and 19 of Attachment A.

The proposed barrier rail modifications at the bridge entail removing the obsolete metal beam guardrail (MBGR), constructing a barrier transition piece to retrofit this older style of bridge rail, and installing a crash cushion system at the end of the new barrier transition. The crash cushion was chosen to minimize the size and length of the terminal end. Installation of the transition barrier requires a footing four feet deep, 5.5 feet wide, and 20 feet long. The crash cushion would be a maximum of 15 feet in length, requiring a foundation one foot deep, four feet wide and the same length as the cushion. At the north end of the proposed retaining wall, the barrier would be extended ten feet and angled away from traffic. It would be placed on top of the proposed gabion wall, and would be attached directly to the retaining wall without a concrete transition section. Examples of a crash cushion and transition barrier are shown in Figure 3.

Figure 1 Project Location Map



location map.dgn 5/13/2008 2:18:04 PM

Figure 2 Project Vicinity Map

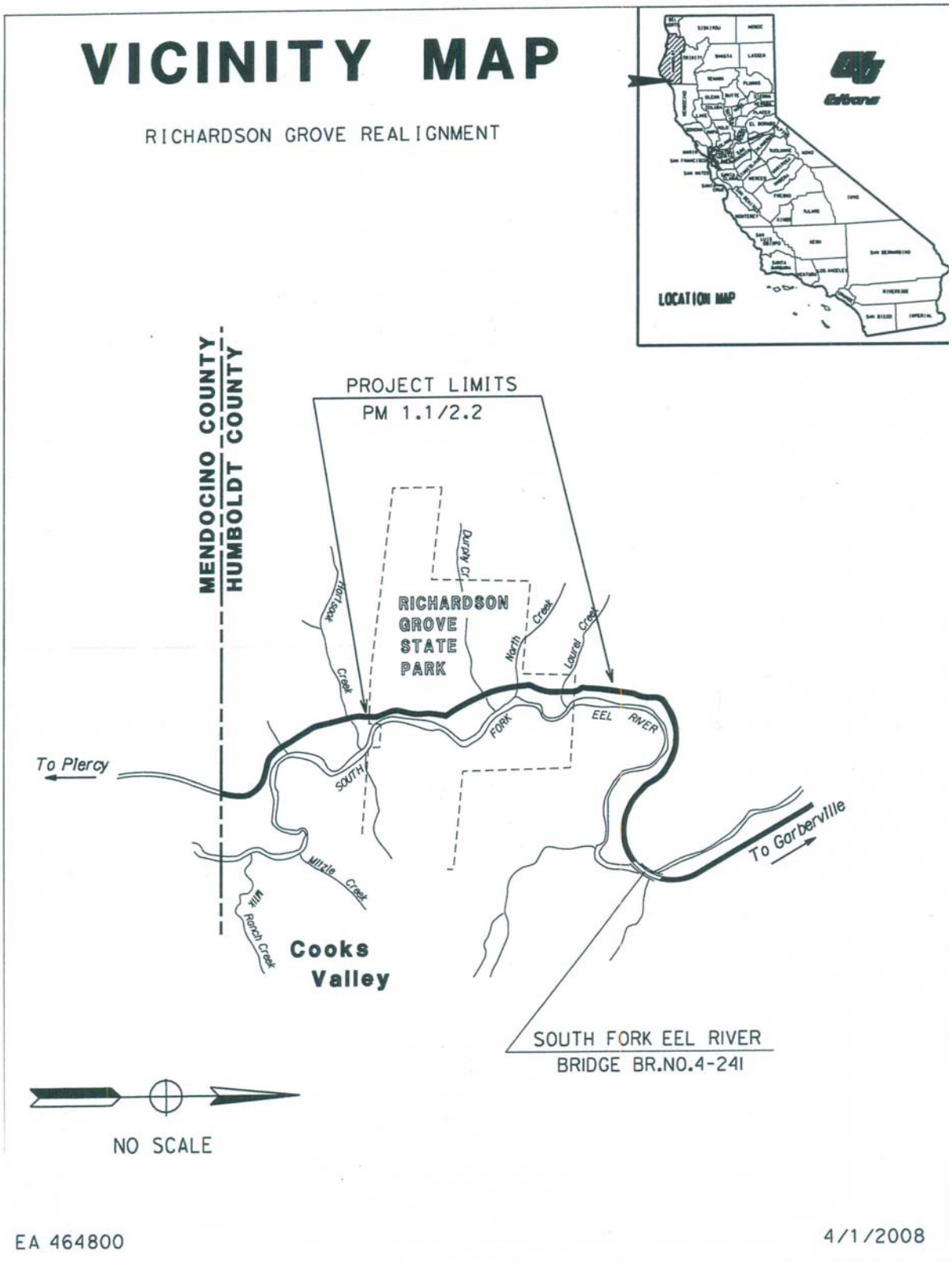


Figure 3 Proposed Barrier Rail Improvements – Examples from other projects

Metal Beam Guardrail Crash Cushion

Metal Beam Guardrail Transition Barrier

Chapter 2 –Affected Environment, Environmental Consequences and Avoidance and Minimization Measures

