

# **APPENDIX E**

## **Incident Frequency Study**



## INCIDENT FREQUENCY STUDY

A project-specific incident frequency analysis was conducted for the Project. This document represents an evaluation of the public safety risks associated with the *Over The River* Project (Project). This report focuses on hazards associated with the three phases of the Project: Installation, Exhibition, and Removal. Hazards are categorized as construction related, public safety related, and natural hazards.

The purpose of this report is to provide a conservative range of effect to public and worker safety during the Project. This analysis will provide supplemental information for local emergency responders, providing an estimate of the frequency of certain hazards, allowing emergency responders the opportunity to prepare for various scenarios in its emergency response preparation and planning.

This study assessed various manmade and natural hazards associated with the Project and the Project area and estimated the frequency for eight hazards associated with human activities and ten natural hazards. When possible, the study quantified risk based on the frequency of the event.

### 1.1 Incident Frequency

Incident frequencies were derived from publicly available records, such as the Natural Hazard Risk Analysis and Pre-Disaster Mitigation Plan for the Upper Arkansas Area (Fremont County Emergency Services Division [FCESD] 2003), and other data provided within the EIS. Risk from natural hazards was quantifiable, while risk from human activities was generally semi-quantifiable.

While future events cannot be known with absolute certainty, incident frequencies can be used to estimate the number of events that might be expected to occur over a period of time based on historic frequencies. Actual frequency may differ from the predicted values of this analysis.

### 1.2 Methodology

Man-made and natural hazards currently exist within the Project Area. However, the Project introduces hazards from construction and public safety issues related to increased visitation. Natural hazards are common in the area, but their impacts will likely be greater with increased human visitation. Alternatives to Alternative 1a may reduce some hazards to the viewing public.

Risk was calculated by determining the baseline frequency of an event and the seasonal duration of the event. For example, severe lightning storms occur 5 times per year on average, and these events tend to occur in July and August. Activities that coincide with these timeframes (e.g., Exhibition in August) may experience these events. The probability of an event is:

$$\text{Frequency of event/exposure time} * \text{length of project}$$

For example, the exhibition period for Alternative 1a occurs within the severe lightning storms period of July and August, an 8-week period. Large numbers of the visiting public would be exposed to these storms during the 2 weeks of the Exhibition phase, plus additional visitors anticipated one week prior to and after the event. In total, the exposure period for high public exposure is 4 weeks total. Thus, hazard to the public is:

$$5 \text{ severe storms}/8 \text{ weeks} * 4 \text{ weeks public exposure} = 2.5 \text{ severe storm event during the Exhibition Phase}$$

This result indicates that emergency responders should anticipate a high probability of a severe storm with lightning during the Exhibition phase. Hazard severity was classified as High (more than one event during Project Phase), Moderate (between 0.1 and 1.0 events during project phase), Low (between 0.01 and 0.1 events during Project phase), and Remote (less than 0.01 events during Project phase). However, statistical analysis may vary from actual values due to uncertainties, human behavior, and public awareness.

Emergency responders would implement the procedures identified in the Natural Hazard Risk Analysis and Pre-Disaster Mitigation Plan for the Upper Arkansas Area (FCESD 2003). To further mitigate hazards to the public and ensure effective responses, the proponents of the Project should coordinate their Event Management Plan with the appropriate local, state, and federal entities to ensure all parties understand the hazards and jointly agree to procedures that would be implemented during the Project.

## **2.0 Alternative 1a – Preferred Alternative**

**Table 1** summarizes construction-related and public safety hazards associated with Alternative 1a, while **Table 2** identifies natural hazards associated with Alternative 1a. The quantification and impacts of each hazard is discussed in the sections below.

### **2.1 Construction-Related Hazards**

During the installation and removal processes, construction workers would be exposed to various work hazards, ranging from potentially minor (poison ivy) to potentially major accidents (significant falls, vehicle accidents). No construction activities would occur during the Exhibition phase and therefore no hazards to construction workers would be present. Due to the nature of the construction work, the primary hazards are expected to be related to the physical environment (trips, falls, poison ivy, bee stings, cuts and scrapes), mechanical equipment (drilling and cable stringing), and travel to and from the workplace. Travel on winding roads, particularly during winter snow storms, pose a threat to workers. A job safety analysis, emphasis on worker safety, and compliance with rules and regulations should maintain a relatively safe worker environment.

For this analysis, construction hazards were classified as OSHA-reportable injury (requiring minor medical attention) and serious injury (requiring hospitalization and/or the loss of work days). It is noted that there is potential overlap between these categories. With the use of proper safety equipment and procedures, most injuries are anticipated to be minor. Serious injuries or substantive equipment failures leading to injuries are expected to be uncommon.

The hazard analysis for construction-related injuries is semi-quantitative. Alternative 1a is considered the baseline rate. Alternatives that reduce or eliminate a hazard would quantitatively affect the baseline rate. For example, Alternative 1a is expected to take approximately two years to install. An alternative to Alternative 1a that reduced the construction labor hours and/or the construction time period would proportionally reduce the hazards to workers. However, if adequate construction crews and relief workers are not provided during the compressed work schedule, the potential for construction-related accidents from human error may increase. The No Action Alternative would completely eliminate construction activities, thereby completely eliminating this hazard to workers.

