Forest Offset Projects on Federal Lands

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1 Executive Summary

The Climate Action Reserve (Reserve) is a national offsets program working to ensure integrity, transparency and financial value in the North American carbon market. It does this by establishing regulatory-quality standards for the development, quantification and verification of GHG emissions reduction projects in North America; issuing carbon offset credits known as Climate Reserve Tonnes (CRTs) generated from such projects; and tracking the transaction of credits over time in a transparent, publicly-accessible system. Adherence to the Reserve's high standards ensures that emissions reductions associated with projects are real, permanent and additional, thereby instilling confidence in the environmental benefit, credibility and efficiency of the U.S. carbon market.

At this time, the Reserve will not register GHG forest offset projects implemented on federal lands unless the project is explicitly approved through a federal legislative or regulatory rulemaking process. The Reserve has received public comments requesting both that the Reserve freely allow offset projects on federal lands as allowed on private lands, and that the Reserve disallow projects on federal lands.

U.S. federal forests are a major carbon pool and forests are a significant component of the U.S. national greenhouse gas inventory. Federal forests encompass 248 million acres and are estimated to contain more than 12 billion tons of carbon. Federal lands are managed by many different agencies, for widely divergent purposes. This paper addresses federal lands which are currently forested or may be forested, and that are administered by one of the four federal agencies that manage 94% of all federal lands, the Forest Service, Bureau of Land Management, National Park Service, and Fish and Wildlife Service. The paper also considers lands that might be brought into federal ownership as a part of implementation of offset project activities.

This paper explores issues involved in implementing GHG forest offset projects on federally owned or managed lands, and the degree to which projects on federal lands can conform to the fundamental principles of quality offsets articulated by the Reserve, that offsets be real, additional, permanent, verified and owned unambiguously.

This analysis comes to three main conclusions:

- ***The main barrier to allowing offsets from federal forests is a lack of clarity that federal agencies have authority to accept obligations that the Reserve requires of owners of forest offset project lands.*** Long-term rights to forest carbon credits may be construed as a property right and the federal government is extremely limited as to the reasons and mechanisms for transferring property rights to private parties. As the federal government is a sovereign entity, other parties have limited recourse if Congress or a land management agency changes the purposes for which land is to be managed, changes land management, and emits carbon on which forest offsets are based. It is both unclear what rights to carbon credits the federal government can and will grant, and unclear whether existing protections of parties contracting with the federal government provide adequate recourse to the Reserve if the federal government were to change policy with the result of reversing offsets. Administrative

mechanisms would have to be developed for agreeing to offset project activities, allocating benefits between project developers and the federal government, and committing the federal government to offset project contracts.

- ***There are some challenges in assuring that offsets are real, additional, and permanent, but in general the existing Reserve forest project protocol can be applied to federal lands.*** Existing Reserve standards for offset quality can apply to federal lands, giving confidence that offsets are real, additional, and permanent. When setting baselines of forest offset projects located on non-federal public lands, existing Reserve rules give substantial weight to past management and existing policies. This same approach could apply to federal lands. Some further interpretation of existing rules may be desirable and the Reserve may wish to publish factors for public lands. In particular, the Reserve may issue more detailed guidance on how to calculate baselines by incorporating consideration of agency funding constraints and delays caused by planning processes and appeals. It is not clear if or how baselines for projects located on federal lands should be adjusted to account for expected future policy changes.

- ***There is modest opportunity for creation of forest carbon credits on federal lands because baseline carbon stocks are high and the administrative costs of implementing offset projects on federal lands are high.*** Laws directing management of federal lands require management practices that result in relatively high growth and relatively high carbon stocks on federal lands. There is modest opportunity for changing management to cause additional growth and sequestration beyond what results from implementation of existing laws. There have been claims that large amounts of offsets could be created by active reforestation after wildfires but research indicates that most burned areas regenerate in the absence of human intervention. Claims that forest thinning can reduce net emissions by reducing emissions from wildfire are not supported by the scientific literature (see Section 2.5.3). Where opportunities exist, they are largely in areas where trees can be established on ground that is suitable for forest but where the vegetation succession is not currently on a trajectory toward forest, or where growth and forest carbon stocks can be increased on nutrient-poor sites by fertilization. Currently, the Reserve does not permit projects that use broadcast fertilization; achieving this potential sequestration would require changing Reserve rules. Administrative costs and slow timelines might make carbon offset projects on federal lands cost-prohibitive. If environmental assessments, environmental impact statements, or changes in land management plans are required, the cost may be more than the value of offsets. Years of delay in changing plans or permitting might reduce the financial rate of return to the point where project developers choose not to implement projects on federal lands.

This analysis also has several other observations that are subsidiary to these main conclusions.

Federal policy toward offsets that might be generated from federal activities is still developing. It could be that the federal government will enact a policy that emission reductions and increased sequestration achieved by federal activities or on federal properties will be retained and counted in the U.S. government greenhouse gas emission inventory.

If the federal government clarifies that it wishes to create GHG offsets and will accept the obligations of creating offsets on federal lands, the government will have to create processes for evaluating proposed projects and selecting projects to implement. The government could establish contracts with private project developers that authorize a project developer to execute specified actions on specified lands and create and own resulting offsets. Alternatively, the federal government could implement activities for the purpose of creating offsets, and quantify and register the resulting sequestration itself. Institutional arrangements would be very different for these different ways of creating offsets. Different federal land management agencies have different mandates and different processes for authorizing and managing use of lands. The federal government could choose to have a single centralized process for authorizing and implementing offset projects, or could allow the main land management agencies to develop their own processes for implementing offset projects.

The current Reserve FPP states that forest offset projects are ineligible on lands that were in federal ownership before the start of the project, unless and until the federal government explicitly authorizes such projects through a federal legislative or regulatory/rulemaking process. Limits on the authorities of federal agencies and willingness of the federal government to accept the responsibilities that the Reserve requires of owners of lands used for forest offset projects must be addressed before the Reserve can guarantee forest offsets generated on federal lands.

2 Background

2.1 The Climate Action Reserve Offset Principles

The Climate Action Reserve (Reserve) is a national offsets program working to ensure integrity, transparency and financial value in the North American carbon market. It does this by establishing regulatory-quality standards for the development, quantification and verification of GHG emissions reduction projects in North America; issuing carbon offset credits known as Climate Reserve Tonnes (CRTs) generated from such projects; and tracking the transaction of credits over time in a transparent, publicly-accessible system. Adherence to the Reserve's high standards ensures that emissions reductions associated with projects are real, permanent and additional, thereby instilling confidence in the environmental benefit, credibility and efficiency of the U.S. carbon market. The Reserve's requirements are stated in the Climate Action Reserve *Program Manual* (Climate Action Reserve 2010a).

The Reserve *Program Manual* (Climate Action Reserve, 2010a) states principles that all emission mitigation offsets must adhere to:

- **Real:** Estimated GHG reductions should not be an artifact of incomplete or inaccurate emissions accounting. Methods for quantifying emission reductions should be conservative to avoid overstating a project's effects. The effects of a project on GHG emissions must be comprehensively accounted for, including unintended effects (often referred to as "leakage")
- **Additional:** GHG reductions must be additional to any that would have occurred in the absence of the Climate Action Reserve, or of a market for GHG reductions generally. "Business as usual"

reductions – i.e., those that would occur in the absence of a GHG- reduction market – should not be eligible for registration.

- **Permanent:** In order to function as offsets to GHG emissions, GHG reductions must effectively be "permanent." This means, in general, that any net reversal in GHG reductions used to offset emissions must be fully accounted for and compensated through the achievement of additional reductions.
- **Verified:** GHG reductions must result from activities that have been verified on an *ex post* basis. Verification requires third-party review of monitoring data for a project to ensure the data are complete and accurate.
- **Owned Unambiguously:** No parties other than the registered project developer must be able to reasonably claim ownership of the GHG reductions.