2.1 Affected Environment

Marbled Murrelet Surveys

The marbled murrelet (*Brachyramphus marmoratus*) is federally listed as threatened and state listed as endangered and has potential habitat in Richardson Grove State Park. The Biological Opinion of the U.S. Fish and Wildlife Service (USFWS) states that there was no evidence that marbled murrelets nest in Richardson Grove State Park; however, USFWS estimated that at least one nesting pair of marbled murrelets may be subjected to disturbance and "limited short-term harassment" from the project (USFWS 2009). As a result, the Department incorporated numerous measures into the project to avoid or minimize expected impacts. Among these measures is a prohibition on construction noise during the hours just before and after sunrise and sunset. The USFWS routinely requires these restrictions in areas of suitable habitat where surveys were not conducted and marbled murrelets are assumed to be present, or where surveys are not current. Another measure incorporated into the project, intended to aid recovery goals for the species by identifying nesting areas, required that a qualified biologist survey suitable breeding habitat for murrelets for two years within the project limits and vicinity. The Department conducted the surveys in 2011 and 2012, and detected no murrelets in either year (ICF International 2011, 2012). Because the survey results in the project area were negative, USFWS lifted the sunrise and sunset work restrictions for the project for five years.[1]

Definitions

"Old growth redwood trees," as defined for this analysis in consultation with State Parks, are those redwoods with a diameter of 30 inches and larger. The diameter is measured at 54 inches above ground level, and is referred to as the diameter at breast height, or DBH. The project is considered to potentially affect the old growth trees if ground disturbing activities are within a specified portion of their root zones. The California Department of Parks and Recreation (CDPR) defines this area as the "root health zone" (CDPR 2011). The root health zone is visualized as a circle with the tree trunk at the center, and a radius from the center of the tree equal to five times the trunk diameter. For example, the root health zone for a tree with a DBH of 30 inches would be a circle with a radius of 150 inches, or 12.5 feet. Project activities that are within 12.5 feet of the 30-inch tree may potentially impact that tree.

Types of roots in the root health zone include structural roots, lateral roots, and absorbing roots. The large woody structural, or buttress, roots are the primary support and stability for the tree. The majority of the structural roots occur within the structural root zone, visualized as a circle extending from the center of the tree to a distance equal to three times its diameter (CDPR 2011; Smiley et al., 2002). Both lateral and fibrous absorbing roots occur throughout the root health zone and are typically smaller in diameter than the structural roots. Lateral roots are

[1] Gregory Schmidt, biologist with U.S. Fish & Wildlife Service, e-mail dated June 18, 2013.

usually closer to the surface and may extend considerable distances from the trunk; they allow the tree to exploit areas that support growth (Harris et al. 2004). The fibrous absorbing roots supply the tree with water and nutrients. Absorbing roots are the smallest and most short-lived of the three types, and rapidly reproduce during favorable growth conditions (Urban 2008).

Design Features That Protect Old Growth Trees

Using survey information and engineering software, the Department designed the proposed project around old growth trees in order to avoid their removal. Every effort was made to accommodate tree roots in the design while meeting the objective of the project to allow passage for two STAA trucks moving in opposite directions. For example, to make needed changes to the "super elevation"[2] the design adds material to the upper side of the road, rather than removing it from the lower side and thereby disturbing tree roots.

The Department further protected trees by obtaining exceptions to mandatory and advisory design standards. The Department obtained design exception to the following mandatory standards: minimum shoulder width; minimum horizontal curve radii; stopping sight distance; minimum super elevations; and horizontal clearance to a fixed object. The Department also obtained design exceptions for the following advisory design features: compound curves; super elevation transitions; alignment consistency; embankment slopes; clear recovery zones; minimum profile grade; and minimum vertical curve length.