**Table 1. Construction-Related and Project-Related Public Safety Hazards for Alternative 1a.**

		Construction Safety <sup>1</sup>		Project-Specific Public Safety				
		OSHA-reportable Construction Injury	Severe Construction Injury	Vandalism	Boating Accident <sup>1</sup>	Severe Boating Accident <sup>2</sup>	Traffic Problems	Criminal Actions
Event frequency		4.5/year	2 years		15/year <sup>2</sup>	3/year <sup>3</sup>		
Installation (2 years duration)	Occurrence Probability (estimated number of events)	Baseline	Baseline	Not significantly different than No Action	Approximately 4 more than No Action	Approximately 1 more than No Action	Baseline	Not significantly different than No Action
	Risk Category	Moderate to High	High	Low	High	Moderate	Low	Low
Exhibition (2-week period with a total of 4 weeks of high use)	Occurrence Probability (estimated number of events)	NA	NA	Approximately 2 to 3 times greater than No Action	Approximately 15 more accidents than No Action	Approximately 3 more accidents than No Action	Approximately 2 times greater than No Action	Approximately 2 times greater than No Action
	Risk Category	NA	NA	High	High	High	High	High
Removal (3 months)	Occurrence Probability (estimated number of events)	Baseline	Baseline	Not significantly different than No Action	Approximately 3 accidents more than No Action	Approximately 1 more than No Action	Not significantly different than No Action	Not significantly different than No Action
	Risk Category	High	Moderate	Low	High	High	Moderate	Low

<sup>1</sup> Based on 2009 Bureau of Labor Statistics data.

<sup>2</sup> Based on data provided in baseline section of EIS.

<sup>3</sup> Boating incidents anticipated this baseline rate due to human misbehavior to low hanging panels and cables.

Note: This table represents the baseline, Alternative 1a. Some comparison is made to the No Action in this table. Additional comparison is made in the other alternative tables through green and yellow highlights in relation to Alternative 1a.

**Table 2. Natural Hazards Associated with Alternative 1a.**

		Natural Hazards									
		Rockfall <sup>1</sup>	Lightning <sup>1</sup>	Tornado <sup>1</sup>	Severe Wind Gust <sup>1</sup>	Flash Floods <sup>1</sup>	Seasonal Flooding <sup>2</sup>	Wildfire <sup>1</sup>	Landslide <sup>1</sup>	Winter Storm <sup>3</sup>	Earthquake > 5.5 Richter scale <sup>4</sup>
Event frequency		3 times/year <sup>5</sup>	5/year <sup>6</sup>	1/10 years <sup>6</sup>	1 in 10 years <sup>5</sup>	1 in 2 years <sup>6</sup>	4 in 10 years <sup>6</sup>	1 per year <sup>6</sup>	2 per year <sup>6</sup>	2/year <sup>6</sup>	2/100 years <sup>6</sup>
Installation (2 years duration)	Occurrence Probability (estimated number of events)	Estimated 6 rockfall events	Estimated 10 lightning events	Estimated chance: 1 in 5	Estimated chance: 1 in 5	Estimated 1 flash flood event	Estimated chance: 1 in 2	Estimated 1 wildfire event	Estimated 4 landslide events	Estimated 6 to 7 winter storms	Estimated chance: 1 in 240
	Risk Category	High	High	Moderate	Moderate	High	Moderate	High	High	High	Remote
Exhibition (2-week period with a total of 4 weeks of high use)	Occurrence Probability (estimated number of events)	Estimated 2 rockfall events	Estimated 3 lightning events	Estimated chance: 1 in 20	Estimated chance: 1 in 20	Estimated chance: 1 in 4	Estimated chance: 1 in 10	Estimated chance: 1 in 4	Estimated 1 landslide event	No winter storm predicted	Estimated chance: 1 in 650
	Risk Category	High	High	Low	Low	Moderate	Moderate	Moderate	High	Remote	Remote
Removal (3 months)	Occurrence Probability (estimated number of events)	Estimated 1 rockfall event	Estimated 1 lightning event	Estimated chance: 1 in 40	Estimated chance: 1 in 160	Estimated chance: 1 in 8	Estimated chance: 1 in 5	Estimated chance: 1 in 3	Estimated 1 landslide event	Estimated 1 winter storm	Estimated chance: 1 in 200
	Risk Category	High	High	Low	Low	Moderate	Moderate	Moderate	High	High	Remote

<sup>1</sup> Based on 2-month seasonal event (e.g., severe summer storms in July and August).

<sup>2</sup> Based on 3-month summer season.

<sup>3</sup> Based on 8-month season for possible winter storms.

<sup>4</sup> Based on annual probability.

<sup>5</sup> Based on data provided in baseline section of EIS.

<sup>6</sup> Based on data provided in Natural Hazard Risk Analysis and Pre-Disaster Mitigation Plan for the Upper Arkansas Area (FCESD 2003).

Note: This table represents the baseline, Alternative 1a. Some comparison is made to the No Action in this table. Additional comparison is made in the other alternative tables through green and yellow highlights in relation to Alternative 1a.

## 2.2 Public Safety Hazards

Human behavior poses the greatest risk to public safety for the Project. Vandalism and criminal activity are expected to increase proportionally with the number of visitors.

Boating accidents are expected to significantly increase due to the proximity of the panels and cable to the water's surface. Cables and panels are expected to be 8 to 20 feet above the water's surface and will create an attractive nuisance to boaters. It should be anticipated that boaters will attempt to hang onto or grapple onto the cable. Others will throw items into the panels. These behaviors will likely result in an increase in mishaps, some which may cause injuries and require swift water rescues. Due to potential consequences to the boating permits, commercial operators may be more vigilant about controlling people within their rafts than private boating parties.

For this analysis, we estimated the number of boating incidents would increase twofold once the cables were installed and would continue through the removal of the cables. The estimation of boating accidents was quantitatively analyzed, as described previously. Thus, during the Exhibition period for Alternative 1a, the hazard to the public is calculated as:

**15 boating accidents/12 week boating season \* 4 weeks public exposure \* 2 times normal rate =  
7.5 boating accidents during the Exhibition Phase**

and

**3 severe boating accidents/12 week boating season \* 4 weeks public exposure \* 2 times normal rate =  
1.5 severe boating accidents during the Exhibition Phase**

In total for the Installation, Exhibition, and Removal phases of the Project, this analysis suggests that Alternative 1a may result in a greater risk, estimated to be an additional 8 boating accidents, with 2 severe boating accidents. These are accidents above the normal levels (e.g., the No Action Alternative). It is important to note that, at a minimum, there would be an increased expectation of boating accidents based on the results of the analysis. Consequently, if Alternative 1a were selected, emergency responders should plan on a substantial increase in the number of boating accidents, swift water rescues, and severe injuries during the Project. It will be important to have sufficient emergency responders available, good communications, and emergency crews must be able to quickly access the river and transport injured boaters from the area. These issues are addressed in the Project's Event Management Plan and should be directly coordinated with the appropriate local emergency response coordinators.

