



MRC Albion IFM Carbon Project

INVENTORY METHODOLOGY

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This document contains specifications for the collection of data in the field for the MRC Albion IFM project inventory, as well as the data to be collected and the standards for data collection and processing.

1.0 Offset Project Boundary

The Project includes approximately 24,054 acres of timberland characterized by Coastal Redwood, Douglas-fir, Tanoak, Pacific Madrone, true oak, and associated conifer and hardwood species. The Project Boundary includes the following GHG emission sources, GHG sinks, and GHG reservoirs (SSRs or Carbon Pools) as defined in table 4.2 of the Compliance Offset Protocol U.S. Forest Projects, June 25, 2015:

- IFM-1 Standing live tree carbon (carbon in above- and below-ground portions of living trees)
- IFM-3 Standing dead tree carbon (carbon in all portions of standing dead trees)
- IFM-7 Carbon in in-use forest products
- IFM-8 Forest product carbon in landfills
- IFM-14 Biological emissions/removals from changes in harvesting on forestlands outside the Project Area
- IFM-17 Biological emissions from decomposition of forest products

The standard procedures for collecting field measurements are detailed below and are generally aimed at the collection of tree data pertaining to the quantification of the IFM-1 and IFM-3 carbon pools. Carbon in carbon pools IFM7, IFM-8, IFM-14, and IFM-17 are calculated as described in the calculation methodologies section below.

2.0 Inventory Sampling Methodology

A full site inventory of the project will be conducted from March 2022 through April 2023 by using guidance provided by the MRC Albion IFM Carbon Project Inventory Specification (Appendix B). Prior to sampling, the forest stands within the project boundary were drawn using aerial imagery taken in June 2018 and May – July, 2021. These stands captured the species composition and structure of the forest. Using the MRC continuous property-wide inventory data collection strategies, stands within the project area were subjected to stratification.

2.1 Stratification Rules

The project area has been stratified to reflect the relative carbon densities within the project area. This pre-inventory stratification for the carbon project was completed using inventory data collected and updated since 2019. Using this data, the available standing carbon volume per acre for each stand was calculated. The stratum breaks for five strata within the project area was decided using the Natural Breaks (Jenks) on ArcGIS Pro for the stand carbon densities. The five strata reflected the stand carbon densities from, very low carbon (C1) to very high carbon (C5). An additional zero carbon stratum was introduced to include roads and landings within the project

boundary. Table 1 shows the pre-cruise carbon density ranges for all strata. A map of the timber stand boundaries is included in Appendix C.

Table 1: MRC Albion IFM Carbon Project pre-cruise carbon density breaks used to stratify the project area. This table also shows the area associated to each stratum and the number of plots proportionally allocated to strata.

Stratum	Pre-cruise Range (Mg CO_{2e}/ac)	Area (ac)	Number of plots
C0 - Zero Carbon	0.00	755.97	0
C1 - Very Low Carbon	0.00 – 136.87	957.06	13
C2 - Low Carbon	136.98 – 296.88	7,163.70	84
C3 - Medium Carbon	296.88 – 427.02	7,989.92	127
C4 - High Carbon	427.02 – 573.00	5,456.67	164
C5 - Very High Carbon	573.00 – 1040.62	1,730.67	50

Table 1 will be updated with the submission of the Initial OPDR.

2.2 Sampling Methodology

Sampling was conducted through the installation of sampling points on a systematic 5 chain by 5 chain (330 x 330 ft.) grid that covers the entire project area. The point grid created using the Fishnet tool in ArcGIS Pro will serve as the master plot grid for the project area. Each point inside the project boundary is assigned a unique Plot ID. This master plot grid was used to select plots for the new inventory cruise and will be used to select new plots in the future.

A stratified random sampling design resulted in the installation of 438 plots. These plots were proportionally allocated to the pre-assigned carbon strata areas (Table 1). Sample plot locations within a given strata were randomly selected using a random point selection script in ArcGIS Pro.

A description of the sampling methodology for each of the carbon pools listed above is included in the Listing form under Section VII.A and is included herein by reference. A detailed description of the data collection procedures for IFM-1 and IFM-3 SSRs is described in Appendix B, MRC Albion IFM Carbon Project Inventory Specification.

3.0 Calculation Methodologies

A description of the calculation methodologies used to determine metric tons per acre of each of the carbon pools listed above is included in the Listing form under Section VII.B. and is included herein by reference. Included are the analytic methods and biomass equation references used to translate field measurements into volume and biomass carbon estimates.

4.0 Data Management Systems and Data Processing

This section will be updated with the submission of the Initial OPDR.

