



Lubrecht Forest Carbon Project

Initial Offset Project Data Report,

Version 1.5 - July 22, 2021



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OPR Project ID: CAR1332

Air Resources Board

Compliance Offset Protocol - U.S. Forest Projects

Adopted: June 25, 2015

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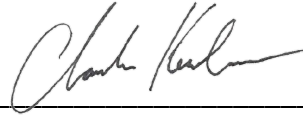
Cal. Code Regs. tit. 17, § 95800-96023 (April 2019)

ATTESTATION

I certify under penalty of perjury under the laws of the State of California the GHG reductions and/or GHG removal enhancements for Lubrecht Forest Carbon Project from February 20, 2019 through August 20, 2019 are measured in accordance with the Compliance Offset Protocol U.S. Forest Projects, June 25, 2015 and all information required to be submitted to ARB in the Offset Project Data Report is true, accurate, and complete.

Charles Kerchner

Printed Name



Signature

Spatial Informatics Group, Senior Scientist

Title

Date: July 22, 2021

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1 INTRODUCTION

Forest Offset Protocol §7.1.1 (a)(1 -2)

The Lubrecht Forest Carbon Project (hereafter Lubrecht Carbon Project) is an Improved Forest Management (IFM) project developed pursuant to the California Air Resources Board Compliance Offset Protocol – U.S. Forest Projects adopted June 25, 2015. The Offset Project Operator is Montana Forest and Conservation Experiment Station (MFCES) which has contracted with Spatial Informatics Group LLC to be the Authorized Project Designee for the project.

This approximately 18,817-acre project is located on commercial timberland land held in fee ownership by MFCES, in Missoula County. The property is part of the Lubrecht Experimental Forest and is used by University of Montana students and faculty for study and research. The property is a conifer-dominated forest with forest-enclosed montane prairies. Land use activities on the property include long-term forestry demonstration sites as well as timber harvesting, livestock grazing, hunting, and recreation. Management of the property is designed to improve education, recreation and ecological values while at the same time generating income for MFCES from forestry, carbon offsets and other sustainable land management.

2 OWNERSHIP

Forest Offset Protocol §7.1.1 (a)(6-7), Regulation §95974

MFCES is the sole owner in fee of the forestland and resource ownership for the real property and is identified as the Offset Project Operator with the legal authority to implement the offset project. The Project Area was determined using property boundaries of parcels the MFCES already owned. There have been no changes in the status of the Forest Owner, including acquisition of new forest landholdings that would impact the project or Project Area.

As the Offset Project Operator, MFCES delegates responsibility to SIG, as the Authorized Project Designee for performing and meeting the requirements of project listing, monitoring, reporting, record retention, verification, and credit issuance for the Lubrecht Carbon Project

3 PROJECT ELIGIBILITY

3.1 PROJECT TYPE

Forest Offset Protocol §2.2, §7.1.1 (a)(2)

The Lubrecht Carbon Project is an Improved Forest Management Project as defined by Air Resources Board Compliance Offset Protocol – U.S. Forest Projects, adopted June 25, 2015. The

project will generate CO₂ emission reductions by managing for increased carbon sequestration and stocking when compared to the project baseline. This will be accomplished by significantly reducing the amount of timber harvest in the project activity in comparison to the baseline scenario.

3.2 LOCATION – UNITED STATES

Forest Offset Protocol §2.2, §3.2, §7.1.1 (a)(10), §7.1.1 (a)(15)

The project occurs on land located in the jurisdiction of Missoula County, the State of Montana, and the United States of America (Figure 1, Figure 2). The physical address of the project site is 38689 Highway 200 East, Greenough, Montana 59823.

3.2.1 Forested Land

Forest Offset Protocol §2.2 (b)(3), §7.1.3 (a)(1)

The Lubrecht Carbon Project takes place on land that has greater than 10 percent tree canopy. Compliance is demonstrated using LiDAR data acquired in 2015. The LiDAR data had an average point cloud with greater than 25 points per square meter in forested stands. The LiDAR data were integrated with leaf-on imagery to assess the current extent of canopy cover within the project area. The result of this analysis was that within the project area, average canopy closure was approximately 57 percent (Figure 3).

3.2.2 Ownership Category

Forest Offset Protocol §3.2 (f), Regulation §95974

MFCES is the sole private owner in fee of the offset project area (Attachment A). The project area is not located 1) on land that is owned by, or subject to an ownership or possessory interest of a Tribe, 2) on Indian Land as defined in 25 U.S.C. §81(a)(1), or 3) on land that is owned by any person, entity, or Tribe within the external borders of such Indian Lands.

3.2.3 Previous Offset Project Status

Forest Offset Protocol §3.1 (b)(4), §7.1.1 (a)(33-34)

Within the Project Area, no greenhouse gas emission reductions or removal enhancements have been credited or claimed for the purpose of greenhouse gas mitigation or reduction goals, either in a voluntary or regulatory context or sold to a third party prior to listing. Land within the Project Area has never been listed or registered with an offset project registry or program.

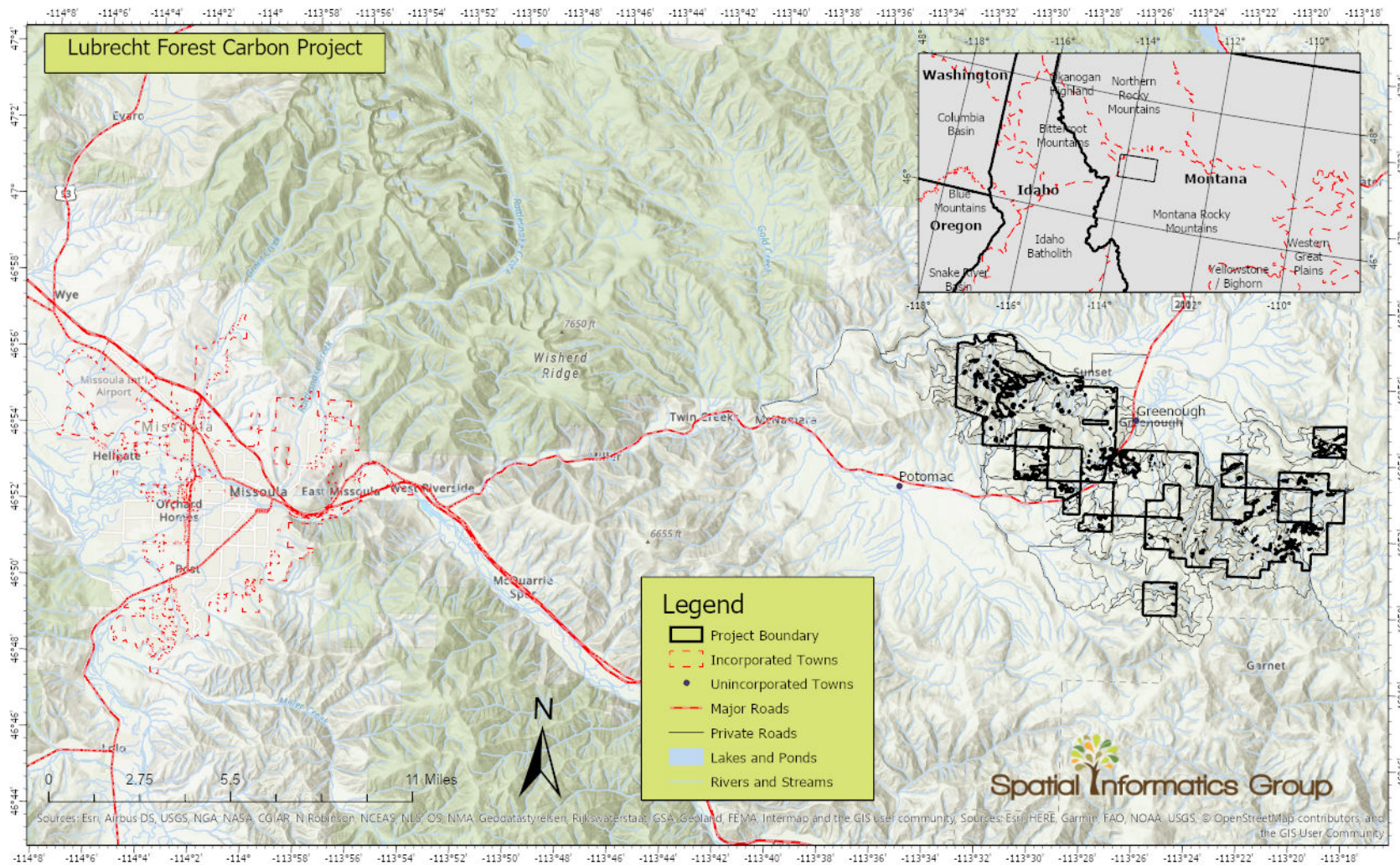


Figure 1. Project Area Vicinity with roads, towns, jurisdictional boundaries

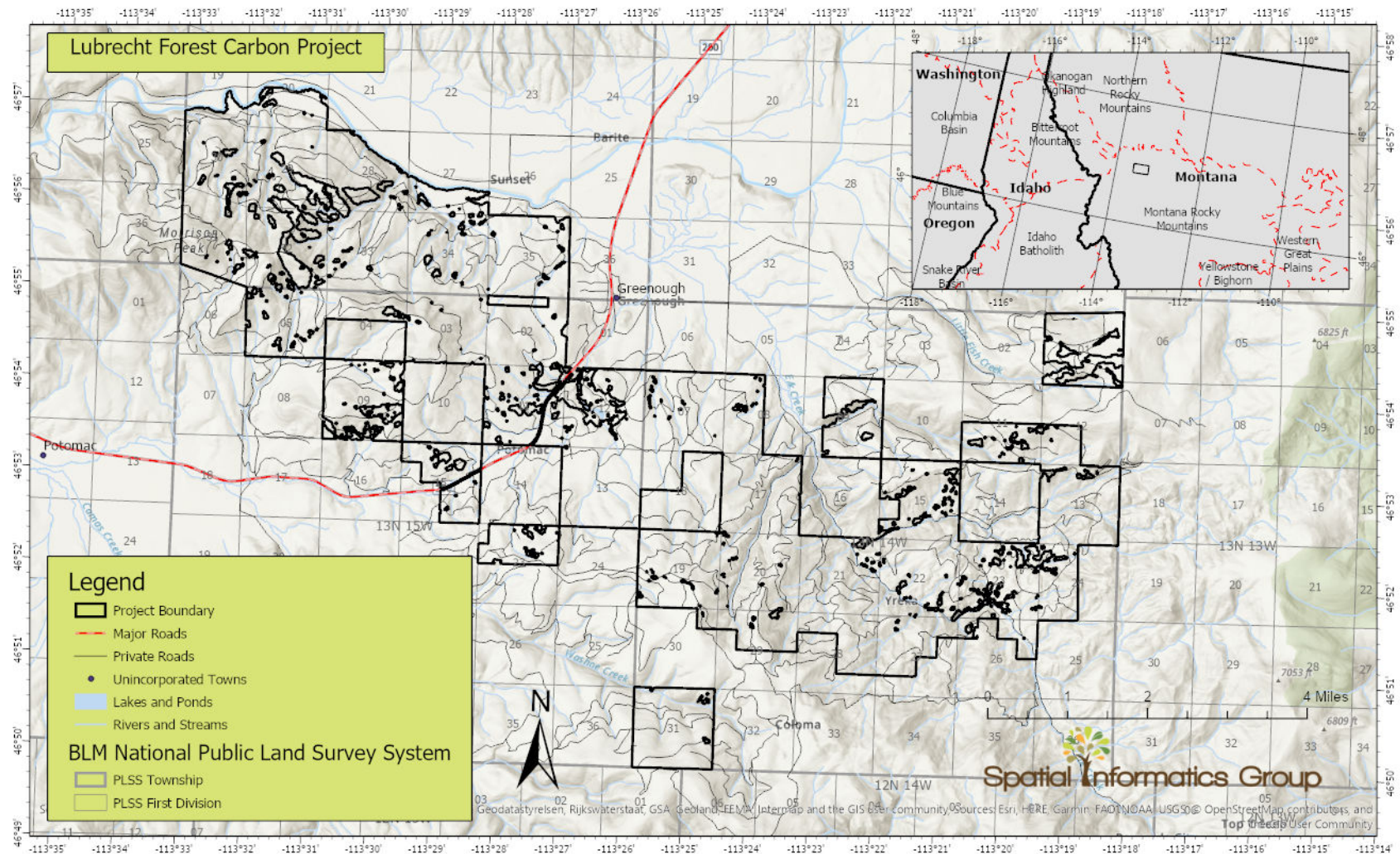


Figure 2. Project Area with major roads, topography, townships, sections, and ranges, and coordinates