Traffic congestion is expected to be significant due to the number of vehicles, driver behavior, and potential for breakdowns. Traffic problems are expected to be proportional to the number of vehicles during peak viewing periods. Traffic due to construction workers is not expected to significantly affect baseline traffic rates.

The analysis for traffic congestion is semi-quantitative. Alternative 1a is considered the baseline rate. Alternatives that reduce or eliminate a hazard would quantitatively affect the baseline rate. For example, Alternative 1a Exhibition period is expected to last two weeks, with one week prior to actual installation and one week after the viewing period also experiencing high visitation. An alternative to Alternative 1a that increased the length of the Exhibition phase (e.g., Alternative 1c) would proportionally increase the length of time traffic congestion was experienced along Highway 50. The No Action Alternative would eliminate the Exhibition of the Project, thereby completely eliminating this hazard.

### 2.3 Natural Hazards

While natural hazards will occur regardless of the alternative selected for the Project (i.e., same as No Action frequency rates), it is the number of people present during these natural events that pose a potential hazard to public and worker safety. Natural hazards identified for this analysis include:

- Rockfalls
- Lightning
- Tornadoes
- Strong Wind Gusts
- Flash Floods
- Seasonal Flooding
- Wildfire
- Landslides
- Severe Winter Storms
- Earthquakes

Many of these hazards have been identified and accounted for within the Natural Hazard Risk Analysis and Pre-Disaster Mitigation Plan for the Upper Arkansas Area (FCESD 2003) as well as the proponents Event Management Plan. Frequencies for these events were derived from the Natural Hazard Risk Analysis and Pre-Disaster Mitigation Plan for the Upper Arkansas Area (FCESD 2003) or from baseline data within this EIS whenever possible.

These natural hazards create both direct and indirect hazards to the public and construction workers. For example, rockfalls could cause injury or mortality if the rockfall occurred directly onto a vehicle. The greater the number of visitors in the Project Area, the higher the possibility of rockfalls striking vehicles. However, the more probable occurrence would be rockfalls that obstruct traffic, resulting in traffic congestion and difficulties evacuating the affected area. The majority of natural hazards pose similar hazards.

Lightning, rockfall, landslides, and wildlife pose the greatest hazards, with lightning posing the greatest hazard. All of these hazards are expected to occur at least once within the Project timeframe. Consequently, emergency responders should be particularly aware of these hazards in their event planning. As with other hazards, it will be important to be able to re-route traffic quickly and efficiently and to have sufficient emergency responders available, good communications, and emergency crews capable of quickly accessing all areas of the Project, and be able to transport injured people from the affected area.

### 3.0 Alternative 1c

Alternative 1c would continue to impose new event-only boat rations but would extend the viewing period for an additional week. **Table 3** summarizes construction-related and public safety hazards associated with Alternative 1c, while **Table 4** identifies natural hazards associated with Alternative 1c. The quantification and impacts of each hazard is discussed in the sections below.

#### 3.1 Construction-Related Hazards

Alternative 1c would be constructed within an approximately two-year timeframe and would require a similar amount of construction labor hours as Alternative 1a. As a result, construction-related hazards are the same as Alternative 1a.

### **3.2 Public Safety Hazards**

Vandalism and criminal activity during Installation and Removal phases would be the same as Alternative 1a since both occur over the same period of time. In Alternative 1c, the Exhibition phase would increase the number of people in the Project area for an additional week, therefore the amount of vandalism and criminal activities may increase during this phase compared to Alternative 1a.

Alternative 1c would increase boating activity relative to Alternative 1a due to the extended Exhibition phase. As a result, boating accidents may slightly increase compared to Alternative 1a.

### **3.3 Natural Hazards**

Certain construction activities during the Installation phase would occur during the summer months and therefore may be affected by natural hazards. Additionally, the Exhibition phase would occur in August and would have one additional week of viewing compared to Alternative 1a. As a result, increases in some natural hazards would be anticipated.

**Table 3. Construction-Related and Project-Related Public Safety Hazards for Alternative 1c.**

	Frequency	OSHA-reportable Construction Injury <sup>1</sup> 4.5/year	Severe Construction Injury 2 years	Vandalism	Boating Accident <sup>2</sup> 15/year <sup>3</sup>	Severe Boating Accident <sup>2</sup> 3/year <sup>3</sup>	Traffic Problems	Criminal Actions
<b>Installation</b> (2-year duration)	<b>Occurrence Probability (estimated number of events)</b>	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a
	<b>Risk Category</b>	High	High	Low	High	Moderate	Low	Low
<b>Exhibition</b> (3-week period with a total of 5 weeks of high use)	<b>Occurrence Probability (estimated number of events)</b>	NA	NA	Same or slightly greater than Alternative 1a	Same or slightly greater than Alternative 1a	Same or slightly greater than Alternative 1a	Same or slightly greater than Alternative 1a	Same or slightly greater than Alternative 1a
	<b>Risk Category</b>	NA	NA	High	High	High	High	High
<b>Removal</b> (3 months)	<b>Occurrence Probability (estimated number of events)</b>	Same as Alternative 1a	Same as Alternative 1a	Not significantly different than Alternative 1a	Not significantly different than Alternative 1a	Not significantly different than Alternative 1a	Not significantly different than Alternative 1a	Not significantly different than Alternative 1a
	<b>Risk Category</b>	High	Moderate	Low	Moderate	Moderate	Moderate	Low

<sup>1</sup> Based on 2009 Bureau of Labor Statistics data.

<sup>2</sup> Based on data provided in baseline section of EIS.

<sup>3</sup> Boating incidents anticipated this baseline rate due to human misbehavior to low hanging panels and cables.

Note: Green highlighted areas indicate hazards that are less than Alternative 1a; yellow areas are hazards that are greater than Alternative 1a.