As a result of the exception for the minimum shoulder width, the road would not have uniform four-foot-wide shoulders, but would be widened where possible while minimizing potential impacts to old growth redwood trees. Exceptions for the mandatory minimum horizontal curve radii, stopping sight distance, as well as the advisory compound curve minimums allowed the Department to achieve the project goals without requiring the removal of additional trees. The same is true for the exceptions granted in the design of shorter super elevation transitions and alignment consistency to accommodate the use of shorter curve radii, where needed.

Decreased super elevations also reduce the amount of material that needs to be removed or added around tree roots. To allow for large trees along the winding roadway, the Department obtained an exception to the recommended horizontal clearance between the road and any fixed object (also known as the clear recovery zone). Clear recovery zones would normally be a minimum of 20 feet beyond the white fog-line for this highway. An exception to this standard was required to keep the highway as it is currently configured. Additionally, the proposed design includes embankment slopes that are steeper than usual, allowing for a narrower project footprint that impinges the least on the adjacent trees, and requires only the minimum of tree removals, none of which are old growth, as defined. The Department obtained approval to deviate from the minimum profile grade and minimum vertical curve length requirements in order to flatten the grade of the road and thereby minimize ground disturbance.

[2] "Super elevation" refers to tilting the roadway to help offset the forces that develop as a vehicle goes around a curve. Super elevation, along with friction of the tires on the road surface, keeps a vehicle from going off the road.

Revised Tree Data

Pursuant to the court order, the Department conducted a second census of all the trees within the area of ground disturbance. The Department also re-measured their diameters, as described below. The Department used this data, combined with extensive field verification, to revise maps of the old growth redwood trees and their root zones. The revised information was used to analyze potential impacts on old growth redwood trees and to update the numbers and sizes of smaller-diameter trees to be removed. The Analysis in Attachment B describes potential project impacts to each old growth redwood tree with a root health zone overlapping the project construction area.

Survey Methods

The Department prepared a set of 21 revised working maps showing the road alignment, the limits of the State's right of way, preliminary project limits, and previous tree survey data. These maps were used at the project site to verify the tree diameters and locations mapped previously. Staff again inventoried all redwood trees having a DBH greater than six inches, and all other trees having a DBH greater than eight inches. The inventory involved verifying or modifying previous data, adding and deleting trees, as necessary. Staff measured trees located within approximately 100 feet from the highway centerline to ensure that the inventory included every tree with a root zone that might be affected by the proposed project.

Measuring Tree Diameters

Tree diameters were re-measured in April 2012 using a standard forestry protocol adapted from the United States Department of Agricultural (USDA), Forest Service, National Core Field Guide, Version 4.0 (USDA 2007). The Core Field Guide specifies that the DBH should be measured 54 inches above the "uphill side of the tree." For this study, staff measured the diameter at 54 inches above the "average grade" around the tree, rather than the uphill side. This method yields a more conservative estimate, since the point of measurement is lower on the tree trunk where the diameter is usually larger. Measuring 54 inches above the average grade is recommended by the International Society of Arboriculture (Swiecki and Bernhardt 2001) as well as the California Forest Practice Rules (CDF 2012). In a separate field review conducted in December 2012, staff measured trees for a second time, and then used the most conservative (i.e., the largest) of the two measurements as the tree diameter on which to base the analysis of potential project impacts.

Root Disturbance and Adaptations of Coast Redwoods

One of the main considerations in evaluating the impacts of construction on redwood trees is the ability of the species to tolerate disturbance. Under contract to the Department, a registered consulting arborist, Dennis Yniguez of Tree Decisions, conducted a comprehensive review of the scientific literature on tree physiology and root impacts, and on redwood biology and ecology (Yniguez 2013). This information was used in the evaluation of potential effects of the project on redwood root systems.

Roots are frequently injured or die from many agents throughout the life of a healthy tree, and new roots often form rapidly after injuries (Perry 1992). Root pruning stimulates roots to

regenerate near the cut (Wilson 1970). When a tree's root, trunk, or branch tissue is disrupted by pruning cuts or other wounds, microorganisms begin to infect the site. The tree responds by forming chemical and physical "walls" (barriers) around the wound to slow or prevent the spread of disease or decay. This process is called compartmentalization (Shigo 1977, 1986). This was demonstrated in a study of the effects of severing roots of four species of deciduous hardwoods (Watson 2008). Different sizes of roots were cut at successive distances from each tree, starting at the trunk. Examining the roots five years later showed that the severed roots of all sizes had only minimal decay. The author concluded that, unlike in branches where leaving a stub can lead to more extensive decay, severing the roots did not cause substantial deterioration from root decay. The minimal decay after 5 years posed no threat to the long-term health and stability of these four species (Watson 2008).