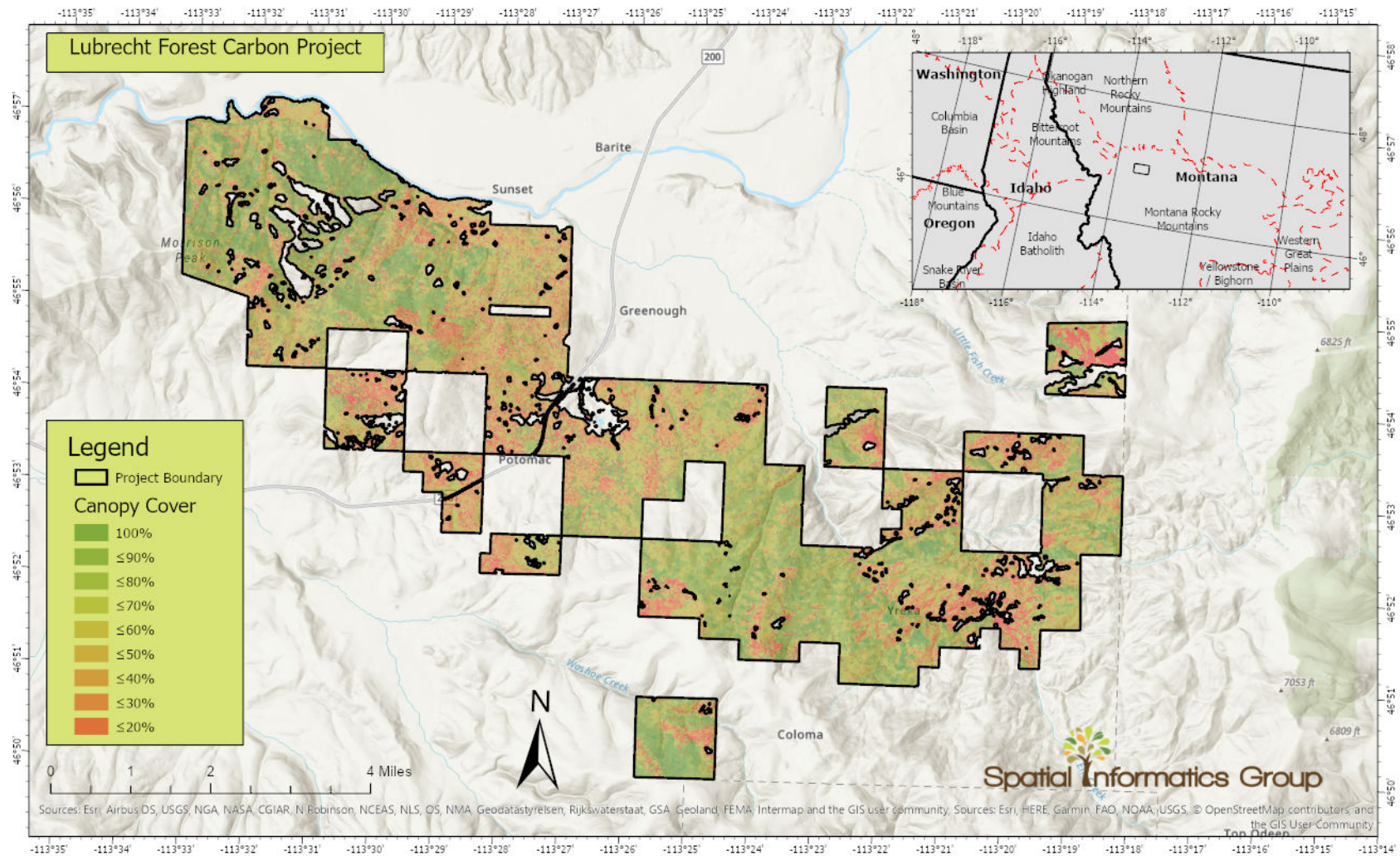


Figure 3. Forest canopy cover

3.3 OFFSET PROJECT AREA

3.3.1 Geographic Boundaries

Forest Offset Protocol §2.2, §7.1.1 (a)(15)

The Lubrecht Carbon Project Area is 18,817 acres, located near the unincorporated town of Greenough, Montana (Figure 1) (Figure 2). The Project Area is located at approximately 46.8960 N and 113.4342 W.

Existing Land Cover and Land Use - §7.1.1 (a)(15)(G)

The Project Area is currently being managed for multiple uses by MFCES, including its primary purpose as a site for education and research demonstration forestry projects as well as timber harvest, recreation, livestock grazing and hunting. The existing land cover within the Project Area is conifer-dominated forest with forest-enclosed montane prairies. The primary forest vegetation types within the Project Area are mixed conifer and mixed pine forest, with the predominant species being Douglas-fir, ponderosa pine, western larch, and lodgepole pine.

Land use activities on the property include long-term forestry demonstration sites as well as timber harvesting, livestock grazing, hunting, and recreation. As part of the Lubrecht Experimental Forest, the Project Area has been used for numerous educational and research focused demonstration projects since 1950. Long-term demonstration sites include uneven-aged management, ponderosa pine planting techniques, tree thinning responses, and small equipment harvesting techniques. Both undergraduate and graduate students use the forest and camp facilities in their forestry, wildlife, recreation, and range management education.

Lubrecht also supports a range of operational activities that include timber harvesting, livestock grazing, hunting, and river-related recreation. Annual harvest activities are primarily through commercial thinning and stand improvement cuts. Lubrecht has active livestock grazing areas for neighboring ranches. The entire forest is open for hunting, with a large section where only nonmotorized access is permitted. Thousands of people use the trail system for hiking in the summer and cross-country skiing in the winter.

Management of the property is designed to improve education, recreation and ecological values while at the same time generating income for MFCES from forestry, carbon offsets and other sustainable land management.



Figure 4. Conifer-dominated forest from the Project Area

Forest Vegetation Types - §7.1.1 (a)(15)(H)

Forest vegetation within the Project Area follows elevational gradients typical of western Montana (Figure 4). Stands of ponderosa pine (*Pinus ponderosa*) interspersed with grassy openings dominate the lower elevations and south-facing slopes. As the elevation increases on north and east slopes, the timber type changes to a mixture of Douglas-fir (*Pseudotsuga menziesii*) and ponderosa pine. In many instances, the Douglas-fir predominates. Western larch (*Larix occidentalis*) is also mixed with the Douglas-fir on many of the easterly and northerly slopes. Smaller portions of the Project Area are covered with dense stands of lodgepole pine (*Pinus contorta*) that established following wildfires. Occasional stands of Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*) occur at the higher elevations and along the moist creek bottoms.

Site Classes - §7.1.1 (a)(15)(I)

The Common Practice value for the Project Area does not differentiate between “high” and “low” site class. Thus, site class was not used in the Common Practice estimate.

Climate Zone/Classification - §7.1.1 (a)(15)(J)

The project is in the warm summer continental climate (Köppen-classification) with significant seasonal temperature changes. The climate zones for the project area are: 3b, 4a, 4b, 5a (USDA-ARS Plant Hardiness Zones, 2012). The climate within the Project Area is a temperate continental climate tempered by Pacific Maritime influences. Weather records have been maintained at the forest since 1956. The average monthly temperature is 4 °C (39 °F) with the lowest in January at -8 °C (17.5 °F) and the highest in July at 16.5 °C (61.7 °F). Daily temperatures in this mountainous terrain have varied from -43 to 40.5 °C (-45 to 105 °F). The average annual precipitation is 455 mm (17.90 inches) with approximately half the total in the form of snow.

Land Pressures - §7.1.1 (a)(15)(J)

Intensive timber harvesting activities occur throughout the region and the project area's high stocking relative to the surrounding area would make the property of interest to local harvesters and sawmills. There is little to no land use pressure for subdivision for development or agriculture.

Known and Potential Diseases - Appendix A (a)(9)

A variety of forest pests and pathogens exists in forestlands in Montana. Potential stressors could include root diseases, defoliating insects (spruce budworm), and bark beetles (ips beetle, western pine beetle, mountain pine beetle, turpentine beetle and Douglas-fir beetle). There have been outbreaks of bark beetles in the late 2000s and early 2010s that affected lodgepole pine and to a lesser extent ponderosa pine and mixed conifer stands. Current mortality levels, however, are well below the unmanaged areas of neighboring forests because stand densities and composition have been adaptively managed. Such stressors could affect future carbon stocks, but they have not significantly impacted current carbon stocks.

Historical Land Uses and Current Zoning - §7.1.1 (a)(15)(K)

Most of the Lubrecht Forest landscape consists of even-aged second-growth stands of approximately 90-120 years of age, the original forest cover having been subjected to commercial liquidation harvest during the late 19th and early 20th centuries by its previous owner (Anaconda Copper Mining Company). Since its conveyance to MFCES in 1937, operational management at Lubrecht Forest is best described as a conservative custodial model, and has focused on improving the health, vigor, and productivity of its young, naturally regenerated stands. Historically, commercial thinning from below, and salvage harvesting have been the primary silvicultural activities, performed at light severities and at modest spatial scales. Exceptions to that management approach were made mainly for the installation of silvicultural research and demonstration sites (relatively few and small in size); however, even those cuttings often focused on thinning second-growth forests, and therefore only modestly influenced forest landscape structure and composition. The projected land use on the property is expected to be a continuation of the historical land uses.

The property is unzoned under Missoula County's current regional plan and land uses on the property are unrestricted.

Forest Stratification - §7.1.1 (a)(15), Appendix A (b)(2)

The forest within the Project Area was stratified in April 2020 (post sampling) into four strata for the statistical calculation of the sampling error. Stratification was conducted using LiDAR data acquired in 2015. The LiDAR data was stratified using an automated approach that used object-based feature extraction techniques to separate out the trees and assign canopy cover and height information. Working in ArcGIS, each LiDAR polygon was assigned a stratum based on its total forested canopy cover (Table 1). The distribution of strata across the project area is shown in Figure 5.

Table 1. Characteristics of strata by percentage tree canopy cover

Strata	All Trees Canopy Cover (% range)	Acres
High Stocking	100 – 72.5%	3,530
Mid-High Stocking	72.5% – 57.5%	6,547
Mid Stocking	57.5% - 45%	4,383
Low-Mid Stocking	<45%	4,357

The strata were applied to the inventory data as a post-stratification for use in sampling error calculations.

Spatial Data - §7.1.1 (a)(15)

An ArcGIS geodatabase has been provided to the Offset Project Registry and the Verification Body (Attachment E). Files include property and project boundaries, public and private roads, watercourses, township and ranges, land cover data, plot locations, and strata.

Delineation of Project Boundary - §7.1.1 (a)(15)

MFCES property boundaries were delineated in GIS based on assessor's parcels, legal descriptions, and ground truthing boundaries where possible. Following this process, a potential project area boundary was selected. United States Geologic Survey (USGS) LandFire EVC 2016 data (Version 2.0.0) was then used to identify forested lands within the project area potentially accessible for timber management and non-forested lands such as meadow clearings, bodies of water, and developed area within the proposed project area were removed from the final Project Area.

