

# Summation of Forestry Studies for Rio Grande Basin

Watershed Health

Forest Biomass Opportunities Evaluation

Watershed and Community Health and Resilience Assessment  
And Action Plan

Spruce Sawlog Quality Changes  
Due to Spruce Bark Beetle Mortality



**Rio Grande Watershed**  
**Emergency Action Coordination Team**

Prepared for Rio Grande Watershed Emergency Action Coordination  
Team (RWEACT) by Forest Stewardship Concepts, Ltd. James Webb  
March 2016

## Copyright

© 2016 FSC & RWEACT: To the extent permitted by law, all rights are reserved and no part of this publication covered by copyright may be reproduced or copied in any form or by any means except with the written permission of both Forest Stewardship Concepts, Ltd. (FSC) and Rio Grande Watershed Emergency Action Coordination Team (RWEACT).

## **INTRODUCTION**

This paper summarizes contents of three studies commissioned by RWEACT to understand forest biomass markets as a means to accomplish watershed protection activities.

RWEACT (Rio Grande Watershed Emergency Action Coordination Team) was established in July 2013 in response to the West Fork Fire Complex. RWEACT brings together local, state and federal agencies, organizations, and individuals to develop an effective, coordinated approach to address fire-caused hazards resulting in the protection of human life, property, and the natural health of the Rio Grande watershed and its environment.

While the immediate mission of RWEACT was focused on emergency actions in the interest of public safety, a partnership has developed between RWEACT and the US Forest Service, Rio Grande National Forest (RGNF), with the shared vision to improve forest health and protect the Rio Grande watershed through management activities. This cutting-edge partnership is focused on utilizing active forest management in a way that may reduce the threat of future landscape scale wildfires and at the same time improve community economic resilience in the face of such events. This public/private collaborative recognizes that the 88,000 acre West Fork Fire Complex burn scar combined with nearly 485,000 acres of spruce beetle infested forests creates a forest/watershed health challenge of significant magnitude and urgency. For example, watershed health and protection can be achieved through the reduction of wildfire size and intensity by removing dead woody material from the forest as directed by the RGNF Forest Plan. The partnership/collaborative will enable this work to be contracted through USFS Stewardship Agreements, which can be implemented by RWEACT and engage contractors at both the local and regional scale.

This on-going discussion has led to the question of how much biomass would need to be removed from the forest to reduce wildfire hazard and improve watershed/forest health, and whether it could be done economically without significant external financial subsidies. RWEACT requested Forest Stewardship Concepts, Ltd. complete an evaluation of the opportunities to improve watershed health and community, economic viability through the utilization of biomass. As the evaluation progressed, it became evident that removal of the material was going to cost more than the anticipated value of the biomass delivered to processors. RWEACT then asked for a “white paper” describing findings to date and refocused FSC’s efforts on collaborative avenues toward active forest management and watershed protection.

## **FOREST BIOMASS OPPORTUNITIES EVALUATION**

An evaluation of the opportunities to improve watershed health and community viability in the Rio Grande Basin through the utilization of public land forest biomass has been completed. Eighty five percent of the spruce fir forests on the RGNF have been infested with spruce beetles since 2005 (RGNF 2013 Forest Health Aerial Survey Fact Sheet). These dead trees create safety hazards and change wildfire behavior across a wide swath of the landscape. Removing some of these trees and thinning non-spruce stands will improve forest health and watershed condition.

As one travels the back roads of the Rio Grande National Forest and sees dead spruce trees everywhere, it is easy to assume that there is considerable opportunity to improve watershed health and salvage the dead trees. In a “waste not ~ want not” world, it is logical to want to make use of such an abundant resource. When the harsh reality of economically viable physical accessibility is considered, opportunities to make use of bark beetle carnage become much more problematic. Much of the available biomass is currently well suited to saw log or house log purposes. As the dead trees continue to deteriorate they will eventually lose much of their commercial value. At that point they will still have utility as “biomass” for an undetermined period.

### **Definition of Biomass:**

The Dictionary of Forestry (Helms 1998) defines biomass as the living or dead weight of organic matter in a tree, stand, or forest in units such as wet or dry weight.

This study further refines biomass as cellulosic materials >3”diameter, dead or alive, that will be removed from the forest or agricultural byproducts that are used in some process that converts them into boards, house logs, firewood, biofuels, bio char, electrical energy, pellets, animal bedding, erosion waddles, and compost or yet to be developed end products. Materials ≤ 3”diameter will remain on site for soil enhancement.

