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DEPARTMENT OF
WATER RESOURCES

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BEFORE THE DEPARTMENT OF WATER RESOURCES
OF THE STATE OF IDAHO

IN THE MATTER OF DISTRIBUTION OF WATER TO WATER RIGHT NOS. 36-02551 & 36-07694 (RANGEN, INC.)	Docket No. CM-DC-2011-004 **IGWA's Proposed Findings of Fact**

Idaho Ground Water Appropriators, Inc. (IGWA), acting for and on behalf of its members, submits the following proposed findings of fact pursuant to verbal instructions given by the Director at the close hearing on May 16, 2013.

Procedural Background

1. Rangen, Inc. filed its first delivery call in September of 2003 seeking to curtail junior-priority water use. In February of 2004 Director Dreher ordered curtailment of all groundwater rights in Water District 130 with priority dates junior to July 13, 1962 (the priority date of Rangen's water right number 36-2551). (*Order* p. 26, Feb. 25, 2004.) The Eastern Snake Plain Aquifer Model (ESPAM) version 1.0 was released shortly thereafter, providing a better tool for evaluating the impact of groundwater pumping on water flows at Rangen. Based on curtailment predictions of ESPAM1.1, Director Dreher withdrew his prior curtailment order. He found it inappropriate to curtail junior rights if ESPAM1.1 predicted less than least 10 percent of the curtailed water would accrue to Rangen, which resulted in no material injury and a futile call. (*Second Amended Order* ¶ 25 p. 28, May 19, 2005.)

2. Rangen filed its current *Petition for Delivery Call* on December 13, 2011, alleging material injury as a result of junior-priority groundwater pumping within the Eastern Snake Plain Aquifer (ESPA). Rangen contends that because ESPAM has been updated to version 2.1 it is no longer appropriate to limit curtailment to junior rights for which ESPAM2.1 predicts at least 10 percent of the curtailed water will accrue to Rangen.

3. ESPAM2.1 had not been completed by the time Rangen filed its *Petition for Delivery Call.* This proceeding was effectively stayed until ESPAM2.1 was completed. As ESPAM2.1 neared completion, a hearing schedule was set, culminating in an evidentiary hearing conducted before Director Gary Spackman from May 1, 2013, through May 16, 2013, at the State Office of the Idaho Department of Water Resources (IDWR or Department).

4. Several dispositive motions were filed prior to the hearing. Rangen filed a *Motion for Partial Summary Judgment Re Material Injury* on January 9, 2013, which was disposed of by an *Order Denying Rangen, Inc.'s Motion for Partial Summary Judgment Re: Material Injury* issued April 24, 2013.

5. Rangen filed a *Motion for Partial Summary Judgment Re Source* on March 8, 2013, which was disposed of by an *Order Granting In Part and Denying In Part Rangen, Inc.'s Motion for Partial Summary Judgment Re: Source* issued April 22, 2013.

6. City of Pocatello filed a *Motion for Declaratory Order Regarding Rangen's Legal Obligation to Interconnect* on March 8, 2013, which was disposed of by an *Order Denying City of Pocatello's Motion for Declaratory Order Re: Rangen's Legal Obligation to Interconnect* issued April 23, 2013.

Water Right Nos. 36-2551 and 36-7694

7. Rangen owns water right no. 36-2551 which has been partially decreed by the SRBA District Court with a priority date of July 13, 1962. (Ex. 1026.) It authorizes the diversion of 48.54 cfs of water from the Martin-Curren Tunnel for year-round fish propagation and domestic purposes. The point of diversion is located in the SESWNW Sec. 32 Township 7S, Range 14E, Boise Meridian. *Id.*

8. Rangen owns water right no. 36-7694 which has been partially decreed by the SRBA District Court with a priority date of April 12, 1977. (Ex. 1028.) It authorizes the diversion of 26 cfs of water from the Martin-Curren Tunnel for year-round fish propagation purposes. The point of diversion is also located in the SESWNW Sec. 32, Township 7S, Range 14E, Boise Meridian. *Id.*

9. Rangen has historically diverted water from Billingsley Creek at a headgate located in the SWSWNW Sec. 32, Township 7S, Rangen 14E, Boise Meridian. However, water right nos. 36-2551 and 36-7694 do not identify Billingsley Creek as a source of water, and do not include a point of diversion or re-diversion in the SWSWNW Sec. 32, Township 7S, Rangen 14E, Boise Meridian.