**Table 4. Natural Hazards Associated with Alternative 1c.**

		Natural Hazards									
		Rockfall <sup>1</sup>	Lightning <sup>1</sup>	Tornado <sup>1</sup>	Severe Wind Gust <sup>1</sup>	Flash Floods <sup>1</sup>	Seasonal Flooding <sup>2</sup>	Wildfire <sup>1</sup>	Landslide <sup>1</sup>	Winter Storm <sup>3</sup>	Earthquake > 5.5 Richter scale <sup>4</sup>
		3 times/year <sup>5</sup>	5/year <sup>6</sup>	1/10 years <sup>6</sup>	1 in 10 years <sup>5</sup>	1 in 2 years	4 in 10 years <sup>6</sup>	1 per year <sup>6</sup>	2 per year <sup>6</sup>	2/year <sup>6</sup>	2/100 years <sup>6</sup>
Installation (2-year duration)	Frequency	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a
	Occurrence Probability (estimated number of events) Risk Category	High	High	Moderate	Moderate	High	Moderate	High	High	High	Remote
Exhibition (3-week period with a total of 5 weeks of high use)	Frequency	Same or slightly greater than Alternative 1a	Same or slightly greater than Alternative 1a	Same or slightly greater than Alternative 1a	Same or slightly greater than Alternative 1a	Same or slightly greater than Alternative 1a	Same or slightly greater than Alternative 1a	Same or slightly greater than Alternative 1a	Same or slightly greater than Alternative 1a	Same as Alternative 1a	Same or slightly greater than Alternative 1a
	Occurrence Probability (estimated number of events) Risk Category	Moderate	High	Low	Low	Moderate	Moderate	Moderate	Moderate	Remote	Remote
Removal (3 months)	Frequency	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a
	Occurrence Probability (estimated number of events) Risk Category	High	High	Low	Low	Moderate	Moderate	Moderate	High	High	Remote

<sup>1</sup> Based on 2-month seasonal event (e.g., severe summer storms in July and August).

<sup>2</sup> Based on 3-month summer season.

<sup>3</sup> Based on 8-month season for possible winter storms.

<sup>4</sup> Based on annual probability.

<sup>5</sup> Based on data provided in baseline section of EIS.

<sup>6</sup> Based on data provided in Natural Hazard Risk Analysis and Pre-Disaster Mitigation Plan for the Upper Arkansas Area (FCESD 2003).

Note: Green highlighted areas indicate hazards that are less than Alternative 1a; yellow areas are hazards that are greater than Alternative 1a.

## 4.0 Alternative 1D

Compared to Alternative 1a, the Exhibition period would occur in September. Existing State Parks commercial boat rations would be in effect during this time period. **Table 5** summarizes construction-related and public safety hazards associated with Alternative 1d, while **Table 6** identifies natural hazards associated with Alternative 1d. The quantification and impacts of each hazard are discussed in the sections below.

### 4.1 Construction-Related Hazards

Alternative 1d would be constructed within a timeframe similar to that of Alternative 1a. As a result, construction-related hazards are the same as Alternative 1a.

### 4.2 Public Safety Hazards

Vandalism and criminal activity during Installation, Exhibition and Removal phases would be the same as Alternative 1a since both occur over the same period of time. In Alternative 1d, the Exhibition phase would occur in September and boating rations would revert to the existing AHRA Rationing Plan. This may result in an increase in boating incidents along certain river segments compared to Alternative 1a, as some segments of the river would not be rationed while others would, resulting in an increase in boaters in the segments that are not rationed and a decrease along the segments that are rationed.

### 4.3 Natural Hazards

Compared to Alternative 1a, shifting the Exhibition phase to September in Alternative 1d potentially reduces natural hazards that the viewing public would experience since the Exhibition phase would occur outside of the severe summer storm period (July-August). Only the Removal phase likely may experience an increase in hazards for construction workers, since the removal process would be more likely to encounter severe winter weather than experienced in Alternative 1a.

**Table 5. Construction-Related and Project-Related Public Safety Hazards for Alternative 1d.**

	Frequency	Construction Safety		Project-Specific Public Safety				
		OSHA-reportable Construction Injury <sup>1</sup> 4.5/year	Severe Construction Injury 2 years	Vandalism	Boating Accident <sup>2</sup> 15/year <sup>3</sup>	Severe Boating Accident <sup>2</sup> 3/year <sup>3</sup>	Traffic Problems	Criminal Actions
<b>Installation</b> (2 years duration)	<b>Occurrence Probability (estimated number of events)</b>	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a
	<b>Risk Category</b>	High	High	Low	High	Moderate	Low	Low
<b>Exhibition</b> (2-week period with a total of 4 weeks of high use)	<b>Occurrence Probability (estimated number of events)</b>	NA	NA	Same as Alternative 1a	Less than Alternative 1a	Less than Alternative 1a	Same as Alternative 1a	Same as Alternative 1a
	<b>Risk Category</b>	NA	NA	High	High	High	High	High
<b>Removal</b> (3 months)	<b>Occurrence Probability (estimated number of events)</b>	Same as Alternative 1a	Same as Alternative 1a	Not significantly different than Alternative 1a	Not significantly different than Alternative 1a	Not significantly different than Alternative 1a	Not significantly different than Alternative 1a	Not significantly different than Alternative 1a
	<b>Risk Category</b>	High	Moderate	Low	Moderate	Moderate	Moderate	Low

<sup>1</sup> Based on 2009 Bureau of Labor Statistics data.

<sup>2</sup> Based on data provided in baseline section of EIS.

<sup>3</sup> Boating incidents anticipated this baseline rate due to human misbehavior to low hanging panels and cables.

Note: Green highlighted areas indicate hazards that are less than Alternative 1a; yellow areas are hazards that are greater than Alternative 1a.