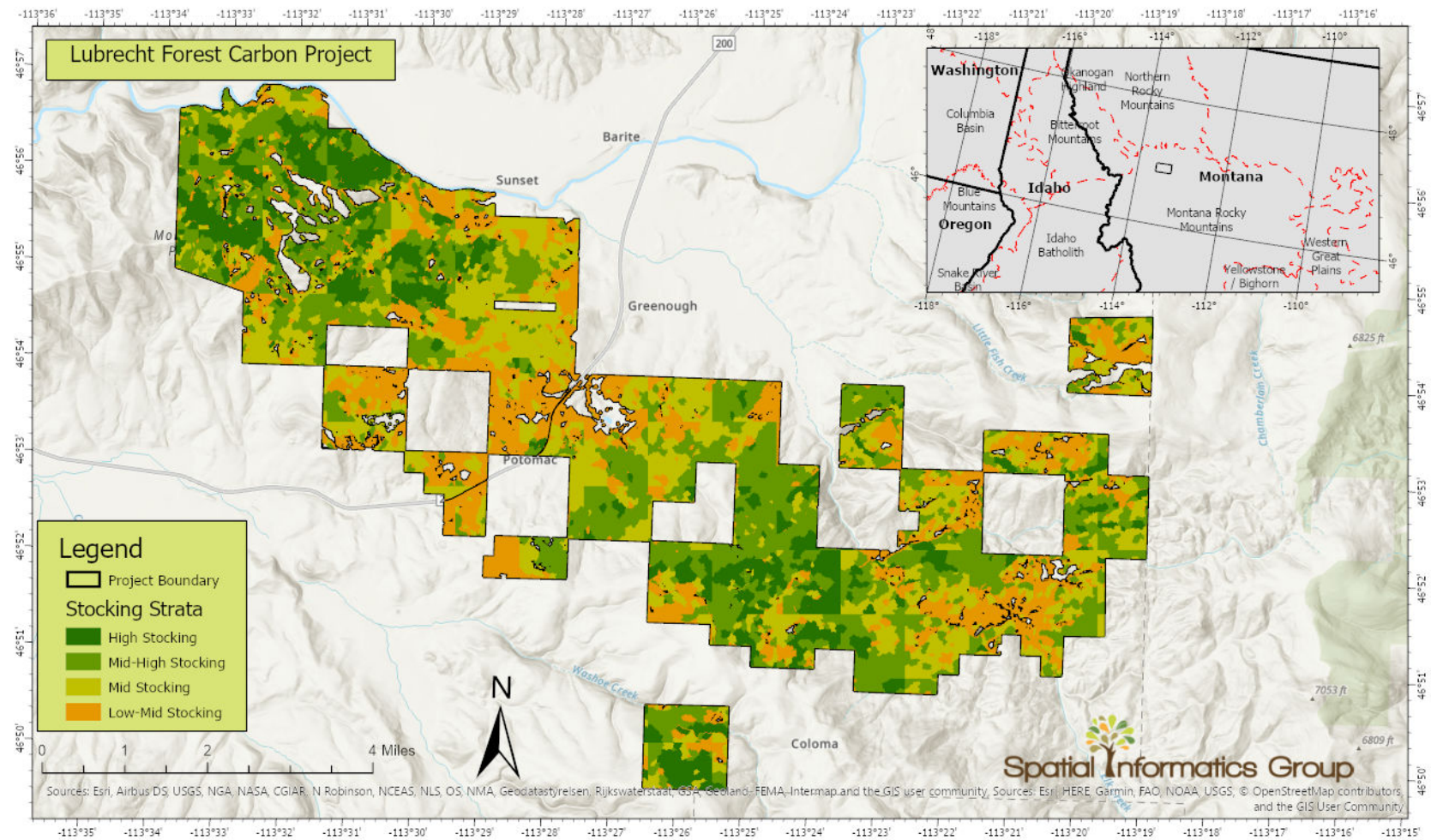


Figure 5. Forest strata

3.3.2 Assessment Areas

Forest Offset Protocol §2.2 (b), §7.1.1 (a)(14)

The entire Project Area is located within the Montana Rocky Mountains Supersection. Within the Montana Rocky Mountains Supersection, there are 16,432 acres within the Mixed Conifer Assessment Area, 2,375 acres within the Spruce / Fir Assessment Area, and 8 acres within the Lodgepole Pine Assessment Area (Table 2). The entire Project Area is 18,817 acres. There were no additional assessment areas less than 20 acres.

The Common Practice value for the Project Area does not differentiate between “high” and “low” site class.

Table 2 – Acres by Supersection and Assessment Areas

Ecosection	Supersection	Assessment Area	Site Class	Acres	Landfire EVT Class
Western Montana	Montana Rocky Mountains	Montana Rockies Mixed Conifer	All Sites	16,432	SAF 218
Western Montana	Montana Rocky Mountains	Montana Rockies Lodgepole Pine	All Sites	2,377	SAF 206, 217, 219, SRM 422
Western Montana	Montana Rocky Mountains	Montana Rockies Spruce / Fir	All Sites	8	SAF 210, 212, 235, 237, 422
Total Acres				18,817	

3.3.3 Forest Conditions

Forest Offset Protocol §3.1 (a)(1), §7.1.1 (a)(19)

Within the Project Area, the dominate species across all age classes are Douglas fir, Western larch, Ponderosa pine and lodgepole pine. Species composition is 62% Douglas-fir, 15% Western larch, 15% ponderosa pine, and 6% lodgepole pine. All other species to not account for more than 5% of the forest by basal area. Species distribution within the Project Area is shown in Table 4 and Table 5.

Young even-aged stands in the Project Area remain relatively rare, having resulted from uncommon regeneration harvests or infrequent stand-replacing disturbance events. Forest health has fluctuated but until recent years has not greatly influenced forest structure. Primary abiotic and biotic disturbance factors have included windstorms, root diseases, defoliating insects (spruce budworm), and bark beetles (ips beetle, western pine beetle, mountain pine beetle, turpentine beetle and Douglas-fir beetle). Forest fires have been minimal.

The primary driver of forest change during the 20th century has been forest succession, with more shade-tolerant species (mainly true fir, and to a lesser extent Engelmann spruce) supplanting shade-intolerant tree species (especially ponderosa pine, and to a lesser extent

Douglas-fir and western larch) and encroaching upon natural prairies. By the 21st century, that successional dynamic hinted at the possibility of eventual large-scale forest cover type conversion to shade-tolerant species dominance.

During the late 2000s and early 2010s, bark beetles reached epidemic levels in western Montana, with associated mortality significantly impacting Project Area's lodgepole pine stands, and to a lesser extent depleted its low-elevation ponderosa pine and mixed-conifer stands. Those experiences, combined with a more concentrated focus by the Experiment Station on long-range forest planning, led to a reevaluation of the conservative custodial model. Silvicultural tending practices such as thinning and salvage harvesting are now supplemented by variable-retention regeneration harvests that are designed to pro-actively recruit new cohorts of shade-intolerant species, and thereby promote resilience via structural complexity and species diversity. Elements of remaining intact old-growth forest have been reserved from treatment, and relic old-growth trees in actively managed stands are retained during harvest whenever possible. As a result of these strategies, the Lubrecht Forest landscape is expected to increase in age, complexity, species diversity, and health, while also exhibiting the breadth of forest species and ecosystems that are typical of western Montana.

3.4 ADDITIONALITY – LEGAL REQUIREMENT TEST

Forest Offset Protocol §3.4.1, §7.1.1 (a)(32), Regulation §95973(a)(2)(A), Regulation §95973(b), Regulation §95975(k)

The Lubrecht Carbon Project is in compliance with all applicable provisions and requirements for the following state and federal laws:

- Montana Streamside Management Zone Law
- Montana Forest Practice Notification Law
- Federal Endangered Species Act
- Federal Clean Water Act

The Forest Project is not legally required and was not legally required at the time of the project's start date. The Lubrecht Carbon Project has met and been in compliance with all local, state, or federal regulatory requirements during the reporting period.

3.5 ADDITIONALITY – PERFORMANCE STANDARD TEST

Forest Offset Protocol §3.4.2, Regulation §95973(a)(2)

Improved Forest Management Projects, such as the Lubrecht Carbon Project, automatically satisfy the performance standard test according to Section 3.4.2 of the Protocol.

3.6 PROJECT OFFSET COMMENCEMENT

Forest Offset Protocol §3.4.2, §7.1.1 (a)(16-17), Regulation §95973(a)(2)

The Lubrecht Carbon Project commencement date is February 20, 2019, which is the date project listing documents were submitted.

The first initial reporting period for the Lubrecht Carbon Project is from February 20, 2019 to August 20, 2019.

3.7 USE OF QUALIFIED CONSERVATION EASEMENTS

Forest Offset Protocol §3.4.1 (b), §7.1.1 (a)(20)

The Lubrecht Carbon Project will not employ a Qualified Conservation Easement.

3.8 BROADCAST FERTILIZATION

Forest Offset Protocol §7.1.1 (a)(21)

The Lubrecht Carbon Project has not utilized broadcast fertilization in the Project Area.

3.9 SUSTAINABLE HARVESTING PRACTICES

Forest Offset Protocol §3.1 (a)(2)(C), §7.1.1 (a)(22)

The project will meet the sustainable management criteria by practicing uneven aged management and retaining canopy on at least 40 percent of the forest, as measured on any 20 acres within the entire forestland owned by MFCES (within the Assessment Area covered by the Project Area).

To meet this requirement, the landowner will practice uneven aged management and retain the designated canopy cover. Compliance with the canopy cover requirement is demonstrated using LiDAR data acquired in 2015 (Figure 6). The LiDAR data had an average point with greater than 25 point cloud per square meter in forested stands. The LiDAR data were integrated with leaf-on imagery to assess the current extent of canopy cover within the project area. The result of this analysis was that within the project area average canopy closure was approximately 57 percent, which is more than the protocol's requirement of greater than or equal to 40 percent (Figure 3).

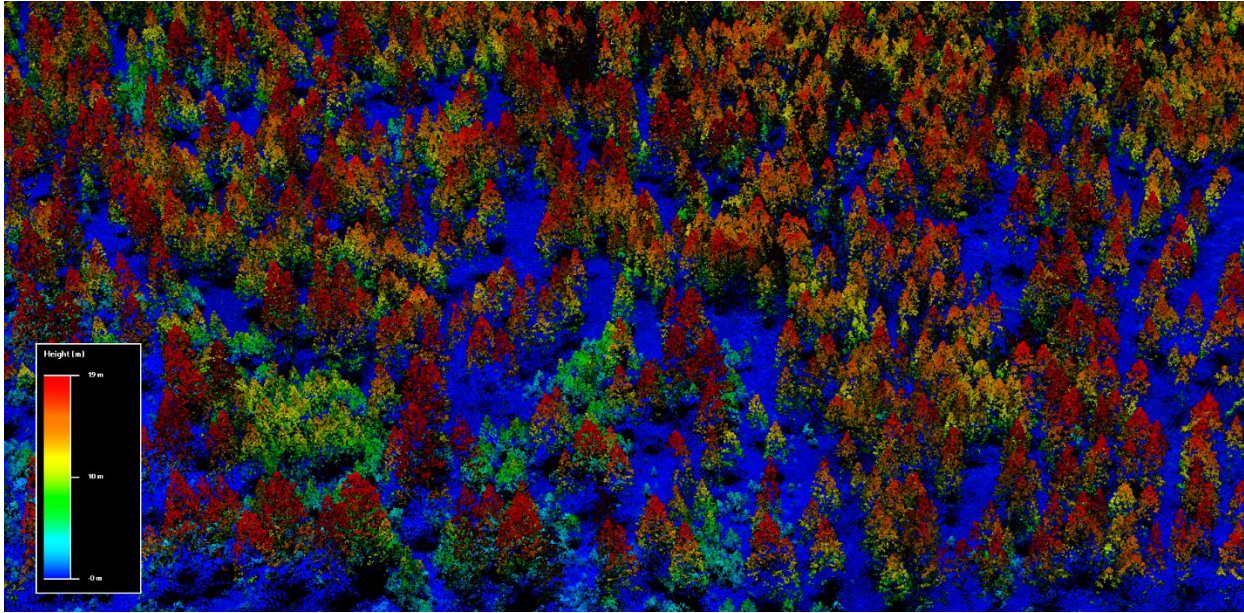


Figure 6. Example of LiDAR data used to determine canopy cover (color ramp indicates tree canopy height).

3.10 NATURAL FOREST MANAGEMENT

Forest Offset Protocol §3.1 (a), Table 3.1, §7.1.1 (a)(23), §7.2.1 (a)(14)

All Forest Projects must promote and maintain a diversity of native species and utilize management practices that promote and maintain native forests comprised of multiple ages and mixed native species within the Project Area and at multiple landscape scales ("Natural Forest Management"). The Lubrecht Carbon Project meets the requirements under "Natural Forest Management" (

Table 3). Based on our inventory results, the Project Area meets the Natural Forest Management native species criteria (Table 4), composition of native species criteria (Table 5), distribution of age class and sustainable management, and structural elements for standing and lying dead wood (Table 6).