Coast redwoods are surprisingly capable of compensating for disruptions to their root systems (Yniguez 2013). Among the characteristics reported in the literature that have enabled the coast redwood to exploit its habitat so successfully are:

- **An extraordinarily resilient root system;**
  Stone and Vasey (1962b:2–3) examined four old growth redwoods whose roots had been removed from the top two feet of soil. The crowns of the trees remained healthy and within four years, 90% of the feeder root system was replaced by a comparable one (Stone 1965). They comment, “What continues to surprise us is that so much of the root system can be removed without any noticeable reduction in vigor." Sturgeon (1964) described the trees along roads in Humboldt County, some of which had portions of their bases removed for road development. He noted, “Judging from the absence of significant loss of vigor in trees bordering the highways, coast redwood is evidently not seriously affected by paving where it does not cover more than half the trees' root zone.” Standish (1972) and McBride and Jacobs (1978) found no decline in tree growth in areas where the trees were subjected to soil compaction by visitors.

- **A strong and widespread root structure;**
  Coast redwoods have strong and widespread lateral roots that disperse aboveground forces to the soil and resist uprooting (Coutts 1983; Ennos 1993; Fritz 1929; Mattheck 1994; Olson et al. 1990; Stokes and Mattheck 1996; U.S. Forest Service 1908). The roots of individual trees graft onto other redwood roots to provide stability and anchorage, “together creating therefore a matrix like steel reinforcing bars in concrete” (Becking 1979).

- **Buttress flares containing specialized swellings called lignotubers;**
  Buttress flares are massive swellings at or below the ground level that can release shoots and regenerate new roots to increase vigor and stability in response to injury (Tredici 1998, 1999). They also store carbohydrates and mineral nutrients and help anchor trees growing on steep slopes (Tredici 1998, 1999).

- **Ability to tolerate heavy siltation from flooding;**
  Fritz (1934) examined the roots of a 1200-year-old coast redwood that fell in Richardson Grove State Park. It adapted to periodic siltation that partially buried its base and raised the ground level more than 11 feet by creating new sets of roots that grew upward into the sediment and formed to fit each new soil level.

- **Ability to withstand low light conditions, fire, and damage from fire, as well as resist decay and attack by insects;**
  The basal bark of a coast redwood trunk is thick and fire resistant, although periodic fires can kill the living tissue beneath the bark (Fritz 1931; Isenberg 1943). Coast redwoods have no important tree-killing insect or disease enemies (Fritz 1931) and are valued for their decay resistance.

- **Ability to obtain water from fog drip and through its needles;**
  Fog, dew, and rain can supplement water that is obtained from roots (Limm et al. 2009; Simonin et al. 2009). In one study in northern California, Dawson (1996) reported that between 8% and 34% of the water used by the coast redwoods was obtained by fog dripping from the foliage into the soil.

- **Ability to move water and minerals in a zig-zag pattern up the tree, supplying the entire crown.**
  Coast redwood tree roots lift water and dissolved minerals (sap) in zigzag patterns, which supplies water to all of the branches and leaves (Perry 1992). Because moisture is distributed completely over the upper crown, death or injury to individual roots of a coast redwood does not lead to corresponding one-sided trunk or branch death in the crown of the tree (Perry 1992). This water distribution pattern gives coast redwoods great adaptability to environmental changes (Rudinsky and Vité 1959).

Condition of Old-Growth Redwoods in the Project Area

Despite more than 90 years of highway traffic, including the passage of more than 15 million cars and trucks over the redwoods' root zones during the past decade, the old-growth redwoods alongside U.S. 101 appear to be in vigorous health (Yniguez 2013). Only three old-growth trees along the highway in Richardson Grove, at PM 1.37 and PM 1.69, show evidence of substantial prior detrimental impacts attributable to root destruction. During construction work on U.S. 101 decades ago, crews cut several large-diameter buttress roots of these three trees. Although spikes (uppermost dead treetops) reflect the severe moisture stress from decades ago, the canopies below appear to be vigorous and healthy today. The vigorous condition of the old-growth redwoods in Richardson Grove alongside U.S. 101 is an external manifestation of their successful resiliency (Yniguez 2013).