**Table 6. Natural Hazards Associated with Alternative 1d.**

		Natural Hazards									
		Rockfall <sup>1</sup>	Lightning <sup>1</sup>	Tornado <sup>1</sup>	Severe Wind Gust <sup>1</sup>	Flash Floods <sup>1</sup>	Seasonal Flooding <sup>2</sup>	Wildfire <sup>1</sup>	Landslide <sup>1</sup>	Winter Storm ****	Earthquake > 5.5 Richter scale
		3 times/year <sup>5</sup>	5/year <sup>6</sup>	1/10 years <sup>6</sup>	1 in 10 years <sup>5</sup>	1 in 2 years <sup>6</sup>	4 in 10 years <sup>6</sup>	1 per year <sup>6</sup>	2 per year <sup>6</sup>	2/year*	2/100 years*
Installation (2 years duration)	Occurrence Probability (estimated number of events)	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a
	Risk Category	High	High	Moderate	Moderate	High	Moderate	High	High	High	Remote
Exhibition (2-week period with a total of 4 weeks of high use)	Occurrence Probability (estimated number of events)	Same as Alternative 1a	Same or slightly less than Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a
	Risk Category	Moderate	High	Low	Low	Moderate	Moderate	Moderate	Moderate	Remote	Remote
Removal (3 months)	Occurrence Probability (estimated number of events)	Same or slightly less than Alternative 1a	Same or slightly less than Alternative 1a	Same or slightly less than Alternative 1a	Same or slightly less than Alternative 1a	Same or slightly less than Alternative 1a	Same As Alternative 1a	Same or slightly less than Alternative 1a	Same or slightly less than Alternative 1a	Same as or slightly greater than Alternative 1a	Same as Alternative 1a
	Risk Category	High	High	Low	Low	Moderate	Moderate	Moderate	High	High	Remote

<sup>1</sup> Based on 2-month seasonal event (e.g., severe summer storms in July and August).

<sup>2</sup> Based on 3-month summer season.

<sup>3</sup> Based on 8-month season for possible winter storms.

<sup>4</sup> Based on annual probability.

<sup>5</sup> Based on data provided in baseline section of EIS.

<sup>6</sup> Based on data provided in Natural Hazard Risk Analysis and Pre-Disaster Mitigation Plan for the Upper Arkansas Area (FCESD 2003).

Note: Green highlighted areas indicate hazards that are less than Alternative 1a; yellow areas are hazards that are greater than Alternative 1a.

## 5.0 Alternative 2

In contrast to Alternatives 1a-d that modified visitor management and altered viewing and construction timetables, Alternatives 2 through 4 modify the length and number of panels displayed along the Arkansas River.

Alternative 2 reduces the length of the Project display to 4.8 miles, compared to the 5.9 miles for Alternative 1a. This represents a 19 percent reduction in Project length. **Table 7** summarizes construction-related and public safety hazards associated with Alternative 2, while **Table 8** identifies natural hazards associated with Alternative 2. The quantification and impacts of each hazard is discussed in the sections below.

### 5.1 Construction-Related Hazards

Alternative 2 would be 19 percent shorter in length than Alternative 1a, with all other factors being consistent with Alternative 1a. As a result of the decrease in total construction length and labor hours, construction hazards associated with the Installation and Removal phases may be reduced by an estimated 19 percent.

### 5.2 Public Safety Hazards

Vandalism and criminal activity during Installation and Removal phases would be the same as Alternative 1a since both occur over the same period of time. In Alternative 2, the display would be shorter in length, which might reduce vandalism and criminal activity, though the frequency of vandalism and criminal activity would generally be correlated with the number of visitors rather than the length of the display.

Boating incidents would increase over the No Action levels due to misbehavior described previously. However, the reduction of the number of panels and the overall length of the display would proportionally decrease opportunities for behavior leading to accidents. Consequently, boating accidents may decrease by an estimated 20 percent<sup>1</sup> relative to Alternative 1a.

### 5.3 Natural Hazards

Reducing the length of the displays may have little to no effect on natural hazard rates if visitors must still traverse the entire corridor to view the display. Nevertheless, public activities presumably would be more concentrated in the display areas, resulting in the potential estimated reduction of up to 20 percent compared to Alternative 1a.

## 6.0 Alternative 3

Alternative 3 reduces the length of the Project display to 4.1 miles, compared to the 5.9 miles for Alternative 1a. This represents a 31 percent reduction in Project length. **Table 9** summarizes construction-related and public safety hazards associated with Alternative 3, while **Table 10** identifies natural hazards associated with Alternative 3. The quantification and impacts of each hazard is discussed in the sections below.

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<sup>1</sup> The percent of boating accidents is not equivalent to the percent reduction in project length due to a weighting factor for display areas minus baseline boating accident levels without this weighting. This applies to Alternatives 2 – 4.

**Table 7. Construction-Related and Project-Related Public Safety Hazards for Alternative 2.**

		Construction Safety		Project-Specific Public Safety				
		OSHA-reportable Construction Injury <sup>1</sup>	Severe Construction Injury	Vandalism	Boating Accident <sup>2</sup>	Severe Boating Accident <sup>2</sup>	Traffic Problems	Criminal Actions
		4.5/year	1/2 years		15/year <sup>3</sup>	3/year <sup>3</sup>		
Frequency	Occurrence Probability (estimated number of events)	Slightly less than Alternative 1a	Slightly less than Alternative 1a	Same as Alternative 1a	Approximately 25% less than Alternative 1a (3 incidents more than No Action)	Approximately 25% of Alternative 1a (slightly more incidents [ $<1$ ] than No Action)	Same as Alternative 1a	Same as Alternative 1a
Risk Category	Risk Category	High	High	Low	High	Moderate	Low	Low
Installation (2 years duration)	Occurrence Probability (estimated number of events)	NA	NA	Same or less than Alternative 1a	Up to 25% less than Alternative 1a (4 incidents more than No Action)	Up to 25% less than Alternative 1a (1 incident more than No Action)	Same or less than Alternative 1a	Same or less than Alternative 1a
	Risk Category	NA	NA	High	High	High	High	High
Exhibition (2-week period with a total of 4 weeks of high use)	Occurrence Probability (estimated number of events)	Same as Alternative 1a	Same as Alternative 1a	Not significantly different than Alternative 1a	Approximately 25% less than Alternative 1a (2 more incidents than No Action)	Approximately 25% less than Alternative 1a (slightly more [ $<1$ ] incidents than No Action)	Not Significantly different than Alternative 1a	Not significantly different than Alternative 1a
	Risk Category	High	Moderate	Low	High	High	Moderate	Low
Removal (3 months)	Occurrence Probability (estimated number of events)	Same as Alternative 1a	Same as Alternative 1a	Not significantly different than Alternative 1a	Approximately 25% less than Alternative 1a (2 more incidents than No Action)	Approximately 25% less than Alternative 1a (slightly more [ $<1$ ] incidents than No Action)	Not Significantly different than Alternative 1a	Not significantly different than Alternative 1a
	Risk Category	High	Moderate	Low	High	High	Moderate	Low