Table 3: Natural Forest Management criteria.

Management Criteria	How project meets requirements
Native Species: Project consists of at least 95% native species based on the sum of carbon in the standing live tree carbon stocks.	100% of the species are consistent with the natural forest type of the Montana Rocky Mountains U.S (Table 4).
Composition of Native Species: No single species within the Project Area comprise more than the percent basal area for standing	The Project Area meets this requirement (Table 5). As shown below, the species with

live trees provided for the Species Diversity Index in the Assessment Area Data File.	the greatest proportion of basal area is Douglas-fir at 62.2%
Distribution of Age Classes/Sustainable Management	The project will meet the sustainable management criteria by not harvesting and retaining canopy on at least 40 percent of the forest, as measured on any 20 acres within the entire forestland owned by MFCES (within the Assessment Area covered by the Project Area).
Structural Elements (Standing and Lying Dead Wood): Forest Owner must maintain (or demonstrate ongoing progress toward) an average of at least: • one metric ton of carbon per acre; or • 1% of standing live tree carbon stocks, in standing dead wood, whichever is higher.	Standing dead represents > 1% of standing live carbon stocks and > 1 metric ton of carbon per acre (Table 6) and meets the minimum requirements for standing live carbon stocks. The project will maintain this carbon pool by continuing to recruit standing dead trees, or else demonstrate ongoing progress towards meeting the higher of the two targets.

Table 4: Native species based on the sum of carbon in standing live pool.

Species	Standing live carbon (MTCO ₂ e/acre)	Percent of total standing live carbon
Black cottonwood	0.2	0.33%
Douglas-fir	41.6	61.74%
Engelmann spruce	0.5	0.74%
Grand fir	0.1	0.17%
Lodgepole pine	3.2	4.82%
Ponderosa pine	10.0	14.89%
Quaking aspen	0.0	0.02%
Red alder	0.1	0.10%
Rocky Mountain juniper	0.0	0.02%
Subalpine fir	0.1	0.07%
Western larch	11.5	17.10%
Total	67.3	100%

Table 5: Composition of native species in project area.

Species	Basal area (ft ² /acre)	Percent of total basal area
Black cottonwood	0.27	0.3%
Douglas-fir	59.30	61.5%
Engelmann spruce	0.83	0.9%
Grand fir	0.27	0.3%
Lodgepole pine	5.83	6.1%
Ponderosa pine	14.68	15.2%
Quaking aspen	0.02	0.0%
Red alder	0.19	0.2%
Rocky Mountain juniper	0.08	0.1%
Subalpine fir	0.17	0.2%
Western larch	14.78	15.3%
Total	96.44	100%
Note: No species exceeds the Species Diversity Index value of any assessment area included in the project, see Table 14.		

Table 6: Initial carbon retention by above ground carbon pools.

Standing-live (MTCO ₂ e/acre)	Standing dead (MTCO ₂ e/acre)	% Standing dead of standing live
67.31	3.31	4.91%

3.11 ONGOING MANAGEMENT ACTIVITIES

Forest Offset Protocol §3.1 (b)

The Forest Offset Protocol requires that standing live carbon stocking must be maintained or increased over any 10 consecutive year period unless the reduction is due to one of the causes listed in §3.1 (b) of the protocol. Over the life of the project, standing live carbon stocks will be monitored through periodic remeasuring of the permanent plots and tracking of disturbances. Changes will be made to the harvest as needed to ensure compliance with requirements.

4 INVENTORY METHODOLOGY

4.1 GHG ASSESSMENT BOUNDARY

Forest Offset Protocol §4.2, Table 4.2

The following sources, sinks and reservoir are included in the Lubrecht Carbon Project:

- IFM-1 Standing live carbon (carbon in all portions of living trees).
- IFM-3 Standing dead carbon (carbon in all portions of dead, standing 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 forestland outside the Project Area.
- IFM-17 Biological emissions from decomposition of forest products.

The following sources, sinks and reservoir are *excluded* from the Lubrecht Carbon Project because no site preparation will occur, or the data is not available, and are therefore not applicable:

- IFM-6 Soil Carbon
- IFM-9 Biological emissions from site preparation will occur

4.2 INVENTORY DESIGN AND SAMPLING PROCESS

Forest Offset Protocol §7.1.1 (a)(24), Appendix A

The inventory used was designed to meet the onsite inventory requirements and quantify the required standing live and standing dead carbon pools outlined in Appendix A in the Forest Offset Protocol.

The inventory design was built off an existing Continuous Forest Inventory (CFI) plot grid developed by Lubrecht Experimental Forest in 2008. The existing CFI design consisted of 100 plots on a systematic grid starting from a random point. The plots on the existing systematic grid are evenly spaced at approximately 2,953 feet. To obtain an inventory that reached a statistical target of 90% confidence level at 5% sampling error, approximately 300 total plots (including the existing Lubrecht CFI plots) were necessary for the project area. Thus in 2018, additional plots were added in the office using GIS software by locating them equidistant between pre-existing CFI plots (both north – south and east – west). This resulted in a systematic grid of 296 plots (including the original CFI plots) evenly spaced at approximately at 1,476 feet by 1,476 feet between the pre-existing CFI plots and the additional plots and 2,953 feet between the additional plots inserted between the pre-existing CFI grid (Figure 7).

The starting point for the original sample grid was selected randomly and plots were installed based on locations from a square grid. As described above, the addition of supplementary plots tied to this initial starting location but offset systematically to locate additional plots (Figure 7). There was no evidence of spatial periodicity in natural features or forest attributes at the property, and thus systematic sampling met statistical assumptions of independence for the purpose of this project.

All plots have uniquely identifying numbers and plot numbers were not re-used in different strata. Non-forest and inoperable land were excluded from the Project Area and plots that fell within those areas were removed. Figure 7 shows the plot location and assessment area boundaries. Table 7 shows how the plots are distributed by assessment area and acreage across the Project Area. Inventory work began on October 14th, 2018 and concluded on November 8th, 2019.

The detailed inventory manual describing plot location and plot design has been provided to the verifier (Exhibit I).

Table 7: Plots and acreage.

Assessment Area	Lodgepole Pine	Mixed Conifer	Spruce / Fir	Total
Acre	2,377	16,432	8	18,817
Plots	30	232	0	262

4.3 FIELD MEASUREMENT AND PLOT MONUMENTING

Forest Offset Protocol §7.1.1 (a)(24), Appendix A

The plot design included 1/9.98th acre and 1/100.42th acre fixed-area plots located at each point on the randomly started, systematic grid developed for the Project Area. Maps of Project Area, plot location, and property physical features were printed and laminated for reference in the field. Using GPS units, plot centers were located in the field and permanently mounted using 3/8-inch pieces of rebar capped with brightly colored plastic and driven into the ground with at least 18 inches of the length of pipe was buried. At the plot center, a length of bright-colored flagging was tied close to plot center and the plot stake. Standard timber cruising tools were used, including diameter tapes for measuring diameter at breast height (DBH) and laser range finders for measuring distances and tree heights. Trees sampled in each plot were uniquely and permanently identified so that individual trees can be tracked over time, and ingrowth trees can be clearly identified.

For each permanently monumented sampling point a nested circular plot design was utilized. All standing live and standing dead trees greater than or equal to 1 inch were tallied in the inner plot and trees greater than or equal to 5 inches were tallied in the outer plot. DBH was measured

to the nearest 1/10th of an inch using a diameter tape at the point that is 4.5 feet off the ground (unless noted otherwise on the tree record) and total height was measured to the nearest foot using a laser range finder. Specific instructions for DBH and height measurements are provided for unusual situations in the inventory manual. One tree was selected at each plot and total length and total age at breast height measurements were collected for calculating site index. The tree selected was from a species common to the forest type/assessment area in which the plot is located. Additional information collected on each tree included species and total percent defect. Height to break was measured on each tree with a broken top and the inside bark diameter at the break was estimated. The details of the methodology are contained in the inventory manual.

4.4 UPDATING PLOTS AND INVENTORY

Forest Offset Protocol Appendix A

The project will comply with the requirement that any field inventory data used cannot be more than 12 years old. The project will use on-the-ground knowledge from scientists, researchers, and the property manager to inform the landowner of any significant disturbance, such as fire, windthrow or ice damage. A disturbance estimated to affect greater than 10 percent of above-ground carbon stocks will trigger re-measurement or relocation of carbon plots. In the years between measurements, the project will use the Forest Vegetation Simulator (FVS), to update its carbon stocks.

4.5 DATA MANAGEMENT SYSTEM

Forest Offset Protocol §7.1.1 (a)(24), Appendix A

The data management and Quality Assurance/Quality Control (QA/QC) procedures are part of the project documents and cover procedures for (1) data collecting; (2) laboratory reports; (3) verifying data entry and analysis techniques; and (4) data maintenance and archiving.

QA/QC Field

A full inventory was conducted by Timber Consulting Foresters, Inc. (Justin Miller, ACF) in October and November 2018. Inventory foresters were trained on the inventory protocol and tested by comparing measurements with the lead forester to ensure accurate, consistent, and precise measurements that meet FIA inspection standards. The inventory company also took independent remeasurements of a 5 percent random sample of plots (using a Blind Checking approach in timber areas and a Cold Check approach in woodland areas due to the variability in multi-stem trees).



QA/QC Desk Procedures

A two-stage process for QA/QC desk procedures was employed. First, the forest carbon analyst independently reviewed the inventory treelist entered by the field crew. Quality assurance of field data is completed by performing data checks for items, such as height and diameter outliers and duplicate plots and trees. Second, another qualified carbon analyst or forester who was knowledgeable about the project and carbon analytical tools conducted a technical review. The technical review included independent estimates of carbon stocks and completed data checks.

Data Maintenance and Storage

Because this is a long-term project, it is important to archive data in a safe place and update the files to a converted format that can be accessed by future software applications. The software programs used for this project include Microsoft Word, Excel and Access '16 – '19, Forest Vegetation Simulator for growth and yield modeling, and ArcMap 10.7 and ArcPro 2.3. Currently, the data are stored in electronic format and saved on a personal computer, remote desktop, and external hard drive. A change log is created to identify adjustments made to measurements in the inventory and quantification methods. SIG will be responsible for maintaining database records. If data are missing the project will search personal computers, external hard drives, and the remote desktop. If data cannot be found, then the issue will be noted in a change log and ensure estimates affected by the missing data result in conservative estimates (i.e. less net GHG reductions).

4.6 QUANTIFICATION METHODOLOGY

The live tree above-ground and below-ground carbon pools were calculated using the approved species-specific FIA component ratio method equations and methodology for cubic foot volume and biomass of tree bole, bark, branches, and roots as required by ARB.

4.6.1 Converting inventory data to carbon

IFM – 1 Standing Live

Forest Offset Protocol Appendix A

Step 1 – Volume calculations. The Forest Offset Protocol requires the use of specific models, equations, and coefficients to determine the volume of live trees (≥ 5 " DBH). These are documented in the publication "Methods and Equations for Estimating Aboveground Volume, Biomass, and Carbon for Trees in the U.S. Forest Inventory, 2010" (Woodall et al., 2011). The Woodall et al. equations calculate gross cubic foot volume in the central stem from the top of a one-foot tall stump to a four-inch top diameter outside bark (VOLCFGRS); independent variables are typically species, DBH/DRC, number of woodland stems, and total height. The calculation of biomass for saplings (1 – 4.9" DBH) does not use volume equations and is calculated in Step 2 below.

Sound cubic foot volume in the same portion of the stem (VOLCFSND) is calculated by reducing VOLCFGRS by the proportion of defect estimated and any volume lost due to broken tops (missing top volume is computed using the simple cone volume equation).

Step 2 – Component Ratio Method (CRM). Methods outlined in the document entitled “Biomass Estimation Component Ratio Method (Appendix J)” on ARB’s website were used to calculate CRM. In summary, the CRM approach as described in Heath et al. (2009) is used to: “1) convert sound volume of wood in the bole to biomass using a compiled set of species specific wood densities (or specific gravities), 2) calculate the biomass of bark on the bole using a compiled set of bark and bark specific gravities; 3) calculate the biomass of tops and limbs as a proportion of the bole biomass based on component proportions from Jenkins et al. (2003).”