Martin-Curren Tunnel

10. The Martin-Curren Tunnel is a man-made tunnel excavated into the ESPA in the late 1800s for irrigation purposes. (Exs. 2278, 2361; Brendecke, Tr. 2043:1-6.) It penetrates nearly horizontally into the ESPA a distance of approximately 300 feet. (Exs. 2198, 2199, 2328.) The outermost 50 feet of the Tunnel is lined with a corrugated steel pipe that is 6 or 7 feet in diameter. (Brendecke, Tr. 2039:12-16) Groundwater enters the tunnel beyond this pipe, at depths from 40 to 70 vertical feet below land surface. (Ex. 2247 at 24, 25).

11. The Martin-Curren Tunnel was constructed high on the Hagerman Rim to enable water emitting from the Tunnel to flow by gravity to farmland south of Rangen. (Exs. 2278, 2361; Brendecke, Tr. 2043:1-6.)

12. The outlet elevation of the Martin-Curren Tunnel is approximately 10 feet below the water level in the ESPA east of the Tunnel, denying it access to the majority of the saturated thickness of the primary aquifer at this location and rendering Tunnel flows highly vulnerable to small changes in aquifer water levels. (Ex. 2198, 2203.) Had the Tunnel been constructed nearer to the base of the ESPA it would have produced more water and been less susceptible to small changes in the elevation of the groundwater table. (Hinckley, Tr. 2227:22-25, 2228:20-2229:24.) The high elevation of the Tunnel relative to the Rangen hatchery demonstrates it was constructed to meet seasonal irrigation needs and not to maximize sustainable, year-round diversion to support fish production. (Exs. 2401, 2247.)

13. The "Lower Springs" at the head of Billingsley Creek issue from permeable deposits approximately 50 feet in elevation beneath the Martin-Curren Tunnel. Like the Tunnel, the Lower Springs discharge groundwater originating in the ESPA and are subject to variations in aquifer water levels, but the springs have access to the full saturated thickness of the aquifer at this location and, as a result, are much less sensitive to changes in the elevation of the water table. (Hinckley, Tr. 2229:9-2230:16; Exs. 2201, 2247.)

ESPA

14. The Martin-Curren Tunnel is located at the western edge of the ESPA. The ESPA is one of the largest and most productive aquifers in the world. It stretches across the Snake River Plain from Ashton to King Hill, covering roughly 10,800 square miles. It is comparable in size to Lake Erie, and is estimated to contain 1 billion acre-feet of water. (Ex. 2401 at 13.)

15. Prior to the construction of large irrigation canals around the turn of the twentieth century, the amount of groundwater that discharged from the ESPA in the Milner to King Hill reach of the Snake River was approximately 4,000 cfs. (Ex. 2401 at 16.) Spring flows to this reach increased dramatically over the first half of the twentieth century due to flood irrigation on the Snake River Plain, peaking at about 7,000 cfs in the early 1950s. (Ex. 2401 at 17.) Since the 1950s, the amount of groundwater stored in the ESPA has declined in response to four primary factors: 1) reduced incidental recharge to the aquifer from reduced diversions into irrigation canals, including the elimination of winter time diversions; 2) reduced incidental recharge to the aquifer due to the lining and piping of irrigation canals and ditches; 3) reduced incidental recharge to the aquifer due to conversions from flood to sprinkler irrigation; and 4) groundwater pumping from the aquifer. (Ex. 2401 at 15, 17, and 18; Ex. 2266; Brendecke, Tr. 2591:12-19.)