<sup>1</sup> Based on 2009 Bureau of Labor Statistics data.

<sup>2</sup> Based on data provided in baseline section of EIS.

<sup>3</sup> Boating incidents anticipated this baseline rate due to human misbehavior to low hanging panels and cables.

Note: Green highlighted areas indicate hazards that are less than Alternative 1a; yellow areas are hazards that are greater than Alternative 1a.

**Table 8. Natural Hazards Associated with Alternative 2.**

		Natural Hazards									
		Rockfall <sup>1</sup>	Lightning <sup>1</sup>	Tornado <sup>1</sup>	Severe Wind Gust <sup>1</sup>	Flash Floods <sup>1</sup>	Seasonal Flooding <sup>2</sup>	Wildfire <sup>1</sup>	Landslide <sup>1</sup>	Winter Storm *****	Earthquake > 5.5 Richter scale
<b>Frequency</b>		3 times/year <sup>5</sup>	5/year <sup>6</sup>	1/10 years <sup>6</sup>	1 in 10 years <sup>5</sup>	1 in 2 years <sup>6</sup>	4 in 10 years <sup>6</sup>	1 per year <sup>6</sup>	2 per year <sup>6</sup>	2/year*	2/100 years*
<b>Installation</b> (2 years duration)	<b>Occurrence Probability (estimated number of events)</b>	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Up to 20 % less than Alternative 1a	Up to 20 % less than Alternative 1a
	<b>Risk Category</b>	High	High	Moderate	Moderate	High	Moderate	High	High	High	Remote
<b>Exhibition</b> (2-week period with a total of 4 weeks of high use)	<b>Occurrence Probability (estimated number of events)</b>	Up to 20 % less than Alternative 1a	Up to 20 % less than Alternative 1a	Up to 20 % less than Alternative 1a	Up to 20 % less than Alternative 1a	Up to 20 % less than Alternative 1a	Up to 20 % less than Alternative 1a	Up to 20 % less than Alternative 1a	Up to 20 % less than Alternative 1a	Up to 20 % less than Alternative 1a	Up to 20 % less than Alternative 1a
	<b>Risk Category</b>	High	High	Low	Low	Moderate	Low	Moderate	Moderate	Remote	Remote
<b>Removal</b> (3 months)	<b>Occurrence Probability (estimated number of events)</b>	Up to 20 % less than Alternative 1a	Up to 20 % less than Alternative 1a	Up to 20 % less than Alternative 1a	Up to 20 % less than Alternative 1a	Up to 20 % less than Alternative 1a	Up to 20 % less than Alternative 1a	Up to 20 % less than Alternative 1a	Up to 20 % less than Alternative 1a	Up to 20 % less than Alternative 1a	Up to 20 % less than Alternative 1a
	<b>Risk Category</b>	Moderate	High	Low	Low	Moderate	Moderate	Moderate	Moderate	Remote	Remote

<sup>1</sup> Based on 2-month seasonal event (e.g., severe summer storms in July and August).

<sup>2</sup> Based on 3-month summer season.

<sup>3</sup> Based on 8-month season for possible winter storms.

<sup>4</sup> Based on annual probability.

<sup>5</sup> Based on data provided in baseline section of EIS.

<sup>6</sup> Based on data provided in Natural Hazard Risk Analysis and Pre-Disaster Mitigation Plan for the Upper Arkansas Area (FCESD 2003).

Note: Green highlighted areas indicate hazards that are less than Alternative 1a; yellow areas are hazards that are greater than Alternative 1a.

### **6.1 Construction-Related Hazards**

Alternative 3 would be 31 percent shorter in length than Alternative 1a, with all other factors being consistent with Alternative 1a. As a result of the decrease in total construction length and labor hours, construction hazards associated with the Installation and Removal phases may be reduced by an estimated 31 percent.

### **6.2 Public Safety Hazards**

Vandalism and criminal activity during Installation and Removal phases would be the same as Alternative 1a since both occur over the same period of time. In Alternative 3, the display would be shorter in length, which might reduce vandalism and criminal activity, though the frequency of vandalism and criminal activity would generally be correlated with the number of visitors rather than the length of the display.

Boating incidents would increase over the No Action levels due to misbehavior described previously. However, the reduction of the number of panels and the overall length of the display would decrease opportunities for behavior leading to accidents. Consequently, boating accidents may decrease an estimated 33 percent relative to Alternative 1a.

### **6.3 Natural Hazards**

Reducing the length of the displays may have little to no effect on natural hazard rates if visitors must still traverse the entire corridor to view the display. Nevertheless, public activities presumably would be more concentrated in the display areas, resulting in the potential reduction of up to an estimated 33 percent compared to Alternative 1a.