The vast majority of available biomass in the upper Rio Grande Basin is located on National Forest system lands. Of the 1,856,757 acres of the Rio Grande National Forest, only 175,167 acres (roughly 9% of the total forest) are eligible for management to improve watershed health based on the present Forest Management plan and economic considerations. Consequently, approximately 2,998,395 tons of wood are potentially available. Currently, 2,698,556 tons are scheduled to be removed via timber sales. The remaining 299,839 tons is made up of small diameter material that, to date has not been commercially viable.

Saw timber salvage sales presently make up the lion’s share of wood harvesting activities to remove dead trees from the forest to improve watershed and forest health. Smaller dead trees are not being removed during present logging operations, due to cost and the lack of businesses that can efficiently utilize the material. Most cellulosic biomass utilization is related to sawmill waste or firewood. Future opportunities to conduct watershed health improvement projects are dependent upon how long the larger dead trees retain their utility as saw or house logs. A significant volume of low value material is likely to be available within the next ten years.

### **Assumptions:**

- ✓ All operations will have to pay their way. No subsidies will be available from federal, state or NGOs for long term stewardship activities.
- ✓ The vast majority of biomass will originate on Rio Grande National Forest lands. Large private ranches on the east side of the Valley have not been included in this assessment for various reasons specific to each property.
- ✓ All forest stewardship activities will comply with the standards and guidelines found in the Forest Management Plan for the Rio Grande National Forest.

- ✓ Current saw log and firewood programs will be maintained or enhanced.
- ✓ By-products from forest stewardship activities will be used for their highest and best purposes.
- ✓ Costs will be based on current, market driven wages for all biomass workers.
- ✓ Integrated operations will likely be the most cost effective.

Once beetle killed trees are no longer suitable for sawlogs or house logs, it may be difficult to find a market for lower quality woody biomass. The primary impediment to financially viable biomass utilization in the Rio Grande Basin is the \$75/ton cost to get the material out of the woods and delivered to processors. Financial subsidies support current biomass removal programs in other parts of Colorado. It is unlikely subsidies will be available for the Rio Grande Basin any time soon.

### **Recommendations:**

1. Continue to make every effort to expediently remove as much of the dead spruce through timber sales as possible while its commercial value will pay for its removal.
2. Explore options to develop markets for firewood and chips for heating large complexes.
3. Develop a plan to utilize dead woody material that has lost its value as saw or house logs.
4. Utilize the Colorado State University Agricultural Experimentation Station located in the San Luis Valley to research the use of biochar as a soil amendment.

The complete study can be reviewed at [www.rweact.org](http://www.rweact.org)

## **WATERSHED AND COMMUNITY HEALTH AND RESILIENCE ASSESSMENT AND ACTION PLAN**

Once the economics of forest biomass removal was understood RWEACT asked how they may become an advocate for watershed/forest health and community vitality in light of the fact that the Rio Grande National Forest was embarking on a three year process to revise its forest plan. This paper describes the need for such advocacy and suggests a path toward that end.

While periods of increased insect activity are normal, the scale of the present activity may be beyond historic epidemics. Spruce forests normally have long (300 – 400 year) periods between large-scale disturbances such as fire or insect mortality. Presently, most old growth spruce stands have been killed. Fortunately spruce seedlings and saplings are present in the understory of many stands. Their presence assures continuing spruce forests following the present insect activity.

Healthy watersheds have high biotic integrity and are resilient following natural and human disturbances. They provide important ecosystem services, such as high quality water, stream and aquifer recharge, high quality wildlife habitat, and long-term soil productivity.

Forest health is the perceived condition of a forest derived from factors such as its age, structure, composition, function, vigor, presence or absence of unusual levels of insects or disease, and resilience to disturbance.

Rural community vitality refers to the ability of rural community members to work together and realize positive social, economic, and environmental outcomes.

Currently, the headwaters region of the Rio Grande Basin is in a state of flux. Forests have been subjected to significant insect mortality which is aggravating wildfire potential and intensity, and simultaneously impacting long term economics of both tourism and forest products industries.

The region is one of the most economically depressed areas in the state of Colorado, as well as the nation. The upper Rio Grande Basin is vulnerable to further degradation of watershed values and community vitality as the consequences of the insect epidemic and climate change becomes evident.