2.2 Environmental Consequences

Trees to Be Removed – Revised Data

Based on the revised analysis, the Department has determined that the proposed project would require the removal of a total of 56 trees, two more than were identified in the May 2010 Final EA. The additional two trees are a redwood measuring 7 inches DBH and an 18-inch DBH red alder. The alder occurs within the boundaries of Richardson Grove State Park, bringing the total number of trees to be removed in the park up by one, from 30 to 31. The largest tree to be removed is a 26-inch DBH Douglas fir, listed in Table 9 of the 2010 Final EA as 24 inches DBH. Table 1 compares the updated information on numbers and species of trees to be removed to the numbers from Table 9 in the 2010 Final EA. The difference between the original and revised numbers and species of trees to be removed reflects a difference in measuring method from the Final EA; intensive field checking; growth of trees since the original measurements; and updated identification of tree species. The changes in tree numbers and sizes are minor, and there would be no increase in the level of anticipated project impacts.

Number of Old Growth Redwood Trees Affected – Revised Data

Using the root health zone criterion of five times the diameter, the Department determined that a total of 116 old growth redwood trees have root health zones that intersect the proposed ground disturbance areas of the project (see Attachment A). This number is larger than that presented in the May 2010 Final EA because the original analysis used the structural root zone measurement (three times the tree DBH), rather than the root health zone measurement used for this supplemental assessment; the larger root health zone area was assessed for this analysis in response to the court order. In some cases, the number of affected trees was reduced because individual trees identified as separate plants in the May 2010 Final EA were reclassified as a single tree if their trunks forked above the 54-inch point of measurement. In all, the study currently assesses an additional 46 old growth redwoods. The table presented in Attachment C is a cross-reference of tree numbers in this Supplement with Tables 9 and 10 of the Final EA.

Individual Tree Analysis

A Department arborist and the project engineer conducted a tree by tree assessment for the proposed project for the May 2010 Final EA. The tree by tree assessment in the Final EA consisted of maps of the locations of more than 1,500 individual trees, measurements of each tree's diameter, tables showing which trees had structural root zones that would potentially be affected by the project, and a quantification of the inches of soil excavation and filling in the structural root zones of affected old growth redwood trees. For this supplement to the assessment, the review team consisted of the project engineer, environmental coordinator, and consulting arborist Dennis Yniguez, using maps based on the updated tree information. The team referred to site-specific, quantitative information available from current project plans and cross-sections, and again systematically examined each old growth redwood tree that might be affected by the project to determine the types and limits of the work that would take place around it.

Table 1 Comparison of Original and Revised Numbers of Trees Proposed To Be Removed

Species	Size*	Final EA Table 9		Revised Numbers	
		Total Quantity	Number in the Park	Total Quantity	Number in the Park
Redwood	4-8	4	2	5	2
Redwood	8-12	0	0	0	0
Redwood	12-18	1	0	1	0
Redwood	18-24	1	0	1	0
Redwood Total		6	2	7	2
Douglas Fir	4-8	3	0	4	1
Douglas Fir	8-12	6	5	6	5
Douglas Fir	12-18	9	4	4	2
Douglas Fir	18-26	2	1	5	2
Douglas Fir Total		20	10	19	10
Big Leaf Maple	4-8	0	0	1	0
Big Leaf Maple	8-12		0	0	1
Big Leaf Maple	12-18	1	1	1	1
Big Leaf Maple	18-24	1	1	1	1
Big Leaf Maple Total		2	2	3	3
Tan Oak	4-8	11	7	10	7
Tan Oak	8-12	11	5	10	5
Tan Oak	12-18	1	1	3	1
Tan Oak	18-24	1	1	1	1
Tan Oak Total		24	14	24	14
Other	4-8	1	1	1	0
Other	8-12	0	0	0	
Other	12-18	1	1		
Other	18-24			2	2
Other Total		2	2	3	2
Grand Total		**54**	**30**	**56**	**31**

*Size, in inches at diameter breast height (the diameter of the tree trunk measured at 4.5 feet above ground level

Specifically, the team evaluated the potential impact of root disturbance within the root health zone of each tree, as well as the condition of the tree and its environmental setting. The evaluation of impacts reflects the scientific literature regarding the biology and management of coast redwood trees; professional experience of the arborist with redwood trees and the effects of construction on trees; extent of work within the root health zone; and the incorporation of

avoidance and minimization measures into the project. The Individual Tree Analysis (Analysis) (Attachment B) presents the supplemental assessment information for the potential effects of the proposed project. This includes, for each tree: the tree's diameter and previous number in a table, if it was listed in the Final EA; the details of proposed project work in its root health zone, and whether it would occur in the structural root zone of the tree; the proposed avoidance and minimization measures proposed; and an appraisal of the potential project effects on each tree's health. Additionally, this Analysis includes illustrations that show the root health and structural root zones for each tree and a depiction of proposed work within these areas of the tree. Figure 1 of the Analysis provides a legend for the illustrations.