16. Spring discharge in the Thousand Springs area is closely related to incidental recharge from surface water irrigation within the North Side Canal Company service area. Incidental recharge from the NSCC has declined significantly. The Winter Water Savings Program alone reduced incidental discharge to the ESPA by roughly 150,000 acre feet per year beginning in 1961. (Ex. 2401 at 8.) Sprinkler usage within the North Side Canal Company service area grew from nearly zero percent in 1982 to nearly 100 percent by 2008. (Ex. 2401 at 9.) Of special significance to Rangen, approximately 24,000 linear feet of laterals off the W-canal in the area west of Wendell, near Rangen, has been lined or placed in pipe since the 1990s, primarily to reduce seepage losses. (Ex. 2401 at 9.) Changes in irrigation practices by the North Side Canal Company in lining its canals directly correlate with decreases in flows at Rangen. (Ex. 2396.) The sensitivity of spring discharge to incidental recharge from the North Side Canal Company likely increases near the edges of the aquifer along the Hagerman Rim, including at Rangen. (Ex. 2401 at 8.)

17. Climate cycles affect ESPA groundwater levels and discharge rates, though without a systematic increasing or decreasing trend. (Ex. 2401 at 15-18; Ex. 2266;

Brendecke, Tr. 2591:12-19.) Drought sequences directly relate to decreases in flows at Rangen. (Ex. 2396.)

18. While the amount of groundwater stored in the ESPA (and corresponding spring flows) have declined from peak levels, average annual spring discharge from springs in the Milner to King Hill reach for the 10-year period ending in 2011 is about 5,000 cfs, which is still substantially above the natural, pre-irrigation levels. (Brendecke, Tr. 2570:7-23.) In the vicinity of Rangen specifically, groundwater levels have been quite stable over the last seven years, and in some cases have increased slightly following the record drought of the early 2000s. (Ex. 1250; Carlquist, Tr. 1683:18-25.) The ESPA is not being "mined" by groundwater pumping (i.e. withdrawals are not outpacing recharge). (Brendecke, Tr. 2568:16-2569:22). The ESPA receives approximately 7.7 million acre feet of recharge annually, whereas groundwater irrigation consumes approximately 2.2 million acre-feet annually. (Ex. 2344.)

Local Hydrogeology

19. The ESPA consists primarily of Quaternary basalts. In the vicinity of Rangen it includes areas of permeable sedimentary deposits immediately underlying the basalts. The Glenns Ferry Formation is the sedimentary deposit that underlies the ESPA at Rangen. Although locally saturated, it is much less permeable than the ESPA and does not provide a useful aquifer in the Rangen area. (Ex. 2223; Ex. 2198, Tr. 2212:19-2213:13; Ex. 2182, Tr. 2175:18-2176:22; Ex. 2190, Tr. 2162:7-2163:9; Ex. 2229, Tr. 2209:8-18; Exs. 2247, 2248, 2249.)

20. The Hagerman Rim is the western termination of the ESPA. Groundwater exits the aquifer in a series of springs along the rim, including at Rangen. (Ex. 2185; Hinckley, Tr. 2165:23-2166:16, 2169:20-2170:19; Ex. 2195, Hinckley Tr. 2193:22-2194:14; Exs. 2247, 2248, 2249.)

21. The contact between the ESPA and the underlying Glenns Ferry Formation, and the topography of that contact, are the major controls on the location and elevation of groundwater discharge from the ESPA in the Hagerman area, including at Rangen. (Exs. 2198, 2238, Tr. 2153:22-2156:3; Ex. 2223, Tr. 2172:1-22; Ex. 2190, Tr. 2178:18-25; Ex. 2226, Tr. 2180:1-2182:2; Ex. 2194, Tr. 2189:19-2190:15; Ex. 2203, Tr 2200:1-23, 2205:19-2206:22; Ex. 2408A, Tr. 2216:3-24; Exs. 2247, 2248, 2249.)