Rural community vitality refers to the ability of rural community members to work together and realize positive social, economic, and environmental outcomes.

Sound forest stewardship is key to mitigating long-term impacts on watershed condition, forest health, and community strength. Broad based agreement on appropriate actions is likely to be elusive. There are deep-seated conflicts over the purpose of public lands in general: Are they to be managed for multiple human uses or to be protected as the nation's remaining biological heritage in the midst of landscapes long dominated by humans? RWEACT is interested in sponsoring a constructive dialog that creates an opportunity to develop community consensus on adaptive management to protect or enhance watershed conditions, and improve forest and community vigor and resilience.

Research on social dynamics associated with bark beetle outbreaks is outlined with summaries of findings and management implications. Sculpting consensus on public land policies and finding compatible solutions is complex and time consuming. Entities attempting to do so must have a clear understanding of the challenges and necessary time commitment. Success is best defined as having gone through a collaborative process and come to eventual consensus on actions to be taken.

Rigid, predetermined solutions seldom make the final settlement. Once agreement is reached, decisions are still vulnerable to administrative appeals and litigation. Well-reasoned, community based plans can be derailed by regional and national level interest groups with little or no affiliation in the community. Still there is a need for a credible group to serve as the catalyst for sound public land management.

Acknowledging all of the challenges and investment of time and finances required, RWEACT plans to establish itself as an advocacy entity, believing the potential benefit is worth the effort. At the

end of this report, an Action Plan containing timelines, milestones, and responsibilities to accomplish stewardship advocacy can be found.

### **Acres of Treatment Needed:**

When one sees all the dead spruce in the Rio Grande Basin numerous questions simultaneously cross the mind. Among them: How does all that dead woody material impact watershed conditions? If it will have deleterious long-term impacts on the watershed, can anything be done to mitigate those impacts? If removing much of the dead material is warranted, is it possible to pay for the watershed condition enhancement by capturing the value of the dead material before it deteriorates? If so, how much material is out there and how long might it maintain its value? Will the public support such a program? Is there initiative within the Forest Service to take on such an ambitious task? Is there a market for the material? Is there a way to streamline NEPA in the face of such an abnormal natural event? And perhaps finally, will Congress be willing to fund such a bold program?

Many questions, few immediate answers. What we do know:

The spruce bark beetle in the Rio Grande Basin has decimated approximately 500,000 acres of spruce forest. Many more acres of high elevation spruce forests across Colorado have been killed or are in the clutches of the bark beetle. Close to 74,000 acres of dead spruce trees are accessible to present road systems, on slopes <30%, are outside wetlands and stream corridors, and are within Forest Plan Management Units that call for silvicultural management.

An Estimated 1,805,000 CCF of dead material is found on those acres, which amounts to 2,238,112 tons of wood.

At the present logging rate of 30,000 CCF/year it will take sixty-one years to cover the ground needed to improve watershed condition. If the present program was ramped up to the 1996 Forest Plan authorized treatment level of 42,000 CCF/year it would take forty-three years to cover the same ground.

The large dead spruce trees are likely to maintain sawlog quality for roughly 10 years. They may be viable house logs for another twenty years. Smaller material will not pay its way off the mountain within seven to eight years.

A ten year accelerated watershed condition improvement program would have to cover 7,400 acres and remove 180,500 CCF per year (6 times the present program) to take advantage of the value of the dead material to fund watershed improvement. Presently there isn't a local or regional market for that volume of material, which presents an opportunity for additional business growth within the San Luis Valley.

Since it is unlikely that anything approaching the watershed treatment program described above is probable in a timely way other coping actions need to be explored. How should we approach

watershed condition concerns in the face of congressional ineptitude, anemic funding and agency malaise?

### **Wildfire Suppression Considerations:**

Fire behavior during the West Fork Fire Complex of 2013 demonstrated the new norm for wildfires in beetle-killed spruce forests. Individual dead trees torched and threw burning embers into the convection column to ignite new fires as much as a half mile ahead of the burning front. With the probability of ignition as high as ninety percent, most embers that landed on receptive fuel beds became new fires. Containment of fires of this nature requires robust, pre-existing, fire control features on the ground with many safety zones scattered along the control features for firefighters to migrate to when it is no longer safe to make a stand along firelines.

