

Appendix A
Aspinall Hydrology Report

ASPINALL EIS HYDROLOGIC REPORT

Introduction

Riverware was the simulation software selected by Reclamation for use in the development of a hydrology model to be used to evaluate alternatives. The model was originally developed by Reclamation in support of assessing the effects of the Black Canyon Water Right on the Aspinall Unit. It has been significantly improved and serves as a tool to analyze effects of the proposed alternatives. This model was developed solely for this purpose and Reclamation does not expect the model to be used as an operations model.

Modeling Scope

For this EIS, three basic model configurations were developed to simulate future conditions: the No Action Alternative; Risk of Spill Alternative; and the Peak Release Alternative. The Risk of Spill and Peak Release Alternatives were modified to include base flows and duration flows to evaluate their ability to better meet the Flow Recommendations. This appendix details the analysis process for determining impacts to hydrology from operation of the No Action Alternative, Alternative A (Risk of Spill), Alternative B (Fish Peaks with Minimum Duration), Alternative C (Fish Peaks with Extended Duration) and Alternative D (Fish Peaks – Fixed Targets). The results of this modeling effort are also presented.

In order to properly evaluate the effects of different reservoir operation scenarios, a hydrologic model was developed using the Riverware modeling program to simulate the operations of the Aspinall Unit under varying hydrologic conditions. The Gunnison River model was developed for the purpose of characterizing the hydrologic effects on the Aspinall Unit and the Gunnison River below the Aspinall Unit caused by the implementation of the proposed alternatives for the Aspinall Unit EIS. Four alternatives have been proposed for the Aspinall Unit EIS. The Action Alternatives modify operations of the three Aspinall Unit reservoirs with the goal of achieving the flow recommendations described in the *Flow Recommendations to Benefit Endangered Fishes in the Colorado and Gunnison Rivers* (2003 Flow Recommendations). The No Action Alternative continues current operations of the Aspinall Unit with occasional attempts to generate a spring peak based on reservoir inflow that is surplus to the volume needed to fill the reservoir and optimize hydropower production. Attempts to “bundle” this surplus water into a spring peak have been occurring since 1992. For each of the action alternatives, rules to operate the Aspinall Unit to achieve the flow targets described in the 2003 Flow Recommendations were developed. Rule sets were modified in each alternative with the goal of minimizing impacts to authorized purposes while still achieving the targets described in the Flow Recommendations. The purpose of this report is to summarize the hydrologic effects observed in the model output as a result of attempting to meet the Flow Recommendation targets for each of the alternatives. The results in this report focus on the model output from the Aspinall Unit and the Gunnison River below the Aspinall Unit.

Modeling Approach

Riverware

Riverware is a generic hydrologic modeling tool using an object-oriented design and a graphical user interface (GUI) to allow users to develop data-driven and variable time-step models for both planning and operational uses. Because of its flexible and extensible design, it can be readily customized to fit specialized modeling needs for any river system. One of the features of Riverware is its ability to solve a river basin network (developed by the user with the graphical user interface) with different controllers or solution techniques. Currently, there are four different controllers: simulation, rule-based simulation, water ownership, and optimization. Riverware has been in development since 1993 and is the result of a continuing collaborative effort between the Center for Advanced Decision Support for Water and Environmental Systems at the University of Colorado, Reclamation, and the Tennessee Valley Authority (TVA).

A model of a river system network is constructed by placing objects from a palette onto a work space using the GUI. Objects in Riverware represent the features of a river basin. The objects supported by Riverware are storage reservoirs, power reservoirs, pumped storage reservoirs, river reaches, aggregate river reaches, confluences, aggregate diversions for municipal and industrial (M&I) and agricultural demands, canals, groundwater, and data objects. Each object has many slots. Slots are essentially place holders for information associated with that object. For example, a storage reservoir has slots such as inflow, outflow, storage, evaporation, elevation, and volume tables. The slots visible depend on the methods the user selects. Almost all of the objects have several different methods available, thus allowing the user to easily customize the physical behavior of an object. For example, to change how a reservoir computes its evaporation, the user simply selects an appropriate evaporation method from the list of methods on the reservoir object. Riverware adds the appropriate slots to the object and the user provides the necessary data. The selected method and data control how the reservoir will compute its evaporation. After the objects are put into the work space and the appropriate methods are selected, they can be linked together so information from one object is propagated to another. For example, the outflow of a reservoir could be linked to the inflow of a downstream river reach. By selecting appropriate objects, methods, and linking the objects together, a river basin network is formed.

After the river basin network is complete, the user can take advantage of many features and utilities that make it easy to input, output, view, manipulate, and analyze data in a model. These utilities include the Simulation Control Table, Data Management Interfaces, plotting, snapshot, expression slots on data objects, and the ability to write binary Microsoft Excel spreadsheet files. Simulation Control Tables allow the user to customize views of information in the model and also to run the model and view the updated model run results. Data Management Interfaces provide a way to transport data between a model and external data sources, such as a database or an ASCII file. With the plotting utilities, virtually any information in the model can be easily plotted for analysis and report generation. The snapshot utility provides the user a way to save information from a model run so it can be used to compare with subsequent model runs. Expression

slots on data objects provide a powerful way to algebraically manipulate data within the model. Additionally, Riverware has a robust diagnostics utility for checking for and helping to pinpoint problems.

Current Riverware applications where the models are operational include the following applications: (1) long-term policy planning model on the Colorado River (rules model with monthly time-step), (2) midterm planning and operations model on Colorado River (24-month simulation model with monthly time-step), (3) daily operational model for Hoover Dam (BOPS, simulation model), (4) operational model for the TVA (TVA, optimization model with 6-hour time-step), (5) Upalco Planning Model (rules model with daily time-step), (6) San Juan River Model for the San Juan basin (rules model with monthly and pseudo daily time-step) and (7) Gunnison River Basin Model (rules model with daily time-step). Riverware models currently under development include the following: (1) Upper Rio Grande Water Operation Basin Model (accounting and rules model with daily time-step), and (2) Yakima River Basin Models (rules model with both monthly and daily time-steps)

Riverware Model of Gunnison River

Hydrologic simulation models, such as Riverware, are essentially mass balance models operating within a rule-based framework to simulate hydrologic interactions between water sources and their uses. Maintaining a water balance assures that the sum of inflows less the sum of outflows equals the change of storage within the basin. **Water inflows** consist of historic stream flows. **Outflows** consist of water flowing across the downstream basin boundary (Gunnison River at the confluence with the Colorado River at Grand Junction), diversions (Gunnison Tunnel and Redlands Canal), and consumptive use (crops, M&I, natural vegetation, free water surface evaporation, etc.). **Water storage** consists of the water within basin reservoirs. In the Gunnison River model only unnatural (man-induced) hydrologic effects are explicitly modeled.

The current Gunnison River model was developed through modification of a model originally created to support the assessment of the effects of the Black Canyon Water Right on the Aspinall Unit. To evaluate how well each run of the modeled alternatives achieved the flow objectives described in the Flow Recommendations, the Gunnison River model produces output at a daily time step. From this daily output, numerous parameters can be evaluated including reservoir content, water volumes through the powerplants, days of powerplant bypasses and spills, peak flows at various points in the river as well as days above a target flow threshold.

The Gunnison River model simulates historic hydrology from 1975 to 2005. This period of record was selected as the most complete historical dataset at the time model analysis began and it is adequately representative of the past hydrological conditions of the basin containing both the driest and wettest periods for which data is available. Statistical analysis conducted by Reclamation (Cutler and Harpman 2005) compared 1906-2005, 1937-1997, and 1975-2005 periods of record and concluded that there is “no basis for presuming the 3 periods of record are statistically different”. In addition, selection of a period of record containing years prior to 1975 would require significant data synthesis as

daily records are incomplete in these earlier years. The initial conditions of the Gunnison River model were selected to be the state of the Aspinall Unit and Gunnison River system at the start of January of 1975. The Gunnison River model runs for the 31 year period between 1975 and 2005. The model runs a single trace of 31 years during this time period. This is adequate for this analysis because the ratio of average annual inflow to live storage for Blue Mesa Reservoir is so large. Flaming Gorge and Glen Canyon's EIS's both used iterative trace methods of analysis, however their ratio of inflow to live storage is in the 40% range. Blue Mesa's ratio of average inflow to active storage is nearly 100% which means an average year's runoff into Blue Mesa is about equal to the reservoir's active storage capacity. Consequently, if managed properly, the reservoir can easily "re-set" itself in a "less-than-average" year. This model was developed and used as a comparative tool to determine the relative performance of the alternatives, not to establish absolute operational flow rates or targets. In addition, it will not be used as an operation model in the future.

The Gunnison River model routes historic flows (as measured and recorded in the historical record), that enter the river system as inflows to Blue Mesa Reservoir, side inflows to Morrow Point and Crystal Reservoir, and flows in the Uncompahgre River as measured at the Uncompahgre River at Delta river gage. Tributary flows between Crystal Reservoir and Delta and between Delta and Whitewater are developed from computed historical gains and losses between the river gages at these points. Historical diversions to the Gunnison Tunnel and modeled diversions to the Redlands Canal are used for the diversion points in the model. Using historical data eliminates the need to model natural hydrologic processes such as rainfall/runoff. Thus, precipitation falling on natural vegetation, consumptive use by natural vegetation, runoff of excess precipitation, evaporation from the free water surfaces of rivers, etc. is assumed to be reflected in the inflows. Therefore reach gains and losses are not modeled. Likewise, it is assumed that precipitation runoff from man-affected areas (agricultural lands, cities, etc.) is not significantly different from natural conditions to warrant explicit modeling treatment.

Outflows from the model consist of the routed flow of the Gunnison River at the confluence with the Colorado River, depletions including consumptive irrigation (irrigated crop evapotranspiration less effective precipitation), M&I use, and net (in excess of natural) evaporation from manmade reservoirs. The change in storage is reflected in the difference between beginning and ending reservoir content. The effects of soil water storage for irrigated lands are incorporated into the historical streamflow and stream reach gains and losses are not explicitly modeled.

All major elements of the Gunnison River system from the Aspinall Unit to the reach of the Gunnison River below the Redlands Diversion Dam are represented in the Gunnison River model. In the model, the Gunnison River below the Aspinall Unit is divided into five sections, known as reaches. The first reach, labeled CrystaltoGunnisonTunnel, extends from Crystal Reservoir to the start of the Black Canyon at the river gage downstream of the Gunnison Tunnel. This reach accounts for releases from Crystal Reservoir and diversions to the Gunnison Tunnel and calculates flows in the Black Canyon. The second reach extends from the start of the Black Canyon down to the river gage in the town of Delta. This reach incorporates tributary flows from the Smith Fork

and the North Fork of the Gunnison River as well as all other measurable tributary flows between Crystal Dam and the river gage in Delta. The third reach extends from Delta to the river gage near the town of Whitewater. This reach incorporates flows from the Uncompahgre River as well as tributary flows from other smaller streams entering the mainstem of the Gunnison River between Delta and Whitewater. The fourth reach extends from the Whitewater gage to the Redlands Diversion Dam. The fifth and final reach extends from the Redlands Diversion Dam to the river gage below the Redlands Diversion Dam. This reach accounts for diversions from the Gunnison River to the Redlands Canal.

The model separates annual reservoir operations into 3 time periods: January-March, April-July, and August-December. Basic daily input data to the model are: historic Blue Mesa Reservoir inflows, both actual and unregulated; historic side inflows to Morrow Point and Crystal; Gunnison Tunnel diversions; and various downstream gains computed from actual gage data. Other data provided as input to the model include forecasted inflow and tunnel demands for each forecast period.

Reservoir inflow forecast data and forecasted tunnel demands are for the current forecast period and are generally set on the first day of the month and also on the fifteenth if available. Forecast data for the last month of the forecast period must generally be adjusted (sometimes weekly) to reflect the improved accuracy which occurs at the end of the forecast period. The model determines remaining forecasted inflow and demand by subtracting the inflows or demands to date from the most recent forecast data available. Remaining minimum canyon demands, which include trout spawning and incubation flows, are computed at various times in the model since these demands are dependent upon flows that occur during the model run.

Based on forecasted inflows, forecasted demands (Gunnison Tunnel and Black Canyon requirements), and storage or release of storage, a volume of water that should be released before the end of the forecast period is determined. This volume is generally referred to as the operation volume. Operation volume is converted to a daily flow rate (cfs) and added to the required downstream releases to compute the desired total release. Actual releases equal this desired release unless policy or physical constraints are triggered. Required downstream releases include tunnel diversion and canyon requirements. Canyon requirements include a minimum flow of 300 cfs and the flow needed to minimize impacts to the spawning and incubation of brown and rainbow trout.

The following is a general description of how the model works:

Weekly Determination

Forecasted inflows, estimated demands and target contents are used to determine preliminary operational releases. On the 1st, 8th, 15th, and 22nd of each month the model makes an estimate of operational volume to release between the current date and the end of forecast period. The operational volume can be defined as the water in excess of estimated demands (filling Blue Mesa Reservoir and identified releases).

The operational release volume is changed to a flow rate based on the remaining days in the forecast period. This operational release rate remains constant until the next estimate is made. The model may modify the operational release under the following circumstances:

- Factors are applied in January, April, October, & November to increase power in January and reduce flows during trout spawn periods.
- Operational releases June 15 to July 31 may be increased at the expense of Blue Mesa Reservoir storage if it is anticipated that higher operation releases will be needed from August through December to reach the December 31 elevation target.
- Operational releases in August through October, which would result in bypass of Crystal Powerplant, could be reduced if it is determined this water could be run through the powerplant in November and December.

Daily Determination

Aspinall target release is then set equal to Gunnison Tunnel plus Operational Release plus minimum Black Canyon Flow (300 cfs, or minimum trout target hydrograph) and adjusted if necessary.

Aspinall target release may be modified under the following conditions:

- Bypasses of inflow (Blue Mesa Reservoir is not allowed to store when it is anticipated that storing water would result in less than 750 cfs at the Redlands Diversion Dam).
- Release may be increased if current operations anticipate Blue Mesa Reservoir content to exceed 820,000 af within 7 days.
- Release may increase if current rate of fill indicates Blue Mesa Reservoir will reach elevation of 7518 ft or greater within 20 days.
- Release will increase if Blue Mesa Reservoir has encroached on required flood control storage according to Flood Control Diagram. Normal ramping rates may be exceeded in these instances.
- Decrease release based on Gunnison River at Delta flows exceeding 14,000 cfs.
- January through March: Crystal releases are limited to the amount which can be utilized in the powerplant.

Constraints which may be applied to the computed release include ramping rates in the Black Canyon, flood control decisions both at Blue Mesa Reservoir and Delta, and power plant limitations.

At Blue Mesa Reservoir, the daily release is set to be “Canyon Requirement + Gunnison Tunnel Demand - Side Inflow to Crystal and Morrow Point + Crystal Operation Release”. Blue Mesa Reservoir daily release may be reset by other constraints:

1. If the desired Blue Mesa Reservoir release results in Blue Mesa Reservoir exceeding its maximum content, release is increased.
2. Blue Mesa Reservoir release is reduced if flow at Delta exceeded 14,000 cfs on the previous day.
3. Blue Mesa Reservoir release adjusted if ramping rates (either up or down) in the canyon are exceeded.
4. Blue Mesa Reservoir release is increased if the minimum brown or rainbow trout spawning or incubation flow, or the minimum canyon flow of 300 cfs is not met. (Can occur due to tunnel diversion changing.)
5. During Jan-Mar release are limited so that all releases at Crystal go through the powerplant.
6. Blue Mesa Reservoir release will be increased, subject to downstream ramping criteria, if with the current rate of fill, Blue Mesa Reservoir would have less than 2 ft of storage space remaining at the end of 7 days. Release is the minimum of 6,000 cfs or the release which would result in having 2 feet of storage space remaining.
7. If high fall releases are anticipated based on average hydrologic conditions, June and July flows may be increased. This provides for additional power generation and more stable canyon flows.

In general, Crystal Reservoir release is equal to the Blue Mesa Reservoir release plus side inflows occurring between Blue Mesa and Crystal reservoirs.

Operation of the Aspinall Unit to maximize peak flows at Whitewater also requires forecasting the time of peak runoff for the North Fork of the Gunnison River, in an attempt to allow releases from Crystal Reservoir to match the North Fork's peak. The required timing of the peak release from Crystal Reservoir was adjusted to closely approximate the timing of the North Fork peak during the last half of May, with the assumption that this level of accuracy in predicting the peak could be reproduced in future operations.

Current depletions are already incorporated by using the historical inflow dataset. Reasonably foreseeable depletions have also been included in all model alternatives. These depletion volumes were developed with the help of the State of Colorado and the Colorado River Water Conservation District. Depletions in the model total about 450,000-537,000 acre-feet per year from the Gunnison River at the Whitewater Gage.

The No Action and action alternatives include full Dallas Creek (17,200 af) Project depletions. Historic depletions are depicted in the gage records which the model is based upon. Future depletions are modeled by assuming the applicable projects' full depletion amount is used each year of the 1975-2005 study period and spread over each year of the study period using a monthly variable distribution.

Also included are all depletions that could occur without further federal action (primarily exercise of state water rights not presently being used as identified by the State of Colorado), and all depletions for which favorable biological opinions did not depend on implementing the action. Depletions used for the alternatives appear in Table 1.

Table 1. Estimated depletions consulted on as part of the biological assessment.

<u>Project</u>	<u>Estimated average annual depletion (af)</u>
Aspinall Unit	10,000
Uncompahgre Project	155,000
Dallas Creek Project	17,200
Paonia Project	10,000
Smith Fork Project	6,000
Bostwick Park Project	4,000
Fruitgrowers Project	4,100
State, local, and private water uses	300,800
	(general estimate)
Dolores Project	99,200*
Future Water uses	3,500
Upper Gunnison Subordination	30,800
Total for Gunnison Basin (excludes Redlands)	541,400

*The Dolores Project consultation addressed a 131,000 af depletion. Updated information indicates actual depletions are approximately 99,200 af.

The model in its present configuration represents the best science available to assess the impacts of implementing operation alternatives on various resources associated with the Gunnison Basin.

Modeling Assumptions

Because of the limitations of the modeling environment, many assumptions were made in the development of the Gunnison River model and the Alternative rule sets. It is recognized that under actual operations, there may be opportunities to match peaks outside of the model parameters. The assumptions that are specific to this model are described below:

1. It is assumed that the timing of the peak flow of the North Fork of the Gunnison River can be predicted accurately five days prior to its occurrence. The peak of the North Fork is known (within the May 15 to May 31 window as stated in the Flow Recommendations) and ramping up at Crystal Reservoir to coincide with this peak occurs five days prior to the peak date. In order to meet the spring peak flow targets while minimizing impacts to other authorized purposes of the Aspinall Unit, it is desired to time spring peak releases from Crystal Reservoir with the spring peak of the North Fork of the Gunnison River. While the date of the North Fork peak is known exactly in the model, releases at Crystal still may not be timed exactly with the peak due to ramping rate constraints that may require a period of greater than five days to reach the needed release at Crystal to meet the spring peak flow target at the Whitewater gage.

2. It is assumed that decisions regarding the operation of the Aspinall Unit to target a spring peak and possibly duration days above a target threshold will be made as of the release of the May 1 forecast from the CBRFC. While the spring peak target is set by the May 1 forecast, if the forecast were to change significantly at a later time, the duration day targets could be modified for that year.

3. It is assumed that the historic hydrology of the Gunnison River Basin (from 1975 to 2005) will be representative of future hydrology. In reality this could be considered unlikely and possibly misleading if the impacts of global climate change significantly alter the hydrology of the Gunnison Basin. Therefore, the analysis of how well these different operations meet the flow recommendations assumes that historic hydrologic conditions will be repeated in the future. If this assumption is not correct, Flow Recommendations may be more difficult or less difficult to meet.

Variables Inherent in the Operation of Aspinall Unit

A number of variables common to the action alternatives may affect the ability to maintain any prescribed pattern of releases from the Aspinall Unit. They include the following:

Inflow forecasts: Reservoir inflow forecasts are provided bi-weekly from January through the end of the runoff season. However these forecasting techniques may not accurately predict the volume of available spring runoff. Forecasted runoff volumes can change by large amounts with each new forecast leading to wide fluctuations in the anticipated reservoir water availability. Often times operational decisions are made based on a forecasted runoff volume that may change drastically later on in the runoff period. Figure 1 shows the historical inflow forecasts for Blue Mesa Reservoir and how the forecasts change throughout the year as well as the differences from the actual inflow volumes for that runoff year. These forecast volumes are categorized based on the hydrologic categories described in the Flow Recommendations. Regardless of these fluctuations, each alternative would pass inflows required for downstream senior direct flow water rights in accordance with Colorado State water law.

Fluctuations in North Fork of the Gunnison River contributions: Flow contributions from the North Fork of the Gunnison River have a significant effect on the ability of the Action Alternative to meet recommended flow targets. The North Fork, like any unregulated river, experiences a wide range of flows due to snowmelt and rain events. Limited snowpack information in this subbasin along with the relatively short travel times to the confluence with the mainstem Gunnison River, create difficulties in predicting the timing of runoff on the North Fork. Matching Aspinall Unit releases with North Fork flows, given the uncertainties in the timing and magnitude of the peak runoff as well as the other issues listed below, complicate Reclamation's ability to achieve the targeted flows set in the Action Alternative.

Unanticipated precipitation events: Extreme runoff events that occur on any tributaries that enter the Gunnison River downstream from Morrow Point Reservoir can affect Reclamation's ability to achieve the flow targets of the Action Alternative. Longer duration events may cause adjustments in the release from the Aspinall Unit. Also, unanticipated high inflows into the Unit could require additional releases to avoid the occurrence of an uncontrolled spill. Reclamation will continue to closely monitor weather conditions during high flow or high release periods in an attempt to avoid releases that would increase the potential for flooding.

Dry 0 D
 Mod Dry 381 MD
 Avg Dry 561 AD
 Avg Wet 709 AW
 Mod Wet 871 MW
 Wet 1123 W

Blue Mesa April thru July unregulated inflow (1000 AC-FT)

YEAR	(1000 AC-FT)													Actual	Gunnison R Whitewater
	JAN	FEB	MAR	APR	mid april	MAY	mid may	JUN	mid june	JUL	July 8	mid july	July 22		
1965		1020 MW	970 MW	1100 MW	1100 MW	1100 MW	1100 MW	1100 MW		1060 MW				1095 MW	
1966		470 MD	680 AD	450 MD	385 MD	320 D	350 D	380 D		485 MD				484 MD	
1967		890 MW	860 AW	540 MD	495 MD	450 MD	450 MD	450 MD		460 MD				444 MD	
1968		730 AW	715 AW	560 MD	580 AD	600 AD	645 AD	690 AD		665 AD				637 AD	
1969		860 AW	840 AW	880 MW	808 AW	735 AW	693 AD	650 AD		710 AW				733 AW	
1970		900 MW	870 AW	740 AW	780 AW	820 AW	820 AW	850 AW		955 MW				947 MW	
1971		730 AW	730 AW	550 MD	550 MD	550 MD	535 MD	520 MD		690 AD				690 AD	
1972	830 AW	775 AW	650 AD	570 AD	570 AD	570 AD	535 MD	500 MD		505 MD				484 MD	
1973	910 MW	940 MW	780 AW	780 AW	815 AW	850 AW	815 AW	780 AW		770 AW				779 AW	
1974	700 AD	900 MW	800 AW	700 AD	700 AD	730 AW	665 AD	600 AD		555 MD				552 MD	
1975	750 AW	780 AW	820 AW	980 MW	980 MW	1000 MW	960 MW	920 MW	850 AW	810 AW	830 AW	846 AW	846 AW	850 AW	AW
1976	670 AD	550 MD	640 AD	610 AD	610 AD	580 AD	580 AD	580 AD	580 AD	480 MD	480 MD	478 MD	478 MD	478 MD	MD
1977	470 MD	300 D	250 D	240 D	240 D	240 D	220 D	200 D	200 D	160 D	160 D	166 D	166 D	167 D	D
1978	800 AW	950 MW	835 AW	1000 MW	950 MW	900 MW	900 MW	940 MW	930 MW	830 AW	820 AW	813 AW	813 AW	811 AW	AW
1979	840 AW	1200 W	1100 MW	1150 W	1100 MW	1050 MW	1050 MW	1000 MW	1000 MW	935 MW	930 MW	934 MW	934 MW	934 MW	MW
1980	650 AD	965 MW	900 MW	1050 MW	1050 MW	1100 MW	1100 MW	1050 MW	1050 MW	995 MW	980 MW	959 MW	959 MW	955 MW	MW
1981	550 MD	420 MD	306 D	350 D	315 D	280 D	328 D	375 D	375 D	270 D	270 D	280 D	280 D	281 D	D
1982	810 AW	862 AW	840 AW	870 AW	870 AW	856 AW	856 AW	830 AW	815 AW	735 AW	740 AW	740 AW	740 AW	740 AW	AW
1983	640 AD	560 MD	500 MD	640 AD	665 AD	690 AD	715 AW	740 AW	740 AW	885 MW	890 MW	891 MW	891 MW	892 MW	W
1984	1300 W	1170 W	1100 MW	1130 W	1203 W	1275 W	1313 W	1350 W	1350 W	1435 W	1430 W	1433 W	1433 W	1433 W	W
1985	970 MW	950 MW	855 AW	850 AW	888 MW	925 MW	925 MW	950 MW	950 MW	1065 MW	1060 MW	1043 MW	1043 MW	1041 MW	W
1986	950 MW	810 AW	930 MW	880 MW	940 MW	1000 MW	1000 MW	950 MW	950 MW	1025 MW	1030 MW	1033 MW	1033 MW	1034 MW	MW
1987	765 AW	765 AW	700 AD	675 AD	675 AD	675 AD	675 AD	675 AD	750 AW	810 AW	800 AW	790 AW	790 AW	788 AW	MW
1988	650 AD	700 AD	650 AD	570 AD	545 MD	520 MD	440 MD	360 D	360 D	395 MD	390 MD	391 MD	391 MD	391 MD	MD
1989	670 AD	625 AD	680 AD	590 AD	519 MD	448 MD	448 MD	429 MD	429 MD	440 MD	440 MD	443 MD	443 MD	443 MD	MD
1990	450 MD	500 MD	450 MD	450 MD	433 MD	415 MD	370 D	324 D	330 D	385 MD	380 D	382 MD	382 MD	382 MD	MD
1991	600 AD	525 MD	475 MD	550 MD	575 AD	600 AD	573 AD	545 MD	545 MD	605 AD	600 AD	601 AD	601 AD	600 AD	AD
1992	625 AD	590 AD	540 MD	600 AD	570 AD	540 MD	520 MD	500 MD	500 MD	450 MD	460 MD	464 MD	464 MD	465 MD	AD
1993	605 AD	680 AD	920 MW	950 MW	985 MW	1020 MW	1020 MW	1020 MW	1020 MW	1010 MW	1000 MW	989 MW	989 MW	987 MW	W
1994	580 AD	525 MD	550 MD	510 MD	535 MD	560 MD	560 MD	580 AD	580 AD	530 MD	520 MD	514 MD	514 MD	512 MD	MD
1995	630 AD	650 AD	740 AW	850 AW	850 AW	950 MW	1020 MW	1100 MW	1100 MW	1310 W	1310 W	1300 W	1249 W	1242 W	W
1996	560 MD	860 AW	900 MW	870 AW	870 AW	900 MW	850 AW	820 AW	820 AW	840 AW	840 AW	830 AW	831 AW	830 AW	AD
1997	1050 MW	1100 MW	1050 MW	900 MW	950 MW	1000 MW	1000 MW	1000 MW	1050 MW	1045 MW	1050 MW	1035 MW	1060 MW	1062 MW	MW
1998	660 AD	660 AD	630 AD	600 AD	650 AD	690 AD	600 AD	600 AD	600 AD	520 MD	550 MD	560 MD	565 AD	565 AD	AD
1999	500 MD	595 AD	520 MD	460 MD	460 MD	600 AD	600 AD	540 MD	600 AD	650 AD	660 AD	656 AD	673 AD	676 AD	AD
2000	475 MD	450 MD	550 MD	630 AD	630 AD	550 MD	550 MD	565 AD	565 AD	505 MD	500 MD	505 MD	504 MD	504 MD	MD
2001	630 AD	550 MD	550 MD	550 MD	560 MD	530 MD	530 MD	485 MD	510 MD	495 MD	500 MD	505 MD	504 MD	505 MD	MD
2002	500 MD	445 MD	410 MD	310 D	270 D	205 D	190 D	180 D	175 D	163 D	160 D	158 D	157 D	156 D	D
2003	575 AD	485 MD	520 MD	510 MD	500 MD	485 MD	450 MD	450 MD	450 MD	440 MD	420 MD	432 MD	432 MD	430 MD	MD
2004	680 AD	630 AD	620 AD	460 MD	460 MD	460 MD	425 MD	425 MD	415 MD	415 MD	420 MD	415 MD	421 MD	422 MD	MD
2005	720 AW	825 AW	805 AW	770 AW	770 AW	750 AW	735 AW	670 AD	640 AD	605 AD	600 AD	590 AD	590 AD	588 AD	AW

Figure 1. Historical April-July unregulated inflow forecasts for Blue Mesa Reservoir with hydrologic categories from the Flow Recommendations.