Diversion and Conveyance System

22. Water diverted by the Martin-Curren Tunnel was originally conveyed by

ditch to irrigate elevated farmland south of Rangen. (Exs. 2278, 2361; Babington, Tr. 212:15:17; Brendecke, Tr. 2043:1-6.) It is collected at the mouth of the Tunnel into a concrete box known as the "Farmer's Box." Water can be conveyed from the Farmer's Box to farmland south of Rangen via three steel pipes, or it can be conveyed to Rangen via two PVC pipes. (Ex. 1292.)

23. There are nine irrigation water rights from the Martin-Curren Tunnel, all of which are senior in priority to Rangen's water right nos. 36-2551 and 36-7694. They collectively authorize the diversion of 10-12 cfs. (Brendecke, Tr. 2033:13-16, 2035:14-18; Ex. 2315.) However, little if any water from the Martin-Curren Tunnel has been diverted for irrigation since 2003 when North Snake Ground Water District constructed the Sandy Pipe. (Brendecke, Tr. 2081:13-20.) The Sandy Pipe delivers surface water from the North Side Canal Company to farmland south of Rangen that was previously irrigated with water from the Martin-Curren Tunnel. (Erwin, Tr. 247:3-8.) Because of the Sandy Pipe, Rangen has since 2003 received water that could have otherwise been delivered to senior rights for irrigation purposes. (Erwin, Tr. 247:17-23; Brendecke Tr. 2081:13-20.)

24. Rangen conveys water to five fish rearing facilities depicted on Exhibit 2286: the Hatchery and Lab (containing the Hatch House and Greenhouse), the Small Raceways, the Large Raceways, and the CTR Raceways. (Sullivan, Tr. 1339:21-1340:10.) Rangen installed a 6-inch PVC pipe to convey water from deep inside the Martin-Curren Tunnel to the Hatch House and Greenhouse. (Courtney, Tr. 384:24-385:3; Sullivan, Tr. 1340:11-14; Rogers, Tr. 1798:14-17.) Water from this pipe cannot be conveyed to the Small Raceways, Large Raceways, or CTR Raceways. (Woodling, Tr. 1234:14-18, 1235:1-7; Sullivan, Tr. 1340:11-14, 1346:5-13.) Dr. Brockway calculated the flow capacity of this pipe at 3.6 cfs. (Ex. 1284 at 9.) Prior to this proceeding, Rangen did not know the flow capacity of this pipe. (Tate, Tr. 884:21-885:7, 889:7-14.)

25. Water delivered through the 6-inch PVC pipe to the Hatch House and Greenhouse is discharged into Billingsley Creek. (Rogers, Tr. 1956:1-7; Brendecke, Tr. 2032:11-14.)

26. Two larger PVC pipes convey water from the Farmer's Box a short distance downhill to another concrete box known as the "Rangen Box." The Rangen Box channels water into a 12-inch steel pipe to the Small Raceways. (Ex.3651.) Dr. Brockway calculated flow capacity of this pipe at 14.3 cfs. (Ex. 1284 at 9.) Prior to this proceeding, Rangen did not know the flow capacity of this pipe. (Tate, Tr. 885:1-7.)

27. Water used in the Small Raceways is normally discharged into Billingsley Creek. (Rogers, Tr. 1956:1-7.) In the early 1980s Rangen constructed a pipe that enables water from the Small Raceways to be transported to the Large Raceways. (Babington, Tr. 203:24-204:1-5, 204:12-15; Ex. 1005.) Rangen does not know the size or capacity of the pipe between the Small Raceways and Large Raceways. (Tate, Tr. 891:9-13.)

28. The Large Raceways can receive water from the Small Raceways, but are primarily supplied by water from Billingsley Creek. (Sullivan, Tr. 1343:3-9; Rogers, Tr. 1806:11-18.) Water from the Large Raceways can be discharged into Billingsley Creek or conveyed to the CTR Raceways. (Sullivan, Tr. 1343:20-23.)