Of these five principles, verification of GHG reductions resulting from federal forestlands need not be problematic. Methods for quantifying forest carbon stock changes are well established. Methods for verification are reasonably well established. Forest projects are being measured and verified and forest carbon offsets are being registered with the Reserve.

The other four principles—real, additional, permanent, and owned unambiguously—may be problematic for forest carbon offsets on federal lands. Each of these issues is addressed separately in later sections of this report. The most problematic issues appear to be related to ownership of offsets. Assuring that offsets are real, additional, and permanent can largely be done using the existing Reserve forest project protocol, but the Reserve may wish to publish some clarifications and factors for applying the forest project protocol to federal lands.

The reader should keep in mind the distinction between carbon stocks and GHG flows. The carbon stock is the amount of carbon in a forest, wood products, or a component of the forest (such as live trees). When trees grow, the forest carbon stock increases by removing carbon dioxide from the atmosphere and keeping some of the carbon in wood. This increase in carbon stock is called sequestration. It is a net flow of carbon dioxide out of the atmosphere. If the sequestration meets all the requirements of an offset, it can count as an offset. If a tree dies and rots or is burned, generally the carbon in the wood flows back into the atmosphere as carbon dioxide. This emission is a flow that reverses previous sequestration. If not cancelled by growth of other trees on the project, the emission would reverse offsets based on the sequestration in the tree that rots or is burned. A stock is an amount present at a particular time. Sequestration is a net flow of carbon out of the atmosphere and into a forest (or other repository) during a specified time period. Emission is a net flow into the atmosphere during a specified time period.

2.2 Reserve Forest Project Protocol

Projects that generate CRTs through forest management must conform to the Reserve's Forest Project Protocol (FPP) (Climate Action Reserve 2010b). The FPP provides requirements and guidance for quantifying the net climate benefits of activities that sequester carbon or avoid emissions on forestland. The protocol provides project eligibility rules; methods to calculate a project's net effects on greenhouse gas (GHG) emissions and removals of CO_2 from the atmosphere ("removals"); procedures for assessing

the risk that carbon sequestered by a project may be reversed (i.e. released back to the atmosphere); and approaches for long term project monitoring and reporting. The goal of this protocol is to ensure that the net GHG reductions and removals caused by a project are accounted for in a complete, consistent, transparent, accurate, and conservative manner and may therefore be reported to the Reserve and server as the basis for the issuance of CRT offsets.

Under Version 3.2 of the FPP, there are two ways in which projects could take place on federal lands. The first option is for projects initiated on private lands to be transferred to federal ownership for long-term management. Transfer into any type of public ownership, including federal ownership, is permitted under this option.

For lands transferred to public ownership, the baseline is assumed to be continuation of private ownership and baseline carbon stocks are determined according to standard procedures that apply to private lands. Transfer to public ownership is assumed to mitigate certain risks (e.g., bankruptcy risks) that might lead to reversals, so such projects have reduced buffer pool (insurance) requirements.

The second option is for projects to be undertaken on lands already owned and managed by federal agencies, i.e., where there is no transfer of land ownership. Under the current FPP, projects initiated on federal lands will only be eligible "if and when their eligibility is approved through a federal legislative or regulatory/rulemaking process." (Climate Action Reserve, 2010b, p. 13). The requirement for a rulemaking process is intended to enable public consideration of appropriate baselines, management priorities, and carbon ownership for projects taking place on federal lands.

This analysis only examines forest offsets. It does not consider other types of terrestrial GHG emission mitigation, such as carbon sequestration in agricultural soils or reduction of manure emissions.

2.3 Extent and Purposes of Federal Lands

Federally owned and managed lands are 29% of the total U.S. land area (Figure 1). Any coherent climate strategy will have to consider these lands to be successful (Galik, Grinnell, & Cooley, 2010). There are 751 million acres of forest in the U.S. and 44% of this forest is publicly owned, including federal, state, local, and tribal government lands (Smith et al. 2009). Of the 328 million acres of forest in public ownership in the U.S., the federal government controls 76% (Figure 1).

Federal land is owned by the federal government, but managed by agencies. Laws mandate the purposes for which federal lands are managed, and each federal agency has a different mandate. Broad management guidance is established by Congress and specified by legislation. Congressional mandates are implemented through site-specific management plans promulgated by agencies responsible for managing federal lands.

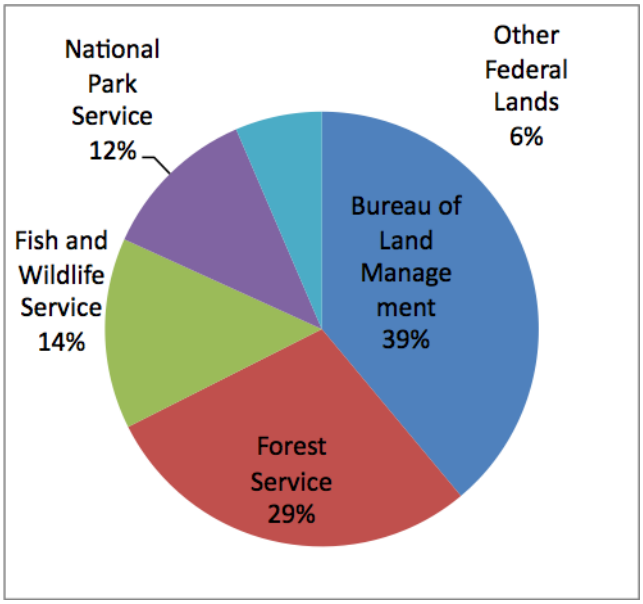
94% of federally owned land is managed by four agencies. These agencies, the lands they manage, and the agency authorizing legislation are listed in Table 1.

Table 1. Main federal land management agencies and their authorizing legislation

Agency	Lands Managed	Authorizing Legislation
Bureau of Land Management	Federal Domain	Federal Land Policy and Management Act of 1976 (FLPMA)
USDA Forest Service	National Forest System, National Grasslands, other	National Forest Management Act of 1976 (NFMA)
US Fish & Wildlife Service	National Wildlife Refuge System, other	National Wildlife Refuge System Improvement Act of 1997 (NWRSIA)
National Park Service	National Park System, other	National Park Service Organic Act of 1916 (Organic Act)

The Forest Service administers more forest than any other federal agency. Of the 248 million acres of federal forestland,[1] 147 million acres are managed by the U.S. Forest Service (Table 3). Of the land the Forest Service manages, 76% is forest. BLM administers a larger total land area than the FS, but much of the BLM land is non-forest. Non-forest lands include grassland, water bodies, rock, ice, and developed land. Other federal agencies that administer significant amounts of land are the Bureau of Indian Affairs, United States Department of Defense, U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, and the Tennessee Valley Authority.

Figure 1. U.S. federal land by agencies (forest and non-forest) (Congressional Reserch Service, 2004)



[1] Estimates of forest land area vary because of differences in the definition of "forest" and because of changes in land cover over time.

Table 2. Total area of federal lands (forest and non-forest) by region and agency, millions of acres (Gorte and Vincent, 2007)

Agency	Alaska	Not Alaska	Total
National Park Service	51.09	27.03	78.13
Fish and Wildlife Service	76.61	13.87	90.47
Bureau of Land Management	83.54	174.74	258.28
USDA Forest Service	21.97	170.82	192.79
Other Federal	19.29	14.34	33.63
Total	252.50	400.80	653.30

Table 3. Area of U.S. forest lands by ownership type, in 2007, in millions of acres (Smith et al. 2009)

Ownership	Forest Area
USDA Forest Service	147.2
Bureau of Land Management	47.6
Other federal	53.6
Subtotal: Federal	248.4
Other Public	79.8
Private	423.0
Total	751.2

2.4 Management of Federal Lands

There are many federal land management mandates. Some lands are under a specific mandate for a specific use. Many lands have multiple, overlapping mandates. However, each agency has a mandated primary land management purpose. Primary purposes are summarized in Table 4.