Travel time: An adjustment in water releases from the Aspinall Unit takes two to three days travel time to reach the Whitewater gage near Grand Junction. During this travel time, changes in tributary flows downstream of the Aspinall Unit can influence the ability to achieve the target flow at the Whitewater gage.

Gage errors: Gage errors are inherent with all measuring equipment, and changing river channel and flow conditions (i.e., sand deposits and erosion) compound gage errors.

Maintenance needs: Dam releases can be interrupted due to a variety of unforeseen events such as mechanical problems, repair of gates, downstream emergencies and other factors. In addition, regularly scheduled maintenance needs and inspections may impact Reclamation's ability to make specific releases.

Safety Concerns: The Black Canyon and Gunnison Gorge are home to Colorado's Premiere Gold Medal Brown Rainbow Trout fishery. Many anglers frequent the area at all times of year. In some areas the characteristically narrow and steep canyon walls cause flow changes to result in rapid changes in water elevation. Without advanced warning, wading fishermen can become stranded on an island or the opposite river bank.

Operational Uncertainties

Uncertainties are recognized in both the EIS alternatives for the Aspinall Unit re-operation and in the overall recovery plan for the endangered fish. Responses of the endangered fish to the Flow Recommendations and other recovery elements have been predicted based on scientific studies of the fish and their habitats, but only actual scientific monitoring conducted through the Recovery Program will determine the status and trends of the endangered fish and their habitats following implementation of the Preferred Alternative and other recovery activities. Also, it is uncertain to what extent non-native fish will benefit from the recommended flows and whether these benefits will offset the positive effects of the modified hydrology on endangered fish. The Recovery Program, which includes Federal, State, Tribal, and water development interests, would be responsible for conducting monitoring and research, and for communicating results of this work to stakeholders and the public during Aspinall Unit operation meetings. The Recovery Program can also recommend recovery actions that would address all of the recovery factors related to the endangered fish. These actions may include experimentation to test new hypotheses, modifications to the Preferred Alternative, or control actions directed against non-native fish, if warranted by monitoring and research results. Any adjustments in, or modifications to, the Flow Recommendations must be approved by the Coordination Committee, which is the governing committee of the Recovery Program. Recommendations for dam release modifications can then be considered by Reclamation, the agency ultimately responsible for unit operations. Thrice-yearly Aspinall Unit operation meetings will provide a forum for all interested parties to discuss Aspinall Unit operations and recovery program progress and recommendations. Representatives of the Recovery Program and other scientists will be invited to each meeting to discuss the effects of dam operations and other resource management actions on the endangered fish. Flexibility in dam releases, discussed later in this appendix, will

also be discussed at these meetings. Future changes in the Preferred Alternative, dam operations and other management policies could be implemented long-term after compliance with applicable law.

Black Canyon of the Gunnison National Park Water Right

On December 31, 2008, the Colorado Water Court issued a decree quantifying the federal reserved water right for the Gunnison River through the Black Canyon NP (Black Canyon water right). The decree quantifies the March 2, 1933 water right as a year-round flow of no less than 300 cfs with variable peak and shoulder flows for each year, the magnitude of which are dependent upon that year's Gunnison River Basin hydrologic conditions. The negotiations for the Black Canyon water right were mentioned in the DEIS. Now that the decree is final and the right is in place, a discussion of the final decree is included in the narrative of Volume I and a copy of the decree is included in Appendix G of Volume II.

Pursuant to the Black Canyon NP Water Right is subordinated to all water rights with adjudicated priorities that are senior to the Aspinall Unit water rights. The Black Canyon NP Water Right is a downstream water right senior to the Aspinall Unit and Reclamation will meet the water right when it is exercised. As such, along with other senior water rights, it is a condition that is common to all alternatives. When the Secretary exercises the Black Canyon NP Water Right, Reclamation shall undertake operational actions consistent with the Black Canyon Decree and in accordance with applicable laws. If the Secretary places a water right call in the exercise of the Black Canyon NP Water Right, Reclamation shall also comply with valid administrative orders from the Colorado State Engineer or the Division Engineer related to the administration of the decree for the Aspinall Unit and the Black Canyon Decree, both of which are made applicable to Reclamation by section 8 of the Reclamation Act of 1902.

As discussed later, this appendix describes examples of operational actions for meeting ESA needs downstream and the decreed water right. The discussion of how the Black Canyon NP water right fits within the alternatives is to provide examples of the range of actions that may be necessary to satisfy the decree and how such actions are consistent with the historic range of operations for the Aspinall Unit.

Pursuant to its normal procedures, Reclamation, beginning in January, will monitor inflow forecasts for operation planning and throughout this process will keep the NPS, US Fish and Wildlife Service, State of Colorado, Western Area Power Administration and others apprised of current and projected operations necessary to meet all Aspinall Unit requirements and the Black Canyon water right peak flow. Coordination will occur throughout the January to May period and formal notification will be made to NPS on April 1 regarding project operations.

Operations for the Black Canyon water right will be consistent with the Aspinall Operation's PBO. The one day peak flow under the Black Canyon water right is based on the May 1 forecasted inflow into Blue Mesa Reservoir for the April through July

period and is determined by formulae in the decree. These peak flows are summarized below.

Spring Peak for Range of Forecasted Inflows.	
Blue Mesa Forecasted April-July Inflow (af)	One day peak flow in Black Canyon (cfs)
372,000 or less	1,019 or less
372,000-500,000	1,019 – 2,968
500,000-715,000	2,968 – 6,246
715,000-925,000	6,246 – 6,513
925,000-1,001,000	6,513 – 7,609
1,001,000 – 1,050,000	7,609 – 11,034
1,050,000 – 1,100,000	11,034 – 11,568
1,100,000 – 1,200,000	11,568 – 12,636
1,200,000 – 1,350,000	12,636 -14,238
1,350,000 – 1,500,000	14,238 – 15,840

In addition to the one day peak, the Black Canyon water right includes a year-round right of no less than 300 cfs and May 1 to July 25 shoulder flows of 300-1,000 cfs, based on forecasted inflow.

Alternatives have not been specifically modeled to include the right, but the right, as decreed, will be included in operational planning undertaken each year by Reclamation, as are other senior water rights on the river. Recommended flow regimes for endangered fish and the Black Canyon NP Water Right are generally compatible in that they both are based on hydrologic conditions and both provide for spring peak flows in the Gunnison River. With the Black Canyon NP Water Right assumed to be exercised and included in each of the alternatives, the incremental hydrological impacts of the action alternatives for the endangered fish flows are generally lessened in comparison to the impacts portrayed in the DEIS. Endangered fish flows are targeted further downstream in critical habitat and also call for a longer duration of the peaks while the Black Canyon NP Water Right calls for a one day peak. Thus, impacts from operating to meet endangered fish peak flows are not significantly altered by meeting the one day Black Canyon NP Water Right peak flow.

Subject to the decree, including the framework set forth in Section 2.3.1.1, of Volume I, Table 73 in this appendix depicts those year types, based on analysis of the historical record, when flows for meeting ESA needs downstream will also satisfy the Black Canyon NP Water Right. It further identifies those year types when further operational actions would be needed to meet both the recommended endangered fish flows and the Black Canyon NP Water Right. The accompanying discussion provides illustrations of the types of operational adjustments that Reclamation may take in such circumstances. The adjustments discussed are within the historical range of Aspinall Unit operations. Furthermore, each of the operational adjustments described also are consistent with the Gunnison Basin PBO. Thus, their implementation does not significantly change the impacts analyzed in this FEIS.

Analysis has been completed to include the reserved right. See Tables 73 – 78. This analysis more clearly allows a comparison of alternatives under a variety of future

conditions. It should be noted, however, that the peak streamflows under the reserved right are very similar to Alternatives B, C, and D; however, alternative operations for endangered fish extend the length or duration of peaks. When the reserved right is applied to the No Action or Alternative A, spring peak targets would be similar to those that would occur under the other alternatives.

Hydrologic Modeling Analysis

Introduction

This appendix details the analysis process for determining impacts to hydrology from operation of the No Action Alternative, and the Action Alternatives. The results of this modeling effort are also presented. Understanding the impact of the alternatives on the water resources of the Gunnison River basin requires modeling the complex relationships associated with multiple diversions and tributaries within the basin.

Riverware was selected primarily because of its flexible capability to simulate all key features within the Gunnison River Basin. Riverware has been used in the Gunnison River Basin since about 1998 in assessing the impact of the Black Canyon Water Right in the Gunnison River Basin. This model development has been completed by the U.S. Bureau of Reclamation (Reclamation).

Impact Analysis Results

The water supply impacts of operating the Aspinall Unit to meet the Flow Recommendations are most visible at Blue Mesa Reservoir. Storage contents at Morrow Point and Crystal Reservoirs do not change significantly between the alternatives as water surface elevations remain relatively constant during operation of the Aspinall Unit. Therefore only reservoir content at Blue Mesa was analyzed to determine water supply impacts from operating to meet the Flow Recommendation targets under the various criteria in each alternative.

The annual maximum content at Blue Mesa Reservoir is shown in Table 3. Annual maximum content is a good measure of impacts to water supply as it shows how filling Blue Mesa Reservoir can be compromised while trying to meet the Flow Recommendation targets. In almost all instances, the peak on the Gunnison River occurs before the reservoir fills so large releases of water to achieve the peak flow target will be reflected in reduced annual storage at Blue Mesa Reservoir. In the wettest of years, differences in maximum annual content from the No Action Alternative may not be that significant as runoff in the Gunnison Basin may far exceed the capacity of Blue Mesa Reservoir. However, in drier years, even with reduced peak flow targets, there can be substantial decreases in the volume of water stored in the reservoir.

Table 3: Maximum Annual Content at Blue Mesa Reservoir

Blue Mesa Max Annual Content (acre-ft)					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	791207	796903	764922	764922	764922
1976	740929	670190	646116	606406	646116
1977	545907	527592	518203	489706	518203
1978	724465	719626	586253	468923	586253
1979	777988	780358	634009	492607	634009
1980	781646	793830	783121	459032	783121
1981	558609	548739	550583	238615	550583
1982	744961	746838	710612	597144	710612
1983	829625	815217	816975	816579	816306
1984	829625	829625	829625	829625	829625
1985	829628	823088	807001	806149	806722
1986	813215	812178	802030	631365	802036
1987	815075	811088	809775	808092	809775
1988	700966	695537	673872	630057	695639
1989	741423	732362	701289	654522	741470
1990	640602	629735	615015	584606	635236
1991	800911	801608	790491	769085	789942
1992	774132	772438	740617	687412	772692
1993	814208	816860	815789	816001	822199
1994	786505	787163	756217	695660	786145
1995	825174	828276	827922	816873	828221
1996	788793	799006	737451	697778	737509
1997	816842	815213	813413	705622	813413
1998	731826	725361	737554	734748	737554
1999	810950	808166	784521	740467	796219
2000	756879	756394	667007	725673	757246
2001	785706	785706	728053	758013	785706
2002	569324	569128	573154	572231	569128
2003	542365	500171	485819	461014	505679
2004	667346	582263	539832	470883	587105
2005	711318	706386	709932	680083	704264
Average	743489	735066	708296	651932	720118

End of month contents at Blue Mesa Reservoir for the No Action Alternative and for Alternatives A, B, C and D are summarized in tables 4 through 8. At the bottom of each table the average end of month content is calculated along with the maximum and minimum end of month contents for the 31 year period of analysis.

Aspinall Unit Operations FEIS

Table 4: End of Month Contents at Blue Mesa Reservoir for No-Action Alternative

	Blue Mesa End of Month Content (ac-ft)											
	No Action											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1975	514685	519816	509464	409228	396325	650416	791149	739725	662208	614177	611726	587145
1976	586285	582351	583395	575570	661022	739654	683794	651171	604766	573260	574307	578343
1977	582369	585167	582365	546853	503815	471947	414877	361782	331143	314930	326227	333434
1978	340330	342332	353386	314492	374899	672120	713904	652233	598951	571687	580255	580467
1979	534136	448137	366498	331586	443765	711769	769996	714314	648787	605550	595261	581003
1980	583937	499655	449459	400306	480821	741916	759924	691519	646129	622736	608289	580425
1981	570041	570768	553460	523419	508438	549169	530007	490702	475310	460970	468738	484196
1982	487449	474212	492002	453386	489928	711075	736558	734713	724174	700392	649374	579792
1983	561707	545938	538161	507924	591263	827807	814270	800294	743377	681240	643005	582046
1984	490783	401758	330195	252257	681714	827762	812356	814326	772179	753695	682398	581093
1985	499355	444986	459616	524120	760935	820997	807247	752757	719480	696688	655076	579784
1986	509722	498615	446220	444707	540775	799937	806441	779417	749238	716830	672528	580075
1987	549193	534355	547420	595418	784319	813824	778353	727574	665172	615086	606912	580740
1988	580856	571770	582507	582860	622944	700966	639347	593103	568171	552251	568039	578145
1989	584359	581745	589095	633957	697648	733077	659320	616764	556457	536856	543941	550515
1990	555606	557872	557359	521242	541683	638952	602991	570670	546669	560255	579351	579528
1991	577053	579997	589594	615248	713655	799117	782484	731335	681820	628113	618143	579294
1992	574450	571609	573297	589926	696723	774132	739801	701695	651206	606617	598694	580246
1993	584363	576221	501860	439503	640033	813282	806028	760822	707268	658274	619775	580215
1994	566751	555368	549666	550873	697288	785228	712301	664082	631828	617593	604035	579825
1995	574751	581125	549605	482442	512735	819067	802527	804070	766519	716609	663081	580207
1996	556833	515040	443111	430929	621661	781892	762011	704324	657640	646528	628215	580508
1997	485696	399443	361514	400280	607747	815704	811848	796286	760819	723442	661616	580318
1998	563844	549819	537967	526221	601970	715157	716013	683354	632701	610038	606155	579783
1999	584377	583693	578252	559351	678299	803893	809042	803842	769843	710361	650851	580401
2000	556868	537684	512756	531203	702990	747438	681275	639832	606070	571578	581309	580393
2001	578616	583465	581590	584652	742021	784704	730443	708400	642201	598768	595429	580226
2002	578884	578612	580930	570651	541926	502155	438421	369525	334454	326146	333730	335657
2003	336007	336310	340882	327130	437650	540714	501534	455671	441298	418941	428312	433163
2004	436320	436940	465896	497292	604600	664930	618719	567351	528169	516557	526484	531962
2005	540018	514552	507653	479155	546360	702919	680537	654346	607341	592377	586776	580718
Avg	536311	518044	503582	490393	594386	724572	706888	668903	626819	597372	582840	554182
Max	586285	585167	589594	633957	784319	827807	814270	814326	772179	753695	682398	587145
Min	336007	336310	330195	252257	374899	471947	414877	361782	331143	314930	326227	333434

Table 5: End of Month Contents at Blue Mesa Reservoir for Alternative A

	Blue Mesa End of Month Content (ac-ft)											
	Alt A											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1975	498173	487156	479086	425899	438420	680660	796846	745416	666498	617209	613334	587144
1976	585609	582002	580304	572878	576046	670190	631902	600104	566237	546023	558094	563634
1977	567775	569839	565483	528528	485432	445486	379725	323646	291600	274290	285287	290795
1978	296273	294212	304590	286162	360011	666226	709066	648379	595963	555192	554041	554239
1979	517893	432505	350873	339792	446538	714320	772366	715151	649418	605995	595497	581003
1980	583325	498996	449459	439732	510948	763584	771358	690527	643328	611887	602194	580425
1981	569379	559826	542973	513533	498561	537046	515370	475521	460143	445811	453582	468811
1982	477854	469171	490294	462568	487653	713171	738434	736207	725300	701192	649798	579792
1983	561494	545547	537573	507414	586715	815170	813366	800239	743321	681197	642982	582046
1984	490783	401758	330195	252011	672117	829624	810247	812922	772264	753766	682436	581093
1985	499356	444986	459600	532329	749097	815384	806555	748065	715485	693864	653579	579784
1986	509656	498579	445587	466582	556351	804477	804228	777258	747269	715437	671787	580075
1987	549196	534357	547774	595816	781482	810781	774407	724427	662800	613409	606023	580740
1988	578771	570631	580005	581244	616817	695537	635242	582472	560113	546554	562525	573338
1989	581316	580147	589095	634006	687656	724019	650270	606068	548618	529021	536108	542683
1990	546744	546199	545403	509255	529707	627926	594762	553725	530475	544069	567337	574725
1991	574057	578245	589594	615248	720401	799936	783181	731891	682241	628411	618300	579294
1992	572379	562998	564600	583474	692709	772438	738109	700337	650183	605894	598310	580246
1993	579844	573722	499545	486693	711159	816789	804036	758832	705768	657214	619213	580215
1994	567029	555889	550456	551881	698355	785831	712904	664376	632049	617750	604118	579825
1995	574755	581127	546065	508584	549164	819920	789153	800002	762455	713503	662055	580207
1996	557643	515459	443192	465176	666493	796333	772217	712512	663810	605890	630528	580508
1997	485650	399418	361514	399818	591111	814744	811913	796176	760725	723376	661581	580318
1998	563862	549853	538017	526265	592170	708151	709552	678171	628795	607277	604691	579783
1999	584348	582677	578252	559630	610823	789972	803690	801866	768044	709091	650177	580401
2000	557204	538324	513721	532040	703695	746954	680791	637006	603940	570072	580510	580393
2001	578616	583465	581590	584652	742021	784704	730443	708400	642201	598768	595429	580226
2002	578884	578612	580753	570455	541656	492016	416039	346526	311480	303189	310781	311537
2003	308899	305907	309763	295228	395751	497029	431101	366392	352864	330564	339964	343693
2004	345398	343817	373009	404477	511873	581892	542888	479244	440593	429026	438974	444296
2005	452368	459156	469671	451159	537794	697575	675780	650530	604465	590345	585643	580718
Avg	525630	507245	493485	489759	588669	716706	696966	657174	615756	586138	572093	543935
Max	585609	583465	589594	634006	781482	829624	813366	812922	772264	753766	682436	587144
Min	296273	294212	304590	252011	360011	445486	379725	323646	291600	274290	285287	290795

Appendix A

Table 6: End of Month Contents at Blue Mesa Reservoir for Alternative B

	Blue Mesa End of Month Content (ac-ft)											
	Alt B											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1975	498173	487156	479086	425899	396341	599919	764863	713460	642415	600184	604307	587145
1976	585299	581842	581484	576063	550616	645860	615877	586084	555494	536619	548692	554233
1977	558375	560441	556089	519139	476051	436117	370371	314304	282269	264966	275967	281477
1978	286957	284900	295283	277626	280172	497037	581688	534120	491595	450345	449829	450116
1979	443321	358857	330501	321823	442468	576737	631152	584882	550130	529162	537466	544385
1980	551649	481484	449459	441787	493537	743532	760655	680011	634564	604136	597823	580425
1981	569219	559481	544029	515380	500407	538889	517211	477361	461981	447647	455419	470647
1982	478999	469773	490780	463005	467735	666501	702226	707358	703558	686435	642025	579792
1983	566377	554659	551365	519398	601261	814170	808018	796713	739798	678655	641634	582046
1984	490783	401758	330195	252256	681614	827004	810848	813036	772362	753849	682479	581093
1985	499356	444986	459582	532306	731296	804302	806285	747795	715255	693702	653493	579784
1986	509652	498577	445585	466586	540353	714661	801829	775287	745472	714166	671112	580076
1987	549200	534359	548097	596179	770705	809775	773689	723854	662368	613104	605861	580740
1988	578804	570648	580114	581366	592363	673872	620972	568480	547062	536507	552479	563294
1989	574433	576531	589095	634064	654411	694204	626752	584887	532345	512756	519846	526423
1990	530487	529945	529155	493018	513485	613770	584764	544007	520764	534361	557632	566448
1991	568588	574200	589594	615248	692000	787553	772074	723024	675787	623846	615881	579294
1992	573382	564152	567138	585968	659887	740617	706318	674833	630962	592306	591106	580246
1993	579984	573672	499499	486648	719102	815768	805918	760713	707186	658216	619744	580215
1994	566766	555396	549709	550928	637386	756023	682125	638427	612494	603925	596788	578925
1995	574432	580957	546065	509914	505757	817832	802466	803352	765802	716061	662787	580207
1996	556984	515118	443126	465110	569729	728820	710707	663167	626622	624600	616588	580509
1997	485924	399571	361514	402903	569558	809095	811476	796163	760713	723368	661577	580318
1998	563864	549857	538023	526270	608773	721365	721738	687947	636162	612485	607452	579783
1999	584403	582706	578252	559127	598276	744118	771617	780482	748579	695349	643020	580401
2000	560838	545247	524156	541097	635099	663460	617086	576946	549831	525818	540021	550932
2001	559001	567098	576104	580357	655912	727335	673129	662555	607651	573434	582479	580226
2002	578433	578355	582570	574482	545679	496034	420053	350534	315484	307190	314780	315535
2003	312897	309903	313756	299218	381385	482680	416772	352081	338568	316279	325683	329415
2004	331124	329547	358748	390227	469248	539503	500187	436586	397974	386434	396394	401725
2005	409806	416604	427139	419963	541400	701417	679151	653234	606503	591785	586446	580718
Avg	518629	501219	490816	487850	563936	683451	673162	635861	597992	571245	559897	535080
Max	585299	582706	589594	634064	770705	827004	811476	813036	772362	753849	682479	587145
Min	286957	284900	295283	252256	280172	436117	370371	314304	282269	264966	275967	281477

Table 7: End of Month Contents at Blue Mesa Reservoir for Alternative C

	Blue Mesa End of Month Content (ac-ft)											
	Alt C											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1975	498173	487156	479086	425899	396341	599919	764863	713460	642415	600184	604307	587145
1976	585299	581842	581484	576063	526619	604494	586858	556960	526935	508072	520151	525697
1977	529844	531915	527573	490641	447581	407683	341982	285955	253954	236674	247685	253203
1978	258690	256642	267043	251922	260767	423287	462661	415900	373482	332305	331826	332138
1979	325369	287668	308928	303759	430537	486839	348973	304036	271498	250704	259092	266072
1980	273571	274602	272228	278558	358195	452871	395464	311699	278136	249486	251310	252150
1981	253540	243641	230247	202772	188200	227138	205963	166542	151521	137420	145304	160611
1982	174213	182756	204040	231953	305312	460731	532528	566154	597144	611206	602138	579792
1983	575217	570457	583116	550787	626131	816579	812008	799932	743015	680963	642858	582046
1984	490783	401758	330195	252034	681521	829159	687815	591598	585344	618246	610590	581094
1985	498954	444775	480926	562644	758030	798847	805790	747301	714835	693404	653335	579784
1986	509645	498573	445581	466595	539990	580674	627972	617265	620722	626160	624590	580076
1987	548120	533792	569913	621502	762405	807983	772650	723025	661744	612662	605627	580740
1988	578736	570613	580109	581423	544162	629154	587768	535512	514118	503577	519557	530377
1989	541521	551745	587658	632765	625402	642997	589275	548230	498881	479308	486406	492990
1990	497059	496524	495747	459632	480132	583445	559364	517332	494110	507720	530997	539817
1991	544832	550070	568471	599978	680915	765364	750686	705947	663016	614820	611094	579294
1992	574628	565200	570928	589992	656736	687168	663074	640567	605138	574050	581427	578580
1993	577637	572439	498386	485536	716604	812946	768978	728689	683051	641154	610698	580215
1994	571224	563764	562403	567133	587247	695151	632589	591972	572748	574496	580520	579825
1995	574361	580920	546065	510227	500445	811717	781489	537623	540576	554857	577549	580207
1996	578453	526737	446663	470446	572780	686633	671865	632077	603192	608036	607806	580509
1997	486139	399695	361514	405069	571691	697000	657949	676677	670522	659624	627781	580318
1998	579487	577071	578173	562277	634707	718324	718933	685697	634467	611286	606817	579783
1999	584390	582700	578252	559245	595117	690159	720809	739649	714352	671228	630238	580402
2000	567286	557528	542669	557163	671118	717084	652542	611614	584477	556313	570509	580393
2001	578616	583465	581590	584652	694948	757013	702779	686341	625577	587016	589197	580226
2002	578555	578424	582245	573558	544757	495112	419132	349615	314566	306272	313863	314618
2003	311980	308987	312840	298303	365553	457880	392007	327349	313863	291592	301004	304743
2004	306458	304888	334103	365605	403987	470552	431323	367801	329260	317766	327748	333095
2005	341191	348008	358579	368970	501996	668891	653897	633060	591300	581037	580452	579781
Avg	480451	468205	463444	464100	536159	628477	603225	558567	528192	509601	508144	494701
Max	585299	583465	587658	632765	762405	829159	812008	799932	743015	693404	653335	587145
Min	174213	182756	204040	202772	188200	227138	205963	166542	151521	137420	145304	160611