IFM – 3 Standing Dead

Forest Offset Protocol Appendix A

Carbon in the standing dead pool was quantified following the steps in the document titled “Adjusting Standing Dead Tree Carbon Pool for Structural Loss and Density” available on the ARB’s website. In summary, after the calculation of VOLCFSND as outlined above in IFM – 1, Step 1, a wood density reduction factor (DRF) from Harmon et al. (2010) based on the decay class of the tree is applied to the volume of wood in the central stem. This DRF is carried forward to the other components of the tree (bark, top, stump, and roots) by the CRM adjustment factor. The appropriate decay factor for each species and decay class as used by FIA is contained in FIA’s REF_SPECIES table (pers. comm., Woodall, C.W., 8/6/2015); and are shown for species sampled in the Project Area. Additionally, each of the CRM components (top, bark, bole, stump, and root) have a structural loss adjustment factor (SLA) from Domke et al. (2011) that accounts for structural losses in standing dead trees (Table 8). These DRFs and SLAs were applied to standing dead trees through CRM. Biomass in each standing dead tree on a per-acre basis was converted to carbon following the same process as in IFM – 1, Step 3.

Table 8. Density Reduction Factors (DRF) and Structural loss adjustment (SLA) factors used to adjust biomass of standing dead trees

Decay Class	Decay Description	Density Reduction Factors		Structural Loss Adj. (SLA) Factors				
		Hardwood	Softwood	Top	Bark	Bole	Stump	Roots
1	Recent dead	97.0%	89.2%	100%	92%	100%	100%	100%
2	Snag / few limbs	75.0%	83.1%	50%	66%	100%	100%	95%
3	Snag / limb stubs	54.0%	59.1%	20%	39%	100%	100%	80%
4	Snag / few stubs	61.3%	43.3%	10%	21%	100%	100%	65%
5	Snag / decayed	61.3%	43.3%	0%	0%	100%	100%	50%
Source: Domke et al. 2011								

IFM – 6 Soil: Excluded

Soil carbon is excluded from the GHG Assessment Boundary for this project since no site preparation activities exceeding 25% of the project area, or mechanical site preparation activities not conducted on contours will occur within the project area over the life of the project.

IFM – 7 Carbon in In-use Wood Products

Forest Offset Protocol Appendix C

Carbon in in-use wood products was calculated by following the quantification methodology in Appendix C of the Forest Offset Protocol. First, carbon in in-use wood products was determined by calculating the carbon in the boles of harvested trees using the Woodall equations.

Second, mill efficiencies were identified for the project's Assessment Area on ARB's website. The total carbon transferred to wood products was accounted for in this protocol and the remainder of the harvested carbon is assumed to be immediately emitted to the atmosphere. The mill efficiencies by wood product class were the following:

Table 9. Mill efficiencies

Mill Efficiencies					
Region	State	Hardwood Sawlog	Hardwood Pulp	Softwood Saw	Softwood Pulp
Rocky Mountain	Montana	56.8%	56.8%	70.4%	70.4%

Third, to determine the carbon storage in in-use wood products over 100 years, it was necessary to determine the percentage of the Project Area's harvest in each wood product class. The default wood product classes for the project's Assessment Area was used, as given in the Assessment Area Data File found on ARB's website. The percentage in each wood product class was found in the Supersection - Montana Rocky Mountains. Note that in 2014 and 2015 UMT harvested approximately 753 acres, which generated 80.5% softwood lumber and 19.5% pulp.

The percentage for each wood product class is broken down as follows:

Table 10. Wood product class percentages

Wood Product Class Percentages								
Supersection	Softwood Lumber	Hardwood Lumber	Plywood	Oriented Strand Board	Non-structural Panels	Misc.	Paper	Alaskan Exports
Montana Rocky Mountains	79.2%	0.0062%	8.2%	0%	0.08%	3.7%	8.8%	0%

Finally, the metric tons C in each class is then multiplied by the 100-year average storage factor (in-use) (Table 11) in Table C.1 of the Forest Offset Protocol. The 100-year average metric tons C is multiplied by 3.667 to get metric tons CO₂e.

Table 11. 100-year average storage factor for in-use wood products.

100 Year Storage Factors for In-use Wood Products						
Softwood Lumber	Hardwood Lumber	Plywood	Oriented Strand Board	Non- structural Panels	Miscellaneous	Paper
46.3%	25.0%	48.4%	58.2%	38.0%	17.6%	5.8%

The 100 year average carbon in in-use wood products in the baseline is deducted from the actual wood products produced in the reporting period. The number is then multiplied by the 80% default "Market Response" as defined in the Forest Offset Protocol, resulting in the Total Quantified GHG Reduction for carbon stored in in-use wood products.

IFM – 8 Forest product carbon in landfills

Forest Offset Protocol Appendix C

Carbon in landfills was calculated by following the quantification methodology in Appendix C of the Forest Protocol. First, forest product carbon in landfills was determined by calculating the carbon in the bole of the tree using the Woodall equations.

Mill efficiencies were identified for the project's assessment areas in the Forest Offset Protocol Resources section of ARB's website. The efficiencies by wood product class are in Table 9.

A percentage was assigned to each product class according to the default values for the project (as determined in Section C.3 of the Forest Offset Protocol). The percentage for each wood product class are in Table 10.

Total carbon is multiplied by the 100-year average storage factor (landfills) (Table 12) was used in Table C.2 in the Forest Offset Protocol. Finally, the metric tons C in each class was multiplied by 3.667 to get metric tons CO₂e.

Table 12. 100-year average storage factor for in landfill.

100 Year Storage Factors for In Landfill						
Softwood Lumber	Hardwood Lumber	Plywood	Oriented Strand Board	Non- structural Panels	Miscellaneous	Paper
29.8%	41.4%	28.7%	23.3%	34.4%	45.4%	17.8%

IFM – 14 Biological emissions/removals from changes in harvesting on forestland outside Project Area

Forest Offset Protocol Appendix C

Biological emissions and removals from changes in harvesting on forestland outside Project Area is calculated using a default 20% “leakage” factor applied to the difference in harvest volume relative to baseline.

IFM –17 Biological emissions from decomposition in forest products

Forest Offset Protocol Appendix C

Biological emissions from decomposition in forest products is quantified as a component of IFM-7 and IFM-8 per Appendix C of the Forest Protocol.

5 BASELINE CARBON STOCKS

5.1 LEGAL CONSTRAINTS

Forest Offset Protocol §5.2.1 (e)(1), §7.1.1 (a)(25), Appendix B (h)

Per the Forest Offset Protocol, the Lubrecht Carbon Project has incorporated all legal constraints into baseline growth and harvesting calculations. Table 13 documents the legal constraints modeled for the Project baseline scenario.

Table 13. Legal constraints matrix (§7.1.1 (a)(25))

Regulation / Range / Agency	Description	Constraint on Forest Management	Modeling of Constraints
Montana Streamside Management Zone Law <u>Geographic Range:</u> Entire Project Area <u>Agency:</u> Montana Department of Natural Resources and Conservation (DNRC)	The Streamside Management Zone (SMZ) law and rules protect and maintains the functions of a SMZ. The law provides SMZ definitions and defines allowed and prohibited activities within SMZ's.	Restricts harvesting activities within designated SMZs.	All acreage within SMZs identified in the Project Area, if harvested, must utilize a selection prescription.
Montana Forest Practice Notification Law (76-13-420 MCA) <u>Geographic Range:</u> Entire Project Area <u>Agency:</u> Montana DNRC	The law requires operators or landowners to notify the department when forest practices are going to take place on private lands and makes recommendations for many aspects of forest engineering, harvesting, and management.	Appropriate forest management prescriptions, road construction, and heavy use equipment during harvesting.	Montana BMP guidelines provide voluntary guidelines, but are considered a constraint in baseline modeling.

Clean Water Act (CWA) <u>Geographic Range:</u> Entire Project Area <u>Agency:</u> U.S. Environmental Protection Agency	Through a variety of programs (including, as appropriate, non-regulatory or regulatory programs), states assist and encourage producers to use BMPs to reduce or prevent instances of nonpoint source pollutants migrating into waters.	Appropriate forest management prescriptions, road construction, and heavy use equipment in proximity to water bodies.	These are voluntary guidelines and are not considered a legal constraint in baseline modeling.
Endangered Species Act (ESA) <u>Geographic Range:</u> Entire Project Area <u>Agency:</u> U.S. Fish & Wildlife Service	The Endangered Species Act (ESA) provides for the conservation of threatened and endangered plants and animals and the habitats in which they are found.	Appropriate forest management prescriptions, road construction, and heavy use equipment in areas inhabited by listed species.	There are no endangered species identified within the Project Area and are not considered a legal constraint in baseline modeling.

Montana Streamside Management Zone Law

(77-5-301[1] Montana Code Annotated)

The Streamside Management Zone (SMZ) law and rules protect and maintains the functions of a SMZ. The law provides SMZ definitions and defines allowed and prohibited activities within SMZ's. The law prohibits seven forest practices in SMZs:

- 1.) Broadcast burning
- 2.) The operation of wheeled or tracked vehicles except on established roads
- 3.) The forest practice of clearcutting
- 4.) The construction of roads except when necessary to cross a stream or wetland
- 5.) The handling, storage, application, or disposal of hazardous or toxic materials in a manner that pollutes streams, lakes, or wetlands, or that may cause damage or injury to humans, land, animals, or plants
- 6.) The side-casting of road material into a stream, lake, wetland, or watercourse
- 7.) The deposit of slash in streams, lakes, or other water bodies

The SMZ law and rules apply to commercial timber harvests on drainages that meet the definition of a stream, lake. SMZ widths are identified as:

Class 1 and 2 stream segments and lakes:

- On SMZ slopes less than or equal to 35%, the SMZ boundary is 50 feet from OHWM.
- On SMZ slopes greater than 35%, the SMZ boundary is 100 feet from OHWM.

Class 3 streams and OBW:

- The SMZ boundary is 50 feet regardless of the SMZ slope. (Note that SIG conservatively modeled the Class 3 streams to the same standard as the Class 1 and 2 streams.)

The Montana SMZ law is administered by the Montana Department of Natural Resources and Conservation (DNRC) and applies to the entire Project Area.

Montana Forest Practice Notification Law

(76-13-420 MCA)

Frequently referred to as the Best Management Practices (BMP) law. It requires operators or landowners to notify the department when forest practices are going to take place on private lands and sets some standards for those practices. These BMP practices are considered voluntary or non-regulatory. Montana BMP guidelines provide recommendations for many aspects of forest engineering, harvesting, and management including road construction, road maintenance, stream crossings, timber harvest operations, site preparations, reforestation, and hazardous materials. Montana BMP law is administered by the Montana DNRC and applies to the entire Project Area.

Clean Water Act

(40 C.F.R. Subchapters D, N, and O (Parts 100-140, 401-471, and 501-503).

The Clean Water Act (CWA) is the primary federal law in the United States governing water pollution with an objective is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. The CWA establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. Under the CWA, the Environmental Protection Agency has implemented pollution control programs such as setting wastewater standards for industry. EPA has also developed national water quality criteria recommendations for pollutants in surface waters. It is administered by the U.S. Environmental Protection Agency (EPA), in coordination with state governments and applies to the entire Project Area.

Endangered Species Act of 1973

(ESA; 16 U.S.C. § 1531 et seq.)

The Endangered Species Act (ESA) purpose is to protect and recover imperiled species and the ecosystems upon which they depend. It is administered by the U.S. Fish and Wildlife Service (USFWS) and the Commerce Department's National Marine Fisheries Service (NMFS). USFWS has primary responsibility for terrestrial and freshwater organisms, while the responsibilities of NMFS are mainly marine wildlife such as whales and anadromous fish such as salmon. The law requires federal agencies to consult with the Fish and Wildlife Service and/or the NOAA Fisheries Service to ensure their actions are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat of such species.

Description of modeling techniques to simulate the effects of constraint is found in Section 5.3.3 and Table 17.

5.2 FINANCIAL CONSTRAINTS

Forest Offset Protocol §5.2.1 (e)(2), §7.1.3 (a)(4-5), Appendix A (a)(10)

The Lubrecht Carbon Project demonstrates that the growth and harvesting regime assumed for the baseline is financially feasible by demonstrating the baseline prescriptions have a positive Net Present Value (NPV).