Table 4. Federal land management mandates by agency

Agency	Primary Land Management Purposes
Bureau of Land Management	**Multiple Use:** livestock grazing, minerals, energy
Forest Service	**Multiple Use:** timber, watershed, wildlife, recreation, wilderness
Fish and Wildlife Service	**Primary Use:** biological integrity, environmental health of refuges
National Park Service	**Park Specific:** varies by site but primary use is protection of natural and cultural heritage values

Agencies may have a secondary mandate that, on a specified subset of lands administered by the agency dominates the agency's primary mandate. A notable secondary mandate is wilderness. Lands federally designated as wilderness occur mainly on National Forest System lands and National Park System lands, but also occur on some BLM domain lands. Designated wilderness prohibits development and resource extraction. Other laws can trump mandates. Most significantly, the General Mining Act of 1872 allows

establishing of mining claims and conversion of lands in mining claims from public ownership to private ownership. Mining claims can even be established in wilderness, and landowners can build roads to access their lands. There is currently a moratorium preventing new mining claims and subsequent laws have placed some limits on establishment of claims and how claims may be managed.

2.5 Biological Potential for Generating Offsets on Federal Lands

Existing published studies and proposals suggest several options for increasing carbon sequestration or decreasing carbon loss on federal lands. We are not aware of any significant opportunities on federal lands to decrease methane or nitrous oxide emissions—the other terrestrial GHGs. The activities discussed here go beyond the range of activities currently allowed under Reserve rules. Potential activities discussed here are:

- Convert non-forest land to forest (afforestation/reforestation)
- Plant trees in areas burned by wildfire (afforestation/reforestation)
- Reduce emissions from wildfires (improved forest management)
- Grow trees larger in existing forests by extending rotations (improved forest management)
- Switch from logging to protected forest (improved forest management)
- Increase growth by fertilizing (improved forest management)

Current Reserve protocols do not allow generation of offsets by reducing fire emissions or broadcast fertilization of forests. Generating offsets by reducing fire or using fertilizer to increase growth would require changes in existing protocols and might require further elaboration of the Reserve's accounting guidelines.

The activities discussed here are all afforestation/reforestation or improved forest management. Reserve forest project protocols also recognize projects that avoid conversion of forest lands to non-forest cover or use. Avoided conversion projects have an extremely limited potential on federal lands as federal lands are not available for conversion like private lands. Federal land retention laws and policies result in lands being retained in federal ownership, and not transferred to private ownership for development. Federal land management policies cause federal forestlands to remain in forest except for very small areas cleared for new facilities. We were not able to find data on area of federal forestland converted to non-forest cover. Total area of federal forestland increased from 1987 through 2007 (Smith et al. 2009). There is some loss of forest, but this loss is less than the area that changes from non-forest to forest, resulting in net increase in forest area.

2.5.1 Convert non-forested areas to forest

One option for forest carbon sequestration is establishing forests on lands that are ecologically suitable for forests, but that currently do not have trees. Typically, this would mean areas where forest was cleared for agriculture, where the land can be converted back to forest. Agricultural uses include growing crops, pasture, and grazing on open range. We were not able to find statistics on the area of cropping or pasture on federal lands, perhaps because there is very little of these activities. Lands used

for open range grazing are often semi-arid or arid and will support only partial tree cover. As discussed below, many areas with current grazing use have partial tree cover and may or may not support a significant increase in trees. Policy goals may require that these cleared lands remain non-forest. Examples of land that would not be available for conversion to forest include historic battlefields managed by NPS, and grass and shrub habitats managed by FWS.

There may be some rangelands that could be converted to forest. Rangelands that historically have not supported forest because of aridity would not support forest in the future and are not candidates for afforestation. However, there are significant areas of rangeland that historically have not been forested because of frequent fires. Primarily in the western U.S. there has been significant encroachment of trees into rangelands in the past century, primarily because of control of wildfires since 1930, livestock grazing that reduces competition from grasses (allowing growth of trees that are not favored as browse) and elimination of grassland and woodland burning by Native Americans (Smith et al. 2009). Given that these conditions favoring conversion of grassland to woodland have been present for 80-200 years, it is not clear how much more rangeland could be converted to forest. Supporting the theory that the net conversion of grassland to forest resulting from changed management of grasslands may be reaching its limit is the fact that the annual area burned in wildfires has approximately doubled from the 1960s to the post-2000 years (Smith et al. 2009), despite major advances in early wildfire detection.

However, if even a modest fraction of existing rangelands can be afforested, it is possible that this afforestation of federal lands could sequester carbon in amounts that are large relative to current voluntary offset creation. The BLM administers about 200 million acres of non-forest land. If only 5% (an arbitrary but low proportion) of this land can be converted to forest, and sequesters carbon at a rate of 2-4 tons CO_2e/acre-year (a modest rate for afforestation projects, assuming that most of the lands are dry and will support only limited tree growth), a major afforestation program on BLM lands could sequester 20-40 million tons CO_2e per year. In comparison, as of September 2011, the Reserve has issued about 16.5 million tons of offsets, cumulative since it was formed as the California Climate Action Registry in 2001.

In summary, there is considerable uncertainty as to the potential supply of federal non-forest lands that could be converted to forest under afforestation/reforestation projects for the purpose of creating forest carbon sequestration offsets. However, even if only a small fraction of federal lands could be afforested, the sequestration could be significant relative to the existing creation of CRTs.

2.5.2 Plant trees in areas burned by wildfire or otherwise in need of reforestation

It has been argued that there are significant areas of federal land, particularly National Forest System lands, where trees have been killed by wildfire and reforestation is needed. Planting trees after wildfire has been proposed as a carbon offset project activity for federal lands. It has been argued that private landowners generally reforest after wildfires, but that federal agencies often do not have the funding or flexibility to plant after wildfires. Federal management plans may specify that tree planting is to be done after wildfire if a natural seed source is not present, but budget limits may preclude planting despite the direction of the management plan (Arora, Biesecker, & Hummon, 2010). In this case, planting could be additional even though it is specified in the pre-existing management plan.

Recently, the Forest Service estimated that it needed reforestation on 991,000 acres (Tidwell, 2009). However, there is substantial uncertainty regarding the actual need. The Government Accountability Office reports that the main reforestation need on federal lands is with the Forest Service, but the Forest Service collects reforestation need data inconsistently, and does not reliably update records as lands reforest or review the accuracy of the data (Government Accountability Office, 2005).

Logged areas generally are not part of the backlog of lands needing reforestation. This is because law requires logged lands to be regenerated, and a portion of logging revenues is set aside to pay for regeneration. There are logged sites where regeneration failed and regeneration funding has been exhausted. These areas appear to be included in Forest Service estimates of areas needing reforestation.

2.5.3 Forest thinning to reduce wildfire

It has been proposed that forest thinning can reduce emissions from wildfires. The carbon implications of forest thinning are mixed, and the effects on net fire emission are uncertain, but there is a way that thinning could be applied to federal lands to increase forest carbon stocks.

There is an ongoing debate about the value of treating forest stands to reduce the risk of stand replacing fire. It has been documented that treatment can limit stand-replacing fire (Hurteau et al. 2008). If an acre is going to burn, then thinning it provides a carbon benefit. However, across the landscape, it is not clear that thinning provides a carbon benefit. In the absence of fire, modeling suggests that over short time periods, not thinning sequesters more carbon than thinning (Hurteau et al. 2008). Based on modeling of fire behavior, Finney (2001) asserts that strategically treating 20% of the landscape can reduce the spread of fire, and that strategically treating about 30% of the landscape could reduce fire by half. Finney's analysis suggests that even if all of the landscape is treated, still about 20% of fire would continue. On a single acre, emissions from thinning are a substantial fraction of emissions from fire and because fire only burns a small percentage of the landscape, thinning the entire forest would cause emissions more than ten times greater than observed fire emissions (Hurteau et al. 2008).