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Table 8: End of Month Contents at Blue Mesa Reservoir for Alternative D

	Blue Mesa End of Month Content (ac-ft)											
	Alt D											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1975	498173	487156	479086	425899	396341	599919	764863	713460	642415	600184	604307	587145
1976	585299	581842	581484	576063	550616	645860	615877	586084	555494	536619	548692	554233
1977	558375	560441	556089	519139	476051	436117	370371	314304	282269	264966	275967	281477
1978	286957	284900	295283	277626	280172	497037	581688	534120	491595	450345	449829	450116
1979	443321	358857	330501	321823	442468	576737	631152	584882	550130	529162	537466	544385
1980	551649	481484	449459	441787	493537	743532	760655	680011	634564	604136	597823	580425
1981	569219	559481	544029	515380	500407	538889	517211	477361	461981	447647	455419	470647
1982	478999	469773	490780	463005	467735	666501	702226	707358	703558	686435	642025	579792
1983	566377	554659	551365	519398	574114	816306	812197	799981	743064	681001	642878	582046
1984	490783	401758	330195	252030	681533	826915	809561	812857	772207	753718	682410	581083
1985	499355	444986	459611	532342	730868	804074	806279	747789	715251	693698	653491	579784
1986	509652	498577	445585	466587	540380	714687	801835	775293	745478	714170	671114	580076
1987	549200	534359	548095	596177	770704	809775	773689	723855	662369	613104	605861	580740
1988	578804	570648	580114	581366	616932	695639	635310	582525	560153	546583	562553	573367
1989	581334	580157	589095	634006	697697	733124	659366	614137	554698	535099	542184	548758
1990	552818	552272	551474	515323	535769	633296	598448	557598	534345	547936	571204	576513
1991	575121	578973	589594	615248	692483	786987	771525	722585	675456	623614	615757	579294
1992	573455	564081	567138	585999	694426	772692	738362	700540	650336	606002	598368	580246
1993	579828	573714	499537	486686	718979	817185	807182	761908	708066	658853	620081	580215
1994	566599	555083	549235	550322	696705	784898	711972	663623	631482	617349	603905	579825
1995	574746	581122	546065	508623	504594	817485	801201	803049	765499	715830	662663	580207
1996	557047	515151	443133	465117	569894	728878	710766	663214	626657	624625	616602	580509
1997	485924	399571	361514	402899	569551	809087	811475	796162	760713	723368	661577	580318
1998	563864	549857	538023	526270	608773	721365	721738	687947	636162	612485	607452	579783
1999	584403	582706	578252	559127	598276	759061	785270	791129	758271	702192	646647	580401
2000	559027	541798	518958	536586	707486	747805	681642	637689	604455	570436	580703	580393
2001	578616	583465	581590	584652	742021	784704	730443	708400	642201	598768	595429	580226
2002	578884	578612	580753	570455	541656	492016	416039	346526	311480	303189	310781	311537
2003	308899	305907	309763	295228	401265	502536	436601	371884	358351	336047	345445	349172
2004	350877	349294	378483	409946	517336	586787	548545	484895	446239	434670	444616	449937
2005	458008	464794	475307	455313	537414	695275	673837	648971	603290	589514	585179	580718
Avg	522439	504693	493535	490014	576006	695006	683462	645166	606073	578121	565756	539464
Max	585299	583465	589594	634006	770704	826915	812197	812857	772207	753718	682410	587145
Min	286957	284900	295283	252030	280172	436117	370371	314304	282269	264966	275967	281477

Another measure of the impact of meeting the Flow Recommendations on the water supply of the Aspinall Unit is to determine the amount of storage used from Blue Mesa Reservoir. Storage usage at Blue Mesa Reservoir is divided into three time periods: January through March, April to the date the reservoir fills (or reaches its maximum content for that year) and from the date of fill through the end of December. This division coincides with operational divisions within the Gunnison River model. Additionally, water demands for spring peaks and duration flows usually occur within the April to max fill date time period while baseflow demands usually occur within the max fill date to end of December period or the January through March period.

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Table 9 shows the annual volume of storage lost from Blue Mesa Reservoir from January through March for each action alternative as compared to the No Action Alternative. Storage usage during this three month time period occurs during efforts to achieve baseflow targets in the Gunnison River as measured at the Whitewater gage. Storage usage mainly occurs during drier years or years that follow a significant dry period.

Table 9: Blue Mesa Reservoir Storage Usage from Jan 1 to Mar 31 for Alternatives A, B, C, and D as compared to the No Action Alternative.

Blue Mesa Storage Usage (acre-ft)				
Difference from No Action (Jan 1 - Mar 31)				
	Alt A	Alt B	Alt C	Alt D
1975	0	0	0	0
1976	-3091	-1911	-1911	-1911
1977	-2173	-2166	-2146	-2166
1978	-6157	-6146	-6112	-6146
1979	0	0	0	0
1980	0	0	0	0
1981	-10487	-9431	0	-9431
1982	0	0	0	0
1983	0	0	0	0
1984	0	0	0	0
1985	0	0	0	0
1986	0	0	0	0
1987	0	0	0	0
1988	-2502	-2393	-2398	-2393
1989	0	0	0	0
1990	-4124	-4112	-4087	-4128
1991	0	0	0	0
1992	-8698	-6159	-2369	-6159
1993	0	0	0	0
1994	0	0	0	-431
1995	0	0	0	0
1996	0	0	0	0
1997	0	0	0	0
1998	0	0	0	0
1999	0	0	0	0
2000	0	0	0	0
2001	0	0	0	0
2002	-177	0	0	-177
2003	-6999	-7004	-7003	-6999
2004	-3416	-3401	-3373	-3422
2005	0	0	0	0
Average	-1543	-1378	-948	-1399

Table 10 shows the annual volume of storage lost from Blue Mesa Reservoir from April to the time of maximum reservoir content. Again all storage usage volumes are relative to

the No Action Alternative. This time period coincides with the months where spring peak targets as well as half bankfull and bankfull targets are trying to be met. Consequently in some years large volumes of storage are used when attempting to meet the Flow Recommendation targets. Years with the biggest impacts appear to be moderately dry years with spring peak targets and more average years with duration targets.

Table 10: Blue Mesa Reservoir Storage Usage from Apr 1 to the date of fill for Alternatives A, B, C, and D as compared to the No Action Alternative.

Blue Mesa Storage Usage (acre-ft)				
Difference from No Action Apr 1 - Max Fill Date)				
	Alt A	Alt B	Alt C	Alt D
1975	0	0	0	0
1976	-67649	-92902	-132613	-92902
1977	-1434	-1428	-1410	-1428
1978	0	-80109	-169199	-80109
1979	0	-45821	-187224	-45821
1980	0	0	-145383	0
1981	0	0	0	0
1982	0	-33127	0	-33127
1983	0	0	0	0
1984	0	0	0	0
1985	0	0	0	0
1986	0	0	0	0
1987	0	0	0	0
1988	-2927	-24701	-68511	-2933
1989	-9061	-40134	-85465	0
1990	0	0	0	0
1991	0	0	0	0
1992	0	-27357	-84352	0
1993	0	0	0	0
1994	0	-30288	-90846	0
1995	0	0	0	0
1996	0	0	0	0
1997	0	0	0	0
1998	-6465	0	0	0
1999	-1705	-25349	-69403	-13651
2000	-485	-89872	-31206	0
2001	0	-52168	-27693	0
2002	-19	0	0	-19
2003	-11075	-29420	-53310	-5567
2004	0	-20366	-64670	0
2005	0	0	0	0
Average	-3252	-19130	-39074	-8889

Table 11 shows the annual volume of storage lost from Blue Mesa Reservoir from the date of fill through the end of December. Storage usage during these months is primarily for meeting baseflow targets in the Gunnison River. Impacts to storage from baseflow releases during this time are the most significant in the driest of years and sometimes carry over from very dry years into the next year.

Table 11: Blue Mesa Reservoir Storage Usage from the date of fill to Dec 31 for Alternatives A, B, C, and D as compared to the No Action Alternative.

Blue Mesa Storage Usage (acre-ft)				
Difference from No Action (Max Fill Date - Dec 31)				
	Alt A	Alt B	Alt C	Alt D
1975	0	0	0	0
1976	0	0	0	0
1977	-24324	-24253	-24030	-24253
1978	-21390	0	0	0
1979	0	0	-29550	0
1980	0	0	-5662	0
1981	-5514	-5523	-3591	-5523
1982	0	0	0	0
1983	0	0	0	0
1984	0	0	0	0
1985	0	0	0	0
1986	0	0	0	0
1987	0	0	0	0
1988	0	0	0	0
1989	0	0	0	-1757
1990	0	0	0	0
1991	0	0	0	0
1992	0	0	0	0
1993	0	0	0	0
1994	0	0	0	0
1995	0	0	0	0
1996	0	0	0	0
1997	0	0	0	0
1998	0	0	0	0
1999	0	0	0	0
2000	0	0	0	0
2001	0	0	0	0
2002	-23924	-20122	-21039	-23924
2003	-47276	-47202	-47069	-47304
2004	-2583	-2722	-2404	-1784
2005	0	0	0	0
Average	-4033	-3220	-4301	-3372

Impacts to flatwater recreation on Blue Mesa Reservoir may be measured by changes in reservoir surface area. Tables 12 through 14 show Blue Mesa Reservoir surface area, measured in acres, at three different times during the year. The end of April is an approximation of the start of the recreation season at Blue Mesa Reservoir. The date of maximum content could be considered to approximate the peak of the recreation season. The end of August is a close approximation to the end of the recreation season which probably tapers off significantly after Labor Day weekend.

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Table 12: Blue Mesa Reservoir surface area at the end of April.

Blue Mesa End of April Surface Area (acres)					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	6514	6663	6663	6663	6663
1976	7744	7726	7747	7747	7747
1977	7560	7440	7378	7175	7378
1978	5600	5304	5211	4923	5211
1979	5775	5856	5676	5490	5676
1980	6432	6781	6798	5221	6798
1981	7406	7340	7353	4333	7353
1982	6889	6961	6964	4691	6964
1983	7303	7300	7380	7585	7380
1984	4927	4924	4927	4925	4925
1985	7411	7465	7465	7661	7465
1986	6821	6992	6992	6992	6992
1987	7859	7861	7863	8004	7863
1988	7789	7779	7780	7780	7780
1989	8072	8072	8073	8066	8072
1990	7392	7312	7193	6938	7352
1991	7969	7969	7969	7885	7969
1992	7828	7792	7806	7829	7806
1993	6780	7146	7145	7137	7146
1994	7586	7592	7586	7690	7582
1995	7113	7307	7316	7318	7308
1996	6707	6981	6981	7022	6981
1997	6432	6428	6456	6476	6456
1998	7425	7425	7425	7659	7425
1999	7640	7642	7639	7640	7639
2000	7458	7463	7522	7626	7493
2001	7799	7799	7774	7799	7799
2002	7712	7711	7737	7731	7711
2003	5730	5400	5442	5433	5400
2004	7225	6470	6339	6107	6520
2005	7088	6872	6610	6139	6904
Average	7096	7090	7071	6828	7089

Appendix A

Table 13: Blue Mesa Reservoir surface area as of the date of fill.

Blue Mesa Max Annual Surface Area (acres)					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	8954	8987	8796	8796	8796
1976	8654	8269	8138	7920	8138
1977	7554	7434	7372	7168	7372
1978	8566	8540	7808	7010	7808
1979	8875	8889	8072	7190	8072
1980	8897	8969	8905	6933	8905
1981	7635	7572	7584	4770	7584
1982	8675	8686	8491	7869	8491
1983	9179	9095	9105	9103	9102
1984	9179	9179	9179	9179	9179
1985	9179	9141	9047	9042	9045
1986	9083	9077	9018	8058	9018
1987	9094	9071	9063	9053	9063
1988	8439	8409	8290	8051	8410
1989	8657	8608	8441	8183	8657
1990	8108	8049	7968	7798	8079
1991	9011	9015	8949	8821	8946
1992	8852	8841	8652	8365	8843
1993	9089	9105	9099	9100	9136
1994	8926	8930	8743	8410	8924
1995	9153	9171	9169	9105	9171
1996	8939	9000	8635	8421	8636
1997	9105	9095	9085	8464	9085
1998	8605	8571	8636	8621	8636
1999	9070	9054	8914	8651	8983
2000	8747	8744	8252	8572	8750
2001	8921	8921	8585	8754	8921
2002	7704	7703	7728	7722	7703
2003	7530	7247	7139	6949	7288
2004	8254	7785	7514	7025	7812
2005	8495	8468	8488	8324	8457
Average	8682	8633	8480	8111	8549

Table 14: Blue Mesa Reservoir surface area at the end of August.

Blue Mesa End of August Surface Area (acres)					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	8647	8678	8507	8507	8507
1976	8165	7885	7807	7625	7807
1977	6070	5694	5598	5301	5598
1978	8171	8150	7477	6574	7477
1979	8511	8516	7800	5492	7800
1980	8387	8382	8324	5571	8324
1981	7176	7061	7075	3861	7075
1982	8621	8629	8474	7684	8474
1983	9007	9007	8986	9005	9006
1984	9090	9082	9082	7838	9081
1985	8722	8694	8692	8689	8692
1986	8883	8870	8859	7981	8859
1987	8583	8566	8563	8558	8563
1988	7846	7786	7699	7486	7787
1989	7978	7919	7800	7569	7963
1990	7712	7604	7541	7366	7629
1991	8603	8606	8558	8466	8556
1992	8443	8435	8295	8108	8436
1993	8771	8759	8771	8589	8778
1994	8235	8237	8096	7840	8233
1995	9030	9006	9026	7500	9024
1996	8457	8502	8230	8062	8230
1997	8984	8983	8983	8305	8983
1998	8342	8314	8368	8355	8368
1999	9028	9017	8890	8647	8953
2000	8104	8089	7752	7949	8092
2001	8479	8479	8227	8359	8479
2002	6144	5923	5962	5953	5923
2003	6907	6114	5977	5732	6166
2004	7691	7089	6756	6127	7132
2005	8182	8162	8176	8067	8153
Average	8225	8137	8011	7457	8069

Reoperation of the Aspinall Unit for Flow Recommendation purposes will create differences in the historic release pattern of water from the Aspinall Unit reservoirs. Higher releases during May for spring peaks and higher flows of extended duration will result in lower releases during months of traditionally high power demand. During dry periods extended releases for base flows may result in minimum releases from the Aspinall Unit during months when releases were higher historically.

Changes in hydropower production can be revealed by analyzing the volume of water that runs through the power plant. Tables 15 through 19 show the monthly volumes of water released through the power plant at Blue Mesa Reservoir for the No Action Alternative and Alternatives A, B, C and D. Annual totals are given in the far right column and monthly average volumes over the 31 year study period are shown in the bottom row. Below the tables for the action alternatives, a comparison with the No

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Action Alternative is provided. Monthly volume differences in acre-feet and a percentage difference are shown for quick comparison to the No Action Alternative.

Table 15: Monthly water volumes through the Blue Mesa Powerplant for the No Action Alternative

	Blue Mesa Monthly Power Volume (Acre-Ft)												Total
	No Action												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1975	14467	14201	35022	152813	184381	57572	94752	125352	113815	83954	43264	52259	971852
1976	26835	26510	27771	75275	52341	81864	125224	86855	82909	60021	21713	13333	680651
1977	10746	14342	23955	72787	78716	78375	80694	76992	52193	37345	13120	16057	555321
1978	17673	13957	22049	118088	111339	51707	96812	105233	78872	51549	16908	21561	705748
1979	70061	106581	117154	127291	139638	70966	119320	119649	105091	75965	40637	43339	1135692
1980	25285	109763	81704	146582	186777	131020	121122	121209	93672	64020	43279	56376	1180808
1981	33088	20565	42311	62874	65022	59946	74834	78351	50703	44063	17046	10103	558906
1982	21949	34053	17179	106331	141966	60090	111703	99106	93763	87149	87264	98275	958830
1983	46858	41304	49652	85447	75828	104529	184652	131889	113295	108133	71667	97995	1111248
1984	121349	114712	104990	158818	90469	184400	190621	126921	117226	94315	114051	138059	1555930
1985	109942	77147	36578	80094	92625	183304	155199	121030	101537	82434	83983	105393	1229267
1986	99533	40709	115653	125996	146670	111264	187342	118989	102842	94750	93164	122627	1359540
1987	59033	43054	41456	76165	77558	177383	124978	109253	105856	84371	37988	50560	987657
1988	24128	30982	20478	53280	57802	64068	119040	88122	57458	45303	10527	13124	584313
1989	20378	26053	36821	48747	56140	83591	125867	93001	86934	50571	15467	13291	656861
1990	15176	15564	27690	70201	59292	55214	100209	74249	56009	25589	18002	25347	542542
1991	25701	18953	25391	44304	88213	114431	110323	103505	82457	77043	41467	61565	793354
1992	27157	25562	28877	47772	31290	64346	113938	94716	90936	79085	36071	42066	681817
1993	22936	34317	109895	137438	131251	165380	150632	118792	105153	95554	68957	64974	1205280
1994	39017	34339	43175	64650	28793	89703	121208	83993	68142	57179	42663	49217	722079
1995	28240	18927	83445	123467	174237	174450	197633	132229	112428	103473	91803	112840	1353173
1996	53060	74824	112274	121666	138187	94383	113958	105176	87781	60082	57064	82902	1101358
1997	124351	110452	82330	64023	109629	152151	144952	113500	111237	108121	101546	111197	1333488
1998	45816	40858	55168	70352	102326	63293	115243	98368	89788	67101	40428	52089	840830
1999	22201	25431	50136	67551	43020	130353	133067	115198	105638	103859	88765	97533	982751
2000	52031	46626	64614	71851	28610	79907	123782	81360	70528	62902	17682	25426	725318
2001	23610	16605	37337	52095	42907	103995	123398	89096	99968	71611	30170	38200	728991
2002	23017	17760	27062	56919	73640	76881	81086	80715	49999	32299	14830	15838	550048
2003	17628	15984	21800	49662	39275	43039	80910	80229	58258	46768	12534	16117	482205
2004	16729	17757	14422	30095	28602	62931	110986	86125	70290	41205	14340	14498	507979
2005	13018	44321	33389	86913	112962	54078	119655	84090	80259	55937	31960	31045	747628
Average	40355	41039	51283	85469	89984	97568	124295	101397	86937	69411	45754	54620	888112

Aspinall Unit Operations FEIS

Table 16: Monthly water volumes through the Blue Mesa Powerplant for Alternative A

	Blue Mesa Monthly Power Volume (Acre-Ft)												Total
	Alt A												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1975	30980	30354	32754	105876	144580	69379	118373	125352	115214	85210	44688	53867	956628
1976	27511	26183	30513	74878	119854	66421	107708	86067	70399	48743	10694	11831	680801
1977	10633	15079	25514	74241	78792	86477	89431	80025	53644	38471	13434	17767	583508
1978	19102	18033	22753	97661	98347	42722	95761	104253	78008	65059	26653	21580	689912
1979	60078	105973	117154	103469	133583	71103	119499	121181	105297	76149	40847	43575	1097909
1980	25898	109810	81044	107145	161514	139630	131342	133630	95481	72071	38526	50282	1146375
1981	33750	30846	41860	62278	65022	62204	77364	78909	50703	44063	17046	10336	574381
1982	16162	29500	13849	95441	138181	55716	111921	96486	94130	87476	87640	98699	928199
1983	47070	41483	49850	85369	79866	107951	178194	131040	113295	108120	71647	97972	1111856
1984	121349	114712	104990	159072	59839	183894	183704	126216	115738	94328	114064	138097	1556022
1985	109942	77148	38595	71868	103120	185471	150402	125031	100842	81265	82657	103896	1228236
1986	99599	40678	115651	104083	139016	116957	188201	118937	102653	94175	92511	121887	1334348
1987	59030	43055	41104	76122	80794	176076	125884	108457	105083	83677	37200	49671	986153
1988	26213	30035	21843	52395	62317	63375	117720	94654	54892	42945	10346	12417	589151
1989	18614	24609	35223	48698	66184	82665	125867	94654	84082	50571	15467	13291	659926
1990	16208	18376	27978	70239	59292	54275	97421	82975	55269	25589	13833	18138	539592
1991	23894	17710	23640	44304	81184	118967	110445	103645	82593	77166	41606	61722	786876
1992	29228	32103	28967	45531	28855	62029	113938	94383	90602	78786	35732	41683	681836
1993	27456	32297	109713	87921	106755	180880	152883	118792	104663	95115	68459	64412	1149348
1994	38739	34096	42906	64431	28734	90167	121208	94301	68214	57244	42736	49300	722075
1995	28236	18929	83447	97321	151965	184126	198099	125949	112428	102516	89724	111814	1304553
1996	52251	75215	112612	87487	120652	121897	118182	107187	89794	61888	59113	85214	1091493
1997	124396	110432	82304	64485	114333	144071	144082	113675	111221	108093	101515	111162	1329769
1998	45798	40843	55151	70359	104913	60505	114704	97095	88513	65957	39131	50625	833595
1999	22230	26417	49121	67271	100960	88503	124895	111824	105462	103330	88170	96858	985043
2000	51694	46322	64289	71978	28741	81098	123782	83703	69833	62278	16975	24628	725322
2001	23610	16605	37337	52095	42907	103995	123398	86096	99968	71611	30170	38200	728991
2002	23017	17760	27239	56938	73715	86754	93352	81362	49999	32299	14830	17015	574280
2003	20622	19288	22534	50474	49321	44873	107731	99169	57501	46768	12534	17259	548074
2004	18200	19965	14233	30095	28602	53324	103855	98474	69828	41205	14340	14669	506812
2005	13018	12082	15995	76950	93553	50863	119072	83152	79321	55095	31061	29911	660072
Average	40791	41160	50586	76015	89855	97947	125433	103312	86280	69589	45269	54122	880359

Difference from No Action													
percent	1.08%	0.29%	-1.36%	-11.06%	-0.14%	0.39%	0.92%	1.89%	-0.76%	0.26%	-1.06%	-0.91%	-0.87%
acre-feet	436	121	-897	-9454	-130	379	1138	1016	-657	178	-484	-498	-7753

Table 17: Monthly water volumes through the Powerplant for Alternative B

	Blue Mesa Monthly Power Volume (Acre-Ft)												Total
	Alt B												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1975	30980	30354	32754	105876	164909	102524	70576	125352	107358	78160	36692	44840	930376
1976	27821	26033	29173	72871	143720	65344	99423	84073	67130	47409	10694	11831	685522
1977	10633	15079	25514	74241	78792	86477	89431	80025	53644	38471	13434	17767	583508
1978	19102	18033	22753	96898	142426	128769	54092	91229	68193	65589	26022	21509	754615
1979	30542	105068	63902	101083	126860	157187	116909	110340	74388	53732	22059	22189	984240
1980	20961	95651	63536	105089	162309	134463	122006	133451	93736	71061	35147	45911	1083321
1981	33910	31032	40459	61486	65022	62204	77364	78909	50703	44063	17046	10336	572533
1982	16852	30043	13963	95489	141347	77833	101494	92152	87038	80498	80658	90927	908294
1983	42187	37252	45166	87169	77298	112683	176483	129221	113295	107140	70453	96624	1094951
1984	121349	114712	104990	158855	90524	184500	187257	126703	115754	94343	114123	138141	1551250
1985	109941	77148	38613	71872	103699	193007	139954	125031	100802	81197	82580	103810	1225656
1986	99603	40677	115651	104076	138871	157768	139635	118510	102481	93649	91916	121212	1324048
1987	59027	43057	40783	76082	91884	171265	125597	108313	104942	83550	37057	49510	991066
1988	26180	30051	21751	52382	86329	60606	110342	94386	53960	39947	10346	12417	598698
1989	15454	21343	31608	48640	97960	79262	119596	92335	79187	50571	15467	13291	664713
1990	16208	18376	27978	70239	59292	52223	93275	82705	55269	25589	13833	16711	531696
1991	21087	16287	19595	44304	106465	105851	109180	101414	80183	75277	39463	59303	778411
1992	28225	31952	27582	45575	64173	61059	113938	98117	84332	73160	29350	34479	681941
1993	27316	32488	109708	87921	99259	182215	150382	118792	105126	95530	68930	64943	1142609
1994	39002	34325	43160	64638	87033	60041	121208	79493	61835	51519	36243	41971	720469
1995	28559	18775	83277	95990	154067	170539	197462	131952	112428	103304	91549	112546	1300449
1996	52910	74896	112337	87487	145143	82974	112241	95064	77663	51003	46766	71276	1009761
1997	124123	110553	82457	61399	115142	152057	143509	113251	111219	108090	101511	111158	1334469
1998	45795	40841	55149	70360	95096	63881	115721	99497	90917	68114	41577	53386	840334
1999	22176	26443	49150	67775	102521	106528	111149	101157	103557	97614	81587	89702	959358
2000	48060	43032	60772	73350	89722	96071	104062	80105	63917	52445	13220	13605	738364
2001	13767	13361	26459	50907	108896	75312	123398	77667	86698	61497	18699	25250	683910
2002	23489	17566	25164	54727	73715	86754	93352	81362	49999	32299	14830	17015	570252
2003	20622	19288	22534	50474	67549	44873	107731	99169	57501	46768	12534	17259	566302
2004	18200	19965	14233	30095	57005	53132	104215	98474	69828	41205	14340	14669	535383
2005	13018	12082	15995	65642	58771	50623	119540	83817	79986	55692	31698	30715	617577
Average	38938	40167	47231	75258	103090	103807	117759	100712	82744	66725	42575	50783	869809

Difference from No Action													
percent	-3.51%	-2.08%	-7.90%	-11.95%	14.56%	6.30%	-5.26%	-0.68%	-4.82%	-3.97%	-6.95%	-7.02%	-2.06%
acre-feet	-1417	-853	-4052	-10211	13106	8239	-9539	-885	-4193	-2686	-3179	-3836	-16303

Appendix A

Table 18: Monthly water volumes through the Blue Mesa Powerplant for Alternative C