Ground Disturbing Activities and Root Impacts

The primary activities for this project that require ground disturbance are widening and realignment of the roadway. Activities that require excavation that are less frequent throughout the project limits include replacing culverts, constructing gabion and soldier pile walls[3], installing barrier rails and cutting back roadside slopes. The locations of these features are shown in relation to the surrounding trees in Attachment A, and shown for each tree's root health zone in Attachment B. Figure 4 shows a typical cross section including three types of ground disturbing activities for this project: digging for new road sections, cutting back slopes, and building embankment.

Ground disturbing activities typically associated with road construction include the severing of roots. Except in the limited areas described in Section 2.2.3 ("Avoidance and Minimization Measures"), the Department has specified that this project would use alternative methods to construct new road sections directly adjacent to old growth redwoods that do not require cutting larger roots. New road sections are constructed by removing soil to a depth of approximately 24 inches and replacing the excavated soil with road base and pavement. Soil is then placed next to the new road section to build the embankment up to fit the new road grade. The Department would require that this activity be done using hand tools or a specialized arborist's tool called a pneumatic excavator[4] within the structural root zone of old growth trees. The Department also proposes irrigating the root zone during construction in drier months, and using a thinner Cement Treated Permeable Base (CTPB) as the road base material. Section 5 contains a full description of proposed protection measures for old growth redwoods within the project limits. Using these alternative methods would prevent impacts to the roots of the adjacent old growth redwoods.

Placing impervious material and embankment over the roots can cause compaction of soils that breaks down soil aggregates, potentially resulting in poor aeration, reduced drainage, impaired root growth, increased erosion and greater susceptibility to root rots (Harris 2004). The proposed construction would add less than 5% of hardened surface (roadbed) to the existing hardened surface within the structural root zone. Because of the limited extent of embankment

[3] Gabion walls are made of rock-filled steel mesh boxes. Soldier pile walls use vertical metal beams (piles) placed in drilled 30-inch-diameter holes up to 20 feet deep, and spaced eight feet apart. Horizontal wooden planks fill in the area between the piles.

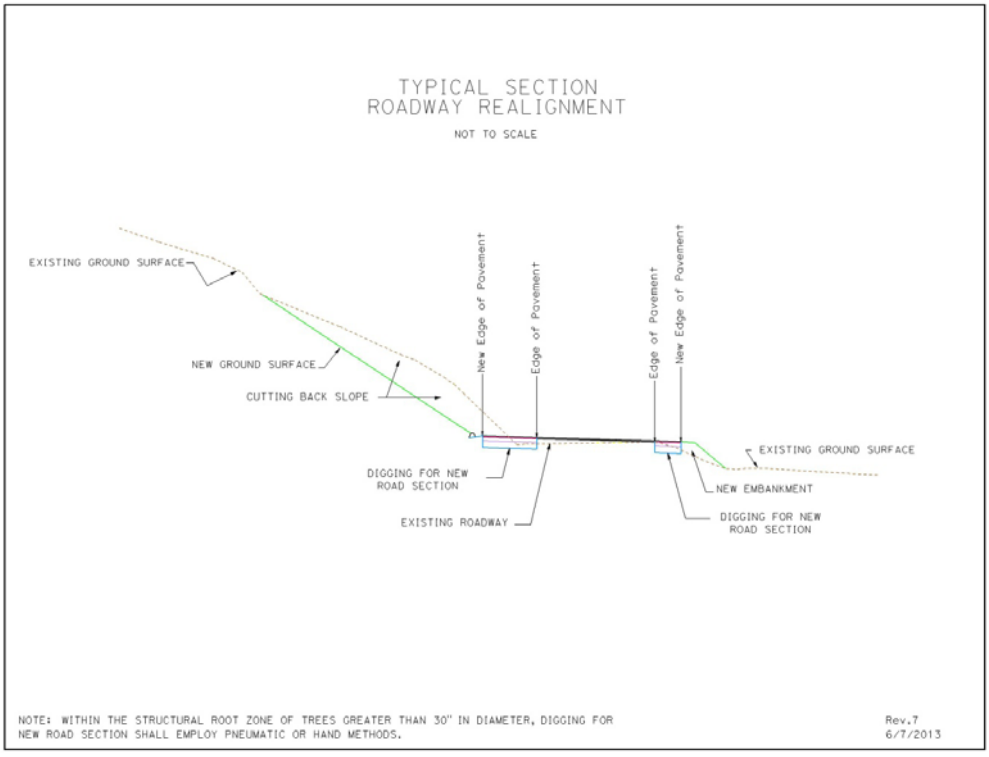
[4] A pneumatic excavator is a specialized arborist tool that removes soil, debris and rock around tree roots with compressed air, without cutting the roots themselves.