Over many decades, it is possible that thinning could eventually result in greater carbon sequestration. This is because studies show that in forests that have not been thinned by fire or logging, large trees tend to die, resulting in lower carbon stocks (Fellows and Goulden 2008, North et al. 2009). However, a single large tree can store as much carbon as dozens or hundreds of small trees. As a result, growing a few very large trees per acre, with very few small trees, can both store large amounts of carbon per acre and maintain fire-resistant stands (North et al. 2009).

Private landowners generally would not thin stands and grow widely spaced, very large trees because the activity would forego most timber revenues and generally would not generate offsets until several decades after the start of the project activity. Because federal forests are managed for a variety of purposes in addition to timber revenues, a project on federal lands might remove smaller trees to protect large trees and, over decades, generate credits.

2.5.4 Grow trees larger in existing forests

There is modest potential to grow trees larger in existing federal forests. The potential is modest because baseline policies of managing forests to culmination of mean annual increment result in forest

carbon stocks on federal lands already being moderately high. Also, there is a biological limit to the amount of carbon a forest can contain.

When a forest grows on a non-forested site, trees start small and grow. Individual trees continue growing through their lives, but across the forest individual trees are also dying. Even if the forest canopy is relatively continuous, individual trees are growing, dying, and decomposing within the forest. The mass of dead wood starts at zero if the stand is starting from bare land. As more trees or bigger trees die, the stock of dead wood increases. At some point in time, totaled across the forest, the emissions from the decomposition of dead wood equal the sequestration of growth of live trees and the forest carbon stock is no longer increasing, and there is no net sequestration. Over long periods of time, carbon stocks in fire-prone conifer forests could be maximized by growing very large, widely spaced trees (Hurteau and North 2009) but this management takes many decades and provides low economic returns. In reality, rates of growth and death are not constant over time. Pulses of tree death occur in years with harsh weather, or because of storms, fire, disease, insect attacks, or logging. Growth varies with the weather and condition of live trees. In an old forest, whether the forest is a net source or net sink of carbon can vary from year to year (Suchanek et al. 2004). Although old forests generally continue to increase their carbon stocks if not disturbed (Luyssaert et al. 2008), the rate of net sequestration declines and the cumulative chance of disturbance increases. As a result, there is effectively a maximum carbon stock for a forest type and climate.

Maximum carbon stocks are not well defined, but the higher the initial stock the less opportunity there is for increase. Total carbon stocks on federal lands are substantial. According to the US Forest Service Carbon On-line Estimation Tool (COLE)[2], forests on federally managed lands store about 12,242 million metric tons of carbon in all forest carbon pools (trees, shrubs, dead wood, the forest floor, and soil). National Forests are responsible for the vast majority of this carbon due both to the high carbon density (mean tons of carbon per hectare) and extensive forested area. BLM lands are second in terms of carbon storage, due primarily to their extensive area. A large proportion of BLM lands are woodland or rangeland, with relatively sparse and relatively small trees. As a result, the carbon density on BLM lands is relatively low. Interestingly, forests on lands designated as National Grassland have about 98 tons of carbon per hectare, more than BLM.

Federal forests have moderately high carbon stocks. Forest on National Forest System lands have an average carbon stock of about 167 metric tons of carbon per hectare (248 metric tons carbon dioxide equivalent per acre) (Table 5). Other forests administered by the Forest Service have an even higher average stock, 174 metric tons of carbon per acre. Lands administered by the NPS have the highest stocking of all federal agencies, 195 tons of carbon per hectare. These carbon stock amounts are only for lands classified as forest, not grassland, developed areas, water bodies, barren lands, or other non-forest lands.

For reference, carbon densities on private forestlands average about 141 metric tons C/hectare, which at 170 million hectares of area is approximately 23,890 million metric tons of carbon. Carbon stocks on

[2] http://www.ncasi2.org/COLE/index.html

private lands tend to be lower because forests on private stands are younger than forest on public lands (Hudiburg et al. 2009). Forests on private lands are younger mainly because of logging.

Table 5. Estimated carbon stocks on forested land by federal land ownership for the U.S. (excluding Alaska and Hawaii)

State	Mean Forest Carbon (metric tons C/hectare)	Area (hectares)	Carbon (million metric tons)	Cumulative Percent of Forest Carbon
National Forest	166.95	58,820,322	9,820	80.2%
Bureau of Land Management	92.73	12,288,825	1,140	89.5%
National Park Service	195.45	3,392,385	663	94.9%
Department of Defense/Energy	150.02	1,740,859	261	97.1%
Fish and Wildlife Service	163.7	1,016,386	166	98.4%
Other federal	155.61	1,064,994	166	99.8%
National Grassland	97.69	114,324	11	99.9%
Other Forest Service	173.98	86,719	15	100.0%
All Federal		77,307,385	12,242	

This difference in carbon stocks between private and federal lands probably does not fully illustrate the degree to which federal lands are closer to their maximum potential carbon stocks. Federal lands tend to be less productive than private forest lands because much of the most productive forest was privatized in the first century and a half of the existence of the U.S., leaving less economically valuable lands in public ownership. Less productive lands tend to support smaller trees and lower carbon stocks (with the exception of a few small areas with peat soils that have high carbon stocks). Thus, a given number of tons per hectare on federal lands is probably closer to the biological potential of those lands than the same number of tons per hectare on private lands.

Looking at individual states shows the difference in carbon stocks between public and private management. On average, National Forest lands are more like private forestlands than most other federal lands. This is because National Forests and private forestlands were both selected for their ability to grow trees. National Park System lands were selected for scenic beauty or historic significance, and scenic lands are often rocky highlands where trees grow slowly and remain small. A large proportion of BLM land is area that was left after privatization of economically valuable lands and designation of lands for specific public purposes. Table 6 gives live tree carbon stock densities on forest lands, by ownership type, in selected states. Carbon densities on National Forest are 1/3 to 2/3 higher than carbon densities on private forestlands.

Table 6. Comparison of live tree carbon stocks on forestland only, by ownership type, for selected states (average metric tons carbon per hectare)

State	Forest Service	Other Federal	State & Local Government	Private	All Ownerships
Maine	103.9	64.7	78.2	61.6	62.7
Georgia	114.8	88.2	81.5	66.5	69.3
Washington	161.6	278.8	166.3	90.9	139.4
California	117.6	86.9	154.4	91.8	106.9

2.5.5 Increase growth via fertilization

Current Reserve rules prohibit broadcast fertilization in forest offset projects (presumably fertilization of individual trees would be allowed, but the cost would be prohibitive). In many U.S. forests, a shortage of nitrogen is limiting growth. Addition of nitrogen fertilizer often increases the growth rate of trees. One argument why fertilization should not be allowed to generate offsets on private forest lands is that, in many cases, the revenue from increased wood production gives a reasonable financial return on the cost of fertilization. However, on federal lands, federal funding is not available for fertilization and the activity would be additional.

If fertilization were to be allowed as a project activity on federal lands, GHG emissions from fertilizer projection and use should be counted as project emissions. Even when accounting for GHG emissions from manufacturing fertilizer, there is a net GHG benefit from increased sequestration from increased growth of trees. Increasing tree growth by fertilization is rarely discussed but could be a viable project activity on federal lands.