**Table 9. Construction-Related and Project-Related Public Safety Hazards for Alternative 3.**

	Frequency	Construction Safety		Project-Specific Public Safety				
		OSHA-reportable Construction Injury <sup>1</sup> 4.5/year	Severe Construction Injury 2 years	Vandalism	Boating Accident <sup>2</sup> 15/year <sup>3</sup>	Severe Boating Accident <sup>2</sup> 3/year <sup>3</sup>	Traffic Problems	Criminal Actions
<b>Installation</b> (2 years duration)	<b>Occurrence Probability (estimated number of events)</b>  <b>Risk Category</b>	Less than the Alternative 1a  High	Less than the Alternative 1a  High	Same as Alternative 1a  Low	60% less than Alternative 1a (2.2 incidents more than No Action)  High	60% less than Alternative 1a (0.4 incidents more than No Action)  Moderate	Baseline  Low	Not significantly different than No Action  Low
<b>Exhibition</b> (2-week period with a total of 4 weeks of high use)	<b>Occurrence Probability (estimated number of events)</b>  <b>Risk Category</b>	NA  NA	NA  NA	Same or less than Alternative 1a  High	Up to 60% less than Alternative 1a (3 incidents more than No Action)  High	Up to 60% less than Alternative 1a ((slightly more incidents [<1] than No Action)  High	Same or less than Alternative 1a  High	Same or less than Alternative 1a  Moderate
<b>Removal</b> (3 months)	<b>Occurrence Probability (estimated number of events)</b>  <b>Risk Category</b>	Same as Alternative 1a  High	Same as Alternative 1a  Moderate	Same as Alternative 1a  Low	60% less than Alternative 1a (1.7 incidents more than No Action)  High	60% less than Alternative 1a (1.7 incidents more than No Action)  High	Same as Alternative 1a  Moderate	Same as Alternative 1a  Low

<sup>1</sup> Based on 2009 Bureau of Labor Statistics data.

<sup>2</sup> Based on data provided in baseline section of EIS.

<sup>3</sup> Boating incidents anticipated this baseline rate due to human misbehavior to low hanging panels and cables.

Note: Green highlighted areas indicate hazards that are less than Alternative 1a; yellow areas are hazards that are greater than Alternative 1a.

**Table 10. Natural Hazards Associated with Alternative 3.**

		Natural Hazards									
		Rockfall <sup>1</sup>	Lightning <sup>1</sup>	Tornado <sup>1</sup>	Severe Wind Gust <sup>1</sup>	Flash Floods <sup>1</sup>	Seasonal Flooding <sup>2</sup>	Wildfire <sup>1</sup>	Landslide <sup>1</sup>	Winter Storm ****	Earthquake > 5.5 Richter scale
		3 times/year <sup>5</sup>	5/year <sup>6</sup>	1/10 years <sup>6</sup>	1 in 10 years <sup>5</sup>	1 in 2 years <sup>6</sup>	4 in 10 years <sup>6</sup>	1 per year <sup>6</sup>	2 per year <sup>6</sup>	2/year*	2/100 years*
Installation (2 years duration)	Frequency	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Up to one-third less than Alternative 1a	Up to one-third less than Alternative 1a
	Risk Category	High	High	Moderate	Moderate	High	Moderate	High	High	High	Remote
Exhibition (2-week period with a total of 4 weeks of high use)	Frequency	Up to one-third less than Alternative 1a	Up to one-third less than Alternative 1a	Up to one-third less than Alternative 1a	Up to one-third less than Alternative 1a	Up to one-third less than Alternative 1a	Up to one-third less than Alternative 1a	Up to one-third less than Alternative 1a	Up to one-third less than Alternative 1a	Up to one-third less than Alternative 1a	Up to one-third less than Alternative 1a
	Risk Category	Moderate	High	Low	Low	Moderate	Low	Moderate	Moderate	Remote	Remote
Removal (3 months)	Frequency	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a
	Risk Category	Moderate	High	Low	Low	Moderate	Moderate	Moderate	Moderate	Moderate	Remote

<sup>1</sup> Based on 2-month seasonal event (e.g., severe summer storms in July and August).

<sup>2</sup> Based on 3-month summer season.

<sup>3</sup> Based on 8-month season for possible winter storms.

<sup>4</sup> Based on annual probability.

<sup>5</sup> Based on data provided in baseline section of EIS.

<sup>6</sup> Based on data provided in Natural Hazard Risk Analysis and Pre-Disaster Mitigation Plan for the Upper Arkansas Area (FCESD 2003).

Note: Green highlighted areas indicate hazards that are less than Alternative 1a; yellow areas are hazards that are greater than Alternative 1a.

## 7.0 Alternative 4

Alternative 4 reduces the length of the Project display to 1.4 miles, compared to the 5.9 miles for Alternative 1a. This represents a 76 percent reduction in Project length. **Table 11** summarizes construction-related and public safety hazards associated with Alternative 4, while **Table 12** identifies natural hazards associated with Alternative 4. The quantification and impacts of each hazard is discussed in the sections below.

### 7.1 Construction-Related Hazards

Alternative 4 would be 76 percent shorter in length than Alternative 1a, with all other factors being consistent with Alternative 1a. As a result of the decrease in total construction length and labor hours, construction hazards associated with the Installation and Removal phases may be reduced by an estimated 50 to 76 percent.

### 7.2 Public Safety Hazards

Vandalism and criminal activity during Installation and Removal phases would be the same as Alternative 1a since both occur over the same period of time. In Alternative 4, the display would be shorter in length, which might reduce vandalism and criminal activity, though the frequency of vandalism and criminal activity would generally be correlated with the number of visitors rather than the length of the display.

Boating incidents would increase over the No Action levels due to misbehavior described previously. However, the reduction of the number of panels and the overall length of the display would decrease opportunities for behavior leading to accidents. Consequently, boating accidents may decrease by an estimated 75 percent relative to Alternative 1a.

### 7.3 Natural Hazards

Reducing the length of the displays may have little to no effect on natural hazard rates if visitors must still traverse the entire corridor to view the display. Nevertheless, public activities presumably would be more concentrated in the display areas, resulting in the potential reduction of up to an estimated 75 percent compared to Alternative 1a.