29. The CTR Raceways are supplied entirely by water discharged from the Large Raceways. (Sullivan, Tr. 1343:17-19.) Water from the CTR Raceways discharges into Billingsley Creek. (Sullivan, Tr. 1336:19-1337:5.)

Fish Rearing Facilities

30. The Hatch House contains 12 hatching troughs with a total capacity of 204 cubic feet. (Ex. 2108.) Approximately 180,000 fingerling fish can be reared in the Hatch House. Rangen receives sufficient water from the Martin-Curren Tunnel to fully operate the Hatch House. (Ramsey, Tr. 701:8-14; Tate, Tr. 894:16-23.)

31. Rangen added the Greenhouse in 1992 as a dedicated research facility to provide a more controlled environment for research. (Courtney, Tr. 61:15-22.) It is not used in Rangen's fish-rearing cycle, but it can be used to rear fish of all sizes. (Tate, Tr. 893:17-23, 24-894:3.) Rangen receives sufficient water to fully operate the Greenhouse. (Ramsey, Tr. 711:14-17.)

32. The Small Raceways are used to rear fish for approximately 6 to 8 weeks to a length of 2.5 to 5 inches. (Maxwell, Tr. 318:22-25, 319:12-15; Ex. 2423.) The Small Raceways were enlarged in the early 1980s. (Babington, Tr. 203:21-204:5.) It takes 2 cfs to fill any one of the Small Raceways. (Tate, Tr. 874:5-16.) Rangen does not receive sufficient water from the Martin-Curren Tunnel to fill all of the raceways within the Small Raceways at all times of year. (Ramsey, Tr. 662:16-663:13, 711:18-712:6.) However, Rangen does not need water in the Small Raceways continuously. (Maxwell, Tr. 324:2-16.)

33. The Large Raceways have a total capacity of 49,200 cubic feet and can raise fish up to 11 inches in length. The Large Raceways are used for 4 months per fish cycle. (Ex. 2423.) It takes 4.82 cfs to fill any one of the Large Raceways. (Ex. 3274 at 14.) Rangen does not currently receive sufficient water to fill all of the

raceways within the Large Raceways.

34. Rangen built the CTR Raceways in the mid-1970s. (Courtney, Tr. 61:19-20; Babington, Tr. 165:16-22.) The only source of supply of water to the CTR Raceways is water discharged from the Large Raceways. (Ex. 1005.) Rangen does not currently receive sufficient water to fill all of the raceways within the CTR Raceways. The CTR Raceways, when used, contain fish in excess of the Idaho Power contract, but the densities do not approach the maximum carrying capacity of the CTR Raceways. (Smith, Tr. 782:4-783:3.)

Water Measurement

35. Accurate water measurements are critical for fish health and, therefore, important to fish research and for fish culture and rearing purposes. (Woodling, Tr. 1249:4-18; Rogers, Tr. 1844:17-19, 1834:14-20; Ex. 2129 p. 9.) Accurate measurements are important in order to calculate the flow index, which is a measure of the adequacy of flow to meet fish production criteria. (Rogers, Tr. 1847:17-24.)

36. Rangen produced water measurement data from 1966 to 2013. (Ex. 1075.) The data mainly reflect measurements taken at the Lodge Dam and in the CTR Raceways. (Ex. 1290; Courtney, Tr. 138:25-140:8; Maxwell, Tr. 277:10-22.) Rangen combined these measurements to calculate the total flow through the Rangen facility. (Maxwell, Tr. 281:7-14, 329:23-330:1; Ex. 1094.) The measurements taken at the Lodge Dam include water from the Martin-Curren Tunnel, Billingsley Creek, unnamed springs above the flow-measurement points, and irrigation return flows from above the Hagerman Rim. (Courtney, Tr. 142:20-144:5.) Some of this water does not flow through any of Rangen's fish rearing facilities. Thus, Rangen's water measurements are not definitive of water actually put to beneficial use in the Rangen Research Hatchery. *Id.*

37. Rangen measures water at the Lodge Dam and the CTR Raceways using a nonstandard and uncalibrated measuring device and practice called "sticking the weir." (Luke, Tr. 1113:2-7.) Rangen could calibrate its measurement devices to make their measurements more accurate and comply with the IDWR's requirements. (Sullivan, Tr. 1413:12-1414:13.)