	Blue Mesa Monthly Power Volume (Acre-Ft)												Total
	Alt C												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1975	30980	30354	32754	105876	164909	102524	70576	125352	107358	78160	36692	44840	930376
1976	27821	26033	29173	72871	150173	81605	87110	84201	66585	47409	10694	11831	695505
1977	10633	15079	25514	74241	78792	86477	89431	80025	53644	38471	13434	17767	583508
1978	19102	18033	22753	94389	136368	162946	95612	90539	68193	65589	26022	21509	821055
1979	30542	58332	14311	97592	122524	194571	194550	109311	72438	53732	22059	22169	992132
1980	20783	24521	33988	91239	144248	191994	151447	136922	82159	69485	27109	27743	1001638
1981	21380	31276	38559	80584	85022	62204	77364	78909	50703	44063	17046	10336	557446
1982	11678	12364	13849	40034	86983	108483	65608	83782	52324	49348	45327	51043	600822
1983	33346	30293	29203	87511	63793	126750	178470	129989	113295	108048	71537	97848	1090083
1984	121349	114712	104990	159052	90449	185029	200955	143806	81458	42992	50429	66256	1361476
1985	110344	76957	15054	62860	104159	193015	134996	125031	100729	81074	82441	103652	1190310
1986	99610	40673	115650	104065	138867	200421	135995	102804	69297	56946	50445	74693	1189465
1987	60106	42545	18395	72560	114703	174710	124845	108103	104738	83367	36850	49275	990198
1988	26248	30018	21721	52321	128944	57168	98863	94178	53960	39947	10346	12417	626130
1989	15454	13222	8263	48503	118152	99212	105907	91544	76020	50571	15467	13291	655607
1990	16208	18376	27978	70239	59292	49226	88377	84003	55269	25589	13833	16711	525100
1991	18216	16864	16597	38461	101551	107857	108401	97118	75887	71539	35223	54517	741830
1992	26979	32150	24839	45337	70050	104668	103777	79169	75908	65600	20776	26466	675720
1993	27997	31374	109589	87921	100646	182922	154766	113905	97253	88466	60917	55898	1111653
1994	34544	30414	38830	61118	130229	69829	110924	76448	55152	41217	23086	25704	697496
1995	28630	18742	83240	95677	154052	166881	198474	201643	72082	39360	15608	27313	1101702
1996	31440	84743	120417	85684	145239	104177	108933	87339	70020	44144	38966	62494	983616
1997	123908	110644	82582	59231	114914	203409	143700	79317	81991	81672	71573	73664	1230302
1998	30172	29246	42200	74480	104779	92857	115487	98944	90364	67618	41014	52751	839911
1999	22188	26437	49143	67657	102517	126412	108046	91220	96975	87519	70252	76920	925287
2000	41612	37198	54535	75786	84355	78417	122189	80866	63917	56581	13220	14627	723304
2001	23610	16605	37337	52095	86826	84642	123398	83511	94545	66744	24650	31969	725931
2002	23346	17619	25559	55326	73715	86754	93352	81362	49999	32299	14830	17015	571176
2003	20622	19268	22534	50474	91413	44873	107731	99169	57501	46768	12534	17259	590166
2004	18200	19985	14233	30095	97635	56904	104215	98474	69828	41205	14340	14669	579785
2005	13018	12082	15995	48126	47230	43778	112294	78754	75026	51241	26947	25658	550149
Average	36776	35032	41606	71658	106211	117113	119864	98863	75310	58605	32700	39420	834157

Difference from No Action

percent	-8.87%	-14.64%	-18.87%	-16.16%	18.03%	20.03%	-3.56%	-1.51%	-13.37%	-15.57%	-28.53%	-27.83%	-6.08%
acre-feet	-3579	-6008	-9677	-13811	18226	19545	-4431	-1534	-11626	-10806	-13054	-15200	-53954

Table 19: Monthly water volumes through the Blue Mesa Powerplant for Alternative D

	Blue Mesa Monthly Power Volume (Acre-Ft)												Total
	Alt D												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1975	30980	30354	32754	105876	164909	102524	70576	125352	107358	78160	36692	44840	930376
1976	27821	26033	29173	72871	143720	65344	99423	84073	67130	47409	10694	11831	685522
1977	10633	15079	25514	74241	78792	86477	89431	80025	53644	38471	13434	17767	583508
1978	19102	18033	22753	96898	142426	128769	54092	91229	68193	65589	26022	21509	754615
1979	30542	105068	63902	101083	126860	157187	116909	110340	74388	53732	22059	22169	984240
1980	20981	95651	63536	105089	162309	134463	122006	133451	93736	71061	35147	45911	1083321
1981	33910	31032	40459	61486	65022	62204	77364	78909	50703	44063	17046	10336	572533
1982	16852	30043	13963	95489	141347	77833	101494	92152	87038	80498	80658	90927	908294
1983	42187	37252	45166	87169	97549	98157	179272	130130	113295	108059	71555	97868	1107658
1984	121349	114712	104990	159055	90435	184484	185034	125596	115729	94319	114062	138072	1547837
1985	109942	77147	36584	71866	103716	193048	139732	125031	100801	81196	82579	103808	1225450
1986	99603	40677	115651	104076	138872	157770	139654	118510	102481	93651	91918	121214	1324075
1987	59027	43057	40784	76082	91884	171264	125597	108313	104942	83550	37057	49510	991066
1988	26180	30051	21751	52382	62323	63388	117755	94668	54905	42956	10346	12417	589122
1989	18624	24518	35233	48698	56140	83593	125867	95676	86066	50571	15467	13291	653844
1990	16208	18376	27978	70239	59292	54961	99101	82786	55269	25589	13833	20217	543848
1991	24618	18045	24368	44304	106298	106901	109163	101304	80076	75180	39354	59179	788790
1992	18152	32096	27510	45543	29652	63491	113938	94433	90652	78831	35782	41740	681831
1993	27471	32290	109712	87921	99420	182156	158133	118860	105420	95794	69229	65281	1151687
1994	39189	34471	43322	64769	28826	89451	121208	84123	68029	57078	42548	49087	722081
1995	28245	18924	83442	97282	153990	170196	197592	131916	112428	103233	91442	112422	1301112
1996	52847	74927	112363	87487	145169	83032	112241	95076	77675	51013	46777	71289	1009896
1997	124123	110553	82457	61402	115142	152060	143503	113251	111218	108090	101511	111157	1334468
1998	45795	40841	55149	70360	95096	63881	115721	99497	90917	68114	41577	53386	840334
1999	22176	26443	49150	67775	102521	101101	112424	104152	104505	100460	84801	93329	968837
2000	49872	44570	62523	72665	29494	84035	123782	83870	70001	62429	17146	24820	725310
2001	23610	16605	37337	52095	42907	103995	123398	89096	99968	71611	30170	38200	728991
2002	23017	17760	27239	56938	73715	86754	93352	81362	49999	32299	14830	17015	574280
2003	20622	19268	22534	50474	43804	44873	107731	99169	57501	46768	12534	17259	542557
2004	18200	19985	14233	30095	28602	53887	103088	98474	69828	41205	14340	14669	506607
2005	13018	12082	15995	78428	98022	52783	118718	82769	78938	54751	30694	29448	665645
Average	39512	40521	47985	75811	94137	105163	119268	101729	83962	67927	43590	52257	871862

Difference from No Action

percent	-2.09%	-1.28%	-8.43%	-11.30%	4.62%	7.78%	-4.04%	0.33%	-3.42%	-2.14%	-4.73%	-4.33%	-1.83%
acre-feet	-844	-518	-3299	-9658	4153	7595	-5027	332	-2974	-1485	-2163	-2362	-16249

Another way of evaluating the impacts to hydropower production at the Aspinall Unit is to count the number of days that the powerplants were bypassed. Bypass flows occur when releases from the dams exceed the capacity of the powerplants. At Blue Mesa Reservoir, bypasses do not occur until the powerplant capacity has been exceeded (typically 3,400 cfs but variable with Blue Mesa Reservoir elevation). Historic operations of the Aspinall Unit generally focused on releasing as much water as possible through the powerplants in order to maximize hydropower production. Redistributing the timing of releases from the Aspinall Unit dams for spring peaks and extended high flow durations will increase the number of days that the powerplants must be bypassed.

Table 20 shows the number of days per year that water was released through the bypass tubes at Blue Mesa Reservoir for the No Action Alternative and Alternatives A, B, C and D. This water bypasses the powerplant and is unavailable for hydropower production.

Table 20: Number of days per year that water bypasses the powerplant at Blue Mesa Reservoir

Blue Mesa Bypasses Number of Days/Year					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	5	8	20	20	20
1976	0	7	12	17	12
1977	0	0	0	0	0
1978	1	1	15	25	15
1979	0	7	24	57	24
1980	1	12	16	50	16
1981	0	0	0	0	0
1982	1	8	16	20	16
1983	24	24	27	23	27
1984	61	55	59	85	59
1985	24	33	34	35	34
1986	20	32	21	48	21
1987	19	19	18	24	18
1988	0	0	1	7	0
1989	0	0	1	12	0
1990	0	0	0	0	0
1991	2	4	4	9	4
1992	0	0	0	7	0
1993	16	27	28	31	27
1994	0	0	2	13	0
1995	46	53	60	85	59
1996	0	9	20	25	20
1997	22	28	26	48	26
1998	0	5	1	2	1
1999	11	5	14	20	11
2000	0	0	6	2	0
2001	0	0	7	3	0
2002	0	0	0	0	0
2003	0	0	0	0	0
2004	0	0	0	0	0
2005	0	0	0	0	0

During very heavy snowpack years, it may be necessary to employ the spillways at the Aspinall Unit reservoirs to pass the large volume of spring runoff water. Generally when a large volume of spring runoff is forecast, Blue Mesa Reservoir is drawn down in advance of the runoff season with the strategy of capturing and storing as much of the spring runoff volume as possible. Operations of the Aspinall Unit that reduce this level of drawdown may increase the chance that the reservoir will spill later on in these wet years. When releases from Blue Mesa Reservoir must exceed 6100 cfs the spillway gates are opened.

Table 21 shows the number of days per year that water is spilled from Blue Mesa Reservoir for the No Action Alternative and for Alternatives A, B, C and D.

Table 21: Number of days per year that water is spilled from Blue Mesa Reservoir

Blue Mesa Spills					
Number of Days/Year					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	0	0	0	0	0
1976	0	0	0	0	0
1977	0	0	0	0	0
1978	0	0	0	0	0
1979	0	0	0	0	0
1980	0	0	0	0	0
1981	0	0	0	0	0
1982	0	0	0	0	0
1983	5	5	6	10	4
1984	17	18	19	42	19
1985	7	6	5	9	5
1986	0	0	0	3	0
1987	0	0	0	0	0
1988	0	0	0	0	0
1989	0	0	0	0	0
1990	0	0	0	0	0
1991	0	0	0	0	0
1992	0	0	0	0	0
1993	0	1	1	2	1
1994	0	0	0	0	0
1995	23	26	23	46	23
1996	0	0	7	8	6
1997	2	1	5	13	5
1998	0	0	0	0	0
1999	0	0	0	0	0
2000	0	0	1	0	0
2001	0	0	1	0	0
2002	0	0	0	0	0
2003	0	0	0	0	0
2004	0	0	0	0	0
2005	0	0	0	0	0

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Morrow Point Reservoir is much smaller in storage capacity than Blue Mesa Reservoir but the generating capacity of the powerplant is twice that of the powerplant at Blue Mesa. Changes in hydropower production at Morrow Point affect the power producing capability of the Aspinall Unit more than changes at Blue Mesa or Crystal Reservoirs.

Tables 22 through 26 show the monthly volumes of water released through the power plant at Morrow Point Reservoir for the No Action Alternative and Alternatives A, B, C and D. As with the tables showing Blue Mesa power volumes, annual totals are given in the far right column and monthly average volumes over the 31 year study period are shown in the bottom row. Again, below the tables for the action alternatives, a comparison with the No Action Alternative is provided.

Table 22: Monthly water volumes through the Morrow Point powerplant for the No Action Alternative

	Morrow Point Monthly Power Volume (Acre-Ft)												
	No Action												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1975	18241	17756	38768	160692	211894	82071	109112	127332	115532	86583	44936	55261	1068178
1976	31568	31738	32333	81963	64693	90245	127618	88779	84020	61956	24026	16197	735137
1977	13521	16014	24896	75690	82165	80223	82393	78729	53040	39148	15344	18128	579291
1978	19554	16889	26091	129617	133389	85048	106192	107569	80530	53007	19467	22821	800173
1979	70789	111246	123125	138663	168267	98923	124975	121237	105892	76729	42147	44359	1226352
1980	27345	111954	83214	155601	208524	152578	125243	122466	94994	66648	43902	57480	1249949
1981	34276	22962	45529	70706	71168	64728	77774	80774	53065	46576	19585	12793	599936
1982	24330	36726	21193	115780	162506	81445	117877	102308	97781	92065	89365	100640	1042016
1983	48997	43856	53767	93830	111445	170282	234275	141150	116760	110765	74849	101212	1301188
1984	124696	118272	112589	178508	186670	281135	256462	135007	120925	98672	116101	140684	1869721
1985	115977	84017	46158	105283	141033	270326	163670	124765	105057	85830	86982	108333	1437431
1986	102323	44647	121430	136998	170599	136802	229749	123420	107890	100251	96738	126823	1497670
1987	62751	47602	47426	94317	110309	232597	129361	112727	108365	86632	41017	53060	1126165
1988	26543	34262	24908	65415	69959	75968	122910	92144	60162	49506	12992	15566	650334
1989	21471	27585	40849	60972	67812	89959	127793	95477	89221	54066	17187	14871	707262
1990	16597	17603	30208	75911	67757	66428	103749	77096	58942	28844	19284	26984	589403
1991	27656	21201	28759	51211	120880	143962	117566	109395	88417	80913	44163	63941	898065
1992	29096	27809	32135	58787	56592	80403	119498	99016	93626	80808	39016	43880	760663
1993	25163	35867	117634	156574	182309	220299	171015	122654	109373	99256	71451	67083	1378677
1994	40474	36487	46342	72103	49345	104352	124433	87239	70672	58449	44482	51183	785561
1995	30109	20953	86701	136438	208154	246182	306453	143444	116487	107333	95814	115512	1613582
1996	54852	76220	116020	141012	176136	116398	119996	107923	89686	63190	58929	84112	1204474
1997	126514	113476	90029	79277	146186	229572	160257	117085	113256	108621	103714	113617	1501602
1998	48282	43362	59521	79735	131413	78646	120178	100694	91598	69069	42481	53827	918806
1999	23813	27028	53117	73752	59186	158795	140023	121385	110033	107917	90317	99304	1064670
2000	53725	49256	66069	82946	51335	88845	126192	83916	72321	64528	19174	27019	785327
2001	25213	18595	39304	59967	63136	112263	125930	92001	101590	73162	31767	40128	783056
2002	24944	20454	29245	65717	78628	79425	83246	81912	51842	33565	15961	16882	581821
2003	19009	18025	24642	56449	53484	52716	83418	82648	60192	48443	14240	17760	531026
2004	18505	19978	19292	39553	46243	71010	111771	86676	71116	42420	15567	15827	557958
2005	14797	46390	35848	92779	128964	66381	122229	85987	81966	57891	33301	32636	799172
Average	42617	43814	55392	96331	115490	126065	137786	104934	89495	72027	47881	56707	988538

Appendix A

Table 23: Monthly water volumes through the Morrow Point powerplant Alternative A

	Morrow Point Monthly Power Volume (Acre-Ft)												Total
	Alt A												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1975	34754	33909	38500	113654	181336	93878	133645	127332	116931	87838	46360	56868	1063007
1976	32245	31411	35076	81566	144973	74802	110102	87991	71510	50676	13008	14695	746056
1977	13408	16752	28455	77144	82240	88325	91131	81761	54490	40275	15658	19838	607478
1978	20983	20965	28795	109190	119977	76064	105141	106589	79665	66517	29192	22840	783916
1979	60807	110639	123125	114841	173675	99142	125154	122768	106098	76913	42356	44595	1200115
1980	27957	112001	82554	116164	206539	161009	135464	134888	96803	74698	39150	51386	1238612
1981	34939	33243	45079	70110	71168	66985	80303	81332	53065	46576	19585	13026	615411
1982	18543	32172	17863	104889	173956	77071	118095	102688	98148	92391	89740	101064	1026621
1983	49206	44034	53965	93752	115482	176967	224574	140302	116760	110752	74829	101190	1301816
1984	124696	118272	112589	178754	196023	278843	241388	134302	119437	98685	116134	140722	1859846
1985	115976	84017	46174	97057	161071	269921	158752	128767	104362	84661	85656	106836	1443250
1986	102388	44616	121428	115084	176869	147826	234252	123368	107701	99675	96086	126083	1496377
1987	62748	47604	47074	94273	113544	229341	190267	111931	107591	85938	40230	52171	1122713
1988	28628	33315	26273	64530	74474	75274	121590	98676	57596	47147	12811	14859	655172
1989	19707	26141	39251	80923	77856	89033	127793	97130	86369	54066	17187	14871	710328
1990	17629	20415	30496	75948	67757	65489	100661	85823	58203	28844	15114	19775	586453
1991	25849	19958	27007	51211	114134	149887	117688	109535	88553	81036	44302	64099	893259
1992	31186	34349	32225	56545	54157	78085	119498	96882	93292	80509	38676	43496	760682
1993	29682	33847	117452	107057	158308	258761	174249	122654	108884	98817	70953	66521	1347185
1994	40195	36244	46073	71884	49286	104816	124433	87547	70745	58513	44555	51266	785558
1995	30105	20954	86703	110292	192953	263073	298854	134143	116487	106376	93735	114486	1568162
1996	54043	76611	116357	106834	165517	146756	124220	109834	91699	64996	60978	86425	1204369
1997	126559	113456	90004	79739	162358	218373	159254	117260	113239	108594	103683	113582	1506100
1998	48264	43347	59504	79742	141259	75859	119639	99420	90324	67925	41184	52363	918830
1999	23842	28015	52101	73473	125380	105286	131462	118011	109857	107389	89722	98630	1063167
2000	53389	48952	65744	83073	51486	90036	126192	86259	71626	63904	18467	26221	785330
2001	25213	18595	39304	59967	63136	112263	125930	92001	101590	73162	31767	40128	783066
2002	24944	20454	29422	65736	78702	89298	95511	82559	51842	33565	15961	18058	606053
2003	22003	21330	25375	57261	63530	54549	110240	101588	59434	48443	14240	18902	596894
2004	19976	22206	19103	39553	46243	61403	104641	99026	70654	42420	15567	15999	556790
2005	14797	14151	18454	82816	109555	63165	121646	85049	81028	57049	32403	31503	711616
Average	43053	43935	54694	86873	119772	127148	138454	106752	88838	72205	47396	56210	985330

Difference from No Action

percent	1.02%	0.28%	-1.26%	-0.82%	3.71%	0.89%	0.48%	1.73%	-0.73%	0.25%	-1.01%	-0.88%	-0.32%
acre-feet	436	121	-697	-9458	4282	1083	668	1818	-657	178	-484	-498	-3208

Table 24: Monthly water volumes through the Morrow Point powerplant Alternative B

	Morrow Point Monthly Power Volume (Acre-Ft)												Total
	Alt B												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1975	34754	33909	38500	113654	213042	132622	84936	127332	109075	80789	38364	47842	1052820
1976	32555	31261	33735	79559	175429	73724	101817	85997	68241	49344	13008	14695	759366
1977	13408	16752	28455	77144	82240	88325	91131	81761	54490	40275	15658	19838	607478
1978	20983	20965	28795	108427	183329	165583	63472	93564	69850	67047	28561	22769	871366
1979	31271	109734	69674	112456	159795	222022	128573	111928	75189	54496	23569	23189	1122095
1980	23020	97842	65046	114108	213460	162713	126128	134708	95057	73689	35771	47015	1188557
1981	35096	33428	43677	69318	71168	66985	80303	81332	53065	46576	19585	13026	613563
1982	19233	32716	17977	104937	162366	103878	107668	95354	91056	85413	82759	93292	1016649
1983	44326	39804	49281	95553	112914	183465	228444	138482	116760	109773	73655	98842	1292276
1984	124696	118272	112589	178509	186769	282004	253881	134789	119453	98701	116173	140766	1886602
1985	115976	84017	46193	97062	162392	276493	147945	128767	104322	84593	85580	106750	1440089
1986	102393	44614	121428	115078	178264	203312	150603	122941	107528	99150	95490	125407	1466208
1987	62744	47605	48753	94233	124686	220907	129980	111787	107451	85812	40086	52009	1124053
1988	28595	33331	26180	64517	99058	72506	114212	98408	56664	44150	12811	14859	665291
1989	16548	22875	35636	80865	111165	85630	121522	94811	81474	54066	17187	14871	716648
1990	17629	20415	30496	75948	67757	63436	96815	85552	58203	28844	15114	18348	578557
1991	23041	18535	22963	51212	142537	133895	116423	107304	86143	79147	42159	61680	885039
1992	30184	34198	30639	56589	89475	77116	119498	92417	87022	74883	32294	36292	760787
1993	29542	34037	117447	107057	150316	263226	171727	122654	109346	99232	71423	67052	1343061
1994	40459	36474	46327	72091	109320	74690	124433	82739	64365	52789	38063	43937	785686
1995	30426	20801	86534	108961	214563	242856	307375	144103	116487	107164	95560	115218	1590051
1996	54702	76292	116082	106834	214305	113879	118278	97811	79568	54110	48631	72486	1152980
1997	126285	113576	90157	76653	166842	215999	154225	116836	113237	108590	103679	113578	1499658
1998	48262	43345	59502	79743	124658	79235	120655	101822	92727	70082	43630	55124	918785
1999	23787	28040	52130	73977	136256	135757	117716	107344	107952	101672	83138	91474	1059243
2000	49755	45662	62227	84446	123105	105010	106472	82662	65711	54071	14712	15198	809030
2001	15371	15351	28426	58779	141275	83581	125930	80571	90320	63048	20296	27179	750125
2002	25395	20261	27347	63525	78702	89298	95511	82559	51842	33565	15961	18058	602025
2003	22003	21330	25375	57261	63530	54549	110240	101588	59434	48443	14240	18902	615256
2004	19976	22206	19103	39553	46466	61211	105000	99026	70654	42420	15567	15999	585361
2005	14797	14151	18454	71508	74773	62926	122114	85714	81693	57646	33039	32306	669121
Average	41200	42961	51340	86115	136984	135382	130420	104279	85303	69341	44702	52871	980898

Difference from No Action

percent	-3.33%	-1.95%	-7.32%	-10.61%	16.81%	7.39%	-5.35%	-0.62%	-4.88%	-3.73%	-6.84%	-0.76%	-0.77%
acre-feet	-1417	-853	-4052	-10216	21494	9317	-7366	-655	-4193	-2686	-3179	-3836	-7640

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Table 25: Monthly water volumes through the Morrow Point powerplant Alternative C

	Morrow Point Monthly Power Volume (Acre-Ft)												Total
	Alt C												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1975	34754	33909	38500	113654	213042	132622	84936	127332	109075	80789	38364	47842	1052820
1976	32555	31261	33735	79559	195752	91133	89504	86125	67696	49344	13008	14695	784368
1977	13408	16752	28455	77144	82240	88325	91131	81761	54490	40275	15658	19838	607478
1978	20983	20965	28795	105918	177672	217427	108888	92874	69850	67047	28581	22769	959768
1979	31271	62998	20282	108964	153683	282556	280492	110899	73238	54496	23569	23189	1225638
1980	22843	26713	35498	100258	191653	279704	185858	138180	83480	72113	27732	28846	1192878
1981	22569	33672	41778	88416	71188	66985	80303	81332	53065	46576	19585	13026	598475
1982	14059	15036	17863	49483	122209	147465	71782	86985	56342	54263	47428	53407	716321
1983	35485	32844	33318	95894	19410	197605	223462	139251	116760	110680	74719	101065	1280493
1984	124696	118272	112589	178732	186639	283713	307395	188055	85157	47349	52478	68881	1753965
1985	116378	83826	24633	88049	164254	276341	142987	128767	104249	84470	85440	106592	1405988
1986	102400	44611	121428	115066	178211	296469	173261	107236	74344	62446	54019	78888	1408380
1987	63824	47093	24365	90712	158296	219404	129228	111577	107247	85629	39879	51775	1129029
1988	28653	33298	26150	64456	147323	69067	102733	98200	56664	44150	12811	14859	698373
1989	16548	14754	12291	80728	138878	107874	107833	94020	78307	54066	17187	14871	717357
1990	17629	20415	30496	75948	67757	60440	91917	86850	58203	28844	15114	18348	571961
1991	20171	18912	19964	45369	138360	144613	115644	103008	81847	75409	37919	56893	858108
1992	28917	34396	28097	56352	96648	127457	109337	83468	78598	67323	23721	28279	762593
1993	30223	32924	117328	107057	151703	262960	194003	117767	101473	92167	63411	58007	1329023
1994	36000	32563	41997	68571	173255	84478	114148	79694	57683	42486	24906	27670	783452
1995	30499	20768	86497	108648	214924	242144	307086	283567	76141	43220	19619	29985	1465098
1996	33232	86139	124162	105031	214284	146682	114970	90085	71925	47252	40852	63705	1138318
1997	126070	113667	90281	74485	166460	285151	174534	82902	84009	82172	73741	79784	1433257
1998	32638	31749	46554	83863	134707	108210	120421	101269	92174	69586	43067	54489	918727
1999	23800	28035	52124	73858	136251	173150	114613	97407	101370	91578	71803	78692	1042680
2000	43307	39827	55990	86882	109157	87355	124599	83423	65711	58207	14712	16220	785390
2001	25213	18595	39304	59967	110222	92910	125930	86415	96167	68296	26247	33897	783164
2002	25273	20313	27742	64124	78702	89298	95511	82559	51842	33565	15961	18058	602948
2003	22003	21330	25375	57261	105816	54549	110240	101588	59434	48443	14240	18902	639181
2004	19976	22206	19103	39553	115322	64983	105000	99026	70654	42420	15567	15999	629808
2005	14797	14151	18454	53992	63232	56081	114868	80651	76734	53195	28268	27249	601693
Average	39038	37806	45714	82516	141201	156037	139117	106847	77869	61221	34827	41507	963701

Difference from No Action

percent	-8.40%	-13.71%	-17.47%	-14.34%	22.28%	23.78%	0.67%	1.82%	-12.99%	-15.00%	-27.28%	-26.80%	-2.51%
acre-feet	-3579	-6008	-9677	-13815	25711	29972	1331	1913	-11626	-10806	-13054	-15200	-24837

Table 26: Monthly water volumes through the Morrow Point powerplant Alternative D

	Morrow Point Monthly Power Volume (Acre-Ft)												Total
	Alt D												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1975	34754	33909	38500	113654	213042	132622	84936	127332	109075	80789	38364	47842	1052820
1976	32555	31261	33735	79559	175429	73724	101817	85997	68241	49344	13008	14695	759366
1977	13408	16752	28455	77144	82240	88325	91131	81761	54490	40275	15658	19838	607478
1978	20983	20965	28795	108427	183329	165583	63472	93564	69850	67047	28581	22769	871366
1979	31271	109734	69674	112456	159795	222022	111928	75189	54496	23569	23189	1122095	
1980	23020	97842	65046	114108	213460	162713	126128	134708	95057	73689	35771	47015	1188557
1981	35096	33428	43677	69318	71168	66985	80303	81332	53065	46576	19585	13026	613563
1982	19233	32716	17977	104937	162366	103878	107668	95354	91056	85413	82759	93292	1016649
1983	44326	39804	49281	95553	139722	167169	225776	139391	116760	110692	74737	101085	1304294
1984	124696	118272	112589	178735	186624	281978	254316	133682	119428	98677	116112	140696	1865805
1985	115977	84017	46163	97055	162487	276127	147723	128767	104321	84592	85578	106748	1439554
1986	102393	44614	121428	115078	178268	203313	150623	122941	107529	99152	95492	125409	1466240
1987	62744	47605	48754	94234	124685	220906	129980	111787	107451	85812	40086	52009	1124053
1988	28595	33331	25180	64517	74480	75287	121625	98690	57609	47159	12811	14859	655143
1989	19718	26150	39261	80924	67812	89961	127793	98152	88353	54066	17187	14871	704245
1990	17629	20415	30496	75948	67757	66175	102641	85633	58203	28844	15114	21854	590709
1991	26572	20293	27735	51211	142053	134944	116407	107194	86036	79050	42049	61556	895102
1992	30091	34342	30768	56557	54964	79548	119498	98732	93342	80554	38727	43554	760677
1993	29698	33839	117451	107057	150477	263067	174318	122722	109640	99495	71722	67390	1346878
1994	40626	36620	46489	72222	49378	104100	124433	87369	70560	58347	44367	51054	785564
1995	30115	20950	86998	110253	214479	242456	306742	143141	116487	107093	95453	115094	1588961
1996	54639	76323	116109	106834	214193	113956	118278	97823	79579	54121	48643	72500	1152996
1997	126286	113576	90157	76656	166844	216001	154218	116836	113237	108590	103679	113578	1499658
1998	48262	43345	59502	79743	124658	79234	120655	101822	92727	70082	43630	55124	918785
1999	23787	28040	52130	73977	136256	123102	118591	110339	108900	104519	86352	95101	1061494
2000	51567	47300	63978	83762	52219	92973	126192	86427	71794	64055	18638	26414	785319
2001	25213	18595	39304	59967	63136	112263	125930	92001	101590	73162	31767	40128	783056
2002	24944	20454	29422	85736	78702	89298	95511	82559	51842	33565	15961	18058	606053
2003	22003	21330	25375	57261	105813	54549	110240	101588	59434	48443	14240	18902	591377
2004	19976	22206	19103	39553	46243	61966	103873	99026	70654	42420	15567	15999	556588
2005	14797	14151	18454	84294	114087	65086	121292	84666	80645	56705	32035	31039	717252
Average	41773	43296	52093	86669	127367	136429	131648	105267	86521	70543	45718	54345	981668

Difference from No Action

percent	-1.98%	-1.18%	-5.95%	-10.03%	10.28%	8.22%	-4.45%	0.32%	-3.32%	-2.08%	-4.52%	-4.17%	-0.69%
acre-feet	-844	-518	-3299	-9662	11877	10365	-9138	333	-2974	-1485	-2163	-2362	-6670

As with Blue Mesa Reservoir, impacts to hydropower production can be evaluated by counting the number of days that the powerplant at Morrow Point Dam was bypassed. Bypass of the powerplant at Morrow Point occurs when releases from the dam must exceed 5000 cfs.