The NPV revenues are based on delivered log prices published by the Bureau of Business and Economic Research in the Montana Sawlog and Veneer Log Price Report, 2nd quarter of 2018. The NPV costs are based on local knowledge and Bureau of Business information. All sources are documented in the NPV calculation workbook.

The expected NPV generated at 5% is \$33/acre, see (Attachment L).

5.3 ESTIMATE BASELINE ONSITE CARBON STOCKS (PRIVATE LANDS)

Forest Offset Protocol §5.2.1, §7.1.1 (a)(26, 28, 29), §7.1.3 (a)(2,3), Appendix B

As outlined in the Forest Offset Protocol, the baseline approach for IFM projects on private lands includes four primary steps.

1. Determine the Common Practice level of above-ground standing live carbon stocks applicable to the Project Area.
2. Determine if the Project Area's initial above-ground standing live carbon stocks are above or below Common Practice.
3. Estimate baseline above-ground standing live carbon stocks, taking into account financial and legal constraints on harvesting, in the Project Area.
4. Determine the baseline carbon stocks over 100 years for all required and optional carbon pools.

5.3.1 Step 1 –Determine the Common Practice level of above-ground standing live carbon stocks applicable to the Project Area.

Supersection, Assessment Area and Site Classification

Based on the geographical location, the Lubrecht Carbon Project is located in the Montana Rocky Mountains Supersection (see Figure 1 and Figure 2).

Based on the LandFire forest cover and associated species listed in the Forest Offset Protocol Appendix F – Assessment Area Data File (located on the ARB's website ¹) almost all acres fall within the Mixed Conifer assessment area.

Site Class

SIG utilized the site tree data that was collected at every plot (see Section 4.3).

No analysis of soils was undertaken as the common practice values for the Montana Rocky Mountain supersection are for all site classes.

Table 14 displays the Common Practice statistic by Assessment Area and the average weighted Common Practice (above-ground live tree carbon). **The weighted average Common Practice is 36.58 MTCO₂e/acre.**

Table 14: Common Practice for Project Area

Montana Rocky Mountain Supersection				
Assessment Area	Lodgepole Pine	Mixed Conifer	Spruce / Fir	Total
Acres	2,377	16,432	8	18,817
				Weighted Average
Common Practice Above Ground Carbon Mean (mtCO ₂ e / acre)	37.98	36.38	24.15	36.58
Species Diversity Index	90%	70%	65%	72.52%
Note: No species exceeds minimum Species Diversity Index value of any assessment area; see Table 5.				

5.3.2 Step 2 - Determine if the Project Area's initial above-ground standing live carbon stocks are above or below Common Practice.

The methods used were designed to meet all the requirements as identified in Section 5.2 of the Forest Offset Protocol.

Initial carbon stocks

Average above-ground standing live carbon stocks for the Project Area was 67.3 MTCO₂e/acre at the project start date. Figure 8 illustrates the difference between ICS and Common Practice.

Figure 9 illustrates tonnes of carbon in each of the 4 carbon pools.

¹ <https://ww3.arb.ca.gov/cc/capandtrade/protocols/usforest/2015/assessment.area.data.file.xlsx>

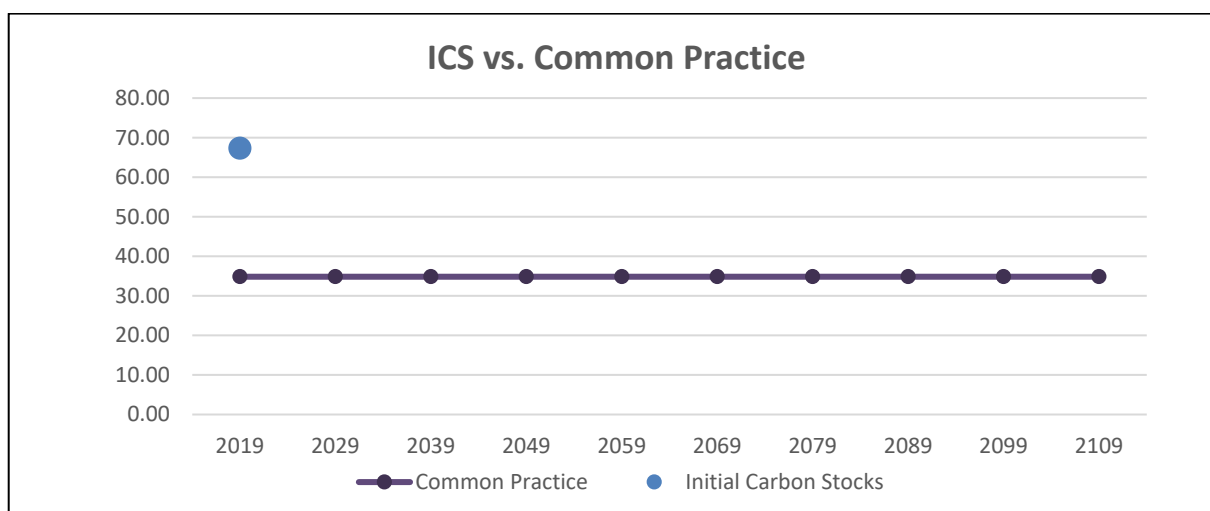


Figure 8: Comparison of the initial carbon stocks in the above-ground live trees (67.3 MTCO₂e) to the Project Area's Common Practice statistic (36.58 MTCO₂e).

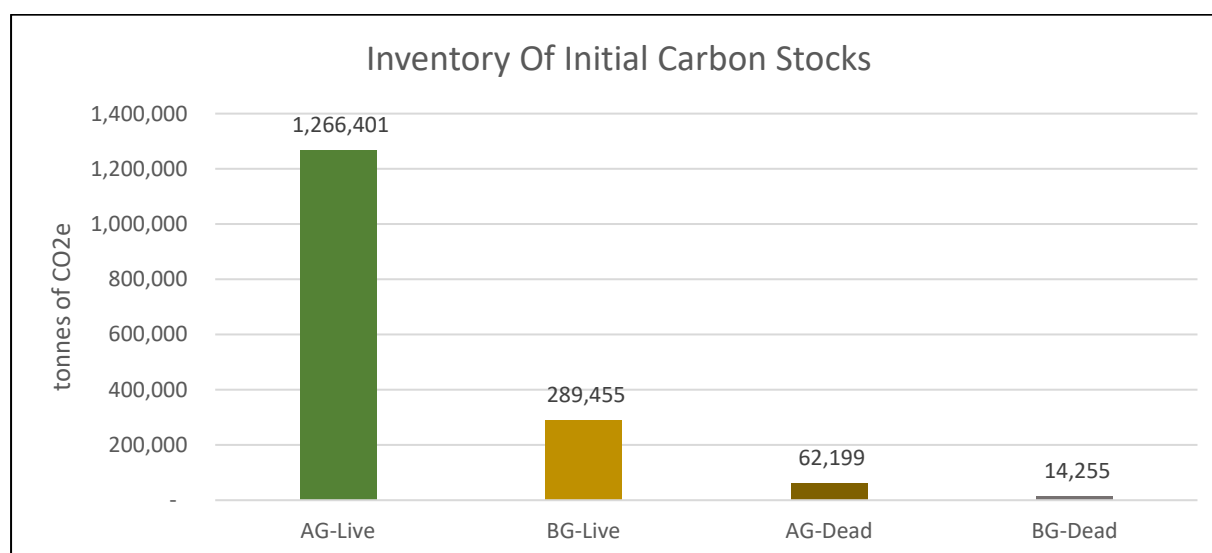


Figure 9: Inventory of initial carbon stocks

End of first reporting period carbon stocks

To accurately estimate the carbon at the end of the first reporting period it was necessary to interpolate FVS's five year growth for the first 30 weeks of 2019. This was accomplished by growing the inventory forward 5 years, resulting in an average annual diameter growth and total height growth increments per tree, as well as per acre mortality per tree.

Next, the initial inventory was grown on an individual tree basis, using the FVS growth estimates, and accounting for seasonal variation in daily uptake, to align the the treelist with the August 20, 2019 reporting date. Seasonal variation was derived from Winget & Kozlowski (1965), which

documents 94.36% of a full season's growth occurring, as illustrated in Figure 10. Tree mortality was added to the dead pool.

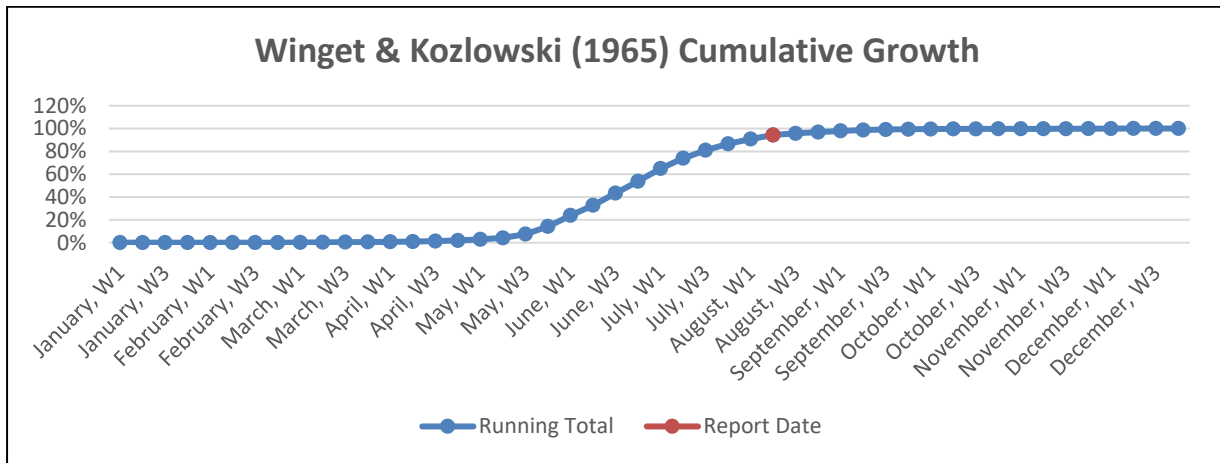


Figure 10: Winget & Kozlowski (1965) Cumulative Annual Growth.

5.3.3 Step 3 and Step 4 – Determine baseline above-ground standing live carbon stocks and all onsite carbon pools.

The baseline above-ground standing live carbon stocks was determined by: (1) modeling above-ground standing live carbon stocks through a series of growth and harvesting scenarios over 100 years; and (2) averaging the model results over the 100-year timeframe, so the baseline is expressed as an average value for above-ground standing live carbon stocks per acre in every year, for 100 years.

Growth and yield model description

This report has been prepared with the oversight of a Professional Forester as required by the Protocol. The modeling required for this report was conducted by foresters at SIG; specifically, Paul Cousar. Mr. Cousar also assisted with the inventory for the project and assisted in drafting the OPDR. Gary Roller from Spatial Informatics Group, LLC was the certified forester providing local expertise and oversight on the project; CA RPF #2899.

The inland empire U.S. variant of the Forest Vegetation Simulator (FVS), an empirical growth and yield model approved by the FPP, was used to simulate the baseline scenario (harvest) and project scenario credits. Local forest professionals indicated 2,500 board feet/acre is a minimum financially viable harvest volume for small selection units, and 4,500 board feet/acre for final harvest units. The minimum harvest was input in FVS by setting the minimum harvest in the MINHARV keyword to 2,500 or 4,500 board feet.

SIG modeled two silvicultural prescriptions, clearcutting and selection harvest. The clearcuts were modeled at the mid-point of each decade, for 2024 to 2094, allowing the existing stands eight opportunities to be harvested. Once harvested the plot was planted with species proportional to the pre-harvest condition, with the total planted varied by the site tree species (Table 15). Subsequent clearcuts occur 50 to 80 years later and may have a thinning 10 to 20 years prior, as a function of the timing that yields the highest NPV by plot.

Table 15. Seedling Magnitudes Post Clearcut Harvest by Site Species.