3 Legal Barriers to Generating Offsets on Federal Lands

The Reserve requires that ownership of offsets be unambiguous. Not only must creators of offsets clearly own them for registration with the Reserve, to sell offsets the seller must be able to transfer ownership to the buyers. In the Reserve's forest offset projects, the Reserve enforces the offset buyer's rights to claims on forest properties through a "Project Implementation Agreement" (PIA), which is a long-term contract between the landowner and the Reserve. It appears that federal agencies would need to be given explicit authorization to sign Reserve PIAs and transfer rights in carbon sequestration to non-federal owners.

Discussion of federal sale of GHG offset rights presumes that the federal government will choose to transfer rights to forest carbon sequestration to non-federal owners. Despite actions by the San Juan National Forest awarding rights to GHG offsets based on externally-funded tree planting on the Forest,[3] there is no clear federal policy statement approving disposition of federal rights to count forest carbon sequestration. There are federal policy statements saying that farmers get rights to GHG emission mitigation credits that may arise from implementation of activities funded by federal agricultural

[3] For information on the project see http://www.americancarbonregistry.org/carbon-registry/projects/carbon-demonstration-project-san-juan-national-forest.

conservation incentive programs such as the Conservation Reserve Program (CRP).[4] However, it is possible that the federal government might choose to retain rights to count the GHG effects of forest carbon sequestration.

There are several possible reasons why the federal government may choose not to sell or transfer rights to sequestration that occurs on federal lands. By not selling offsets from federal lands, the government can require fewer reductions from the private sector, to meet a given amount of collective U.S. emission reductions. The government may wish to avoid accusations that it is subsidizing offsets or emitters, because in many cases the present value of foregone timber harvests could be much greater than offset revenues. The government may wish to count federal land carbon sequestration towards its own GHG emission mitigation goals. There may be international diplomatic reasons for avoiding sale of offsets from federal lands. In summary, there are reasons why the federal government might, or might not sell offsets generated on federal lands, and the decision will have to be made at a high political level before the government will sell offsets.

It is not clear that the federal government would be willing to do what the Reserve requires of owners of lands where forest offset projects are located. Reserve forest offsets are to be secured by a Project Implementation Agreement (PIA), which is a contract between the landowner and the Reserve that runs for a time period between 100 and 199 years, extending 100 years after the last issuance of offsets. The PIA is required to be recorded as a restrictive covenant on the deed to the property. The PIA subordinates any future deed, mortgage, lien, lease or other encumbrance on the property to the PIA. Also, the PIA binds the landowner to replace reversed offsets, including transferring to the Reserve more offsets than are reversed if the reversal happens within 50 years of the start of an improved forest management project. The landowner may elect to also establish a conservation easement on the property, giving the project a lower withholding rate for the buffer pool that insures against reversals of offsets.

It is not clear that the federal government could agree to the Reserve's terms.[5] Before forest carbon offsets generated on federal lands can meet Reserve standards, federal intent to create offsets and transfer them to non-federal ownership must be clarified. Aspects of transferring offsets include deciding whether the federal government or a project developer would register a project and receive the offsets, processes for awarding federal approval of projects, and the extent of obligations the federal government will accept.

[4] Federal conservation incentive payment program rules stating that GHG credits may be generated by program activities and asserting no federal claim on these credits are: EQIP (§1466.36, 74 *Federal Register* 2317), WRP (§1467.20, 74 *Federal Register* 2336), AMA (§1465.36, 73 *Federal Register* 70256), GRP (§1415.10, 74 *Federal Register* 3875), FPP (§1491.21, 74 *Federal Register* 2822), WHIP (§636.21, 74 *Federal Register* 2800), CRP (§1410.63(6), 68 *Federal Register* 24845), and HFRP (§625.8, §74 *Federal Register* 1967).

[5] For example, the federal Antideficiency Act may prevent agencies from agreeing to long-term encumbrances on federal land.

3.1 Possible Federal Offset Development and Sale Processes

Federal agencies have historically sold products from federal lands and the use of federal lands. Prime examples are selling timber, allowing mineral extraction in exchange for royalty payments, and lease payments by concessionaires that provide recreational services on federal lands. Given these precedents, if offsets can be generated on federal lands, agencies should be able to sell the offsets on behalf of the federal government.

If the government is willing to alienate rights to GHG emission mitigation achieved on federal lands, it is not clear what kinds of arrangements the government would allow or require. The federal government could allow different agencies to use different approaches to creating credits. Approaches to transferring rights to sequestration range from allowing private entities to make improvements to public resources in exchange for being able to own and sell any GHG credits that might result from the improvements, to the federal government implementing activities, registering credits, and selling the credits through a centralized process.

If the federal government chooses to allow private parties to undertake resource improvement activities on federal lands in exchange for the private entity owning any resulting GHG offsets, the government will have to establish processes for specifying what activities (and in what locations) are considered to be resource improvement, assuring equal access to opportunities to implement activities on federal lands, and assuring that the government is getting fair market compensation for the benefits that private parties are receiving for use of federal lands.

If the government chooses to create and sell greenhouse gas emission offsets (rather than allowing others to create offsets on federal lands), it is not clear what sales process would apply, and whether agencies would have the option of using different processes. Greenhouse gas credits are a new type of commodity. The exploitation of natural resources like minerals, oil, gas, coal, and timber provide precedents for the use of federal forest offsets in the private market. In practice, disposition of rights on federal lands varies greatly from one resource to the next, with significant implications for both the distribution of benefits between the private and public sector as well as amongst private parties. For locatable minerals, a private entity may establish a claim to a mineral deposit simply by being the first to do so, and the claim must be on lands that are classified as open to location of mining claims. However, there is a moratorium on lands being converted to private ownership (“patented”) for mining. The entity must physically mark the mining claim and file notice with the BLM and pay modest fees. (Mineral Lands and Mining)

By contrast, for other resources including oil, gas, coal and timber, BLM leases are awarded through competitive or non-competitive bidding. Though the process itself varies with each resource, most leases are awarded based on a competitive oral or written auction with advance public notice. In some instances a floor price is established based on economic assessment, and for others no such economic assessment is required (U.S. Department of the Interior, Bureau of Land Management, 2009). In the case of forest resources, “[a]ll timber or other vegetative resources to be sold shall be appraised and in no case shall be sold at less than the appraised value” (Public Lands: Interior). Once resource extraction commences, royalties may then be paid to the government as a percentage of the extracted resource.

However, for locatable minerals on BLM lands there are no royalty payments paid to the US government; the lack of government payment has been the source of contention for years (Feriancek, 1999).

The main legislation directing the BLM, the Federal Land Policy and Management Act of 1976, provides that "the public lands be managed in a manner which recognizes the Nation's need for domestic sources of minerals, food, timber, and fiber." To sell these commodities, it is required that "the United States receive fair market value of the use of the public lands and their resources unless otherwise provided for by statute" (U.S. Department of the Interior, Bureau of Land Management and Office of the Solicitor, 2001). While carbon assets are not explicitly identified in the Act, it is possible that GHG offsets could be construed as minerals that could be sold without amendment to the Federal Land Policy and Management Act.

Finally, it is not clear that land management agencies would necessarily execute carbon offset transactions. Sale of federal lands that have been declared as surplus to the needs of the federal government is largely centralized and conducted by the General Services Administration (GSA). It is possible that sale of carbon credits, if the sale involves easements on land, could be centralized through GSA rather than being conducted by land management agencies.

Due to the varying public processes for assignment and valuation of resource rights on federal lands, it is presently unclear what mechanism would be appropriate, or applicable, for carbon projects in federal forests. In particular, a mechanism must be agreed upon that provides "fair market value" to the governing agency, and provides equitable access to private market participants. The government might establish a single, centralized mechanism for awarding offset rights, or establish principles and allow each land management agency to develop its own process that is tailored to the mission of the agency and the agency's existing administrative processes and capacities.