One reason the West Fork Complex got so large was the scarcity of safe places to make a stand against it. One way to provide opportunities to catch future wildfires in the spruce type is to create fuelbreaks by removing dead standing trees and cleaning up dead woody debris on the ground. When this cleaned up area coincides with roads that provide access for fire apparatus and escape routes for firefighters, there is a much more likely chance fire suppression activities will prevail. These fuelbreaks will provide a much safer place to engage future fires.

It should be noted that the fire not only burned dead trees but also killed almost all the living young seedlings and saplings in the understory. In some cases aspen sprouts will fill the void in areas adjacent to aspen clones. In other areas forest regeneration is decades to centuries away.

### **Travel Corridor Safety:**

Fuelbreaks along existing roads also significantly reduce the probability that hazardous trees will blow down on people in these corridors. It is currently almost impossible to find a place to camp in the spruce type on the RGNF without being at least a tree length away from the forest edge and well into an open meadow. Many historical dispersed recreation sites are extremely hazardous at the present time.

### **User Safety & Wildfire Containment Option:**

Perhaps the best we can hope for given real world constraints, is to protect forest users from falling trees and provide wildland firefighters with a safer place to make a stand against the next large wildfire. This can be accomplished by creating strategic fuelbreaks along road corridors that lend themselves to wildfire control. By removing dead standing or recently fallen trees from an area 660 feet on each side of some existing roads we begin to improve conditions for firefighters, forest users and watershed integrity simultaneously.

This stopgap approach will treat 160 acres per mile on 12.5 miles of road per year at the current annual treatment program level of around 2,000 acres per year.

## **Action Plan**

The Watershed and Community Health and Resilience Assessment concluded with an Action Plan that concisely outlined actions, timeframes and responsibilities required to advocate for improved watershed conditions and community vitality during the Rio Grande Forest Plan revision. The action plan contains nineteen items. Fifteen were to be accomplished by the end of 2015. To date four have actually been completed.

The complete study can be reviewed at [www.rweact.org](http://www.rweact.org)

## **Spruce Sawlog Quality Changes Due to Spruce Bark Beetle Mortality**

Developing markets for the anticipated volume of dead material is dependent upon many factors. Key among them is the deterioration rate of the trees. How long are the trees likely to be suitable for sawlogs, the most valuable conversion scenario? Once they no longer have sawlog characteristics how long will they be viable house logs? Smaller stems are thought to deteriorate much faster and may quickly lose their value as mine props.

Knowing the rate of deterioration will facilitate developing markets for the type of material available into the future.

In the absence of specific research the “Watershed Health & Forest Biomass Opportunities Evaluation” assumed that Engelmann spruce killed by spruce bark beetle would remain viable as sawlogs approximately ten years. This assumption was based on anecdotal evidence. It is well documented that as long as the trees remain standing, dead spruce can be viable for house logs for at least twenty years. Previous research has not specifically focused on sawlog quality.

Sawlogs are those logs that can be cut into boards, dimension lumber, timbers, posts or beams.

In a recent letter to the US Forest Service, Rocky Mountain Regional Forester, Intermountain Forest Association (IFA) observes that beetle-killed spruce is deteriorating much faster than anticipated. This prompted the interest in taking a closer look at beetle killed spruce deterioration over time.

Having a good understanding of spruce sawlog deterioration rates is critical to development of long term strategies for improving watershed health and forest restoration. Eighty seven beetle killed trees, with various mortality dates, scattered across the Rio Grande forest were felled, bucked and analyzed to determine how time since mortality impacted wood quality.

Two charts from the study capture the essence of the findings:

Chart 2: Average % Defect Since Death, compares the percent of beetle related defect to the number of years since death. It shows that defect increases from approximately twenty five percent to forty two percent over a ten year period.