**Table 11. Construction-Related and Project-Related Public Safety Hazards for Alternative 4.**

		Construction Safety		Project-Specific Public Safety				
		OSHA-reportable Construction Injury <sup>1</sup>	Severe Construction Injury	Vandalism	Boating Accident <sup>2</sup>	Severe Boating Accident <sup>2</sup>	Traffic Problems	Criminal Actions
Frequency		4.5/year	2 years		15/year <sup>3</sup>	3/year <sup>3</sup>		
Installation (2 year duration)	Occurrence Probability (estimated number of events)	Approximately half to 75% less than Alternative 1a	Approximately half to 75% less than Alternative 1a Moderate to High	Approximately half of Alternative 1a	Approximately 80% less than Alternative 1a	Approximately 80% less than Alternative 1a	Approximately half of Alternative 1a	Approximately half of Alternative 1a
	Risk Category	High	High	Low	High	Moderate	Low	Low
Exhibition (2-week period with a total of 4 weeks of high use)	Occurrence Probability (estimated number of events)	NA	NA	Same as Alternative 1a	Approximately 80% less than Alternative 1a	Approximately 80% less than Alternative 1a	Same or less than Alternative 1a	Same or less than Alternative 1a
	Risk Category	NA	NA	Low	High	Moderate	Moderate	Moderate
Removal (3 months)	Occurrence Probability (estimated number of events)	Same as Alternative 1a	Same as Alternative 1a	Same as Alternative 1a	Approximately 80% less than Alternative 1a	Approximately 80% less than Alternative 1a	Same as Alternative 1a	Same as Alternative 1a
	Risk Category	High	Moderate	Low	High	Moderate	Moderate	Low

<sup>1</sup> Based on 2009 Bureau of Labor Statistics data.

<sup>2</sup> Based on data provided in baseline section of EIS.

<sup>3</sup> Boating incidents anticipated this baseline rate due to human misbehavior to low hanging panels and cables.

Note: Green highlighted areas indicate hazards that are less than Alternative 1a; yellow areas are hazards that are greater than Alternative 1a.

**Table 12. Natural Hazards Associated with Alternative 4.**

		Natural Hazards									
		Rockfall <sup>1</sup>	Lightning <sup>1</sup>	Tornado <sup>1</sup>	Severe Wind Gust <sup>1</sup>	Flash Floods <sup>1</sup>	Seasonal Flooding <sup>2</sup>	Wildfire <sup>1</sup>	Landslide <sup>1</sup>	Winter Storm ****	Earthquake > 5.5 Richter scale
		3 times/year <sup>5</sup>	5/year <sup>6</sup>	1/10 years <sup>6</sup>	1 in 10 years <sup>5</sup>	1 in 2 years <sup>6</sup>	4 in 10 years <sup>6</sup>	1 per year <sup>6</sup>	2 per year <sup>6</sup>	2/year*	2/100 years*
Frequency	Occurrence Probability (estimated number of events) Risk Category	Same as Alternative 1a High	Same as Alternative 1a High	Same as Alternative 1a Moderate	Same as Alternative 1a Moderate	Same as Alternative 1a High	Same as Alternative 1a Moderate	Same as Alternative 1a High	Same as Alternative 1a High	Up to three-quarters less than Alternative 1a High	Up to three-quarters less than Alternative 1a Remote
Installation (1 year duration)	Occurrence Probability (estimated number of events) Risk Category	Up to three-quarters less than Alternative 1a Moderate	Up to three-quarters less than Alternative 1a Moderate	Up to three-quarters less than Alternative 1a Low	Up to three-quarters less than Alternative 1a Remote	Up to three-quarters less than Alternative 1a Low	Up to three-quarters less than Alternative 1a Low	Up to three-quarters less than Alternative 1a Low	Up to three-quarters less than Alternative 1a Moderate	Up to three-quarters less than Alternative 1a Remote	Up to three-quarters less than Alternative 1a Remote
Exhibition (2-week period with a total of 4 weeks of high use)	Occurrence Probability (estimated number of events) Risk Category	Same as Alternative 1a Moderate	Same as Alternative 1a High	Same as Alternative 1a Low	Same as Alternative 1a Low	Same as Alternative 1a Moderate	Same as Alternative 1a Moderate	Same as Alternative 1a Moderate	Same as Alternative 1a Moderate	Same as Alternative 1a Moderate	Same as Alternative 1a Remote
Removal (3 months)	Occurrence Probability (estimated number of events) Risk Category	Same as Alternative 1a Moderate	Same as Alternative 1a High	Same as Alternative 1a Low	Same as Alternative 1a Low	Same as Alternative 1a Moderate	Same as Alternative 1a Moderate	Same as Alternative 1a Moderate	Same as Alternative 1a Moderate	Same as Alternative 1a Moderate	Same as Alternative 1a Remote

<sup>1</sup> Based on 2-month seasonal event (e.g., severe summer storms in July and August).

<sup>2</sup> Based on 3-month summer season.

<sup>3</sup> Based on 8-month season for possible winter storms.

<sup>4</sup> Based on annual probability.

<sup>5</sup> Based on data provided in baseline section of EIS.

<sup>6</sup> Based on data provided in Natural Hazard Risk Analysis and Pre-Disaster Mitigation Plan for the Upper Arkansas Area (FCESD 2003)

Note: Green highlighted areas indicate hazards that are less than Alternative 1a; yellow areas are hazards that are greater than Alternative 1a.

## 8.0 Conclusions

Based on the available information, this hazard analysis indicates that the magnitude of risk associated with the Project is primarily a function of 1) duration of construction, 2) duration of exhibition, 3) timing of exhibition period, 4) length of the project along the river, and 4) boating activity levels. These factors affect the number of people exposed to manmade and natural hazards, thus increasing or decreasing risk.

### References:

Bureau of Labor Statistics. 2009. Highest incidence rates of total nonfatal occupational injury and illness cases, 2009. <http://www.bls.gov/iif/oshwc/osh/os/ostb2423.pdf>. Accessed November 29, 2010.

Bureau of Labor Statistics. 2009. Highest incidence rates of nonfatal occupational injury and illness cases with days away from work, restricted work activity, or job transfer, 2009. <http://www.bls.gov/iif/oshwc/osh/os/ostb2424.pdf>. Accessed November 29, 2010.

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