	Site Species				
Reforestation Metric	LAOC	PICO	PIEN	PIPO	PSME
# of Seedlings Planted	800	1000	800	650	800
# of Seedlings Surviving*	720	950	720	552	720
# of Trees At Age 60**	475-525	575-625	475-525	390-410	475-525
Site Species: LAOC = Larch, PICO = Lodgepole, PIEN = Spruce, PIPO = Ponderosa, PSME = Douglas fir					
* Seedling survival is measured five years after harvest and immediate planting					
** Variation is a function of site productivity and species composition					

The selection harvests were also modeled at the mid-point of each decade. However, unlike the clearcut prescriptions, the selectively harvested areas will not be planted and will instead rely on natural ingrowth (Table 16). Selection harvest was modeled starting in 2024, 2034 and 2044 using the FVS Q Ratio keyword. The ratio used is 2, with 2 inch DBH classes. Plots had to have at least 100 square feet of basal area and could not be cut below 65 square feet. Also, only 50 percent of the merchantable trees are allowed to be cut in any single entry. A cutting cycle of ten years was evaluated. If sufficient volume (> 2.5 mbf/ac) could be removed without cutting below the basal area limit, another harvest occurred.

Table 16. Ingrowth Magnitudes Post Selection Harvest by Site Species.

	Site Species				
Selection Ingrowth	LAOC	PICO	PIEN	PIPO	PSME
# of Seedlings Expected	350	450	350	250	350
# of Seedlings Surviving*	315	382	315	212	315
Site Species: LAOC = Larch, PICO = Lodgepole, PIEN = Spruce, PIPO = Ponderosa, PSME = Douglas fir					

FVS creates a TreeList output file that estimates the change in DBH, height and mortality for each individual tree over 100 years based on the silvicultural prescription defined. FVS also creates a CutList with the specific trees harvested in the prescriptions. The TreeList and CutList were

output into SIG's Carbon Assessor tool CAMEO. Next, a series of queries with appropriate volumetric equations are used following the Component Ratio Method, with ARB coefficients, to quantify MTCO₂e for all pools at each 5-year time step over 100 years.

Baseline linear optimization

A linear optimization program was used to optimize the baseline harvest schedule over 100 years. The above-ground live carbon inventory and the harvested merchantable carbon are entered into the Linear Programming (LP) model. The only silvicultural constraint was to allow selection harvest, or let grow prescriptions, in stream side management zones, as prescribed by Montana's only containable BMP for stream side management.

Regulation	Modeling Constraint
Montana Streamside Management Zone Law ((77-5-301[1] Montana Code Annotated)	All acreage within an SMZ, if harvested, must utilize a selection prescription.
Montana Forest Practice Notification Law ((76-13-420 MCA)	Montana BMP guidelines provide voluntary guidelines but are considered a legal constraint in the baseline modeling.
Clean Water Act of 1972 (33 U.S.C. §1251 et seq.).	The baseline prescriptions do not violate the Clean Water Act. The property is relatively flat with good road access, which minimizes erosion and stream damage.
Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884).	There are no endangered species identified within the Project Area.

Baseline results

The LP optimization process was able to find an optimal solution that met the constraints. Table 18 shows the baseline model acreages by stratum, initial cut year, and prescription.

Table 18. Acres by stratum, prescription and year of initial harvest in baseline modeling.

Strata	Init Cut Year	Clearcut	Selection	Let Grow	Total
High Stocking	2024	2,274	-	-	2,274
	2034	-	-	-	-
	2044	-	230	-	230
	2054	392	-	-	392
	2064	471	-	-	471
	2074	84	-	-	84
	2084	-	-	-	-
	2094	-	-	-	-

	9999	-	-	78	78
High Stocking Total		3,221	230	78	3,529
Mid-High Stocking	2024	2,590	-	-	2,590
	2034	288	-	144	432
	2044	-	-	303	303
	2054	432	-	-	432
	2064	1,064			1,064
	2074	1,151	-	-	1,151
	2084	-	-	-	-
	2094	-	-	-	-
	9999	-	504	-	504
Mid-High Stocking Total		5,524	504	447	6,475
Mid Stocking	2024	1,951	-	71	2,022
	2034	0	-	12	12
	2044	71	-	141	212
	2054	71	-	-	71
	2064	581			581
	2074	848	-	-	848
	2084	-	-	-	-
	2094	-	-	-	-
	9999	-	495	-	495
Mid Stocking Total		3,522	495	224	4,241
Low-Mid Stocking	2024	1,974	-	-	1,974
	2034	136	-	-	136
	2044	-	-	263	263
	2054	136	-	-	136
	2064	681			681
	2074	477	-	-	477
	2084	-	-	-	-
	2094	68	-	-	68
	9999	-	622	-	622
Low-Mid Stocking Total		3,472	622	263	4,357
Grand Total		15,739	1,698	1,164	18,602

Figure 11 illustrates a decline in the above-ground live carbon pool from 1,266,401 MTCO₂e at the project start date to 541,754 MTCO₂e after the clearcuts and single-tree selection harvest from 2019 – 2029. Onsite carbon stocks nearly double from 2029 to 2069 as the regenerated stands mature. Stocks then decrease again for 20 years before rising to nearly the initial stocking level.

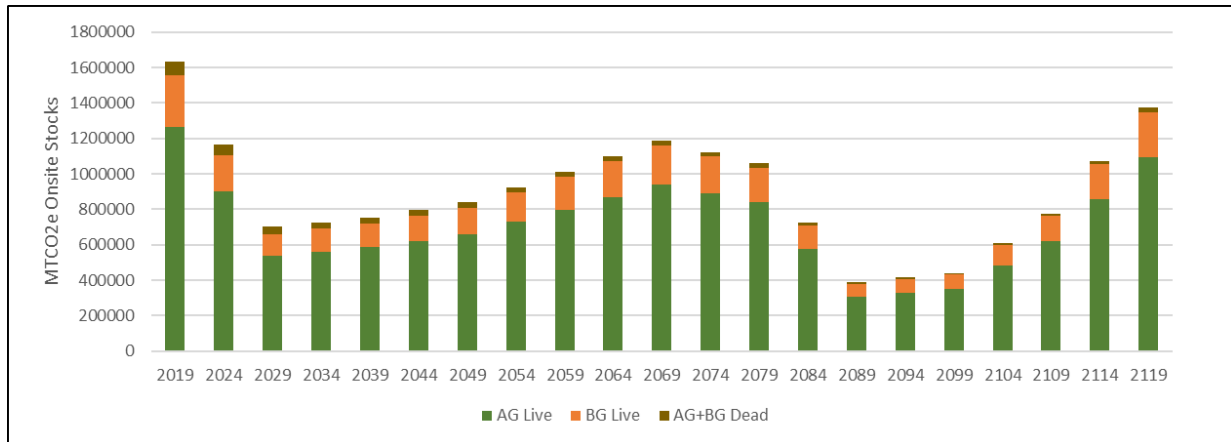
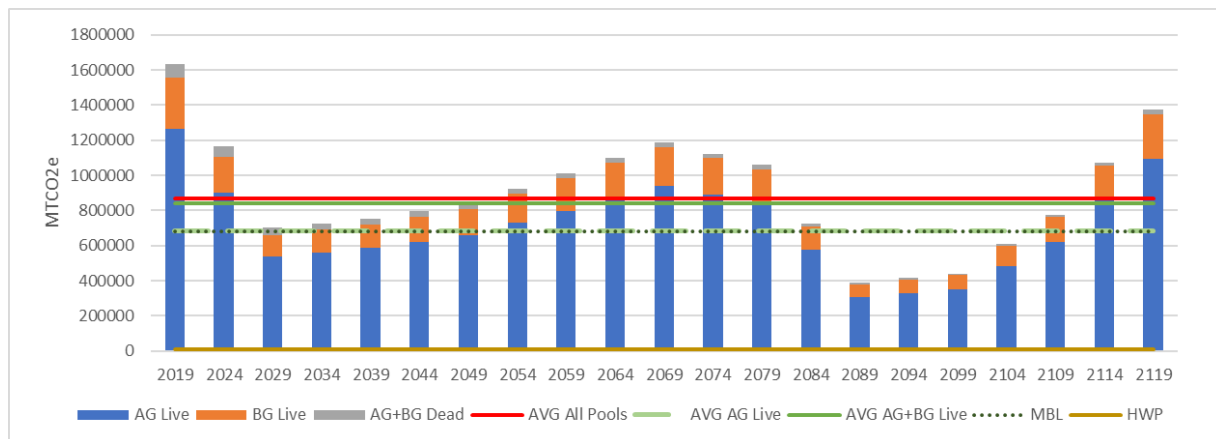


Figure 11. Baseline MTCO2e by pool over time



The baseline harvest volumes were determined by modeling optimal harvest timing and intensity such that the removal of carbon stocks was minimized, and the average annual aboveground live stocks, which fluctuate over time with planned silvicultural treatments, equals the minimum baseline. All required and relevant legal constraints and financial conditions were considered.

Figure 12. Baseline for all required carbon pools (FPP §7.1.1 (a)(29)).

5.4 ESTIMATING BASELINE CARBON IN HARVESTED WOOD PRODUCTS

Forest Offset Protocol §5.2.3, §7.1.1 (a)(30), Appendix C

Wood products were calculated using a two-part process. These are:

1. Determine the actual amount of carbon in standing live carbon stocks (prior to a mill) that would have been harvested in each year of the baseline over 100 years; and
2. Determine the annual amount of harvested carbon that would have remained stored in wood products, averaged over 100 years.

5.4.1 Step 1

Under the baseline scenario, the average carbon in trees cut for wood products is 25,286 MTCO₂e/year and the 100-year average delivered to the mill is 20,695 MTCO₂e annually over 100 years.

5.4.2 Step 2

Step 2 accounts for milling efficiencies (Forest Offset Protocol Appendix C, C.2) and estimates the average carbon storage over 100 years in wood products based on regional mill efficiencies from life cycle data.

Using the equations in the Forest Offset Protocol Appendix C, it is estimated 5,781 MTCO₂e per year are stored in in-use wood products and 9,782 MTCO₂e stored in wood products including landfill per year (Table 19).

Table 19: Average carbon stored in wood products and landfill over 100 years.

Carbon in Harvested Wood Products Pools	Tonnes CO ₂ e
IFM – 7: Baseline carbon stored long-term in in-use wood products	5,781
IFM – 8: Baseline carbon stored in landfill	4,000
Baseline carbon stored long-term in in-use & landfill wood products	9,782

5.5 DETERMINATION OF WEIGHTED AVERAGE CARBON STOCKS (WCS)

Forest Offset Protocol §5.2.1 (a)(3), §7.1.3 (a)(5)

The weighted average carbon stocks (WCS) estimate is not needed where the minimum baseline level (MBL) is equal to or above the common practice; therefore, it was not estimated.

6 PROJECT CARBON STOCKS

6.1 ACTUAL ONSITE CARBON STOCKS

Forest Offset Protocol §5.2.4, §7.1.1 (a)(27), Appendix A, Appendix B

The project used 262 plots to compute onsite stocks. The project will comply with the requirement that any field inventory data used cannot be more than 12 years old.

6.1.1 Inventory Confidence Statistics

The Project Area was stratified by forested canopy closure. Therefore, the sampling error was quantified using a stratified method. Only the standing live carbon was stratified to calculate mean onsite MTCO₂e. The stratified sampling error at the 90 percent confidence interval is 5.44%. The confidence deduction equals the sampling error minus 5%, rounded to the nearest one-tenth of one percent. Thus, the confidence deduction equals 0.4% (Table 20).

Table 20. Stratified sampling error at 90% Confidence Interval.

Mean Onsite MTCO ₂ e/acre	n	Standard Error	Sampling Error	Confidence Deduction
67.31	262	4.2	5.44%	0.4%

6.2 ACTUAL CARBON IN HARVESTED WOOD PRODUCTS

Forest Offset Protocol §5.2.5, §7.1.1 (a)(27), Appendix A, Appendix B, Appendix C

There has been harvesting since the project commencement date, removing about 11,451.6 green tons of logs.

6.3 CALCULATING SECONDARY EFFECTS

Forest Offset Protocol §5.2.6, §7.2.1 (a)(18)

The project accounts for market response factor of 80% in the project baseline (Table 21). The secondary effect is also accounted for in the ARBOC calculation worksheet.

Secondary effects include leakage from activity shifting as a result of changes in forest management activity due to the project. Secondary effects are calculated as 20 percent of the difference between actual and baseline carbon in harvested wood. In the first year of the project this is $20\% \times (12,862 - 25,286) = -2,485$ tonnes CO₂e. The secondary effect is also accounted for in row 28 of Table 22.