3.2 Transferring Offset Ownership to Buyers

A key aspect of offsets is that they are transferred. GHG emissions are reduced (or carbon is sequestered) in one location controlled by one entity, and the right to count that emission mitigation is transferred to a different entity. If an offset cannot be legally transferred, it will not be possible for third parties to purchase the offset and retire it against their own emissions obligations.

Offsets are a type of property. Transferring ownership of forest offsets is a transfer of a kind of property right. Federal agencies are highly constrained in their ability to give up property rights. Federal policy is to generally retain existing federal lands in federal ownership. At the same time, as described above, the federal government commonly sells mineral and gas rights, and these are property rights. If the federal government were to sell forest sequestration offset rights, however, the authority to sell these rights probably will have to be specifically established by Congress.

3.3 Recourse Upon Federal Reversal of Offsets

The Reserve guarantees the validity of forest offsets by putting offsets into a buffer pool that can be drawn upon to replace reversed offsets. In addition to contributions of offsets to the buffer pool, the PIA

commits landowners to compensating the Reserve with replacement offsets for losses that are "avoidable" reversals. In some cases, the landowner must provide the Reserve additional, compensatory offsets in addition to replacement of reversed offsets.

Before allowing the creating and transfer of forest offsets from federal lands, the Reserve would have to be confident that it could enforce obligations to maintain carbon storage on federal lands. The United States government, like any national government, is a sovereign entity. As a sovereign entity, it cannot be sued for damages unless it previously agrees to allow suits. The U.S. government has waived sovereign immunity in some cases, mainly through the Federal Tort Claims Act, which waives the immunity for some actions by federal employees, and the Tucker Act, which allows parties to sue for claims arising out of contracts to which the federal government is a party. Because the Reserve PIA is a contract, the Tucker Act may give the Reserve sufficient rights to enforce the terms of the agreement. However, GHG offsets are a relatively new kind of property right with a long-term claim on the lands where they are created and because the relationship between land conditions and offsets is complex. The Federal Tort Claims Act and the Tucker Act are limited waivers of sovereign immunity, and may not adequately provide for the Reserve's interests in the carbon underlying offsets issued by the Reserve. Further legislative or judicial clarification may be required.

In addition, it is possible that the Reserve's PIA would have to be modified to be applied to federal lands. The PIA binds the landowner to adjudication under the laws of the State of California. Federal lands within a state are subject to federal authority to control occupancy and use, protection of the lands, and to prescribe the conditions upon which others may obtain rights in the lands, even if those involve functions that are customary police powers of the states. State police power may extend, however, to public lands as to which Congress has not legislated federal control. As a general rule, Federal courts have jurisdiction over suits relating to federal actions on public lands. It is possible that the PIA would have to be revised to operate under federal law, and possibly other changes would also be required.

There are likely to be disputes about the effects of project activities, responsibility for failure of project activities to achieve expected outcomes, and responsibility for reversals of sequestration. Desire to avoid such disputes is another reason why the federal government might choose not to allow private actors to get credits from privately funded activities on federal lands. This is especially true if the government would have to sign a PIA committing to replace reversed offsets.

4 Applying Existing Reserve Protocols to Federal Lands

The Reserve requires that offsets represent real, additional, and permanent emission mitigation. Many of the provisions in the Reserve Forest Project Protocol can be applied to federal lands, for the purposes of selecting baselines and quantifying emission reductions.

4.1 Reforestation Projects

As noted in Section 2.5.2, one of the significant potential opportunities for reforestation on federal lands may be replanting areas affected by wildfires. However, there is considerable uncertainty about the appropriate baseline rate of regeneration and sequestration after fire. The Reserve seeks to avoid this

uncertainty by requiring that lands be non-forest for at least 10 years to be eligible to be included in a reforestation project. On private lands, this rule may be adequate, assuming that private landowners will not forego revenues by letting land sit idle for more than a decade. However, on federal lands this criterion may not be sufficient to exclude lands that would regenerate in the absence of a planting project. Even after large and intense fires, immediate regeneration can be more than enough to regenerate forests (Donato et al. 2009, Casaday at al. 2010). Under moderate fire severity, sprouting by pre-existing deciduous trees and shrubs can result in conversion from forest dominated by conifers to hardwood or shrub communities. Grass and shrubs can inhibit tree invasion (Bramble et al. 1990, Hill et al. 1995) and grazing and other human activities can significantly alter tree colonization (Boulant et al. 2009). Northern California and Southwestern Oregon have been posited as areas where shrubs often establish after wildfire, and it is often argued that these shrubs prevent re-colonization by conifer trees. However, even in these Northern California and Southern Oregon sites where shrubs dominate in the years following fire, by 20 years after wildfire most sites have substantial conifer populations (Shatford and Hibbs 2007, Joint Fire Science Program 2009). If the Reserve chooses to allow projects on federal lands, it is likely that project developers will seek to register projects that involve tree planting on previously-burned lands and the Reserve may need to promulgate more explicit or more rigorous rules for screening out lands that would regenerate in the absence of a project.

Aside from replanting after wildfires, there may be some minimal opportunities for reforestation after logging on federal lands. As noted in Section 2.5.2, the opportunity is small because law requires logged lands to be regenerated, and a portion of logging revenues is set aside to pay for regeneration. Lands with failed regeneration would most likely not qualify as sites for Reserve offset projects unless there has been substantial failure of reforestation efforts and reforestation funding has been exhausted. The Reserve would need to establish criteria for when such lands would be eligible.

In conclusion, while a significant area of federal land is listed as needing reforestation, the baseline rate of natural regeneration of trees on these lands often is significant, even if trees have not established in the 10 years after a wildfire. The existing Reserve rule that lands must not have been in forest for at least 10 years may need to be strengthened if federal lands are going to be allowed to generate offsets, and if there is a significant area of federal land that might be enrolled in projects under the existing Reserve rules.

4.2 Improved Forest Management Projects

There are some differences between public and private lands. One of the main differences is that public land management policies and practices are different from the policies and practices on private lands, especially commercial forestlands. Federal forest management practices have changed significantly in the past century, with significant commercial logging in second half of the twentieth century, and substantial reduction of commercial logging on federal lands after about 1990. Currently on federal lands, management strongly emphasizes maintenance of ecosystem functions such as water quality and habitat for wildlife, especially rare and threatened species. These ecological priorities result in financial returns from logging tending to be much lower, in net present value, than on private lands. On some lands, such as National Parks, wildlife refuges, and lands managed by the Department of Defense or the Department of Energy, logging is incidental to the main land use, or prohibited.

One way to address the fact that land management practices are different on federal lands and private lands would be for the Reserve to develop distinct "common practice" carbon stock estimates for federally owned lands. These "common practice" stock estimates could be applied to determine baseline forest management practices and policies on federal lands in the same way that "common practice" estimates are used to calibrate baseline carbon stocks for improved forest management projects on private lands.

For improved forest management projects on non-federal public lands, the Reserve's FPP requires determining project baselines in part by projecting future changes in carbon stocks that would result from implementation of existing and anticipated future policies. Existing federal land management practices tend to be very explicitly stated and can be applied as constraints in modeling timber harvest. Federal lands are also subject to complicated planning processes and public challenges of logging plans. It is not clear how planning delays should or could be incorporated into baseline modeling. Also, it is not clear how future policy changes should be anticipated. However, given the complexities, it is clear that simply modeling logging that maximizes net present value of timber revenues (subject to promulgated regulations and practices) is not appropriate for calculating baselines for projects on federal lands.

Finally, Section 2.5.3 above discusses opportunities for thinning after wildfires to boost carbon sequestration potential. These projects could in principle be implemented as improved forest management projects, and no new guidelines would have to be developed. This approach would grant offsets based on increases in carbon stocks and would exclude crediting based on claims of reducing fire emissions. This approach would maintain the existing Reserve policy of not crediting claims of reduced fire emissions. This policy exists because locations of avoided fires cannot be known with certainty. Fire ignition and spread are stochastic. Over a very large area (such as the state of California) it may be possible to document a decrease in fire emissions. However, even at this large scale, variability in weather, climate change, and changes in fire fuels could confound efforts to quantify reductions in fire resulting from fuels treatments. In an area the size of a project—even a project encompassing hundreds of thousands of acres—it is unlikely that it would be possible to show with statistical confidence that fire emissions have been reduced.

