SUBMIT OPTION SUBMITTAL FORM BY:
1. EMAIL TO: COLORADORIVERBASINSTUDY@USBR.GOV
2. U.S. MAIL TO: BUREAU OF RECLAMATION, ATTENTION MS. PAM ADAMS, LC-2721, P.O. BOX 61470, BOULDER CITY, NV 89006-1470
3. FACSIMILE TO: 702-293-8418

Option Submittal Form

Contact Information (optional): ☐ **Keep my contact information private.**

Contact Name:	Title:
Affiliation:	
Address:	
Telephone:	E-mail Address:

Date Option Submitted: January 27, 2012

Option Name:

Forest Management

Description of Option:

A large percentage of the runoff from the Colorado River Basin is derived from forests, particularly in Colorado. Previous studies and information have demonstrated that areas in which forest cover is reduced by clear-cutting or fires have shown dramatically increased amounts of runoff. This is the result of reduced interception, decreased evapotranspiration, and sometimes reduced permeability of the soil surface. The magnitude of increased runoff over affected areas may be as much as 100 mm, or 4 inches, per year. Forest management would entail the replacement of mature forests that have been cleared by harvesting, fires, or insect infestations with stands of replacement growth more likely to be favorable for generating runoff.

Location: Describe location(s) where option could be implemented and other areas that the option would affect, if applicable. Attach a map, if applicable.

The demonstration of the viability of this option starts with the State of Colorado, as the majority of flow of the Colorado River system results from runoff generated in that State. Even though Arizona, New Mexico, Utah, and Wyoming have significant forested areas, the annual amounts of runoff from the forested areas in these states is much lower than in Colorado. The forested area in Colorado is over 21,000,000 acres, the large majority of which is in the Colorado River Basin. This generates an average annual runoff of approximately 11 million acre-feet per year.

Quantity and Timing: Roughly quantify the range of the potential amount of water that the option could provide over the next 50 years and in what timeframe that amount could be available. If option could be implemented in phases, include quantity estimates associated with each phase. If known, specify any important seasonal (e.g., more water could be available in winter) and/or frequency (e.g., more water could likely be available during above-average hydrologic years) considerations. If known, describe any key assumptions made in order to quantify the potential amount.

As a simplifying assumption, if five percent of the forested area in Colorado were managed to increase runoff and the magnitude of the increased runoff was four inches, over 300,000 acre-feet of increased flow would be generated annually. However, available studies have indicated that the increased rate of runoff after clear cutting, fires, or extensive deforestation due to insect infestations rapidly declines as new growth of replacement forest is established. The new growth frequently has higher rates of transpiration than the mature growth it replaces, and the resultant overall rates of runoff may then be actually lower than before. Another factor is that the magnitude of the increased runoff even with large percentages of forest removal is highly uncertain. A recent report by the National Academy of Science (Hydrologic Effects of Changing Forest Landscape, 2008) includes the following chart that shows the uncertainty of runoff predictions associated with forest removal.

Additional Information

Technical Feasibility: Describe the maturity and feasibility of the concept/technology being proposed, and what research and/or technological development might first be needed.

Forest management is a mature science. However, objectives have generally been to increase lumber production, maintain habitat and ecosystems, or limit erosion. The primary objective of forest management has rarely been to improve runoff conditions. One known location of studies to evaluate catchment management practices such as controlled burning to minimize the understory created by new growth is Western Australia. The Water Corporation of Western Australia is sponsoring these studies, but the primary objective is just to reverse the decline in runoff that results from replacement of old growth forests with new growth forests that use more water. The overall technical feasibility is highly uncertain.

Costs: Provide cost and funding information, if available, including capital, operations, maintenance, repair, replacement, and any other costs and sources of funds (e.g., public, private, or both public and private). Identify what is and is not included in the provided cost numbers and provide references used for cost justification. Methodologies for calculating unit costs (e.g., $/acre-foot or $/million gallons) vary widely; therefore, do not provide unit costs without also providing the assumed capital and annual costs for the option, and the methodology used to calculate unit costs.

Unknown

Permitting: List the permits and/or approvals required and status of any permits and/or approvals received.

A variety of permits would be required from local, state, and Federal agencies. A summary of applicable permitting requirements is provided in the following table from the National Academy of Science report.

Legal / Public Policy Considerations: Describe legal/public policy considerations associated with the option. Describe any agreements necessary for implementation and any potential water rights issues, if known.

A variety of interest groups may pursue litigation to prevent, delay, or modify forest management practices. Also, quantification of the amount of increased runoff would be difficult and allocating the water to users would be problematic.

Forest management practices must comply with a variety of local, state, and Federal policies. Historically, the most comprehensive regulations and policies affecting forest management have been adopted by the states.

Implementation Risk / Uncertainty: Describe any aspects of the option that involves risk or uncertainty related to implementing the option.

Among the more significant implementation risks are:

- The amount of increased runoff from forest management practices is very difficult to predict or monitor.
- Increased runoff from forest reduction due to harvesting, fire, or insect infestation typically lasts for two to four years until reforestation occurs. At that time, the new growth forest usually has a higher level of evapotranspiration than that old growth forest, and the amount of runoff is likely to be lower than before the forest area was reduced.

Reliability: Describe the anticipated reliability of the option and any known risks to supply or demand, such as: drought risk, water contamination risk, risk of infrastructure failure, etc.

Reliability of the supply both in terms of predicting the quantity of water generated through forest management as well as the longevity of the increased supply is low.

Water Quality: Identify key water quality implications (salinity and other constituents) associated with the option in all of the locations the option may affect.

The quality of runoff from areas of reduced forest cover is typically lower than that from areas of complete forest cover. The forest, understory, and associated mulch on the forest floor effectively protect the soil from erosion. When forests have a reduced coverage of trees and other vegetation; the volume and rate of runoff are increased but with a resultant increase in turbidity and organic content in the runoff.

Energy Needs: Describe, and quantify if known, the energy needs associated with the option. Include any energy required to obtain, treat, and deliver the water to the defined location at the defined quality.

Energy Required	Source(s) of Energy
Unknown	Unknown

Hydroelectric Energy Generation: Describe, and quantify if known, any anticipated increases or decreases in hydroelectric energy generation as a result of the option.

Location of Generation	Impact to Generation
	Any increase in runoff results in a commensurate increase in hydropower production at downstream generating facilities, such as those at Lake Powell and

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	Lake Mead.

Recreation: Describe any anticipated positive or negative effects on recreation.

Location(s)	Anticipate Benefits or Impacts
	Forest management to increase runoff would be based on a reduced density of forestation. This is typically universally related to the recreational valve of forests. However, there could be an increase in the value of flow-based recreation, such as boating, fishing, and white-water rafting.

Environment: Describe any anticipated positive or negative effects on ecosystems within or outside of the Colorado River Basin.

Location(s)	Anticipated Benefits or Impacts
	Forests are huge receptors of greenhouse gases. Other air quality aspects are unknown.
	Healthy forests provide robust habitat for a variety of diverse terrestrial, aquatic, and avian species. Deforestation results in greatly reduced species diversity.

Socioeconomics: Describe anticipated positive or negative socioeconomic (social and economic factors) effects.

Unknown

Other Information: Provide other information as appropriate, including potential secondary benefits or considerations. Attach supporting documentation or references, if applicable.

See attached “Issue Brief Concerning Federal Land Management Effects on Water Management Within the Colorado River Basin” dated November 28, 2011.