Table 27 shows the number of days per year that water was released through the bypass tubes at Morrow Point Reservoir for the No Action Alternative and Alternatives A, B, C and D. This water bypasses the powerplant and is unavailable for hydropower production.

Table 27: Number of days per year that water bypasses the powerplant at Morrow Point Reservoir

Morrow Point Bypasses Number of Days/Year					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	0	3	6	6	6
1976	0	1	0	4	0
1977	0	0	0	0	0
1978	0	0	4	7	4
1979	0	0	9	36	9
1980	0	7	12	34	12
1981	0	0	0	0	0
1982	0	0	5	3	5
1983	12	14	16	14	16
1984	31	27	31	62	32
1985	17	16	19	24	19
1986	2	4	12	40	12
1987	6	5	5	4	5
1988	0	0	0	0	0
1989	0	0	0	0	0
1990	0	0	0	0	0
1991	0	0	0	0	0
1992	0	0	0	0	0
1993	3	15	16	24	14
1994	0	0	0	4	0
1995	35	39	48	76	47
1996	0	0	17	22	17
1997	12	8	11	35	11
1998	0	0	0	0	0
1999	0	1	8	16	6
2000	0	0	3	0	0
2001	0	0	3	0	0
2002	0	0	0	0	0
2003	0	0	0	0	0
2004	0	0	0	0	0
2005	0	0	0	0	0

Spillway usage at Morrow Point Reservoir is rare, primarily because almost all of the inflow to the reservoir is controlled by releases at Blue Mesa Reservoir. The maximum release capacity of the powerplant and bypass tubes at Morrow Point is 6500 cfs which exceeds the same combined capacity at Blue Mesa Reservoir. However, when Blue Mesa Reservoir is forced to release water through the spillway gates, the probability becomes high that the spillways at Morrow Point dam will have to be used. When releases from Morrow Point Reservoir must exceed 6500 cfs the spillway gates are opened.

Table 28: Number of days per year that water is spilled from Morrow Point Reservoir

Morrow Point Spills Number of Days/Year					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	0	0	1	1	1
1976	0	0	0	0	0
1977	0	0	0	0	0
1978	0	0	0	0	0
1979	0	0	0	0	0
1980	0	0	0	0	0
1981	0	0	0	0	0
1982	0	0	0	0	0
1983	5	6	7	9	6
1984	19	21	20	40	19
1985	8	6	9	16	9
1986	0	0	0	0	0
1987	0	0	0	0	0
1988	0	0	0	0	0
1989	0	0	0	0	0
1990	0	0	0	0	0
1991	0	0	0	0	0
1992	0	0	0	0	0
1993	0	3	4	4	4
1994	0	0	0	0	0
1995	25	28	25	44	26
1996	0	0	5	6	5
1997	2	1	5	15	5
1998	0	0	0	0	0
1999	0	0	0	0	0
2000	0	0	1	0	0
2001	0	0	0	0	0
2002	0	0	0	0	0
2003	0	0	0	0	0
2004	0	0	0	0	0
2005	0	0	0	0	0

Crystal Reservoir is the smallest of the Aspinall Unit reservoirs in terms of storage capacity and powerplant capacity. The reservoir is primarily used to re-regulate or stabilize the fluctuating releases from Morrow Point Reservoir before this water reaches the Black Canyon of the Gunnison River. Changes in hydropower production at Crystal Reservoir have the least impact on the power producing capability of the Aspinall Unit.

Tables 29 through 33 show the monthly volumes of water released through the power plant at Crystal Reservoir for the No Action Alternative and Alternatives A, B, C and D. The format of these tables is identical to the tables provided for Blue Mesa and Morrow Point Reservoirs.

Appendix A

Table 29: Monthly water volumes through the Crystal powerplant for the No Action Alternative

	Crystal Monthly Power Volume (Acre-Ft)												Total
	No Action												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1975	26314	23059	44512	125225	135546	108448	122585	131477	119443	92053	49089	61911	1039962
1976	42146	39618	39061	89352	80662	103878	131480	93053	86574	66382	29499	22457	824162
1977	20136	19128	26844	78915	86691	83440	86483	82834	55136	43297	20352	22783	626042
1978	23787	21320	32214	124835	127960	128221	125711	113001	84427	56371	25215	25674	888735
1979	72463	117707	131485	126952	135736	128120	131947	125015	107882	78558	45570	46678	1248112
1980	31980	115278	85556	128166	135587	131428	131696	125505	98140	72612	45360	59983	1161291
1981	36956	26584	50421	79270	79118	72741	84622	86427	58514	52294	25299	18810	671057
1982	29670	40764	27280	115982	133794	109979	129276	109697	106913	103042	94110	105938	1106444
1983	53813	47712	60003	102990	132080	127650	130063	127215	120642	115797	81978	108418	1208359
1984	125344	117257	121888	125618	130486	122103	129414	126615	121483	108113	115127	126639	1470088
1985	125561	94364	60582	121168	130043	123637	130636	127283	111706	93510	93722	114934	1327146
1986	108573	50589	125536	124565	132057	126021	131901	129145	119172	112237	104749	129370	1393917
1987	71064	54453	56443	114005	122119	126196	126173	120608	114155	91785	47822	58679	1103502
1988	31964	39221	31628	78647	85557	95588	125688	101347	66370	58995	18530	21050	754584
1989	23959	29909	46960	74297	82795	100553	125722	101241	94517	61968	21085	18427	781433
1990	19813	20689	34050	82182	78658	84930	111925	83679	65674	36214	22188	30673	670676
1991	32047	24607	33880	58776	121476	125395	128795	122343	101885	89651	50214	69259	958328
1992	33461	31220	37081	70795	88930	106191	128649	108832	99810	84762	45630	47954	883316
1993	30143	38221	126021	128325	135870	128329	127829	125479	117495	105163	77068	71826	1211788
1994	43776	39748	51158	80255	75634	117889	125505	94709	76510	61418	48588	55596	870786
1995	34298	24017	91648	121565	132227	124224	125625	127402	120818	115180	104785	121487	1243277
1996	58877	78348	120331	124058	132076	123482	126117	114280	94129	70245	63142	86837	1191922
1997	125809	113741	101650	95888	129945	125098	129275	121338	116738	109863	108600	119054	1396998
1998	53818	47146	66116	89980	124665	101739	127294	106123	95821	73565	47124	57738	991129
1999	27443	29464	57645	80548	79896	117935	126750	125326	118313	116066	93819	103275	1076478
2000	57546	53235	68308	95046	80393	103642	125295	89839	76500	68276	22566	30609	871255
2001	28833	21612	42326	68573	85795	118669	125296	98719	105385	76738	35391	44466	851803
2002	29276	24532	32593	75323	85104	83777	88357	84824	56150	36514	18566	19260	634266
2003	22135	21120	28966	63881	71700	68715	89315	88287	64698	52285	18088	21465	610654
2004	22494	23351	26665	49878	68825	84399	113836	88144	73151	45244	18358	18830	633175
2005	18790	49532	39603	99087	121702	86666	122758	90460	85963	62365	36334	36222	849483
Average	47171	47663	61240	96595	107843	109325	121484	108718	94649	77760	52515	60526	985489

Table 30: Monthly water volumes through the Crystal powerplant for Alternative A

	Crystal Monthly Power Volume (Acre-Ft)												Total
	Alt A												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1975	42827	39213	42245	121806	131099	119696	123750	125378	118420	93309	50513	63519	1071773
1976	42823	39291	41804	88954	108323	88666	114571	92265	74065	55103	18480	20955	785300
1977	20023	19866	28403	80369	86786	91542	95221	85867	56587	44424	20666	24494	654228
1978	25216	25396	32918	117392	118816	121684	120852	112021	83563	69881	34940	25692	888371
1979	62481	112148	125582	121160	128116	122585	126131	124279	108087	78742	45760	46914	1202005
1980	32593	114541	84897	121262	128733	129259	129199	128646	99948	80201	40608	53889	1143875
1981	37619	36865	49970	78674	79118	74998	87152	86985	58514	52294	25299	19043	686532
1982	23882	36211	23950	113265	130122	109725	126430	110077	107280	102766	94485	106362	1084555
1983	54025	47890	60201	102912	129267	125135	129611	127204	120674	115805	81958	108396	1203076
1984	125382	117292	121905	125678	130222	122340	128495	126338	121123	108025	114941	126250	1467991
1985	125170	94365	60598	120363	127761	123812	130917	128046	111156	92341	92396	113437	1320360
1986	108639	50559	125999	123535	130158	124348	130297	126207	118157	110891	104097	126333	1379220
1987	71080	54455	58091	113145	121672	126255	126708	119909	113381	91091	47035	57790	1098592
1988	34049	38274	32993	77762	89355	94894	126069	107879	63804	56636	18349	20343	760407
1989	22195	28466	45362	74248	90040	98627	126185	102894	91665	61968	21085	18427	782161
1990	20844	23502	34338	82220	78658	83991	109137	92406	64934	36214	18018	23464	667726
1991	30240	23363	32128	58776	120815	126001	128438	122466	102020	89774	50354	69417	953793
1992	35532	37761	37172	68553	86495	104362	128286	108499	99476	84462	45291	47570	883460
1993	34662	36201	125520	124144	130942	124865	127959	125479	117295	104938	76570	71264	1199840
1994	43498	39505	50889	80036	75574	118175	125506	95017	76582	61483	48661	55679	870606
1995	34294	24019	91650	119968	128718	123428	125546	126456	120261	114385	102706	120470	1231902
1996	58057	78739	120386	121308	127845	124062	126375	116291	96142	72051	65191	89150	1195607
1997	125881	113721	101625	96351	128162	124944	129533	121520	116803	109835	108572	119019	1395948
1998	53800	47131	66099	89987	123401	100042	126875	104849	94547	72422	45827	56274	981255
1999	27472	30450	58630	80268	97701	106579	126237	125139	118147	115811	93224	102600	1080258
2000	57206	52931	67983	95173	80524	104792	125335	92182	75806	67653	21859	29811	871257
2001	28833	21612	42326	68573	85800	118688	125336	98719	105385	76738	35391	44466	851867
2002	29276	24532	32770	75342	85178	93650	100623	85470	56150	36514	18566	20436	658498
2003	25129	24424	29699	64693	79651	70548	114578	107227	63941	52285	18088	22607	672869
2004	23985	25580	28476	49878	68825	74792	106705	100493	72689	45244	18358	19002	632007
2005	18790	17293	22208	85248	112514	83450	122367	89522	85025	61524	35435	35089	772466
Average	47595	47603	60349	95001	107754	108286	121627	110185	93923	77897	52024	59941	982187

Difference from No Action													
percent	0.90%	-0.13%	-1.46%	-1.65%	-0.08%	-0.95%	0.12%	1.35%	-0.77%	0.18%	-0.94%	-0.97%	-0.34%
acre-feet	425	-60	-892	-1594	-69	-1037	142	1467	-725	137	-491	-685	-3301

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Table 31: Monthly water volumes through the Crystal powerplant for Alternative B

	Crystal Monthly Power Volume (Acre-Ft)												Total
	Alt B												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1975	42827	39213	42245	121806	130832	108287	109193	125240	112986	86259	42517	54492	1015897
1976	43133	39141	40463	86948	114394	87419	106286	90271	70796	53769	18480	20955	772055
1977	20023	19866	28403	80369	86786	91542	95221	85867	56587	44424	20666	24494	654228
1978	25216	25396	32918	117124	126275	123958	84663	98997	73748	70411	34329	25622	838658
1979	32945	111216	78903	119838	128280	124909	111890	112921	77178	56325	26992	25508	1006907
1980	27656	101166	67388	120341	129064	124878	125728	125869	98203	79212	37229	49518	1086252
1981	37779	37050	48569	77883	79118	74998	87152	86985	58514	52294	25299	19043	684684
1982	24573	36754	24065	111914	127496	92118	117466	102743	100188	96483	87503	98590	1019892
1983	49142	43659	55517	104712	127438	124040	129265	127147	120722	115294	80764	107048	1184748
1984	125439	117346	121931	125728	130482	122085	129071	126886	121475	108173	115223	126767	1470607
1985	125683	94365	60617	120747	127860	123652	128898	126956	110787	92273	92320	113351	1317513
1986	108642	50557	124989	122491	128810	118086	123200	125543	117728	110340	103502	125653	1364541
1987	71057	54456	55770	112926	120641	125093	126034	119737	113240	90965	46892	57628	1094438
1988	34016	38290	32900	77749	99174	92126	123112	107611	62872	53638	18349	20343	760182
1989	19035	25199	41747	74190	101326	96224	125038	100575	86770	61968	21085	18427	771582
1990	20844	23502	34338	82220	78658	81938	104691	92135	64934	36214	18018	22037	659830
1991	27433	21940	28084	58776	121358	126119	127459	120260	99611	87885	48211	66998	934133
1992	34529	37610	35786	86597	100180	100951	128014	102233	93207	78836	38909	40366	859219
1993	34522	36392	125262	123881	132381	124652	127762	125462	117474	105143	77041	71795	1201768
1994	43761	39735	51143	80243	100724	98796	125624	90209	70203	55758	42168	48350	846713
1995	34618	23866	91480	119198	127516	124357	125579	126943	120468	114972	104531	121188	1234715
1996	58727	78421	120287	121546	126977	111147	125332	104168	84011	61166	52844	75212	1119837
1997	124786	113134	101778	93264	127100	125300	127734	120786	116268	109832	108509	119015	1387506
1998	53797	47129	68097	89987	122624	102300	125699	107251	96950	74579	48274	59036	993723
1999	27417	30476	56658	80772	97058	111735	125493	121365	116271	110830	86641	95445	1060160
2000	53575	49541	64466	96545	100414	103764	112147	88584	69890	57820	18104	18788	833739
2001	18990	18368	31449	57385	106004	96992	125329	87289	94114	66625	23920	31516	767981
2002	29727	24339	30695	73131	85178	93650	100623	85470	56150	36514	18556	20436	654469
2003	25129	24424	29699	64693	88475	70548	114576	107227	63941	52285	18088	22607	681691
2004	23965	25580	26476	49878	86128	74600	107065	100493	72689	45244	18358	19002	649478
2005	18790	17293	22208	77940	93892	83103	122668	90186	85690	62120	36072	35692	745856
Average	45735	46530	57172	94285	111375	105141	117849	107529	90441	75085	49335	56617	957194

Difference from No Action

percent	-3.04%	-2.17%	-6.64%	-2.39%	3.28%	-3.83%	-2.99%	-1.09%	-4.45%	-3.44%	-6.05%	-6.46%	-2.87%
acre-feet	-1436	-1033	-4099	-2310	3532	-4184	-3536	-1188	-4208	-2675	-3180	-3909	-26295

Table 32: Monthly water volumes through the Crystal powerplant for Alternative C

	Crystal Monthly Power Volume (Acre-Ft)												Total
	Alt C												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1975	42827	39213	42245	121806	130832	108287	109193	125240	112986	86259	42517	54492	1015897
1976	43133	39141	40463	86948	114129	90465	93673	90399	70251	53769	18480	20955	762108
1977	20023	19866	28403	80369	86786	91542	95221	85867	56587	44424	20666	24494	654228
1978	25216	25396	32918	114925	122289	126826	101381	98307	73748	70411	34329	25622	851367
1979	32945	70034	29311	117367	128292	124559	128389	110395	75228	56325	26992	25508	925345
1980	27478	30037	37840	106782	127503	124688	120443	123446	86443	77465	29190	31349	922666
1981	25249	37294	46669	76980	79118	74998	87152	86985	58514	52294	25299	19043	689596
1982	19398	19074	23950	58795	93017	102483	85344	74373	65474	65351	52172	58705	719137
1983	40301	36700	39554	104979	129374	124852	131535	132065	123863	116666	81848	108271	1170009
1984	130018	121629	123573	129933	130697	122102	126474	110114	93591	57173	57104	74770	1277178
1985	124872	94174	39057	112030	127672	123087	127369	125912	110377	92150	92180	113193	1282074
1986	108649	50554	124013	121480	127833	123374	114359	117355	85787	74817	62031	88260	1198512
1987	72137	53944	33382	110462	123767	125838	126190	119552	113037	90782	46684	57394	1073169
1988	34084	38257	32870	77687	111739	88486	111654	107385	62872	53638	18349	20343	757365
1989	19035	17079	18402	74053	103733	101216	112426	96784	83603	61968	21085	18427	730811
1990	20844	23502	34338	82220	78658	78942	100077	93433	64934	36214	18018	22037	653218
1991	24562	22318	25085	52934	117526	122433	125658	116029	95315	84146	43971	62211	892486
1992	33283	37808	33043	68360	100658	107369	122029	93285	84783	71276	30335	32354	814582
1993	35204	35278	122761	121378	131087	124556	127218	124957	111061	100537	69028	62749	1165814
1994	39303	35824	46813	76723	107337	99721	121636	87164	63520	45455	29011	32083	784592
1995	34689	23832	91443	119071	127449	124301	125347	127195	85382	51934	28590	35981	975215
1996	37256	88267	125351	121055	126977	107890	124554	96442	76368	54307	45065	66430	1068963
1997	124773	113368	101902	91097	127290	123425	119688	91139	88686	83414	78630	85221	1226953
1998	38174	35534	53149	94107	126408	108879	128213	106698	96397	74082	47711	58400	967752
1999	27429	30470	56652	80653	97467	110576	124472	111428	111335	100735	75306	82663	1009185
2000	47127	43806	58229	98981	102817	101351	125352	89345	69890	61956	18104	19810	836768
2001	28833	21612	42326	88573	101319	106594	125708	93133	99962	71872	29871	38235	828039
2002	29605	24391	31090	73729	85178	93650	100623	85470	56150	36514	18556	20436	655393
2003	25129	24424	29699	64693	102282	70548	114686	107227	63941	52285	18088	22607	695608
2004	23965	25580	26476	49878	100232	77965	107065	100493	72689	45244	18358	19002	666947
2005	18790	17293	22208	80424	82877	76366	119670	85124	80730	57670	31320	30835	683308
Average	43688	41797	51394	90951	111365	106044	115603	103734	83661	67133	39642	46190	901203

Difference from No Action

percent	-7.38%	-12.31%	-18.08%	-5.84%	3.27%	-3.00%	-4.84%	-4.58%	-11.61%	-13.87%	-24.51%	-23.69%	-8.55%
acre-feet	-3482	-5865	-9849	-5644	3523	-3281	-5881	-4984	-10987	-10627	-12873	-14336	-84286

Table 33: Monthly water volumes through the Crystal powerplant for Alternative D

	Crystal Monthly Power Volume (Acre-Ft)												Total
	Alt D												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1975	42827	39213	42245	121806	130832	108287	109193	125240	112986	86259	42517	54492	1015897
1976	43133	39141	40463	86948	114394	87419	106286	90271	70796	53769	18480	20955	772055
1977	20023	19966	28403	80369	86786	91542	95221	85867	56587	44424	20666	24494	654228
1978	25216	25396	32918	117124	126275	123958	84663	98997	73748	70411	34329	25622	838658
1979	32945	111216	78903	119838	128280	124909	111890	112921	77178	56325	26992	25508	1006907
1980	27656	101166	67388	120341	129064	124878	125728	125869	98203	79212	37229	49518	1086252
1981	37779	37050	48569	77883	79118	74998	87152	86985	58514	52294	25299	19043	684684
1982	24573	36754	24065	111914	127496	92118	117466	102743	100188	96483	87503	98590	1019892
1983	49142	43659	55517	104712	128603	124317	131234	131540	123564	116678	81865	108291	1199122
1984	129390	121041	123431	129702	130676	122086	128626	126531	121282	108076	115050	126481	1482372
1985	125402	94364	60587	120534	127616	123669	128971	127032	110811	92272	92318	113349	1316925
1986	108643	50557	125061	122565	128882	118087	128201	125543	117729	110341	103504	125653	1364765
1987	71057	54456	55771	112926	120640	125093	126034	119737	113241	90965	46892	57628	1094439
1988	34016	38290	32900	77749	89340	94908	125437	107893	63817	56648	18349	20343	759690
1989	22205	28474	45372	74249	82795	100555	125551	103916	93648	61968	21085	18427	778244
1990	20844	23502	34338	82220	78658	84677	110817	92216	64934	36214	18018	25543	671981
1991	30964	23698	32856	58776	120939	126389	127645	120159	99504	87788	48101	66874	943693
1992	34457	37754	35715	88565	87302	105363	127599	108549	99526	84507	45342	47628	882306
1993	34678	36194	124877	123479	132171	124670	128624	125622	117689	105349	77340	72132	1202828
1994	43928	39881	51305	80374	75686	117805	125644	94838	76397	61317	48473	55467	871095
1995	34304	24015	91645	120042	127529	124377	125601	127342	120784	115009	104424	121080	1236153
1996	58663	78451	120407	121912	127170	111160	125327	104180	84022	61176	52856	75225	1120549
1997	124781	113130	101778	93268	127096	125297	127735	120786	116268	109832	108509	119014	1387494
1998	53797	47129	68097	89987	122625	102300	125699	107251	96950	74579	48274	59036	993724
1999	27417	30476	56658	80772	97058	111402	126080	124080	117350	113676	89855	99072	1073896
2000	55387	51279	69217	95861	61276	107372	125952	92349	75973	67804	22030	30004	871505
2001	28833	21612	42326	88573	85879	118987	125953	98719	105385	76738	35391	44466	852862
2002	29276	24532	32770	75342	85178	93650	106623	85470	56150	36514	18556	20436	658498
2003	25129	24424	29699	64693	75920	70548	114757	107227	63941	52285	18088	22607	669317
2004	23965	25580	28476	49878	68825	75354	105638	100493	72689	45244	18358	19002	631803
2005	18790	17293	22208	90727	115494	85194	122657	89139	84642	61180	35068	34625	777016
Average	46426	47084	57967	94940	107728	107141	118655	108694	91758	76301	50347	58084	965124
Difference from No Action													
percent	-1.58%	-1.22%	-5.35%	-1.71%	-0.11%	-2.00%	-2.33%	-0.02%	-3.05%	-1.88%	-4.13%	-4.03%	-2.07%
acre-feet	-744	-579	-3274	-1655	-115	-2184	-2829	-24	-2891	-1459	-2168	-2442	-20365

Due to the smaller size of the powerplant at Crystal Reservoir, bypasses occur with a much greater frequency than at the other two Aspinall Unit reservoirs. Bypasses of the Crystal Powerplant occur when releases from the dam exceed 2150 cfs. Typically releases upstream at Morrow Point Dam are planned so that all water from Morrow Point can still be run through the powerplant at Crystal. However, spring runoff during wet or even average years can cause Aspinall Unit releases to increase to a point where the powerplant at Crystal must be bypassed.

Table 34 shows the number of days per year that water was released through the bypass tubes at Crystal Reservoir for the No Action Alternative and Alternatives A, B, C and D.