Chart 2: Average % Defect Since Death

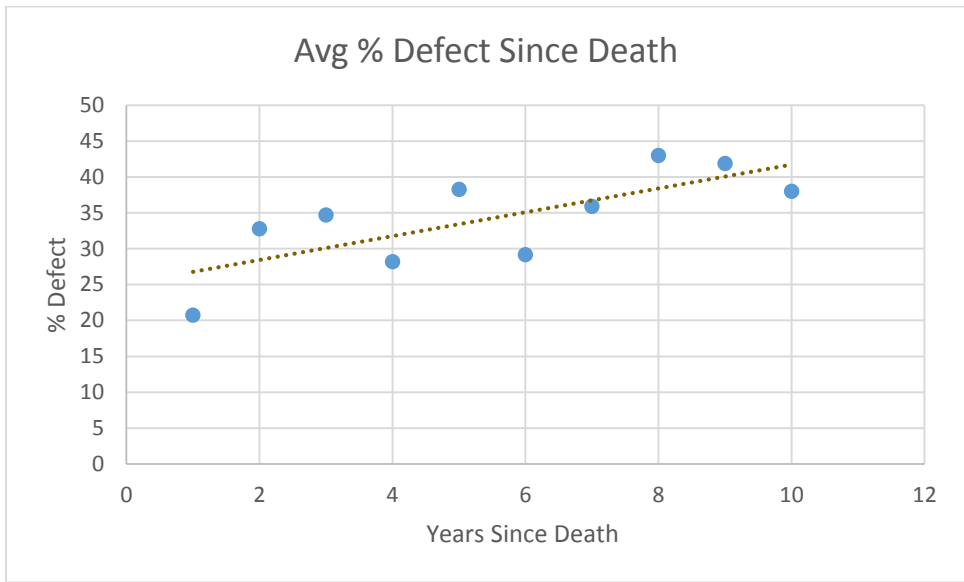
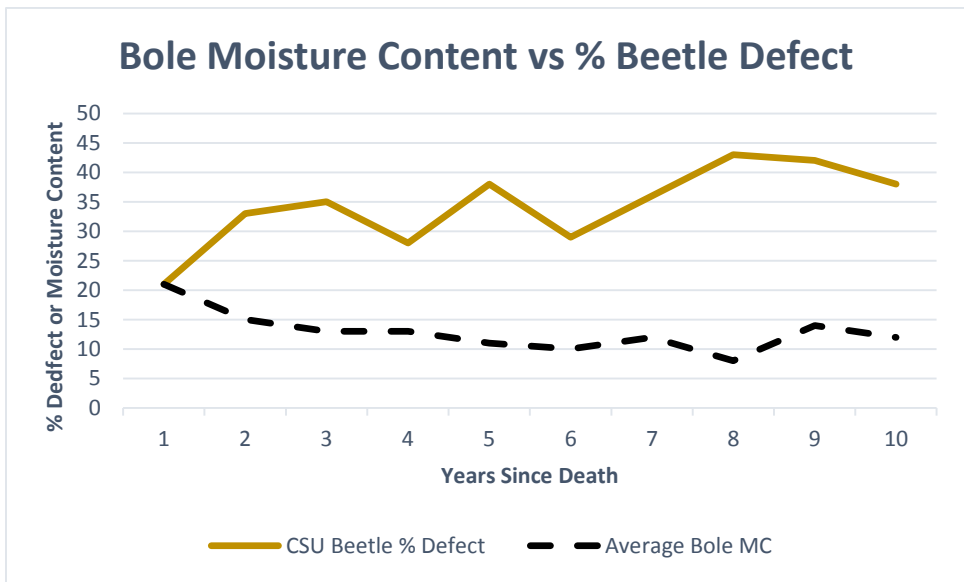


Chart 3: Bole Moisture Content vs % Beetle Defect, shows a strong relationship between tree moisture content and percent defect. As moisture content goes down defect in the form of checking or cracking goes up.

Chart 3: Bole Moisture Content vs % Beetle Defect



High variability of time since death of individual trees within any stand neutralizes the utility of mapping polygons to focus salvage operations on the areas with oldest mortality.

The strongest indicators of spruce killed sawlog quality are time since death, moisture content, diameter, and precipitation zone. These indicators can be used to establish hazard reduction activities on a broad scale if one of the goals is to capture sawtimber value before it deteriorates.

Any treatment area will have a spread in time since death for individual trees and hence a continuum of sawlog conditions within the treatment unit.

**Conclusions:**

The information gathered in this spruce deterioration study provides an insight into the factors most likely to influence sawlog quality following mortality caused by the beetles. It points out the highly variable distribution of mortality within aerial mapping polygons. It appears that time since death, moisture content, diameter and precipitation zones are the most useful indicators in predicting spruce sawlog defect following beetle mortality. These factors can be utilized to guide the development of the wildfire and falling tree hazard mitigation program on the forest.

The complete study can be reviewed at [www.rweact.org](http://www.rweact.org)