and impervious material being placed by this project, and the resilience of coast redwood root systems, these are not likely to adversely affect old growth trees (Yniguez, 2013).

Road widening would likely result in additional compaction of the soils within the structural root zone of some old growth redwoods. Realignment of the existing road, however, could decrease compaction in other areas in where realignment would move the roadbed further away from certain trees. Following realignment, crews would remove the old section of road. The minor increase in compacted area created by these limited highway modifications, a total of 0.14 acres in the structural root zones, would be insignificant to the health and stability of the old-growth redwoods (Yniguez 2013). Research has consistently demonstrated that soil compaction over a small percentage of the root structure of a vigorous old-growth redwood would not, in itself, have any significant detrimental or life-threatening effects (Gothier 1980; Hartesveldt et al. 1975; McBride and Jacobs 1978; Standish 1972; Stone 1965; Stone and Vasey 1962a, 1962b; Sturgeon 1964).

The Department designed the proposed project to maintain as much sheet flow of rain runoff from the highway as possible, to utilize the exceptional filtering properties of the forest duff layer. At PM 1.78 and PM 2.10, the proposed project includes redirecting drainage, which is currently inadequately controlled and causing erosion, to existing culverts. Because of this design feature, the Department included the trees at these locations in the impact analysis. Other than these minor improvements, the proposed project would not change existing drainage patterns.

Figure 4 A Typical Cross Section of Ground Disturbing Activities in Road Improvement



Results of Tree Evaluations

Ground disturbing activities would occur within the structural root zone for 74 of the 116 old growth redwood trees analyzed, 70 of which occur within the boundaries of Richardson Grove State Park. Each tree was rated according to the predicted effects of root disturbance on tree health that would be indicated by a change in the appearance of needles (leaves) (Yniguez 2013). For 95 of the trees evaluated, the Department determined that root zone disturbance would have, at most, a very slight effect on tree health. For a total of 21 trees, the Department determined that the project would have slight effect on tree health, but no decline in foliage density or tree health. In no case would root disturbance have a significant detrimental effect on the health or stability of old-growth redwoods (Yniguez 2013).

There is ample evidence in the literature to support these conclusions. Research on coast redwood root regeneration has demonstrated the extraordinary ability of coast redwoods to regenerate new roots even after up to 90 percent of the "feeder" (absorbing) roots have been destroyed (Stone 1965; Stone and Vasey 1962a, 1962b). By contrast, the disturbances for this project would be confined to a small percentage of the area occupied by roots. Additionally, all of the trees evaluated for the current effort have already been affected by the highway in their immediate vicinity, and have adjusted to those effects (Yniguez 2013).

The proposed project design includes the placement of culverts within the structural root zones of five old growth redwoods (Trees #12, 13, 15, 104 and 105). The Department proposes using a cement backfill at these locations to allow for excavating a narrower trench, thereby limiting the extent of root disturbance. In addition, the culvert at PM 1.34 appears to be located above the large buttress root of Tree #12; the replacement culvert would not be placed any deeper than the existing culvert. Because of the limited total area of root disturbance, the resilience of coast redwood root systems, and the use of avoidance and minimization measures, culvert replacement would not threaten the trees' health and stability (Yniguez 2013).

Tree #13 is within 12 feet of a cut slope at PM 1.35 – 1.36, and crews would likely encounter roots larger than two inches in diameter during construction. As discussed further below, construction crews would cut the roots cleanly to promote compartmentalization and sealing of root tissue. There is abundant water available around this tree, and the area of soil excavation and root removal is too small to significantly diminish the availability of water to the tree (Yniguez 2013). The remaining undisturbed roots would continue to absorb and distribute water throughout the circumference of the tree crown. Death or injury to individual roots of a coast redwood does not lead to corresponding one-sided trunk or branch death in the crown of the tree (Perry 1992).