Table 34: Number of days per year that water bypasses the powerplant at Crystal Reservoir

Crystal Bypasses Number of Days/Year					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	82	94	91	91	91
1976	1	15	20	26	20
1977	0	0	0	0	0
1978	69	73	64	76	64
1979	65	168	122	116	122
1980	87	117	104	117	104
1981	0	0	0	0	0
1982	51	27	73	32	73
1983	113	114	124	103	110
1984	280	283	280	141	215
1985	136	140	142	164	142
1986	137	131	129	130	129
1987	79	70	79	81	79
1988	17	5	8	18	8
1989	31	21	11	20	31
1990	0	0	0	0	0
1991	43	45	42	51	42
1992	2	1	11	20	2
1993	141	101	101	150	97
1994	42	42	39	23	41
1995	148	156	155	139	148
1996	91	103	107	99	80
1997	117	108	130	99	130
1998	16	15	35	29	35
1999	70	74	67	54	45
2000	30	28	18	22	3
2001	48	47	47	30	19
2002	0	0	0	0	0
2003	0	7	11	18	5
2004	0	0	6	16	0
2005	31	27	21	1	24

Spillway usage at Crystal Reservoir primarily occurs during wetter hydrologic periods. Even though the combined powerplant and bypass tube capacity is only 4,150 cfs, which is less than the capacity of the upstream powerplant at Morrow Point, spillway usage at Crystal can generally be avoided with prudent operation of the Aspinall Unit reservoirs. Targets specified in the Flow Recommendations for average and wetter years will usually necessitate usage of the spillway at Crystal Dam. On rare occasions when downstream tributary flows are large enough to supply sufficient water to the Gunnison River, spillway usage at Crystal may not be needed to reach spring peak flow targets. However, the spring peak flow targets are high enough that it will typically take releases from the Aspinall Unit that will require spilling water at Crystal Reservoir. When inflows to Crystal Reservoir exceed 4,150 cfs water will go over the spillway. Table 35 shows the number of days per year during the study period that Crystal spills.

Table 35: Number of days per year that water is spilled from Crystal Reservoir

Crystal Spills					
Number of Days/Year					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	0	7	21	21	21
1976	0	6	11	17	11
1977	0	0	0	0	0
1978	0	0	16	27	16
1979	0	8	26	58	26
1980	0	11	16	47	16
1981	0	0	0	0	0
1982	0	7	16	18	16
1983	24	27	28	28	29
1984	78	76	78	103	78
1985	26	36	38	38	38
1986	15	26	24	48	24
1987	16	16	16	21	16
1988	0	0	0	1	0
1989	0	0	1	8	0
1990	0	0	0	0	0
1991	4	7	8	13	8
1992	0	0	0	10	0
1993	20	43	38	43	37
1994	0	0	2	12	0
1995	64	79	80	104	80
1996	0	12	22	27	22
1997	24	31	28	48	28
1998	0	5	2	4	2
1999	7	5	14	19	11
2000	0	0	8	3	0
2001	0	0	6	2	0
2002	0	0	0	0	0
2003	0	0	0	0	0
2004	0	0	0	0	0
2005	0	0	0	0	0

The Gunnison River flows into Black Canyon National Park a few miles below Crystal Reservoir. As such, flows in the canyon are directly influenced by releases at Crystal Reservoir. Attempts to meet spring flow targets in the Gunnison River at the Whitewater Gage will provide some benefit to the resources of the Black Canyon.

Table 36 shows peak flows in the Black Canyon, occurring in the month of May, as measured at the gage just downstream of the Gunnison Tunnel diversion dam. All action alternatives provide some level of spring peaks with greater magnitude and more frequency than the No Action Alternative.

Table 36: Peak flows in the Black Canyon occurring during the month of May

Gunnison River - Black Canyon May Peak Flow (cfs)					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	3323	6341	6839	6839	6839
1976	396	5129	4387	4984	4387
1977	450	476	476	476	476
1978	3602	3602	6051	6058	6051
1979	3655	5515	5071	4837	5071
1980	3564	6376	6253	6178	6253
1981	354	354	354	354	354
1982	3559	4935	6451	6054	6451
1983	3490	4496	2831	2831	4909
1984	4827	6429	4827	4827	4827
1985	3781	5800	7339	7449	7360
1986	3441	5108	6759	6712	6763
1987	3121	3549	3523	4249	3523
1988	355	1341	2921	3462	1341
1989	299	1793	3314	3732	299
1990	299	299	299	299	299
1991	3519	4177	4720	4706	4687
1992	653	642	3330	3940	642
1993	3681	5244	4458	4579	4471
1994	342	340	4167	4964	344
1995	3788	6690	6991	6991	6991
1996	3204	5209	8475	8775	8518
1997	3565	5388	7274	7366	7274
1998	3364	4803	3843	3940	3844
1999	435	4955	4944	5225	4944
2000	471	471	6204	4248	483
2001	1660	1660	5537	4089	1660
2002	439	476	476	476	476
2003	951	1793	2863	2863	1295
2004	299	299	2863	2990	299
2005	3527	3480	1535	1476	3533

Table 37 contains peak flows in the Black Canyon, occurring in the months of June or July. Annual peak flows in the Black Canyon are divided into these two categories because of how operations at the Aspinall Unit dictate the timing of spring peak flows. Typically when the annual peak occurs during the month of May, this is a result of operational releases from the Aspinall Unit intended to create a spring peak in the lower Gunnison River. When the annual peak occurs during the months of June or July this is usually a result of very wet hydrologic conditions that have caused the Aspinall Unit reservoirs to fill completely and spill excess water that cannot be stored.

Table 37: Peak flows in the Black Canyon occurring during the months of June or July

Gunnison River - Black Canyon June-July Peak Flow (cfs)					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	3320	3311	4506	4506	4506
1976	1293	895	1157	3487	1157
1977	438	806	806	806	806
1978	1739	1644	4430	5600	4430
1979	3646	4189	6684	7069	6684
1980	3190	2836	5299	6482	5299
1981	438	753	753	753	753
1982	2869	2146	4025	4428	4025
1983	10750	10081	10707	11212	9613
1984	10990	11076	10458	10906	10444
1985	11743	11564	9063	9248	9081
1986	5028	5652	6782	7062	6782
1987	5856	6611	6346	5955	6346
1988	1042	1038	918	1072	1038
1989	1051	1051	1003	3498	1051
1990	699	793	903	896	823
1991	4144	4446	3600	4848	3585
1992	1382	1212	2000	4350	1352
1993	5666	7573	7587	7596	7588
1994	1944	1946	1146	2908	1943
1995	12156	11750	11871	12560	11876
1996	2200	4114	5840	5989	5849
1997	7682	7462	7808	7994	7808
1998	1910	1614	1885	3408	1884
1999	3991	2791	5093	5673	4757
2000	1140	1227	3602	1626	1316
2001	1572	1572	1224	1164	1572
2002	438	858	858	858	858
2003	671	1242	1242	1242	1242
2004	840	911	981	1334	859
2005	1147	1134	1147	1074	1181

The total annual volume of water through the Black Canyon will not change under alternatives considered. Higher spring peak flows will result in lower flows at other times of the year. Tables 38-42 show average monthly flows for No Action and Action Alternatives for the study period.

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Table 38: Average monthly flows for the Gunnison River in the Black Canyon for the No Action Alternative

	Gunnison River - Black Canyon Average Monthly Flow (cfs)											
	Jan	Feb	Mar	Apr	No Action				Sep	Oct	Nov	Dec
					May	Jun	Jul	Aug				
1975	426	415	707	2191	3062	1905	1567	1161	1108	835	791	1007
1976	695	689	547	601	342	777	1106	526	575	504	406	363
1977	327	336	354	445	421	425	423	427	434	309	351	371
1978	387	384	424	1543	1822	1694	1143	827	571	395	334	418
1979	1179	2130	2142	2227	2647	1917	1348	1024	907	671	652	759
1980	520	2004	1356	2089	2958	2220	1157	996	781	699	762	976
1981	601	479	472	300	300	352	359	368	303	209	300	308
1982	483	734	353	1413	2342	1283	1247	875	1160	1350	1652	1723
1983	575	859	859	1149	1762	4239	4011	1789	1197	1260	1075	1763
1984	2150	2150	2018	3044	4322	7328	4585	1563	1335	1464	2029	2384
1985	2105	1699	985	1972	2985	6257	1932	1093	1076	1131	1575	1869
1986	1765	911	2117	1504	2469	2145	3244	1042	1207	1370	1750	2215
1987	1156	980	866	1083	1710	3546	1165	922	946	817	804	954
1988	515	680	514	565	324	533	1023	495	361	368	309	334
1989	395	536	764	346	298	626	1024	474	502	299	300	300
1990	322	373	401	354	296	443	605	362	313	299	370	406
1991	518	440	504	666	1934	2231	1215	1057	1017	945	837	1119
1992	543	539	539	555	545	857	1171	808	837	764	737	774
1993	486	582	2002	2519	3447	4049	2145	1152	1165	1107	1195	1164
1994	706	704	704	590	916	1166	1140	556	517	559	811	699
1995	564	423	1392	2045	3455	5673	7889	1661	1239	1413	1675	1972
1996	953	1355	1819	1641	2987	1556	1177	806	727	712	1033	1402
1997	2131	2118	1618	1420	2537	4582	1642	1127	1277	1332	1815	1931
1998	573	643	842	945	1593	762	1154	734	726	604	766	935
1999	440	527	656	369	430	2148	1535	1218	1365	1458	1561	1675
2000	922	920	919	791	393	758	1126	460	410	468	375	482
2001	462	380	512	345	485	1140	1153	614	832	636	559	717
2002	464	432	393	370	393	409	435	435	335	299	301	303
2003	351	372	387	354	357	354	436	436	331	299	301	309
2004	368	395	349	299	298	489	813	366	317	299	300	300
2005	300	885	532	595	1570	573	1095	533	532	420	611	585
	773	651	900	1143	1578	2000	1633	830	787	756	861	905

Table 39: Average monthly flows for the Gunnison River in the Black Canyon for the Alternative A

	Gunnison River - Black Canyon Average Monthly Flow (cfs)											
	Jan	Feb	Mar	Apr	Alt A				Sep	Oct	Nov	Dec
					May	Jun	Jul	Aug				
1975	567	706	670	1400	2532	1703	1965	1181	1130	855	815	1033
1976	866	683	592	594	1682	516	881	513	366	321	311	341
1977	326	349	419	473	422	422	423	427	434	309	351	371
1978	410	457	435	1200	1604	1503	1126	811	556	618	496	418
1979	1016	2119	2142	1527	2727	1929	1349	1049	911	674	658	763
1980	530	2005	1345	1427	3116	2362	1323	1196	811	830	662	876
1981	612	664	464	370	300	390	400	397	303	299	300	310
1982	388	652	259	1230	2528	1210	1251	882	1167	1355	1656	1730
1983	579	862	862	1146	1836	4394	3822	1756	1197	1280	1377	1763
1984	2150	2150	2018	3045	4475	7130	4752	1552	1310	1464	2029	2384
1985	2105	1699	986	1833	3205	6159	1854	1156	1068	1112	1553	1845
1986	1767	910	2117	1235	2556	2346	3345	1041	1204	1360	1749	2203
1987	1156	981	861	1082	1770	3552	1179	909	933	808	790	940
1988	549	663	536	580	397	521	1001	604	315	348	305	323
1989	356	510	736	345	462	610	1024	501	455	299	300	300
1990	339	423	406	354	298	427	639	504	301	299	300	379
1991	499	418	476	656	1823	2329	1217	1059	1019	948	839	1121
1992	576	553	540	515	505	818	1171	801	832	779	731	767
1993	559	546	1989	1685	3047	5193	2237	1152	1158	1099	1155	1155
1994	702	700	700	587	317	1174	1140	563	515	560	812	897
1995	564	423	1392	1609	3285	6179	8115	1504	1239	1398	1643	1955
1996	940	1362	1825	1267	2515	2066	1248	901	760	742	1066	1440
1997	2132	2117	1618	1425	2896	4427	1923	1130	1277	1332	1817	1930
1998	572	642	842	945	2141	715	1145	713	708	565	768	911
1999	440	545	681	364	1527	1254	1395	1161	1362	1449	1551	1664
2000	926	914	914	793	395	775	1129	496	395	459	363	479
2001	462	380	512	345	485	1140	1153	614	832	636	559	717
2002	464	432	393	370	393	409	435	435	335	299	301	322
2003	359	431	396	365	520	384	874	746	315	299	301	348
2004	392	434	346	299	298	326	697	567	309	299	300	303
2005	300	304	299	527	1254	519	1089	518	515	405	595	571
	780	853	856	964	1658	2039	1668	869	778	759	853	967

Appendix A

Table 40: Average monthly flows for the Gunnison River in the Black Canyon for the Alternative B

	Gunnison River - Black Canyon Average Monthly Flow (cfs)											
	Alt B											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1975	887	706	670	1400	3309	2361	1173	1181	995	741	651	885
1976	701	680	570	560	2148	500	745	481	313	299	311	341
1977	326	349	419	473	422	561	565	477	456	327	337	398
1978	410	457	435	1187	2757	3014	448	600	391	627	466	417
1979	536	2103	1276	1787	2495	4167	1427	872	391	309	340	415
1980	480	1759	1061	1382	3403	2425	1172	1195	782	814	625	805
1981	514	667	441	357	300	390	400	397	303	299	300	310
1982	400	662	301	1231	2858	1662	1081	783	1047	1242	1471	1603
1983	799	786	786	1176	1806	4652	3891	1726	1197	1264	1357	1741
1984	2150	2150	2016	3044	4324	7329	4707	1580	1310	1484	2030	2365
1985	2105	1689	985	1833	3480	9068	1667	1158	1065	1111	1651	1843
1986	1767	910	2117	1235	2809	5605	1913	1034	1201	1352	1739	2192
1987	1156	981	855	1082	1944	3395	1175	905	930	804	765	937
1988	549	663	534	500	797	475	801	600	302	299	306	323
1989	305	451	679	344	1008	553	922	463	372	299	300	300
1990	339	423	406	354	298	392	572	500	301	299	300	355
1991	443	382	410	655	2276	2065	1195	1023	975	918	803	1082
1992	560	650	516	616	1001	802	1171	699	729	667	624	650
1993	587	649	1599	1685	2525	5337	2189	1152	1165	1108	1194	1163
1994	706	704	704	500	1204	667	1140	485	411	467	703	778
1995	559	421	1389	1585	4207	5482	7872	1672	1239	1410	1674	1967
1996	951	1366	1820	1267	4069	1694	1149	704	557	564	850	1213
1997	2128	2119	1620	1376	3281	4177	1833	1123	1277	1332	1817	1930
1998	572	842	842	945	1873	772	1162	752	747	620	807	956
1999	439	545	682	372	1718	1828	1172	968	1330	1356	1441	1548
2000	567	657	657	515	1853	1046	805	439	299	299	300	300
2001	302	321	335	325	1806	658	1153	426	643	472	398	507
2002	471	428	389	333	393	675	637	447	335	299	301	322
2003	399	431	396	365	819	384	874	748	315	299	301	348
2004	382	434	346	299	760	324	703	587	309	299	300	303
2005	500	304	299	637	668	515	1098	529	527	416	606	564
	750	836	843	971	2026	2186	1513	829	717	713	805	932

Table 41: Average monthly flows for the Gunnison River in the Black Canyon for the Alternative C

	Gunnison River - Black Canyon Average Monthly Flow (cfs)											
	Alt C											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1975	887	706	670	1400	3309	2361	1173	1181	995	741	651	885
1976	701	680	570	560	2530	799	548	463	304	299	311	341
1977	326	349	419	473	422	561	565	477	456	327	337	398
1978	410	457	435	1145	2958	3812	1202	588	391	627	466	417
1979	536	1261	469	1725	2397	5475	4552	858	359	309	340	415
1980	447	522	580	1159	2566	5024	2403	1252	587	788	491	510
1981	411	672	411	342	300	390	400	397	303	299	300	310
1982	315	343	299	299	1746	2400	498	302	464	735	877	955
1983	855	861	526	1184	1512	5027	3877	1738	1197	1279	1375	1761
1984	2150	2150	2016	3045	4309	7305	6713	3179	734	629	850	1216
1985	2112	1696	635	1682	3539	8804	1585	1156	1064	1109	1549	1841
1986	1767	910	2117	1235	2918	5842	2577	779	644	755	1042	1435
1987	1173	971	491	1023	2487	3290	1163	903	927	801	765	933
1988	550	563	534	579	1581	417	695	596	302	299	306	323
1989	305	305	299	342	1450	933	699	450	319	299	300	300
1990	339	423	406	354	298	342	492	521	301	299	300	355
1991	386	389	361	559	2206	2252	1184	953	908	857	732	1004
1992	540	554	473	814	1184	1659	1005	553	585	564	460	520
1993	568	629	1987	1685	2945	5350	2745	1072	1033	991	1050	1016
1994	634	634	633	531	2371	833	972	435	295	299	462	513
1995	560	420	1388	1581	4091	5611	8100	5660	561	370	397	581
1996	801	1527	1952	1237	4105	2357	1095	575	425	453	729	1070
1997	2124	2121	1622	1339	3280	5089	2515	871	785	902	1314	1381
1998	816	634	631	1014	2036	1265	1158	744	737	612	795	945
1999	440	545	682	370	1761	2681	1121	828	1220	1192	1250	1340
2000	762	756	765	657	1333	733	1100	452	299	306	300	316
2001	462	380	512	345	1252	815	1153	623	741	557	495	615
2002	469	429	365	343	393	575	637	447	335	299	301	322
2003	399	431	396	365	1208	384	874	748	315	299	301	348
2004	382	434	346	299	1422	385	703	587	309	299	300	303
2005	500	304	299	343	501	400	975	447	444	343	525	501
	714	744	751	911	2090	2644	1758	950	692	661	642	747

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Table 42: Average monthly flows for the Gunnison River in the Black Canyon for the Alternative D

Gunnison River - Black Canyon Average Monthly Flow (cfs)												
	Alt D											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1975	667	706	670	1400	3309	2361	1173	1181	996	741	651	865
1976	701	680	670	560	2148	500	746	481	313	299	311	341
1977	326	349	419	473	422	561	565	477	455	327	337	398
1978	410	467	435	1187	2757	3014	445	600	391	627	455	417
1979	536	2103	1276	1787	2495	4167	1427	872	391	309	340	415
1980	460	1759	1061	1382	3403	2425	1172	1195	782	814	625	805
1981	614	667	441	357	300	390	400	397	303	299	300	310
1982	400	662	301	1231	2858	1662	1081	763	1047	1242	1471	1603
1983	799	786	786	1176	2261	4155	3872	1741	1197	1279	1078	1761
1984	2160	2160	2018	3046	4310	7329	4725	1642	1310	1464	2029	2384
1985	2105	1699	985	1633	3489	6065	1664	1156	1006	1111	1651	1843
1986	1767	910	2117	1235	2808	3608	1913	1034	1201	1352	1739	2192
1987	1166	981	655	1082	1944	3396	1175	906	930	804	766	937
1988	549	663	634	580	397	621	1002	604	316	346	306	323
1989	367	510	736	345	298	626	1024	517	486	299	300	300
1990	339	423	406	354	296	436	667	501	301	299	300	412
1991	501	424	486	666	2272	2083	1196	1021	877	916	802	1080
1992	569	663	617	616	516	843	1171	802	833	779	732	766
1993	569	546	1959	1585	2928	5310	2193	1153	1171	1110	1199	1169
1994	709	707	706	592	319	1162	1140	660	515	557	809	894
1995	564	423	1362	1606	4005	5466	7886	1656	1239	1409	1672	1963
1996	960	1350	1821	1267	4065	1596	1149	704	557	565	890	1213
1997	2126	2119	1620	1376	3281	4177	1833	1123	1277	1332	1817	1930
1998	672	842	842	945	1873	772	1162	752	747	620	807	956
1999	439	546	682	372	1716	1678	1193	1037	1346	1403	1495	1607
2000	697	880	885	805	407	826	1126	501	401	401	366	482
2001	662	380	612	345	485	1140	1163	614	832	636	669	717
2002	664	432	393	370	393	675	637	447	335	299	301	323
2003	599	431	396	366	430	384	874	746	316	299	301	346
2004	382	434	346	289	298	337	684	667	309	299	300	303
2006	300	304	299	662	1326	661	1083	612	610	400	669	663
	750	642	655	601	1805	2194	1533	845	737	732	825	956

Appendix A

Recreational and fishery values are affected by various flow levels in the Black Canyon and downstream Gunnison Gorge. Tables 43 through 54 present various flow data for the No Action and Action Alternatives.

Table 43: Number of days in the Gunnison River in the Black Canyon with flows between 400 cfs and 1,200 cfs from May through September

Gunnison River in Black Canyon Days 400-1200 cfs May-Sep					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	89	82	100	100	100
1976	113	75	72	56	72
1977	136	131	131	131	131
1978	96	108	68	57	68
1979	78	78	59	29	59
1980	87	75	77	48	77
1981	42	40	40	40	40
1982	96	98	109	47	109
1983	31	31	31	31	31
1984	9	10	9	43	10
1985	61	56	56	68	56
1986	44	48	59	77	59
1987	100	100	101	99	101
1988	78	80	77	77	80
1989	110	112	71	71	110
1990	61	72	72	53	72
1991	109	106	110	114	110
1992	144	145	136	133	144
1993	71	74	71	76	61
1994	109	109	115	68	109
1995	29	30	29	30	30
1996	101	105	122	113	122
1997	28	27	27	77	27
1998	123	123	123	116	123
1999	73	75	98	99	91
2000	132	102	78	79	125
2001	111	111	111	122	111
2002	110	109	109	109	109
2003	80	78	78	74	78
2004	68	63	67	67	65
2005	141	143	151	111	142
Average	85.8	83.7	82.5	77.9	84.6

Table 44: Number of days in the Gunnison River in the Black Canyon with flows exceeding 3,000 cfs from May through September

Gunnison River in Black Canyon Days > 3000 cfs May-Sep					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	20	13	31	31	31
1976	0	7	12	18	12
1977	0	0	0	0	0
1978	5	4	32	42	32
1979	11	11	34	64	34
1980	15	17	22	52	22
1981	0	0	0	0	0
1982	12	11	21	24	21
1983	44	40	36	41	40
1984	80	80	80	106	81
1985	41	41	40	40	40
1986	31	32	29	50	29
1987	20	22	24	31	24
1988	0	0	0	5	0
1989	0	0	2	11	0
1990	0	0	0	0	0
1991	13	13	14	18	14
1992	0	0	3	13	0
1993	68	55	56	61	55
1994	0	0	4	14	0
1995	94	82	83	106	83
1996	17	15	23	28	23
1997	40	38	33	50	33
1998	9	8	4	9	4
1999	11	7	15	22	13
2000	0	0	9	4	0
2001	0	0	8	4	0
2002	0	0	0	0	0
2003	0	0	0	0	0
2004	0	0	0	0	0
2005	3	1	0	0	2
Average	17.2	16.0	19.8	27.2	19.1

Appendix A

Table 45: Number of days in the Gunnison River in the Black Canyon with flows exceeding 3,000 cfs during the month of June

Gunnison River in Black Canyon Days > 3000 cfs June					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	1	0	13	13	13
1976	0	0	0	2	0
1977	0	0	0	0	0
1978	0	0	18	25	18
1979	3	3	21	30	21
1980	2	0	5	30	5
1981	0	0	0	0	0
1982	0	0	9	15	9
1983	17	17	17	20	13
1984	30	30	30	30	30
1985	30	30	30	30	30
1986	5	6	20	30	20
1987	18	18	17	15	17
1988	0	0	0	0	0
1989	0	0	0	2	0
1990	0	0	0	0	0
1991	6	8	2	7	2
1992	0	0	0	8	0
1993	30	30	30	30	30
1994	0	0	0	0	0
1995	30	30	30	30	30
1996	0	5	5	10	5
1997	25	23	20	30	20
1998	0	0	0	4	0
1999	11	0	6	13	4
2000	0	0	2	0	0
2001	0	0	0	0	0
2002	0	0	0	0	0
2003	0	0	0	0	0
2004	0	0	0	0	0
2005	0	0	0	0	0
Average	6.7	6.5	8.9	12.1	8.6

Table 46: Number of days in the Gunnison River in the Black Canyon with flows between 500 cfs and 1,000 cfs from May through September

Gunnison River in Black Canyon Days 500-1000 cfs May-Sep					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	19	2	45	45	45
1976	80	70	65	43	65
1977	0	55	55	55	55
1978	67	75	47	48	47
1979	30	30	41	18	41
1980	61	29	28	27	28
1981	0	17	17	17	17
1982	38	38	41	12	41
1983	0	0	0	0	0
1984	0	0	0	32	0
1985	0	0	0	0	0
1986	0	0	5	72	5
1987	71	71	72	61	72
1988	44	53	73	55	53
1989	28	31	55	57	33
1990	48	56	48	31	56
1991	4	2	33	67	33
1992	95	97	91	108	95
1993	0	0	0	0	0
1994	73	73	24	41	73
1995	0	0	0	30	0
1996	61	66	78	49	78
1997	0	0	0	77	0
1998	90	91	90	83	90
1999	2	5	42	48	8
2000	25	33	57	43	32
2001	78	78	49	89	78
2002	0	50	50	50	50
2003	6	65	64	61	64
2004	47	53	54	55	54
2005	89	105	94	22	102
Average	34.1	40.2	42.5	45.0	42.4

Appendix A

Table 47: Number of days in the Gunnison River in the Black Canyon with flows less than 400 cfs from May through September

Gunnison River in Black Canyon Days < 400 cfs May-Sep					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	0	0	1	1	1
1976	39	63	61	71	61
1977	17	22	22	22	22
1978	0	0	37	37	37
1979	0	0	18	27	18
1980	0	0	0	15	0
1981	111	113	113	113	113
1982	0	0	0	74	0
1983	0	0	0	0	0
1984	0	0	0	0	0
1985	0	0	0	0	0
1986	0	0	0	2	0
1987	0	0	0	0	0
1988	75	72	68	59	72
1989	43	38	72	63	43
1990	92	81	81	100	81
1991	0	0	0	0	0
1992	0	0	0	0	0
1993	0	0	0	0	0
1994	32	32	26	62	32
1995	0	0	0	0	0
1996	0	0	0	4	0
1997	0	0	0	0	0
1998	0	0	0	0	0
1999	4	9	1	1	4
2000	21	50	57	61	26
2001	25	25	25	19	25
2002	43	44	44	44	44
2003	73	70	65	62	72
2004	85	90	78	69	88
2005	0	0	0	39	0
Average	21.3	22.9	24.8	30.5	23.8

Table 48: Number of days in the Gunnison River in the Black Canyon with flows at 300 cfs from May through October