Table 21: Baseline carbon stored in wood products with market response shift.

Baseline carbon harvested for wood products (tonnes CO ₂ e)	Secondary effects Emissions from shifting activities	Total reduction (tonnes CO ₂ e)
25,286	2,485	774, 634

7 CALCULATION OF GHG REDUCTIONS AND REMOVALS

Forest Offset Protocol §5

7.1 ALL PROJECT TYPES

Using the calculation worksheet and all required calculations described in Sections 4 and 5 of the OPDR, 652,230 ARBOCs will be issued to the project for the initial reporting period under the compliance protocol (February 20, 2019 – August 20, 2019).

Table 22. GHG reductions and removals worksheet.

Type of Project – Improved Forest Management			
Reporting Periods		Data entered for the <u>end</u> of each Reporting Period	
Project Start Date		Feb. 20, 2019	
Reporting Period Begin Date			Feb. 20, 2019
Reporting Period End Date			Aug. 20, 2019
Calculating GHG Reductions/Removals for Onsite Carbon Stocks – All Project Types			
1	Sampled Onsite Carbon Stocks (tonnes CO ₂ e)	1,623,310	1,661,109
2	Confidence Deduction		0.4%
3	Adjusted Sampled Onsite Carbon Stocks (adjusted for confidence deduction) (tonnes CO ₂ e)		1,654,465
4	Soil Carbon Emissions		-
5	Increment in Actual Onsite Carbon Stocks (tonnes CO ₂ e)		1,654,465
6	Baseline Onsite Carbon Stocks (tonnes CO ₂ e)	1,623,310	873,259
7	Increment in Baseline Onsite Carbon Stocks (tonnes CO ₂ e)		
8	Quantified GHG Reductions / Removals for Onsite Carbon Stocks (tonnes CO ₂ e)		781,206

Calculating Carbon Stored in Wood Products Including Market Effects and Leakage – All Project Types			
9	Actual Carbon in Trees Harvested for Wood Products in (tonnes CO ₂ e)		12,862
10	Baseline Carbon in Trees Harvested for Wood Products (tonnes CO ₂ e)		25,286
11	Actual Carbon in Harvested Wood Delivered to Mills (tonnes CO ₂ e)		10,476
12	Baseline Carbon in Harvested Wood Delivered to Mills (tonnes CO ₂ e)		20, 596
13	Actual Carbon Stored Long-term in Wood Products (tonnes CO ₂ e) – Excl. Landfill		2,779
14	Actual Carbon Stored Long-term in Wood Products (tonnes CO ₂ e) – Incl. Landfill		4,673
15	Baseline Carbon Stored Long-term in Wood Products (tonnes CO ₂ e) – Excl. Landfill		5,781
16	Baseline Carbon Stored Long-term in Wood Products (tonnes CO ₂ e) – Incl. Landfill		9,782
17	Diff Between Actual and Baseline Carbon in Harvested Wood (tonnes CO ₂ e) – Excl. Landfill		(3,002)
18	Difference Between Actual and Baseline Carbon in Harvested Wood (tonnes CO ₂ e) – Incl. Landfill		(5,109)
19	Difference in Actual and Baseline Carbon Stored in Wood Products (tonnes CO ₂ e) - Landfill Adj.		(5,109)
20	GHG Reductions / Removals for Carbon Stored in Wood Products (tonnes CO ₂ e) w/ Mkt. Response		(4,087)
Calculating Other Secondary Effects - Improved Forest Management Projects			
27	Difference Between Actual and Baseline Carbon in Trees Harvested for Wood Products (tonnes CO ₂ e)		(12,424)
28	Other Secondary Effects Emissions (Shifting Activities/Materials) IFM Projects (tonnes CO ₂ e)		(2,485)
Quantified GHG Reductions and Removals			
34	Annual GHG Reductions/Removals Net of Discounts and Secondary Effects (tonnes CO ₂ e)	-	774,634
35	Cumulative GHG Reductions/Removals; <u>not</u> Incl. Neg. Carryover or Reversals (tonnes CO ₂ e)	-	774,634
36	Cumulative Negative Carryover from Year (tonnes CO ₂ e)		-
37	CRTs Issued - <u>Net</u> of Negative Carryover, <u>before</u> Buffer or Adjust for Reversals (tonnes CO ₂ e)	-	774,633
Calculation of Buffer Pool Contribution			
38	Project Specific Reversal Risk Rating		15.87%

39	ARBOCs from other Reporting Periods Submitted to Buffer Pool		N/A
40	Buffer Pool Contributions (CRTs)	-	122,935
Accounting for Reversals			
41	Annual Reversals (tonnes CO ₂ e)		-
42	Total "Avoidable Reversals" to be compensated by the Forest Owner (tonnes CO ₂ e)		-
43	"Unavoidable Reversals" compensated by the Reserve from the Buffer Pool (tonnes CO ₂ e)		-
Compensating for Avoidable Reversals			
44	"Avoidable Reversals" compensated by retirement of CRTs in the Forest Owners Reserve Account (tonnes CO ₂ e)		-
45	"Avoidable Reversals" compensated by retirement of CRTs issued to other Forest Projects Registered with the Reserve (tonnes CO ₂ e)		-
46	Carryover "Avoidable Reversals" which need to be compensated by Forest Owner (tonnes CO ₂ e)		-
ARBOCs Issued to Account Holder (following verification)			
47	Annual ARBOCs Issued to Account Holder		651,698
48	Vintage I - Calendar year of Reporting Period start date (Vintage)		2019
49	Portion of CRTs in first vintage in Reporting Period		651,698
50	Vintage II - Calendar year of Reporting Period end date (Vintage - if different from start date vintage)		
51	Portion of CRTs in second vintage Reporting Period		-
52	Cumulative CRTs Issued to Account Holder		651,698

8 REVERSAL RISK RATING

8.1 REVERSAL RISK RATING BY CATEGORY

Forest Offset Protocol §3.5.3, §7.1.1 (a)(31), Appendix D

Financial Risk (§Appendix D, Table D.2)

Buffer account contribution associated with financial risk come from the potential financial failure of an organization resulting in bankruptcy can lead to dissolution of agreements and forest management activities to recover losses that result in reversals. Given the Lubrecht

Carbon Project does not employ a Qualified Conservation Easement (QCE) and it is not on public lands, all risk ratings are assigned accordingly.

- Financial Failure (Default) 5%

Management Risk (§Appendix D, Table D.3, D.4, D.5)

Management failure is the risk of management activities that directly or indirectly could lead to a reversal. The types of management risk include 1) illegal forest biomass removal, 2) conversion of forest to an alternative use, and 3) over harvesting. The Lubrecht Carbon Project is in the United States so the default illegal harvesting risk of 0% is used.

- Illegal Harvesting U.S. (Default) 0%
- Conversion to Alternative Land Use (Default) 2%
- Over Harvesting (Default) 2%

Social Risk (§Appendix D, Table D.6)

Social risks exist due to changing government policies, regulations, and general economic conditions. The risks of social or political actions leading to reversals are low but could be significant. Since the project is located within the United States, the default social risk of 0% is used.

- Social Risk U.S. (Default) 0%

Natural Disturbance Risk (§Appendix D, Table D.7, D.8, D.9)

Natural disturbances can pose a significant risk to the permanence of the GHG emission reductions and GHG removal enhancements. While natural disturbances are only partially controlled by management activities, wildfire, insects, and disease risk can be reduced through management actions. Types of natural disturbance risk include 1) wildfire, 2) disease or insect outbreaks, 3) other episodic catastrophic events.

A wildfire risk can be reduced through the use of certain techniques including reducing surface fuel loads, removing ladder fuels, adding fuel breaks, and reducing stand density. The Lubrecht Carbon Project utilizes several techniques to reduce fire risk, including reducing surface fuel loads, reducing stand density, and maintaining spatial heterogeneity in forest structure. Prescribed fires and fire risk reduction techniques are used to: implement silvicultural prescriptions, reduce fuel loads, promote seral species, maintain natural processes, develop age class distribution, maintain patch sizes, and create landscape heterogeneity (Exhibit II). As required, a letter from the state fire protection agency with direct responsibility for fire

protection over the Project Area has been provided to verifiers. Therefore, a reversal risk rating of 2% is used for wildfire risks. The default is for all other natural disturbance risks are used.

- Wildfire 2%
- Disease or Insect Outbreak (Default) 3%
- Other Episodic Catastrophic Events (Default) 3%

8.2 REVERSAL RISK RATING BY CATEGORY

Forest Offset Protocol §3.5.3, §7.1.1 (a) (23, 31), Appendix D, Table D.10

Table 23 summarizes the assigned risk analysis by category for the project.

Table 23. Project contributions to buffer account based on risk

Risk Type	Risk Category	Contribution to Reversal Risk Rating
Financial	Financial Failure	5%
Management	Illegal Forest Biomass Removal	0%
	Conversion	2%
	Over-Harvesting	2%
Social	Social	0%
Natural Disturbance	Wildfire	2%
	Disease or Insect Outbreak	3%
	Other Catastrophic Events	3%
Overall Contribution Based on Appendix D.1 Equation		15.87%

Overall contribution to Buffer Account is 15.87% as calculated per the equation in the Forest Offset Protocol, Appendix D.1 Equation, and shown below:

- **Equation:** $100\% - (1 - \text{Financial Failure}\%) \times (1 - \text{IllegalForestBiomassRemoval}\%) \times (1 - \text{Conversion}\%) \times (1 - \text{OverHarvesting}\%) \times (1 - \text{SocialRisk}\%) \times (1 - \text{Wildfire}\%) \times (1 - \text{Disease/InsectOutbreak}\%) \times (1 - \text{OtherCatastrophicEvents}\%)$.
- **Project Specific:** $100\% - (1 - 5\%) \times (1 - 0\%) \times (1 - 2\%) \times (1 - 2\%) \times (1 - 0\%) \times (1 - 2\%) \times (1 - 3\%) \times (1 - 3\%)$.

9 REFERENCES

- CAR 2010. Forest Project Protocol Version 3.2. Retrieved on September 19, 2013 from <http://www.climateactionreserve.org/how/protocols/forest/dev/version-3-2/>
- CAR 2010. Volume Equations for the United States outside of California, Oregon, Washington, Alaska and Hawaii (September 23, 2010). <http://www.climateactionreserve.org/how/protocols/forest/resources/#biomass-equations>
- Heath, Linda S.; Hansen, Mark; Smith, James E.; Miles, Patrick D.; Smith, Brad W. 2009. Investigation into calculating tree biomass and carbon in the FIADB using a biomass expansion factor approach. In: McWilliams, Will; Moisen, Gretchen; Czaplewski, Ray, comps. 2009. 2008 Forest Inventory and Analysis (FIA) Symposium; October 21-23, 2008; Park City, UT. Proc. RMRS-P-56CD. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 26 p.
- Hollinger, D.Y., Dail, J.A., Davidson, E.A., Goltz, S.M., Hughes, H., Leclerc, M.Y., Lee, J.T., Richardson, A.D., Rodrigues, C., Scott, N.A., Achuatavarier, D., Walsh, J. 2004. Spatial and temporal variability in forest atmosphere CO₂ exchange. *Global Change Biology* 10, 1689-1706.
- Jenkins, Jennifer C.; Chojnacky, David C.; Heath, Linda S.; Birdsey, Richard A. 2003. National scale biomass estimators for United States tree species. *Forest Science*. 49: 12-35.
- Scott, C. T. 1981. Northeastern forest survey revised cubic-foot volume equations. Res. Note NE-304. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station. 4 p.
- U.S. Department of Agriculture, Forest Service. 2010. Forest Inventory and Analysis National Core Field Guide (version 5.0). Retrieved from: <http://www.climateactionreserve.org/wp-content/uploads/2011/09/NRS-FG-5.0-Oct-2010-Complete-Document.pdf>
- U.S. Department of Agriculture, Forest Service. 2014. Northeast Forest Inventory and Analysis. Retrieved from http://www.fs.fed.us/ne/fia/methodology/def_qz.htm on April 8, 2014.

EXHIBIT I: SPATIAL INFORMATICS GROUP, FOREST CARBON OFFSET PROJECT INVENTORY MANUAL