4.3 Avoided Conversion Projects

For avoided conversion projects, minor clarification of the FPP might be needed, to make explicit that such projects can only occur on lands that by law and policy are available for conversion. Most federal lands are not available for conversion, either by law or policy, and should not be considered for avoided conversion projects, even if conversion would provide much more revenue than forestry. Also, the federal government does not sell lands just because there is private demand to buy the lands. Thus, the existing Reserve FPP prohibition of avoided conversion projects on lands in public ownership prior to the start of the project could be extended to federal lands.

5 Meeting the Reserve's Offset Quality Standards

The Reserve requires that offsets be real, additional, permanent, verified, and owned unambiguously. There appears to be no reason why offsets generated on federal lands could not be verified like offsets generated on private lands. Issues relating to ownership of forest offsets generated on federal lands are discussed above. This section discusses how forest carbon offsets generated on federal lands can be real, additional, and permanent. Also this section discusses why some activities that have been proposed as large producers of offsets on federal lands may have limited potential.

5.1 Real and Additional Reductions

The Reserve Program Manual states that to be "real," an offset must represent actual emission mitigation, and not be an artifact of incomplete or biased accounting. One way an offset may be an artifact of incomplete accounting is if emissions previously occurring within the project boundary are simply displaced outside the project boundary, and this "leakage" of emissions is not accounted for. Because both private and federal forest lands sell timber into the same private wood market, leakage from projects on federal lands would be like leakage from projects on private lands. The same leakage accounting rules should apply to federal lands as apply to private lands.

The Reserve also requires that offsets must be additional. For forestry projects, additionality is largely determined by comparing actual project carbon stocks to an estimate of baseline carbon stocks. According to the Reserve's definition, the baseline for a carbon offset project is an estimate of the quantity of GHG emissions or removals that would have occurred in the absence of a carbon market. To create offsets, management would have to change, increasing carbon sequestration or decreasing emissions relative to baseline amounts. Additional GHG emission reductions (or net sequestration) are determined by comparing actual emissions and sequestration to baseline quantities.

The Reserve's Forest Project Protocol requires that to count as offsets, GHG reductions and removals achieved by projects must be "above and beyond any GHG reductions or removals that would result from compliance with any federal, state, or local law, statute, rule, regulation, or ordinance." If Congress establishes law directing carbon sequestration on federal lands, or if policy development processes establish policies or regulations promoting sequestration, the Reserve would have to specify what exemptions to the existing "legal requirement" additionality test would be allowed to create offsets.

In theory, the baseline for forest carbon projects should reflect the most likely management scenario on public lands in the absence of a market for carbon offsets. Legal mandates for federal land management, and existing land management plans and activities, establish baselines for federal land carbon sequestration and GHG emissions. The laws that give federal land management agencies authority to manage lands state the purposes for which the lands will be managed, and give general direction about how lands will be managed. Agencies are legally bound by these mandates, and interpret how to apply the mandates on the ground. Baseline management practices will be driven by legal requirements and management mandates, but may also reflect budget constraints, and competing management priorities. In principle, baselines (for both public and private lands) can be established using data on the historical and projected future emissions and removals. However, such data may not always be applicable to

individual project areas and it may be difficult for such projections to take into account future budget and policy changes.

A summary of the legal underpinnings and planning process of federal land agencies is provided in Smith & Travis (2010). Smith & Travis identify the pertinent aspects of forest management decision-making in each of the four agencies identified previously. In theory, the multiple use mandates of the National Forest System and Bureau of Land Management lands, with emphasis on ecosystem services, should allow a management shift toward increased forest carbon sequestration. Management mandates for other lands allow limited flexibility for changing management to increase forest carbon sequestration.

Federal land management mandates vary in the degree to which they would allow forest carbon offset projects. Federal lands with single-use mandates are most restrictive with regard to accommodating forest carbon offset projects. There may be little opportunity to change management to enhance carbon sequestration while supporting the specific single-use purpose, unless the single use is explicitly related to enhancing carbon sequestration. For example, there are significant areas of grassland that would support forest in historical national parks in the east. Because the main purpose of the parks is historic, such as showing battlefield conditions during the civil war, converting lands that were agricultural during the civil war to forest would not be compatible with the mission of the park.

In many cases carbon sequestration is compatible with mandated uses, even if there is limited opportunity for increasing the sequestration beyond what is already occurring. However, in these cases the sequestration is part of the baseline, and would not be additional.

Two of the major categories of federal lands noted above, national forest and national wildlife refuges, are characterized as primary-use or multiple-use lands, as opposed to single-use. In both of these cases, there appears to be more flexibility for implementing forest projects. Offset projects could be implemented as long as they are compatible with the overall mandates of providing forests and water (on national forest system lands) and wildlife habitat (on wildlife refuges). For discussion of the magnitude of potential offsets, see the section above on the biological potential of various management activities.

FS resource management direction is given by the National Forest Management Act of 1976 (NFMA), and BLM management direction is given by the Federal Land Policy and Management Act of 1976 (FLPMA). Both laws require that agencies manage lands for multiple use and sustained yield. The NFMA defines sustained yield such that “prior to harvest, stands of trees throughout the National Forest System shall generally have reached the culmination of mean annual increment of growth.” This means that trees must have grown to the point that, on average, growth (in terms of volume per year) begins declining. In productive Douglas-fir forests in the Pacific Northwest, this CMAI has been interpreted to be about 80 years, although some scientists think it may be more than 120 years (Curtis 1995). In contrast, industrial forest management companies are currently cutting their productive Douglas-fir forest stands at ages around 40 years, far below culmination of mean annual increment. In productive west coast conifer forests, improved forest management offset projects on private lands often talk about extending rotations to 60 or maybe 70 years. A project that extends rotations to 60 years would

not even achieve the baseline FS management of an 80-year rotation because the FS mandate is not to maximize present value of timber harvests.

Although one of the original mandates of the national forests was to provide timber, in the past two decades there has been very limited timber harvesting on federal lands. In part this is a result of environmental challenges to timber sales, and in part because of an agreement to provide habitat for the Northern Spotted Owl on public forests in the Pacific Northwest in exchange for private forests not having to provide habitat. Spotted Owls need large areas of old, complex-structured forest, incompatible with clearcut logging.

Agencies other than the Forest Service and BLM have management mandates other than timber harvesting. For these other federal agencies that hold significant amounts of forest—specifically, the Fish and Wildlife Service, National Park Service, Department of Defense, and Department of Energy, timber harvest may only be ancillary to the primary use of the land. The missions of FWS and NPS are to conserve habitat and ecosystems. Commercial logging is not allowed; any tree cutting would only be to serve the conservation mission. As a result, there has been little logging on these non-multiple use lands, on average trees are older than on commercial forest or multiple use forest lands, and on a per-acre basis the forest carbon stocks on these lands are high. There is little that land managers could do to further increase sequestration beyond the existing baseline sequestration on lands that presently have trees. Sequestration could occur on lands that presently do not have trees and would not otherwise regenerate to trees in the near future.

Under baseline management, forests in the U.S. are sequestering substantial amounts of carbon. All lands, of all ownership types, are estimated to have sequestered a net of 1,015 million metric tons CO_2e in 2009 (U.S. EPA 2011). This baseline trend of sequestration is expected to continue for decades, but the annual sequestration is expected to decline over time. We have not found estimates of sequestration only for federal lands but Birdsey and Lewis (2003) estimated that 28% of the net U.S. forest sink from 1987 through 1997 was on National Forest lands. This suggests that National Forests, which comprise approximately 60% of federal forestlands, are sequestering about 280 million metric tons CO_2e per year.