Gunnison River in Black Canyon Days at 300 cfs May-Oct					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	0	0	1	1	1
1976	25	17	62	60	62
1977	30	31	31	31	31
1978	0	3	33	33	33
1979	0	0	25	48	25
1980	0	0	0	11	0
1981	128	131	131	131	131
1982	0	0	0	65	0
1983	0	0	0	0	0
1984	0	0	0	0	0
1985	0	0	0	0	0
1986	0	0	0	0	0
1987	0	0	0	0	0
1988	31	57	79	72	57
1989	74	69	63	83	74
1990	111	103	102	108	104
1991	0	0	0	0	0
1992	0	0	0	0	0
1993	0	0	0	0	0
1994	17	17	11	85	17
1995	0	0	0	0	0
1996	0	0	0	0	0
1997	0	0	0	0	0
1998	0	0	0	0	0
1999	4	9	1	0	3
2000	0	0	68	30	0
2001	25	25	25	17	25
2002	64	64	64	64	64
2003	98	94	89	86	96
2004	108	111	104	95	104
2005	0	0	0	32	0
Average	23.1	23.6	28.7	33.9	26.7

Appendix A

Table 49: Number of days in the Gunnison River in the Black Canyon with flows less than 600 cfs from May through October

Gunnison River in Black Canyon Days < 600 cfs May-Oct					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	0	0	4	4	4
1976	131	122	128	151	128
1977	184	154	154	154	154
1978	61	40	75	71	75
1979	0	0	70	66	70
1980	0	5	6	33	6
1981	184	178	178	178	178
1982	0	0	16	110	16
1983	0	0	0	0	0
1984	0	0	0	28	0
1985	0	0	0	0	0
1986	0	0	3	12	3
1987	0	0	0	0	0
1988	137	115	115	116	115
1989	136	131	117	132	128
1990	152	154	173	171	145
1991	0	0	0	0	0
1992	24	31	18	93	24
1993	0	0	0	0	0
1994	122	122	119	109	122
1995	0	0	0	60	0
1996	0	0	54	102	54
1997	0	0	0	24	0
1998	17	17	17	17	17
1999	35	28	27	29	22
2000	130	127	113	114	120
2001	43	43	87	83	43
2002	184	143	143	143	143
2003	179	119	114	109	121
2004	137	148	138	129	148
2005	112	121	127	143	119
Average	63.5	58.0	64.4	76.8	63.1

Table 50: Number of days in the Gunnison River in the Black Canyon with flows between 600 cfs and 900 cfs from May through October

Gunnison River in Black Canyon Days 600-900 cfs May-Oct					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	22	17	41	41	41
1976	3	46	35	6	35
1977	0	30	30	30	30
1978	36	66	47	49	47
1979	31	31	31	11	31
1980	61	43	41	29	41
1981	0	6	6	6	6
1982	31	31	38	36	38
1983	0	0	0	0	0
1984	0	0	0	45	0
1985	0	0	0	0	0
1986	0	0	1	94	1
1987	31	31	31	31	31
1988	16	36	54	50	36
1989	17	18	35	32	25
1990	32	30	10	13	39
1991	18	17	17	20	17
1992	109	102	114	38	109
1993	0	0	0	7	0
1994	2	2	12	21	2
1995	0	0	0	0	0
1996	91	84	53	4	53
1997	0	0	0	70	0
1998	104	105	104	97	104
1999	1	2	2	31	7
2000	6	9	53	26	14
2001	75	75	40	40	75
2002	0	41	41	41	41
2003	4	40	41	39	41
2004	47	35	34	33	36
2005	10	21	20	12	20
Average	24.1	29.6	30.0	30.7	29.7

Appendix A

Table 51: Number of days in the Gunnison River in the Black Canyon with flows between 900 cfs and 1,500 cfs from May through October

Gunnison River in Black Canyon Days 900-1500 cfs May-Oct					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	101	113	92	92	92
1976	50	3	2	3	2
1977	0	0	0	0	0
1978	44	50	15	7	15
1979	86	96	24	27	24
1980	61	78	85	45	85
1981	0	0	0	0	0
1982	114	112	97	8	97
1983	91	92	89	88	90
1984	64	66	66	1	67
1985	92	106	106	107	107
1986	85	88	97	11	97
1987	104	103	104	100	104
1988	31	33	9	3	33
1989	31	34	23	2	31
1990	0	0	1	0	0
1991	130	130	129	130	128
1992	51	51	43	35	51
1993	107	108	109	103	109
1994	55	55	42	33	55
1995	73	87	85	12	83
1996	44	58	47	43	47
1997	106	105	105	15	105
1998	47	47	48	48	48
1999	90	95	116	96	114
2000	48	48	2	33	50
2001	60	60	42	50	60
2002	0	0	0	0	0
2003	1	24	23	23	22
2004	0	1	6	7	0
2005	52	34	35	29	36
Average	58.6	60.5	53.0	37.1	56.5

Table 52: Number of days in the Gunnison River in the Black Canyon with flows between 1,500 cfs and 3,000 cfs from May through October

Gunnison River in Black Canyon Days 1500-3000 cfs May-Oct					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	41	41	16	16	16
1976	0	6	7	6	7
1977	0	0	0	0	0
1978	38	24	15	15	15
1979	56	46	25	16	25
1980	47	41	30	25	30
1981	0	0	0	0	0
1982	27	30	12	6	12
1983	49	52	59	55	54
1984	40	38	38	4	36
1985	51	37	38	37	37
1986	68	64	54	17	54
1987	29	28	25	22	25
1988	0	0	6	10	0
1989	0	1	7	7	0
1990	0	0	0	0	0
1991	23	24	24	16	25
1992	0	0	6	5	0
1993	9	21	19	13	20
1994	5	5	7	7	5
1995	17	15	16	6	18
1996	32	27	7	7	7
1997	38	41	46	25	46
1998	7	7	11	13	11
1999	47	52	24	6	28
2000	0	0	7	7	0
2001	6	6	7	7	6
2002	0	0	0	0	0
2003	0	1	6	13	0
2004	0	0	6	15	0
2005	7	7	2	0	7
Average	20.5	19.8	16.8	12.1	15.6

Appendix A

Table 53: Number of days in the Gunnison River in the Black Canyon with flows between 3,000 cfs and 5,000 cfs from May through October

Gunnison River in Black Canyon Days 3000-5000 cfs May-Oct					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	20	10	25	25	25
1976	0	6	12	18	12
1977	0	0	0	0	0
1978	5	4	28	34	28
1979	11	6	20	23	20
1980	15	10	10	20	10
1981	0	0	0	0	0
1982	12	11	16	21	16
1983	28	22	17	22	22
1984	39	40	39	38	39
1985	21	15	12	13	12
1986	30	27	15	10	15
1987	16	17	21	29	21
1988	0	0	0	5	0
1989	0	0	2	11	0
1990	0	0	0	0	0
1991	13	13	14	18	14
1992	0	0	3	13	0
1993	62	35	38	36	40
1994	0	0	4	14	0
1995	61	35	31	25	38
1996	17	11	6	6	6
1997	26	21	16	13	16
1998	9	8	4	9	4
1999	11	7	13	13	13
2000	0	0	6	4	0
2001	0	0	6	4	0
2002	0	0	0	0	0
2003	0	0	0	0	0
2004	0	0	0	0	0
2005	3	1	0	0	2
Average	12.9	9.6	11.5	13.7	11.4

Table 54: Number of days in the Gunnison River in the Black Canyon with flows greater than 5,000 cfs from May through October

Gunnison River in Black Canyon Days > 5000 cfs May-Oct					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	0	3	6	6	6
1976	0	1	0	0	0
1977	0	0	0	0	0
1978	0	0	4	8	4
1979	0	5	14	41	14
1980	0	7	12	32	12
1981	0	0	0	0	0
1982	0	0	5	3	5
1983	16	18	19	19	18
1984	41	40	41	68	42
1985	20	26	28	27	28
1986	1	5	14	40	14
1987	4	5	3	2	3
1988	0	0	0	0	0
1989	0	0	0	0	0
1990	0	0	0	0	0
1991	0	0	0	0	0
1992	0	0	0	0	0
1993	6	20	18	25	15
1994	0	0	0	0	0
1995	33	47	52	81	45
1996	0	4	17	22	17
1997	14	17	17	37	17
1998	0	0	0	0	0
1999	0	0	2	9	0
2000	0	0	3	0	0
2001	0	0	2	0	0
2002	0	0	0	0	0
2003	0	0	0	0	0
2004	0	0	0	0	0
2005	0	0	0	0	0
Average	4.4	6.4	8.3	13.5	7.7

The city of Delta is located on the banks of the Gunnison River downstream of the confluence of the mainstem of the Gunnison River with the North Fork of the Gunnison River. The city's proximity to the river gives it the highest potential for flood damage along the entire stretch of the mainstem Gunnison River downstream of the Aspinall Unit to the confluence with the Colorado River at Grand Junction.

Operations of the Aspinall Unit to create or enhance the spring peak on the Gunnison River at the Whitewater gage have a direct impact on the potential for flooding in the city of Delta. Table 55 shows the peak flow in the Gunnison River occurring during the month of May as measured at the gage at Delta. Annual spring peaks that occur during May are typically enhanced by releases from the Aspinall Unit. These releases are intended to coincide with the annual peak on the North Fork of the Gunnison River in

order to achieve the spring peak flow targets at the Whitewater gage with using minimal amounts of storage from Blue Mesa Reservoir.

Table 55: Peak flows in the Gunnison River occurring during the month of May as measured at the gage at Delta

Gunnison River @ Delta					
May Peak Flow (cfs)					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	7019	9828	10308	10308	10308
1976	3889	7281	6649	6754	6649
1977	900	895	895	895	895
1978	8964	8964	9677	9423	9677
1979	11153	12935	12144	11922	12144
1980	12722	15100	15047	14488	15047
1981	2651	2651	2651	2651	2651
1982	6807	8006	9374	8664	9374
1983	13364	14034	12712	12712	12712
1984	16421	16386	16421	16421	16421
1985	9655	11542	13047	13237	13098
1986	8744	10338	11878	11887	11878
1987	7503	8074	7596	8214	7596
1988	2133	2723	4536	4754	2723
1989	1988	3146	4879	5081	1988
1990	1456	1456	1456	1456	1456
1991	6939	7461	7119	7040	7104
1992	4101	4111	6647	6740	4108
1993	15696	17260	16146	16338	16176
1994	3294	3292	6282	6538	3295
1995	10805	11924	12919	12920	12919
1996	7291	9136	11931	12202	11959
1997	9475	11256	12145	12085	12146
1998	8281	8454	7396	7551	7396
1999	3284	7091	7100	7497	7100
2000	2872	2875	7122	5588	2891
2001	2950	2950	6910	5956	2950
2002	842	842	842	842	842
2003	4499	4499	6144	6421	4499
2004	2390	2390	4451	4728	2390
2005	10278	10021	7603	7771	10070

Table 56 shows the peak flows in the Gunnison River that occur during the months of June or July. Annual peak flows that occur during the months of June or July are typically products of wet years where Blue Mesa Reservoir has filled and the spillways are in use at the Aspinall Unit reservoirs.

Table 56: Annual peak flows in the Gunnison River occurring during the months of June or July as measured at the gage at Delta

Gunnison River @ Delta June-July Peak Flow (cfs)					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	6055	5964	7388	7388	7388
1976	2377	1887	2598	4900	2598
1977	689	876	876	876	876
1978	5784	5688	7752	7803	7752
1979	7759	8500	10433	11343	10433
1980	8521	8334	10817	12266	10817
1981	1775	1775	1775	1775	1775
1982	5768	5026	6950	7062	6950
1983	18507	17586	18413	16710	17146
1984	17922	17843	17923	17898	17921
1985	17209	16908	13956	13999	13955
1986	8343	8444	12406	12713	12405
1987	8194	9137	9015	8381	9015
1988	1951	1951	1951	2187	1951
1989	1622	1622	1484	4519	1622
1990	1602	1602	1602	1602	1602
1991	5589	5908	5182	6117	5168
1992	2476	2441	4180	6136	2453
1993	10824	12001	11997	11994	11997
1994	3177	3186	2153	4897	3172
1995	16522	15951	16471	16526	16474
1996	3331	4796	6834	7489	6841
1997	10224	9805	12754	13699	12755
1998	5567	5283	5541	6973	5541
1999	5350	4161	6970	7277	6601
2000	1946	2042	5087	3087	2152
2001	2807	2807	2649	1757	2807
2002	690	816	816	816	816
2003	3894	3894	3894	3894	3894
2004	1599	1599	1599	2143	1599
2005	4305	4195	4840	4785	4884

While the magnitude of spring peak flows is the first indicator of potential flood damage, another important parameter to analyze is the duration of high flows. Extended periods of high flows can significantly increase damages if flooding is occurring. Table 57 shows the number of days per year that flows in the Gunnison River as measured at the gage at Delta exceeded 15,000 cfs. Flows of this magnitude may cause fairly significant flooding within the city of Delta and in lands near the river outside of the city.

Table 57: Number of days per year that flows in the Gunnison River exceeded 15,000 cfs as measured at the gage at Delta

Gunnison River @ Delta					
Days > 15000 cfs					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	0	0	0	0	0
1976	0	0	0	0	0
1977	0	0	0	0	0
1978	0	0	0	0	0
1979	0	0	0	0	0
1980	0	2	1	0	1
1981	0	0	0	0	0
1982	0	0	0	0	0
1983	2	2	2	3	2
1984	5	8	5	5	5
1985	1	1	0	0	0
1986	0	0	0	0	0
1987	0	0	0	0	0
1988	0	0	0	0	0
1989	0	0	0	0	0
1990	0	0	0	0	0
1991	0	0	0	0	0
1992	0	0	0	0	0
1993	1	2	1	1	1
1994	0	0	0	0	0
1995	2	3	3	3	3
1996	0	0	0	0	0
1997	0	0	0	0	0
1998	0	0	0	0	0
1999	0	0	0	0	0
2000	0	0	0	0	0
2001	0	0	0	0	0
2002	0	0	0	0	0
2003	0	0	0	0	0
2004	0	0	0	0	0
2005	0	0	0	0	0

Table 58 shows the number of days per year that flows in the Gunnison River as measured at the gage at Delta exceeded 14,000 cfs. Operating criteria in the Riverware model attempt to reduce releases from the Aspinall Unit once flows at Delta exceed 14,000 cfs in an effort to keep the flows from exceeding 15,000 cfs.

Table 58: Number of days per year that flows in the Gunnison River exceeded 14,000 cfs as measured at the gage at Delta

Gunnison River @ Delta					
Days > 14000 cfs					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	0	0	0	0	0
1976	0	0	0	0	0
1977	0	0	0	0	0
1978	0	0	0	0	0
1979	0	0	0	0	0
1980	0	3	3	1	3
1981	0	0	0	0	0
1982	0	0	0	0	0
1983	3	3	3	6	2
1984	12	13	12	12	12
1985	3	3	0	0	0
1986	0	0	0	0	0
1987	0	0	0	0	0
1988	0	0	0	0	0
1989	0	0	0	0	0
1990	0	0	0	0	0
1991	0	0	0	0	0
1992	0	0	0	0	0
1993	2	4	3	4	3
1994	0	0	0	0	0
1995	6	5	3	7	3
1996	0	0	0	0	0
1997	0	0	0	0	0
1998	0	0	0	0	0
1999	0	0	0	0	0
2000	0	0	0	0	0
2001	0	0	0	0	0
2002	0	0	0	0	0
2003	0	0	0	0	0
2004	0	0	0	0	0
2005	0	0	0	0	0

Table 59 shows the number of days per year that flows in the Gunnison River as measured at the gage at Delta exceeded 12,000 cfs. Generally when the river at the Delta gage exceeds 12,000 cfs, this can initiate preparations for flooding if there is a possibility that the river flows will continue to increase.

Table 59: Number of days per year that flows in the Gunnison River exceeded 12,000 cfs as measured at the gage at Delta

Gunnison River @ Delta					
Days > 12000 cfs					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	0	0	0	0	0
1976	0	0	0	0	0
1977	0	0	0	0	0
1978	0	0	0	0	0
1979	0	3	1	0	1
1980	2	7	9	9	9
1981	0	0	0	0	0
1982	0	0	0	0	0
1983	7	11	9	9	8
1984	36	35	35	34	35
1985	5	5	13	21	13
1986	0	0	3	5	3
1987	0	0	0	0	0
1988	0	0	0	0	0
1989	0	0	0	0	0
1990	0	0	0	0	0
1991	0	0	0	0	0
1992	0	0	0	0	0
1993	9	10	10	11	10
1994	0	0	0	0	0
1995	20	32	21	27	22
1996	0	0	0	1	0
1997	0	0	3	9	3
1998	0	0	0	0	0
1999	0	0	0	0	0
2000	0	0	0	0	0
2001	0	0	0	0	0
2002	0	0	0	0	0
2003	0	0	0	0	0
2004	0	0	0	0	0
2005	0	0	0	0	0

Table 60 shows the number of days per year that flows in the Gunnison River as measured at the gage at Delta exceeded 10,000 cfs. It is assumed that when the Gunnison River through Delta stays below 10,000 cfs there is no immediate threat of flooding in the city.

Table 60: Number of days per year that flows in the Gunnison River exceeded 10000 cfs as measured at the gage at Delta

Gunnison River @ Delta Days > 10000 cfs					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	0	0	2	2	2
1976	0	0	0	0	0
1977	0	0	0	0	0
1978	0	0	0	0	0
1979	3	6	8	14	8
1980	7	10	13	23	13
1981	0	0	0	0	0
1982	0	0	0	0	0
1983	16	18	16	18	15
1984	53	56	54	54	54
1985	10	18	19	23	19
1986	0	3	13	16	13
1987	0	0	0	0	0
1988	0	0	0	0	0
1989	0	0	0	0	0
1990	0	0	0	0	0
1991	0	0	0	0	0
1992	0	0	0	0	0
1993	19	26	26	25	26
1994	0	0	0	0	0
1995	47	52	53	53	53
1996	0	0	4	4	4
1997	1	3	12	22	12
1998	0	0	0	0	0
1999	0	0	0	0	0
2000	0	0	0	0	0
2001	0	0	0	0	0
2002	0	0	0	0	0
2003	0	0	0	0	0
2004	0	0	0	0	0
2005	2	1	0	0	1

Targets established in the Flow Recommendations report are all measured at the Whitewater gage on the Gunnison River. Peak flows that occurred during the month of May at the Whitewater gage for the No Action Alternative and Alternatives A, B, C and D are shown in Table 61. Annual peaks that occur during the month of May are typically products of operations at the Aspinall Unit intended to create or enhance spring peaks in the lower Gunnison River by timing releases from the Unit with the runoff peak on the North Fork of the Gunnison River.

Table 61: Annual peak flows in the Gunnison River occurring during the month of May as measured at the gage at Whitewater

Gunnison River @ Whitewater May Peak Flow (cfs)					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	8924	11201	12296	12296	12296
1976	5125	9336	8386	8386	8386
1977	1199	1194	1194	1194	1194
1978	10662	10658	11364	11424	11364
1979	15161	16896	16261	16033	16261
1980	13882	16404	16326	15545	16326
1981	3771	3771	3771	3771	3771
1982	9135	9829	11023	10294	11023
1983	18051	18754	17306	17306	17306
1984	19052	19051	19053	19051	19051
1985	13735	13596	14951	15137	14999
1986	10353	11896	13231	13278	13232
1987	9713	10066	9723	10463	9723
1988	3434	3665	5814	5974	3665
1989	2462	3465	5243	5371	2462
1990	2347	2347	2347	2347	2347
1991	8409	8787	8593	8514	8580
1992	6050	6043	8583	8647	6045
1993	20489	21948	21040	21144	21058
1994	4909	4907	7755	7875	4911
1995	12899	14539	15627	15628	15625
1996	7857	9788	12412	12655	12422
1997	11993	13739	14530	14470	14531
1998	9852	10021	9158	9324	9158
1999	4139	7703	7783	8156	7783
2000	4766	4767	7840	6091	4779
2001	3491	3491	7439	6536	3491
2002	1170	1170	1170	1170	1170
2003	5310	5363	7033	7191	5310
2004	3411	3411	5207	5366	3411
2005	13572	13473	11372	11483	13516

Table 62 shows peak flows in the Gunnison River, occurring during the months of June or July, as measured at the gage at Whitewater for the No Action Alternative and Alternatives A, B, C and D. Typically, peak flows that occur during these two months are more a result of wetter hydrology that necessitates the release or spill of large volumes of water from the Aspinall Unit.

Table 62: Annual peak flows in the Gunnison River occurring during the months of June or July as measured at the gage at Whitewater

Gunnison River @ Whitewater June-July Peak Flow (cfs)					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	8010	8132	8895	8895	8895
1976	3472	3349	3768	6086	3768
1977	1573	1636	1636	1636	1636
1978	7584	7391	9667	9725	9667
1979	10485	11100	12933	14712	12933
1980	9761	9694	12219	13746	12219
1981	2611	2611	2611	2611	2611
1982	7391	6734	8199	8204	8199
1983	20481	19418	20350	19265	19058
1984	20744	20736	20941	20859	20939
1985	16498	16192	15503	15530	15504
1986	9784	9727	13727	14018	13727
1987	9199	10354	10191	9364	10191
1988	2571	2571	2571	2961	2571
1989	2363	2363	2201	4915	2363
1990	2566	2566	2566	2566	2566
1991	5999	6471	6166	6895	6151
1992	4123	4088	5974	7638	4099
1993	14515	14649	14658	14764	14656
1994	4092	4106	3451	6395	4085
1995	19506	19476	19125	18751	19130
1996	4066	5164	7510	8148	7515
1997	10625	10362	14074	14304	14075
1998	6656	6399	6631	7527	6631
1999	6857	5137	7573	7867	7337
2000	2691	2772	6185	4139	2905
2001	3380	3380	3392	2748	3380
2002	1061	1061	1061	1061	1061
2003	4942	4942	4942	4952	4942
2004	2165	2165	2165	2859	2165
2005	6296	6089	6714	6657	6778

Another goal of the Flow Recommendations other than spring peaks is to increase the number of days of high flows in the lower Gunnison River. The Flow Recommendations set targets of 8,070 cfs for median half-bankfull flow and 14,350 cfs for median bankfull flow. These two targets represent the median flows for a large number of river cross-sections from Delta downstream to Whitewater. The full range of half bankfull flows is approximately from 4,500 cfs to 12,500 cfs. The full range of bankfull flows extends from 7,500 cfs to over 28,500 cfs. Tables 63 through 72 show the number of days that flows exceed a threshold value between 5,000 cfs and 14,350 cfs for the No Action Alternative and Alternatives A, B, C and D.

Appendix A

Table 63: Number of days per year that flows in the Gunnison River exceed 5,000 cfs as measured at the gage at Whitewater

Gunnison River @ Whitewater Days > 5000 cfs					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	41	47	39	39	39
1976	2	11	13	21	13
1977	0	0	0	0	0
1978	42	38	44	52	44
1979	67	60	75	91	75
1980	67	70	67	81	67
1981	0	0	0	0	0
1982	38	37	43	38	43
1983	89	87	91	88	91
1984	94	94	95	119	95
1985	84	84	82	82	82
1986	99	95	77	97	77
1987	60	59	59	66	59
1988	0	0	3	3	0
1989	0	0	2	7	0
1990	0	0	0	0	0
1991	26	24	24	27	24
1992	2	2	8	15	2
1993	79	73	73	78	72
1994	0	0	11	21	0
1995	94	86	88	111	87
1996	28	16	27	31	27
1997	78	76	75	81	75
1998	40	39	40	42	40
1999	12	12	17	25	16
2000	0	0	10	6	0
2001	0	0	10	6	0
2002	0	0	0	0	0
2003	2	3	9	14	2
2004	0	0	1	2	0
2005	48	43	41	37	44
Average	35.2	34.1	36.3	41.3	34.6

Table 64: Number of days per year that flows in the Gunnison River exceed 6,000 cfs as measured at the gage at Whitewater

Gunnison River @ Whitewater Days > 6000 cfs					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	32	31	37	37	37
1976	0	9	11	17	11
1977	0	0	0	0	0
1978	26	23	42	50	42
1979	53	42	57	74	57
1980	61	57	55	73	55
1981	0	0	0	0	0
1982	26	23	32	29	32
1983	74	71	71	71	71
1984	86	86	87	110	86
1985	81	81	81	79	80
1986	65	65	59	79	59
1987	43	41	43	48	43
1988	0	0	0	0	0
1989	0	0	0	0	0
1990	0	0	0	0	0
1991	9	10	13	19	13
1992	1	1	5	12	1
1993	74	64	64	69	64
1994	0	0	7	17	0
1995	93	77	82	105	82
1996	10	11	23	28	23
1997	66	65	64	71	64
1998	29	28	29	33	29
1999	9	7	14	20	12
2000	0	0	7	1	0
2001	0	0	7	3	0
2002	0	0	0	0	0
2003	0	0	3	7	0
2004	0	0	0	0	0
2005	31	26	26	24	29
Average	28.0	26.4	29.6	34.7	28.7

Appendix A

Table 65: Number of days per year that flows in the Gunnison River exceed 7,000 cfs as measured at the gage at Whitewater

Gunnison River @ Whitewater Days > 7000 cfs					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	26	16	33	33	33
1976	0	7	8	10	8
1977	0	0	0	0	0
1978	14	13	36	45	36
1979	35	29	44	56	44
1980	50	46	45	65	45
1981	0	0	0	0	0
1982	16	15	23	26	23
1983	59	58	67	66	66
1984	78	75	77	103	79
1985	75	72	73	72	73
1986	41	39	44	65	44
1987	32	32	34	36	34
1988	0	0	0	0	0
1989	0	0	0	0	0
1990	0	0	0	0	0
1991	4	4	9	9	9
1992	0	0	3	7	0
1993	66	58	58	63	56
1994	0	0	4	13	0
1995	76	74	74	102	74
1996	7	9	20	26	20
1997	56	53	50	63	50
1998	17	17	14	20	14
1999	0	4	11	17	8
2000	0	0	3	0	0
2001	0	0	3	0	0
2002	0	0	0	0	0
2003	0	0	1	1	0
2004	0	0	0	0	0
2005	19	18	17	15	19
Average	21.6	20.6	24.2	29.5	23.7

Table 66: Number of days per year that flows in the Gunnison River exceed 8,070 cfs as measured at the gage at Whitewater

Gunnison River @ Whitewater Days > 8070 cfs					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	7	9	23	23	23
1976	0	2	2	2	2
1977	0	0	0	0	0
1978	10	6	22	25	22
1979	26	27	33	39	33
1980	41	36	36	40	36
1981	0	0	0	0	0
1982	8	12	14	10	14
1983	53	53	54	54	59
1984	67	67	67	79	67
1985	59	57	56	54	56
1986	23	22	27	38	27
1987	15	15	16	18	16
1988	0	0	0	0	0
1989	0	0	0	0	0
1990	0	0	0	0	0
1991	1	2	1	1	1
1992	0	0	1	1	0
1993	49	48	49	49	48
1994	0	0	0	0	0
1995	72	73	72	79	72
1996	0	6	9	10	9
1997	48	46	37	42	37
1998	5	8	5	7	5
1999	0	0	0	1	0
2000	0	0	0	0	0
2001	0	0	0	0	0
2002	0	0	0	0	0
2003	0	0	0	0	0
2004	0	0	0	0	0
2005	12	12	8	8	12
Average	16.0	16.2	17.2	18.7	17.4