Outside the boundary of Richardson Grove State Park, the Department proposes installing gabion walls at the end of a soldier pile wall, and within the structural root zones of Trees # 104 and 106. The Department chose to use gabions walls at the ends of the proposed soldier pile

wall because they are flexible and would have less impact on the trees than extending the length of the soldier pile wall.

The Department has identified one location, at Tree #83, where fill placed up to the trunk would be four inches or greater in depth. At this tree, the Department proposes using a “brow” log, to help maintain air circulation and allow the tree to gradually adjust to the change in grade. Specific information on the use of a brow log is described in Section 5, Avoidance and Minimization Measures. Using this method, the Department has concluded that the effect of the embankment on this tree would be slight and temporary, and is well within the tree’s ability to adapt (Yniguez 2013).

The disturbances to the root zone of the old growth redwoods by the proposed project would be effectively limited by the proposed avoidance and minimization measures (Yniguez 2013). There is no reason to expect that the crown of any old-growth redwood would exhibit signs of stress such as branch dieback, needle loss, or needle desiccation as a result of proposed project activities (Yniguez 2013).

2.3 Avoidance and Minimization Measures

The Department has incorporated numerous protection measures into the proposed project that avoid or minimize the effects of project activities on the old growth trees and their environment. The project team collaborated with Darin Sullivan, the Department’s arborist, to develop the measures, and they were reviewed by consulting arborist Dennis Yniguez. This list of measures was approved for the 2010 Final EA and contributed to the finding of no significant impact for this project.

This is a complete list of the avoidance and minimization measures that would be incorporated into the proposed project to ensure that old growth redwood trees would not be adversely affected:

- A pneumatic excavator or hand tools would be used when digging the soil within the structural root zone of old growth redwoods, with the exception of culvert work, soldier pile, gabion and barrier wall installation, and cutting back roadside slopes. Mechanized equipment may be used at these locations upon approval of the construction engineer.

  When widening or realigning the roadway within the structural root zone of old growth redwoods, crews must either use hand tools or a pneumatic excavator to remove the soil around roots two inches and larger and protect them from being cut. The pneumatic soil excavation technique is recommended when root preservation is a key objective for "high-value" trees (Gross and Julene 2002).

- Except for areas of proposed cuts (culvert work, wall work and cutting back roadside slopes), roots within the structural root zone of old growth redwoods that are larger than

two inches in diameter would not be cut. Roots less than two inches in diameter that must be cut would be cut back cleanly with a sharp instrument.

- In areas where the road would be widened or realigned, cement-treated permeable base (CTPB) would be used in the base section for new pavement. CTPB minimizes the thickness of the new road section by approximately six inches compared to other common road base, provides porosity and minimizes compaction of roots.

- To protect roots and promote air circulation in soil where new embankment is constructed, any duff would be raked off the area by hand, stored, and replaced as erosion control.

- In locations where embankment four inches in depth or greater would be placed up to the trunk of old growth redwood trees, a brow log[5] would be placed against the trunk, parallel to the road.

  If more than one log is needed, crews would anchor the logs to each other using rebar. Embankment would then be added against the brow log rather than against the tree. Using this method would maintain air circulation at the trunk of the tree and allow it to gradually adjust to the change in grade.

- Except for the cut slope at PM 1.35, the structural root zone of old growth redwoods would be irrigated within 24 hours of digging below the finished grade. Irrigation would continue once a week thereafter, using a water truck with a fan spray, from June 1 through September 30. Water equivalent to ½ inch in depth would be applied to the area defined as from the edge of pavement to 25 feet beyond the edge of pavement.

- A 5-year program of invasive plant removal would be implemented within Caltrans ROW to increase the resiliency of the old growth forest community in the project area.

- No heavy equipment would be staged or parked on native soil within the drip line of old growth redwood trees.

- Long term equipment and material storage sites would not be located in the Park. Equipment and material for immediate use would not be stockpiled off the paved area without concurrence from Arborist, except for the unpaved turnout at PM 1.79+/- to the west.

- Trenching for the culvert work would be done from the paved roadway.

- A certified arborist would monitor and document all ground disturbing activities around old growth redwoods.

[5] Crews would use the largest redwood removed for the project (21 inches in DBH, providing 12-14 inches of heartwood) as a brow log, as it would take the longest time to decompose.

- Vegetation for replanting would be obtained from the California Department of Parks and Recreation Shadowbrook Nursery.

  To prevent erosion, disturbed areas would be mulched with native duff and soils, and replanted before the onset of heavy winter rains.

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