5.0 Quality Assurance/Quality Control (QA/QC)

Procedures for ensuring quality control are explained in the attached Appendix B, MRC Albion IFM Carbon Project Inventory Specification document under the Section 5.0.

6.0 Inventory Monitoring

This section will be updated with the submission of the Initial OPDR.

7.0 Identification of Known or Potential Diseases

According to the 2021 California Forest Pest Conditions¹ report published by the California Forest Pest Council, following are the known or potential diseases that may affect the health of the project's inventory.

One of the most well-known diseases that affects forests in Northern California is sudden oak death. Sudden oak death is caused by the fungus-like plant pathogen *Phytophthora ramorum* and primarily affects several species of oak trees such as coast live oak (*Quercus agrifolia*), and tanoak (*Notholithocarpus densiflorus*) and can also affect other tree species such as Douglas fir, California bay laurel, and coast redwood. *P. ramorum* infects the phloem and inner bark to cause bleeding cankers on oak species. It can also infect sapwood, restricting water transport in the xylem. Foliar symptoms are generally not observed on true oaks, however, tanoak leaves in the canopy may exhibit mid-vein and petiole and twig necrosis. The disease thrives in cool, wet climates and is particularly prevalent in California, coastal evergreen forests and tanoak/redwood forests within the fog belt².

Of the several insects and pathogens affecting Douglas-fir species, black stain root disease and Heterobasidion root disease have been identified in Mendocino County. Black stain root disease is caused by the fungal pathogen *Leptographium wageneri* var. *pseudotsugae* and vectored primarily by the root-feeding bark beetle, *Hylastes nigrinus* and the reproduction weevils *Pissodes fasciatus* and *Steremnius carinatus*. The pathogen colonizes the sapwood xylem in the roots, which blocks water transport to the upper stem and foliage thereby creating tree mortality³. Black stain can be distinguished from other root diseases by the distinctive chocolate brown to purple-black stain in the sapwood of roots and lower stems of infected trees. The black stain appears in arcs roughly concentric with the growth rings when observed in cross section⁴. Black stain is recognizable by weakening symptoms in the trees such as declining vigor, reduced needle retention, and dull gray/green foliage discoloration. Since the disease spreads via root grafting with neighboring hosts as well as by insect vectors, it can be partially controlled by removing all the infected trees from the area of infection as well as adjacent trees not yet displaying symptoms.

¹ https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd1008290.pdf

² <https://www.suddenoakdeath.org/>

³ Michelle C. Agne, Peter A. Beedlow, David C. Shaw, David R. Woodruff, E. Henry Lee, Steven P. Cline, Randy L. Comeleo. 2018. Interactions of predominant insects and diseases with climate change in Douglas-fir forests of western Oregon and Washington, U.S.A., Forest Ecology and Management. 409. 317-332.

⁴ Hessburg, P.F., Goheen, D.J., Bega, R.V., 1995. Black stain root disease of conifers. Forest Insect Disease Leaflet 145, USDA Forest Service, Washington, D.C.

Heterobasidion root disease (previously called annosus root disease) is caused by either *Heterobasidion occidentale* or *Heterobasidion irregulare*. *H. occidentale* affects many species of western conifers including *Abies* spp., *Tsuga* spp., Douglas-fir, and *Picea* spp.. *H. irregulare* affects a broad range of conifer and hardwood tree species. Spores of the fungus germinates on freshly exposed wood surfaces and develops hyphae that grow through woody tissues. Mycelial growth that invades the healthy root network ultimately results in death of living cells and wood decay in the sapwood and heartwood. Conks form on infected host tissues at sheltered locations on the bases and roots of host trees and in decaying stumps. The most reliable way to diagnose heterobasidion root disease is to find fruiting bodies in infected trees or stumps in the form of small light-colored pustules or button conks, or larger woody crust-like or shelving conks. *H.occidentale* and *H. irregulare* spread long distances aboveground via airborne spores, and locally underground through mycelial growth across host tree root contacts⁵.

In addition, *Fusarium circinatum*, a fungal plant pathogen that causes the serious disease pitch canker that affects *Pinus radiata* (Monterey pine) has also been identified in California. The fungus causes cankers that girdle branches which results in canopy dieback. The resin exudates ('pitch') from the girdling lesions are found in one or two whorls of a branch tip that causes it to die. In most cases, axial growth of the pathogen does not extend very far proximally, and so does no further visible damage to the tree. The disease intensifies through repeated infections that can lead to extensive dieback in the canopy⁶.