Appendix A

Table 67: Number of days per year that flows in the Gunnison River exceed 9,000 cfs as measured at the gage at Whitewater

Gunnison River @ Whitewater Days > 9000 cfs					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	0	6	7	7	7
1976	0	2	0	0	0
1977	0	0	0	0	0
1978	3	3	13	13	13
1979	18	18	24	31	24
1980	26	24	29	32	29
1981	0	0	0	0	0
1982	1	5	7	4	7
1983	51	51	51	51	53
1984	59	59	59	59	59
1985	42	41	39	43	39
1986	14	14	21	28	21
1987	5	7	6	5	6
1988	0	0	0	0	0
1989	0	0	0	0	0
1990	0	0	0	0	0
1991	0	0	0	0	0
1992	0	0	0	0	0
1993	35	40	41	42	41
1994	0	0	0	0	0
1995	67	69	70	69	70
1996	0	4	6	6	6
1997	29	30	21	28	21
1998	1	4	1	1	1
1999	0	0	0	0	0
2000	0	0	0	0	0
2001	0	0	0	0	0
2002	0	0	0	0	0
2003	0	0	0	0	0
2004	0	0	0	0	0
2005	9	9	7	6	9
Average	11.6	12.5	13.0	13.7	13.1

Table 68: Number of days per year that flows in the Gunnison River exceed 10,000 cfs as measured at the gage at Whitewater

Gunnison River @ Whitewater Days > 10000 cfs					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	0	4	6	6	6
1976	0	0	0	0	0
1977	0	0	0	0	0
1978	2	2	9	9	9
1979	16	16	22	30	22
1980	13	12	17	26	17
1981	0	0	0	0	0
1982	0	0	6	2	6
1983	43	43	44	44	44
1984	56	58	56	57	56
1985	30	30	31	35	31
1986	4	7	17	24	17
1987	0	2	1	2	1
1988	0	0	0	0	0
1989	0	0	0	0	0
1990	0	0	0	0	0
1991	0	0	0	0	0
1992	0	0	0	0	0
1993	24	35	35	34	35
1994	0	0	0	0	0
1995	61	64	69	68	69
1996	0	0	4	5	4
1997	11	11	15	25	15
1998	0	1	0	0	0
1999	0	0	0	0	0
2000	0	0	0	0	0
2001	0	0	0	0	0
2002	0	0	0	0	0
2003	0	0	0	0	0
2004	0	0	0	0	0
2005	7	7	5	5	7
Average	8.6	9.4	10.9	12.0	10.9

Appendix A

Table 69: Number of days per year that flows in the Gunnison River exceed 11,000 cfs as measured at the gage at Whitewater

Gunnison River @ Whitewater					
Days > 11000 cfs					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	0	1	4	4	4
1976	0	0	0	0	0
1977	0	0	0	0	0
1978	0	0	2	2	2
1979	12	13	21	27	21
1980	7	7	13	24	13
1981	0	0	0	0	0
1982	0	0	1	0	1
1983	33	31	36	38	32
1984	53	56	53	53	53
1985	21	24	27	31	27
1986	0	4	13	17	13
1987	0	0	0	0	0
1988	0	0	0	0	0
1989	0	0	0	0	0
1990	0	0	0	0	0
1991	0	0	0	0	0
1992	0	0	0	0	0
1993	22	28	28	27	28
1994	0	0	0	0	0
1995	55	59	65	65	65
1996	0	0	4	3	3
1997	3	5	13	24	13
1998	0	0	0	0	0
1999	0	0	0	0	0
2000	0	0	0	0	0
2001	0	0	0	0	0
2002	0	0	0	0	0
2003	0	0	0	0	0
2004	0	0	0	0	0
2005	6	6	2	2	6
Average	6.8	7.5	9.1	10.2	9.1

Table 70: Number of days per year that flows in the Gunnison River exceed 12,000 cfs as measured at the gage at Whitewater

Gunnison River @ Whitewater Days > 12000 cfs					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	0	0	2	2	2
1976	0	0	0	0	0
1977	0	0	0	0	0
1978	0	0	0	0	0
1979	8	9	11	17	11
1980	3	6	10	18	10
1981	0	0	0	0	0
1982	0	0	0	0	0
1983	28	27	26	31	27
1984	48	47	49	47	49
1985	15	18	22	28	22
1986	0	0	9	11	9
1987	0	0	0	0	0
1988	0	0	0	0	0
1989	0	0	0	0	0
1990	0	0	0	0	0
1991	0	0	0	0	0
1992	0	0	0	0	0
1993	21	24	25	26	25
1994	0	0	0	0	0
1995	47	54	56	55	56
1996	0	0	1	1	1
1997	0	3	9	19	9
1998	0	0	0	0	0
1999	0	0	0	0	0
2000	0	0	0	0	0
2001	0	0	0	0	0
2002	0	0	0	0	0
2003	0	0	0	0	0
2004	0	0	0	0	0
2005	5	4	0	0	4
Average	5.6	6.2	7.1	8.2	7.3

Appendix A

Table 71: Number of days per year that flows in the Gunnison River exceed 13,000 cfs as measured at the gage at Whitewater

Gunnison River @ Whitewater					
Days > 13000 cfs					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	0	0	0	0	0
1976	0	0	0	0	0
1977	0	0	0	0	0
1978	0	0	0	0	0
1979	5	6	6	11	6
1980	2	4	4	7	4
1981	0	0	0	0	0
1982	0	0	0	0	0
1983	22	23	21	23	21
1984	39	37	38	40	38
1985	7	11	12	18	13
1986	0	0	6	7	6
1987	0	0	0	0	0
1988	0	0	0	0	0
1989	0	0	0	0	0
1990	0	0	0	0	0
1991	0	0	0	0	0
1992	0	0	0	0	0
1993	19	21	22	22	22
1994	0	0	0	0	0
1995	38	48	41	41	42
1996	0	0	0	0	0
1997	0	1	5	10	5
1998	0	0	0	0	0
1999	0	0	0	0	0
2000	0	0	0	0	0
2001	0	0	0	0	0
2002	0	0	0	0	0
2003	0	0	0	0	0
2004	0	0	0	0	0
2005	3	2	0	0	2
Average	4.4	4.9	5.0	5.8	5.1

Table 72: Number of days per year that flows in the Gunnison River exceed 14,350 cfs as measured at the gage at Whitewater

Gunnison River @ Whitewater					
Days > 14350 cfs					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	0	0	0	0	0
1976	0	0	0	0	0
1977	0	0	0	0	0
1978	0	0	0	0	0
1979	4	6	4	5	4
1980	0	3	3	2	3
1981	0	0	0	0	0
1982	0	0	0	0	0
1983	13	17	16	16	16
1984	28	26	25	25	25
1985	3	3	5	5	5
1986	0	0	0	0	0
1987	0	0	0	0	0
1988	0	0	0	0	0
1989	0	0	0	0	0
1990	0	0	0	0	0
1991	0	0	0	0	0
1992	0	0	0	0	0
1993	17	17	17	17	17
1994	0	0	0	0	0
1995	21	31	22	26	21
1996	0	0	0	0	0
1997	0	0	1	1	1
1998	0	0	0	0	0
1999	0	0	0	0	0
2000	0	0	0	0	0
2001	0	0	0	0	0
2002	0	0	0	0	0
2003	0	0	0	0	0
2004	0	0	0	0	0
2005	0	0	0	0	0
Average	2.8	3.3	3.0	3.1	3.0

Following the publication of the DEIS the Black Canyon Water Right was decreed and is since considered a component of the No Action Alternative. Due to the complexity of the Riverware model used to evaluate the effects of Aspinall Unit Operations and the subsequent re-evaluation of impacts, the Water Right has not been included in the model. However, a separate model analysis has been performed comparing the Black Canyon water right peak target with the flows at various locations modeled under each alternative in the EIS.

Table 73 compares the model-derived peaks which occur in the Black Canyon under the preferred alternative with the Black Canyon water right peak flows.

Table 73: Black Canyon water right peak flow impact analysis

Modeled Year	Reserved BC Right Peak Flow per decree (cfs)	Preferred Alternative - Modeled BC Peak flows (cfs)	Impact on Decreed Peak (See Notation A and B below)
1975	7595	6839	A
1976	4188	4387	Met
1977	829	806	Met
1978	6484	6051	A
1979	11034	6684	B
1980	11568	6253	B
1981	886	753	Met
1982	6433	6451	Met
1983	5864	10707	Met
1984	13437	10458	B
1985	6513	9063	Met
1986	7595	6782	A
1987	5635	6346	Met
1988	3273	2921	A
1989	2176	3314	Met
1990	1673	903	A
1991	4492	4720	Met
1992	3578	3330	A
1993	8922	7587	B
1994	3883	4167	Met
1995	6866	11871	Met
1996	6484	8475	Met
1997	7595	7808	Met
1998	5864	3843	A
1999	4492	5093	Met
2000	3730	6204	Met
2001	3426	5537	Met
2002	778	858	Met
2003	2740	2863	Met
2004	2359	2863	Met
2005	6312	1535	A

Notation A: In years identified with notation A, under actual operations, the analysis shows that the historical range of Aspinall Unit operations will ensure that the one-day peak flow identified in the decree will be met, although some operational adjustments may be necessary. Adjustments may involve operational changes including, but are not limited to, increased powerplant releases, timing releases with higher tributary inflows to the Aspinall Unit, or increased bypasses at Crystal or Morrow Point dams. All operational adjustments would be encompassed within operations already contemplated under alternatives being considered. Accordingly, both the peak flow for the Black Canyon NP Water Right and the peak flow target for the endangered fish as described in the preferred alternative are met. The analysis is based on historical hydrology. Future conditions may not replicate the modeled historical hydrology.

Notation B: In the four out of the 31 years of the study period with notation B, the analysis was able to achieve the peak flow targets for the endangered fish but

did not meet the Black Canyon NP Water Right peak flow. In general, the model limited releases from the Aspinall Unit to avoid flooding at Delta due to high North Fork tributary flows. These high tributary flows provided most of the water that helped meet the endangered fish peak flow target and therefore higher releases from the Aspinall Unit into the Black Canyon were not required to meet the endangered fish peak flow target

In these types of years, when the Secretary exercises the Black Canyon NP Water Right consistent with the terms and conditions of the decree and other applicable laws, operational adjustments at the Aspinall Unit will be required to meet the peak flows. Generally, when April-July inflows exceed 1,000,000 af, an operations plan to meet the Black Canyon Right peak can be developed. However, due to the increased risk of flooding in high water years, operational decisions may require the flexibility to make adjustments on a daily basis. To reduce the risk of flooding at Delta, Reclamation may look for opportunities to meet the Black Canyon NP Water Right peak flow (and/or the endangered fish peak flow target) later in the spring/summer after high tributary flows have receded.

Examples of potential adjustments are listed below; however it is important to note these examples are based on “perfect knowledge” of past conditions using the results of the Riverware Hydrology model, and are discussed to serve as examples of how operations could be modified in the future under similar conditions to meet the Black Canyon Water Right peak flows. Future conditions may not replicate the modeled historical hydrology. Actual operational conditions will require adjustments to be made in real time under constantly changing conditions. Modeling of the study period has shown that during actual operations in high water years, there may be significant risks of flooding Delta and the Black Canyon decree requires Reclamation to give highest priority to flood control.

In modeled years identified as Notation A and B in Table 73, a variety of modifications to operations depicted by the Riverware model may be undertaken in order to allow the Black Canyon NP Water Right and endangered fish flow targets to be met with one peak flow operation at the Aspinall Unit. For instance, in years with moderate Black Canyon NP Water Right peak targets in the 6,000 to 8,000 cfs range, the use of spillways at the Aspinall Unit may be utilized in conjunction with improved timing with tributary inflows. In years with lower water right peak targets, it may be as simple as increasing releases from the bypasses within the Aspinall Unit. Higher target years are often more complicated and in some cases it may be necessary to conduct peak releases from the Aspinall Unit either before or after the peak runoff of the North Fork Gunnison River in order to meet the flow targets but avoid flooding in Delta. In all cases, consideration will be given to the timing of Aspinall Unit storage and release operations to efficiently and safely allow the delivery of peak flows utilizing bypasses, power releases, spillways, and tributary flows as necessary.

A list of sample operational adjustments follows:

- Bypassing water at Aspinall Unit facilities
- Use of the spillways at Aspinall Unit facilities
- Timing of Aspinall Unit storage operations and use of Aspinall storage and release activities to efficiently allow the delivery of peak flows.
- Timing of peak releases with higher side/tributary inflows above Crystal Dam to reduce the need to use spillways at Aspinall Unit facilities.
- Timing the peak release with peak runoff of the North Fork Gunnison in order to achieve on peak flow for both the Whitewater target flows and the Black Canyon.
- In some cases it may be necessary to time peak releases from the Aspinall Unit to either before or after the peak runoff of the North Fork Gunnison River in order to meet the Whitewater target flows but avoid flooding in Delta.

Yearly operation plans to meet the Black Canyon NP Water Right, endangered fish flow recommendations, and Unit purposes will be developed in coordination with the State of Colorado, the National Park Service, Reclamation, Western, the Service and other affected interests through the established Aspinall Operations coordination process in order to ensure that operational decisions to exercise this right are in accord with the best available information and with full consideration of river management issues. Wetter years will require an increased level of planning, analysis, and coordination and communication among all stakeholders.

Tables 74 through 79 compare the Black Canyon Water Right and ESA Whitewater Peak Targets with the flows modeled for each alternative in the Black Canyon, at Delta, and Whitewater.

Table 74: One day peak flow comparison under the No Action Alternative in cfs.

	No Action				
	Black Canyon		Delta	Whitewater	
	Decreed Target	Modeled Flow	Modeled Flow	ESA Target	Modeled Flow
1975	7595	3323	7019	14350	8924
1976	4188	1293	3889	8070	5125
1977	829	450	900	900	1573
1978	6484	3602	8964	14350	10662
1979	11034	3655	11153	14350	15161
1980	11568	3564	12722	14350	13882
1981	886	438	2651	900	3771
1982	6433	3559	6807	14350	9135
1983	5864	10750	18507	8070	20481
1984	13437	10990	17922	14350	20744
1985	6513	11743	17209	14350	16498
1986	7595	5028	8744	14350	10353
1987	5635	5856	8194	8070	9713
1988	3273	1042	2133	2600	3434
1989	2176	1051	1988	2600	2462
1990	1673	699	1602	900	2566
1991	4492	4144	6939	8070	8409
1992	3578	1382	4101	2600	6050
1993	8922	5666	15696	14350	20489
1994	3883	1944	3294	2600	4909
1995	6866	12156	16522	14350	19506
1996	6484	3204	7291	14350	7857
1997	7595	7682	10224	14350	11993
1998	5864	3364	8281	8070	9852
1999	4492	3991	5350	8070	6857
2000	3730	1140	2872	2600	4766
2001	3426	1660	2950	2600	3491
2002	778	439	842	900	1170
2003	2740	951	4499	2600	5310
2004	2359	840	2390	2600	3411
2005	6312	3527	10278	14350	13572

*No Action Alternative does not include Black Canyon NP Reserved Right

Appendix A

Table 75: One day peak flow comparison under Alternative A in cfs.

Alt A - Risk of Spill Alternative					
	Black Canyon		Delta	Whitewater	
	Decreed Target	Modeled Flow	Modeled Flow	ESA Target	Modeled Flow
1975	7595	6341	9828	14350	11201
1976	4188	5129	7281	8070	9336
1977	829	806	895	900	1636
1978	6484	3602	8964	14350	10658
1979	11034	5515	12935	14350	16896
1980	11568	6376	15100	14350	16404
1981	886	753	2651	900	3771
1982	6433	4935	8006	14350	9829
1983	5864	10081	17586	8070	19418
1984	13437	11076	17843	14350	20736
1985	6513	11564	16908	14350	16192
1986	7595	5652	10338	14350	11896
1987	5635	6611	9137	8070	10354
1988	3273	1341	2723	2600	3665
1989	2176	1793	3146	2600	3465
1990	1673	793	1602	900	2566
1991	4492	4446	7461	8070	8787
1992	3578	1212	4111	2600	6043
1993	8922	7573	17260	14350	21948
1994	3883	1946	3292	2600	4907
1995	6866	11750	15951	14350	19476
1996	6484	5209	9136	14350	9788
1997	7595	7462	11256	14350	13739
1998	5864	4803	8454	8070	10021
1999	4492	4955	7091	8070	7703
2000	3730	1227	2875	2600	4767
2001	3426	1660	2950	2600	3491
2002	778	858	842	900	1170
2003	2740	1793	4499	2600	5363
2004	2359	911	2390	2600	3411
2005	6312	3480	10021	14350	13473

Table 76: One day peak flow comparison under Alternative B in cfs.

Alt B - Fish Peak with Duration Alternative					
	Black Canyon		Delta	Whitewater	
	Decreed Target	Modeled Flow	Modeled Flow	ESA Target	Modeled Flow
1975	7595	6839	10308	14350	12296
1976	4188	4387	6649	8070	8386
1977	829	806	895	900	1636
1978	6484	6051	9677	14350	11364
1979	11034	6684	12144	14350	16261
1980	11568	6253	15047	14350	16326
1981	886	753	2651	900	3771
1982	6433	6451	9374	14350	11023
1983	5864	10707	18413	8380	20350
1984	13437	10458	17923	14350	20941
1985	6513	9063	13956	14350	15503
1986	7595	6782	12406	14350	13727
1987	5635	6346	9015	8070	10191
1988	3273	2921	4536	4990	5814
1989	2176	3314	4879	5315	5243
1990	1673	903	1602	900	2566
1991	4492	4720	7119	8070	8593
1992	3578	3330	6647	8070	8583
1993	8922	7587	16146	14350	21040
1994	3883	4167	6282	8070	7755
1995	6866	11871	16471	14350	19125
1996	6484	8475	11931	14350	12412
1997	7595	7808	12754	14350	14530
1998	5864	3843	7396	8070	9158
1999	4492	5093	7100	8070	7783
2000	3730	6204	7122	8070	7840
2001	3426	5537	6910	8070	7439
2002	778	858	842	900	1170
2003	2740	2863	6144	5395	7033
2004	2359	2863	4451	4385	5207
2005	6312	1535	7603	10180	11372

Table 77: One day peak flow comparison under Alternative C in cfs.

Alt C - Fish Peak with Increased Duration Alternative					
	Black Canyon		Delta	Whitewater	
	Decreed Target	Modeled Flow	Modeled Flow	ESA Target	Modeled Flow
1975	7595	6839	10308	14350	12296
1976	4188	4984	6754	8070	8386
1977	829	806	895	900	1636
1978	6484	6058	9423	14350	11424
1979	11034	7069	11922	14350	16033
1980	11568	6482	14488	14350	15545
1981	886	753	2651	900	3771
1982	6433	6054	8664	14350	10294
1983	5864	11212	16710	8380	19265
1984	13437	10906	17898	14350	20859
1985	6513	9248	13999	14350	15530
1986	7595	7062	12713	14350	14018
1987	5635	5955	8381	8070	10463
1988	3273	3462	4754	4990	5974
1989	2176	3732	5081	5315	5371
1990	1673	896	1602	900	2566
1991	4492	4848	7040	8070	8514
1992	3578	4350	6740	8070	8647
1993	8922	7596	16338	14350	21144
1994	3883	4964	6538	8070	7875
1995	6866	12560	16526	14350	18751
1996	6484	8775	12202	14350	12655
1997	7595	7994	13699	14350	14470
1998	5864	3940	7551	8070	9324
1999	4492	5673	7497	8070	8156
2000	3730	4248	5588	8070	6091
2001	3426	4089	5956	8070	6536
2002	778	858	842	900	1170
2003	2740	2863	6421	5395	7191
2004	2359	2990	4728	4385	5366
2005	6312	1476	7771	10180	11483

Table 78: One day peak flow comparison under Alternative D in cfs.

Alt D - Fish Peak with Revised Target Alternative					
	Black Canyon		Delta	Whitewater	
	Decreed Target	Modeled Flow	Modeled Flow	ESA Target	Modeled Flow
1975	7595	6839	10308	14350	12296
1976	4188	4387	6649	8070	8386
1977	829	806	895	900	1636
1978	6484	6051	9677	14350	11364
1979	11034	6684	12144	14350	16261
1980	11568	6253	15047	14350	16326
1981	886	753	2651	900	3771
1982	6433	6451	9374	14350	11023
1983	5864	9613	17146	8070	19058
1984	13437	10444	17921	14350	20939
1985	6513	9081	13955	14350	15504
1986	7595	6782	12405	14350	13727
1987	5635	6346	9015	8070	10191
1988	3273	1341	2723	2600	3665
1989	2176	1051	1988	2600	2462
1990	1673	823	1602	900	2566
1991	4492	4687	7104	8070	8580
1992	3578	1352	4108	2600	6045
1993	8922	7588	16176	14350	21058
1994	3883	1943	3295	2600	4911
1995	6866	11876	16474	14350	19130
1996	6484	8518	11959	14350	12422
1997	7595	7808	12755	14350	14531
1998	5864	3844	7396	8070	9158
1999	4492	4944	7100	8070	7783
2000	3730	1316	2891	2600	4779
2001	3426	1660	2950	2600	3491
2002	778	858	842	900	1170
2003	2740	1295	4499	2600	5310
2004	2359	859	2390	2600	3411
2005	6312	3533	10070	14350	13516

The Redlands Canal diverts water from the Gunnison River downstream of the gage at Whitewater. The power canal has water rights senior to the Aspinall Unit that total 750 cfs. The significance of the Redlands Canal not being able to divert 750 cfs is that this could initiate a call from the Redlands Water and Power Company that could affect upstream users with priority dates later than 1941.

Table 79 shows the number of days per year that the Redlands Canal diverts less than 750 cfs for the No Action Alternative and Alternatives A, B, C, and D. This does not automatically mean a call on the river is in place but it does create the potential for a call by the Redlands Water and Power Company.

Table 79: Days per year that the Redlands Power Canal diverts less than 750 cfs.

Redlands Canal Days < 750 cfs					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	33	18	18	18	18
1976	8	11	11	11	11
1977	218	179	179	179	179
1978	70	35	37	38	37
1979	0	0	0	0	0
1980	6	2	3	10	3
1981	68	35	38	39	38
1982	0	0	0	11	0
1983	0	0	0	0	0
1984	0	0	0	0	0
1985	0	0	0	0	0
1986	0	0	0	0	0
1987	0	0	0	0	0
1988	4	3	3	4	3
1989	0	0	2	5	0
1990	66	42	42	43	42
1991	0	1	9	31	1
1992	0	0	0	0	0
1993	0	0	0	0	0
1994	0	0	0	0	0
1995	0	0	0	0	0
1996	0	0	0	0	0
1997	0	0	0	0	0
1998	0	0	0	0	0
1999	3	2	3	2	3
2000	0	0	3	1	0
2001	0	0	7	0	0
2002	114	60	68	67	60
2003	153	56	56	56	56
2004	49	30	31	31	30
2005	0	0	0	0	0
Average	25.5	15.3	16.5	17.6	15.5

Downstream of the Redlands Power Canal Diversion Dam lies the final miles of the Gunnison River before it joins the Colorado River in Grand Junction. During wetter periods there is usually sufficient water downstream of the diversion dam. However, this stretch of river can experience very low flows due to the diversion of the majority of the water by the power canal during drier periods. Endangered fish need sufficient flows to migrate up the Gunnison River. Most of the migration occurs from April through September. When flows drop below 100 cfs downstream of the diversion dam, fish migration may become impossible. Table 80 shows the number of days from April through September that flows in the Gunnison River downstream of the Redlands Diversion Dam fall below 100 cfs for the No Action Alternative and Alternatives A,B, C and D. As can be seen in the table, this condition occurs primarily during drought years.

Table 80: Days per year that flows below Redlands Diversion Dam are less than 100 cfs during the months of April through September

Gunnison River below Redlands Canal Days < 100 cfs Apr-Sep					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	0	0	0	0	0
1976	0	0	2	3	2
1977	18	27	27	27	27
1978	0	0	0	3	0
1979	0	0	0	1	0
1980	3	3	3	10	3
1981	20	23	24	27	24
1982	0	0	0	0	0
1983	0	0	0	0	0
1984	0	0	0	0	0
1985	0	0	0	0	0
1986	0	0	0	0	0
1987	0	0	0	0	0
1988	6	3	4	6	3
1989	5	0	1	5	0
1990	19	11	12	11	13
1991	0	0	0	0	0
1992	0	0	0	0	0
1993	0	0	0	0	0
1994	0	0	0	5	0
1995	0	0	0	0	0
1996	0	0	0	0	0
1997	0	0	0	0	0
1998	0	0	0	0	0
1999	5	5	5	5	5
2000	2	1	4	1	1
2001	0	0	0	0	0
2002	17	28	28	28	28
2003	9	16	16	16	16
2004	11	6	9	9	6
2005	0	0	0	0	0
Average	3.7	4.0	4.4	5.1	4.1

A fish ladder is currently in place at the Redlands Diversion Dam which enables the endangered fish to navigate around this structure. The ladder is most effective when flows in the Gunnison River downstream of the diversion dam are above 300 cfs. Most endangered fish travel upstream from April through September. Table 81 shows the number of days from April through September that flows in the Gunnison River downstream of the Redlands Diversion Dam drop below 300 cfs for the No Action Alternative and Alternatives A, B, C, and D. Again, the impacts to fish migration generally occur during drought years.

Table 81: Days per year that flows below the Redlands Diversion Dam are less than 300

Gunnison River below Redlands Canal					
Days < 300 cfs					
Apr-Sep					
	NoAction	Alt A	Alt B	Alt C	Alt D
1975	0	0	0	0	0
1976	31	36	42	66	42
1977	179	179	179	179	179
1978	7	9	47	43	47
1979	0	0	10	18	10
1980	15	8	9	26	9
1981	104	105	106	106	106
1982	0	0	0	8	0
1983	0	0	0	0	0
1984	0	0	0	0	0
1985	0	0	0	0	0
1986	0	0	0	0	0
1987	0	0	0	0	0
1988	40	37	47	58	37
1989	38	40	46	79	39
1990	83	85	96	104	83
1991	0	1	1	2	0
1992	0	0	0	3	0
1993	0	0	0	0	0
1994	18	17	21	23	18
1995	0	0	0	0	0
1996	0	0	3	11	3
1997	0	0	0	0	0
1998	0	0	0	0	0
1999	15	15	15	15	15
2000	21	20	31	28	19
2001	5	5	17	6	5
2002	157	157	164	159	157
2003	105	89	89	89	89
2004	63	74	75	75	76
2005	1	1	1	4	1
Average	28.5	28.3	32.2	35.5	30.2