Because of these long-standing federal land management mandates, there is limited potential to increase carbon stocks on federal lands beyond the current baseline trend. Offset projects will only be eligible where the management mandates are flexible enough that project activities are not effectively required by the mandates, but where the offset activities contribute to outcomes that are compatible with or enhance mandated uses. Differences in the mandates of different agencies mean that different agencies have different baseline policies. To ensure that these agency-specific policy differences are properly incorporated into baseline calculations, the Reserve may provide more specific guidance on calculating baselines on federal lands, or may require different baseline-setting methods be used for lands managed by different agencies.

5.2 Permanence

Permanence is an issue for carbon sequestration projects because the sequestration can be reversed, and the carbon converted back to atmospheric carbon dioxide.

Sequestration on public lands often is considered to be more permanent than forest sequestration on private lands because a substantial fraction of public lands are held for conservation, historic, or other non-remunerative purposes. Despite the fact that trees may have substantial value as timber, policy makers have a decades-long track record of maintaining conservation policies, and land managers land managers are fairly consistent about implementing policy.

Once initiated, forests often persist, despite fires, insects, droughts, and storms. This biological resilience, combined with the limited ability of agencies to convert forest lands to other kinds of land use should provide substantial stability for forest carbon projects on federal lands, assuming that projects are compatible with existing land management mandates.

The Reserve's existing forest carbon reversal buffer mechanism could be applied to public lands, in addition to private lands. As with private lands, actuarially appropriate buffer withholding rates can only be determined over time, and a history of sequestration and loss is established. As is done on private lands, initial buffer withholding rates could be made based on proxy indicators and professional judgments about loss rates. It is possible that Congress could change federal land management policies. Past trends in the direct of changes in policy toward more maintenance of ecosystem functions may or may not continue. Ensuring sufficient compensation for "intentional" reversals that might result from federal policy changes would depend on whether the Reserve can enter into and enforce contracts with the federal government similar to the Project Implementation Agreement used for private lands.

6 Administrative Barriers to Generating Offsets on Federal Lands

Separate from biological, physical, and legal limits on generating forest carbon offsets on federal lands, there are administrative barriers.

Agencies interpret and apply legal directives through policies, regulations, land management plans, and other official statements. Because carbon offset projects must be in addition to what would have happened without the project, offset activities are likely to be different from actions or uses specified in land management plans. If a carbon offset project activity is different from what is specified in an adopted land management plan, the agency may not be able to implement the project until the plan is revised to include the project activity or land use. Land management plans often are scheduled to be revised every ten years. However, budget constraints and time needed to resolve conflicts often cause delays in the plan revision schedule.

The environmental effects of federal land management actions must be analyzed. Full environmental impact statements (EIS) can take years and cost millions of dollars. Even less intensive environmental assessments (EA) necessary to support a finding of no significant impact (FONSI) can take months to

years to complete and cost tens to hundreds of thousands of dollars. Writing management plans and administering contracts to get activities implemented can involve similar administrative costs.

High costs of federal planning and decision processes will limit implementation of forest carbon sequestration projects to a fraction of the biological potential for sequestration. Slow growth rates on many federal lands will make many potential sequestration projects not cost effective, because of long delays until significant amounts of sequestration are achieved.

7 Conclusions

Under the current version of its Forest Project Protocol (Version 3.2), the Reserve will not register GHG forest offset projects implemented on federal lands unless the project is explicitly approved through a federal legislative or regulatory rulemaking process. Exploring issues involved in implementing GHG forest offset projects on federally owned or managed lands, this analysis comes to three main conclusions:

- ***The main barrier to allowing offsets from federal forests is a lack of clarity that federal agencies have authority to accept obligations that the Reserve requires of owners of forest offset project lands.*** Long-term rights to forest carbon credits may be construed as a property right and the federal government is extremely limited as the reasons and mechanisms for transferring property rights to private parties. As the federal government is a sovereign entity, other parties have limited recourse if Congress or a land management agency changes the purposes for which land it to be management, changes land management, and emits carbon on which forest offsets are based. It is both unclear what rights to carbon credits the federal government can and will grant, and unclear whether existing protections of parties contracting with the federal government provide adequate recourse to the Reserve if the federal government were to change policy with the result of reversing offsets.

- ***There are some challenges in assuring that offsets are real, additional, and permanent but the existing Reserve forest project protocol can most likely be applied to federal lands.*** Existing Reserve standards for offset quality can apply to federal lands, giving confidence that offsets are real, additional, and permanent. When setting baselines of forest offset projects located on non-federal public lands, existing Reserve rules give substantial weight to past management and existing policies. This same approach could apply to federal lands. Some further interpretation of existing rules may be desirable and the Reserve may wish to publish factors for public lands. In particular, the Reserve may issue more detailed guidance on how to calculate baselines by incorporating consideration of agency funding constraints and delays caused by planning processes and appeals.

- ***There is modest opportunity for creation of forest carbon credits on federal lands because baseline carbon stocks are high and the administrative costs of implementing offset projects on federal lands are high.*** Laws directing management of federal lands require management practices that result in relatively high growth and relatively high carbon stocks on federal lands.

There is modest opportunity for changing management to cause additional growth and sequestration beyond what results from implementation of existing laws. There have been claims that large amounts of offsets could be created by active reforestation after wildfires but research indicates that most burned areas regenerate in the absence of human intervention. Claims that forest thinning can reduce net emissions by reducing emissions from wildfire are not supported by the scientific literature. Where opportunities exist, they are largely in areas where trees can be established on ground that is suitable for forest but where the vegetation succession is not currently on a trajectory toward forest, or where growth and forest carbon stocks can be increased on nutrient-poor sites by fertilization. Currently, the Reserve does not permit projects that use broadcast fertilization; achieving this potential sequestration would require changing Reserve rules. Administrative costs and slow timelines might make carbon offset projects on federal lands cost-prohibitive. If environmental assessments, environmental impact statements, or changes in land management plans are required, the cost may be more than the value of offsets. Years of delay in changing plans or permitting might reduce the financial rate of return to the point where project developers choose not to implement projects on federal lands.

This analysis also has several other observations that are subsidiary to these main conclusions.

Federal policy toward offsets that might be generated from federal activities is still developing. It could be that the federal government will enact a policy that emission reductions and increased sequestration achieved by federal activities or on federal properties will be retained and counted in the U.S. government greenhouse gas emission inventory.

If the federal government clarifies that it wishes to create GHG offsets and will accept the obligations of creating offsets on federal lands, the government will have to create processes for evaluating proposed projects and selecting projects to implement. The government could establish contracts with private project developers that authorize a project developer to execute specified actions on specified lands and create and own resulting offsets. Alternatively, the federal government could implement activities for the purpose of creating offsets, and quantify and register resulting sequestration. The federal government could choose to have a single centralized process for authorizing and implementing offset projects, or could allow the main land management agencies to develop their own processes for implementing offset projects.

The current Reserve FPP states that forest offset projects are not allowed on lands that were in federal ownership before the start of the project, unless the federal government explicitly authorized through a federal legislative or regulatory/rulemaking process. Limits on the authorities of federal agencies and willingness of the federal government to accept the responsibilities that the Reserve requires of owners of lands used for forest offset projects must be addressed before the Reserve can guarantee forest offsets generated on federal lands the way the reserve can guarantee forest offsets generated on private lands.

Even if the legal basis for selling forest carbon credits from federal lands is clarified, it is likely that few offsets would be generated from federal lands because there appears to be modest biophysical opportunity for forest carbon sequestration beyond business as usual, and because administrative costs of creating offsets are likely to be high.

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