⁵ https://apps.fs.usda.gov/r6_decaid/views/heterobasidion_root_disease.html

⁶ Gordon, T.R.; Storer, A.J.; Wood, D.L. 2001. The pitch canker epidemic in California. *Plant Disease*. 85: 1128–1139.

Appendix A:

Inventory Change Log

MRC Albion IFM Inventory Change Log

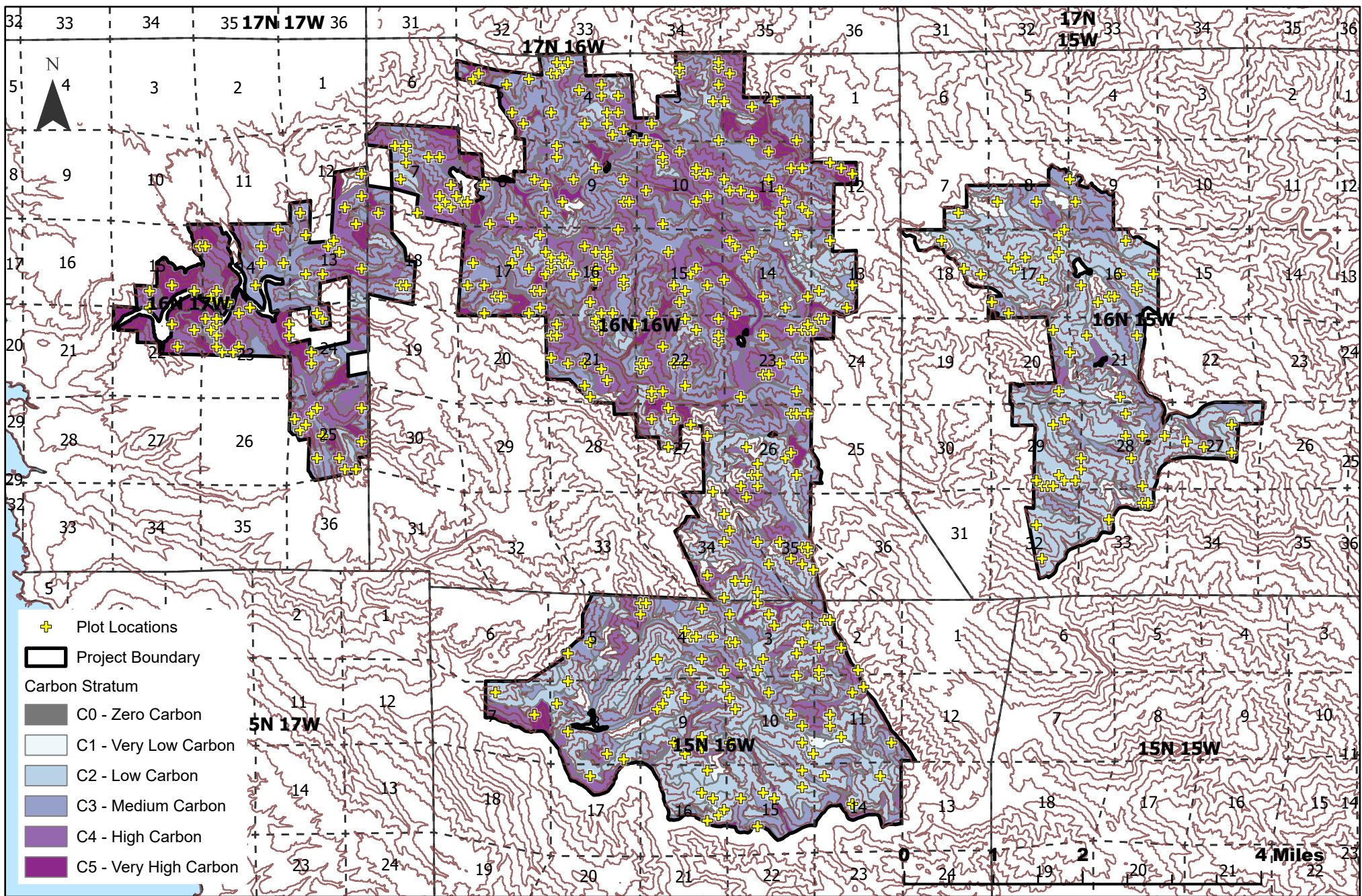
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Appendix B:
MRC Albion IFM Carbon Project Inventory Specification

(Confidential)

Appendix C:

Plot and Strata Map



MRC Albion IFM Project - Plot and Strata Map

These lands belong to the Mendocino Redwood Company, LLC situated in the Mendocino County of the State of California.
 These lands are part of an Improved Forest Management project developed using the ARB Compliance Offset Protocol for U.S Forest Projects.