38. Rangen's measurements have systematically under-measured its flow by 15.9 percent for many years. (Ex. 3358; Sullivan, Tr.1428:22-1430:2.)

39. Rangen does not measure water flow at the Martin-Curren Tunnel, the Farmer's Box, the Rangen Box, the 6-inch PVC pipe to the Greenhouse and the

Hatchery building, the 12-inch steel pipe to the Small Raceways, or the pipe from the Small Raceways to the Large Raceways. (Maxwell, Tr. 322:5-19.) Prior to this proceeding, Rangen did not know the flow capacities of these pipes. (Tate, Tr. 883:21-893:16.) It is possible to measure flows at all of these locations and to calculate the capacities of the pipes. (Brockway, Tr. 1059:12-20, 1066:3-6.)

40. The lack of measured flow through Rangen's fish rearing facilities makes it difficult to analyze the extent of beneficial use or waste of water. (Sullivan, Tr. 1560:17-24.)

Beneficial Use of Water

41. Neither observed nor estimated flows from the Martin-Curren Tunnel have been high enough to provide water to the 1977 water right (36-7694) since the time of its appropriation. In fact, the total flow measured through the Rangen facility—which includes flow from the Martin-Curren Tunnel, the Lower Springs, Billingsley Creek, and irrigation return flow from above the Hagerman Rim—has not been high enough to provide water to Rangen's 1977 water right. (Ex. 2283.) Watermaster Cindy Yenter confirmed there has never been water available for use under Rangen's 1977 water right. (Tr. 592:12-17.) Thus, water has never been put to beneficial under Rangen's 1977 water right. (Brendecke, Tr. 2075: 1-3; Exs. 1075, 2283.)

42. Rangen has since 2007-2008 operated its facility to raise fish for conservation purposes under a contract with Idaho Power Company. (Tate, Tr. 901:1-5.) The contract requires low flow and density indices. This prevents Rangen from raising as many fish as it could otherwise. (Kinyon, Tr. 482:9-14.) However, the Idaho Power contract pays more than raising fish for commercial purposes. (Kinyon, Tr. 527:16-17; Tate, Tr. 901:11-14.) The Idaho Power contract requires Rangen to deliver fish to Idaho Power three times annually: 125,000 in March, 125,000 in August, and 60,000 in November (Tate, Tr. 855:16-21, 860:6-862:14; Courtney, Tr. 316:18-20.) Rangen has always received and currently receives sufficient water to meet its obligations to Idaho Power. (Courtney, Tr. 531:18-23, 532:9-13; Kinyon, Tr. 507:3-10; Ramsey, Tr. 701:8-14.)

43. Rangen stated that it made its 2011 delivery call to obtain more water for research. The Rangen hatchery was originally constructed to conduct trout-related research in support of its aquaculture feed business. (Ex. 2384; Ex. 1015 at Rangen Bates No. 1590.)

44. The Greenhouse is the best-suited facility for research on fish of all sizes at

Rangen. (Woodling, Tr. 1236:25-1238:19, 1247:22-1249:3, 1254:11-16; Ramsey, Tr. 1203:13-21.) The vast majority of the research performed at Rangen has occurred in the Greenhouse. (Ramsey, Tr. 715:2-7, 717:8.) Rangen has always received and continues to receive enough water from the Martin-Curren Tunnel to operate the Greenhouse. (Ramsey, Tr. 711:14-17; Tate, Tr. 894:16-23.) However, Rangen no longer uses the Greenhouse and has not used it for some time. (Woodling, Tr. 1238:20-1239:2.)

45. Rangen stated a desire to conduct more research in its raceways. Rangen has done very little research in raceways in the past, and any research that could be done in the raceways could be done more accurately in the Greenhouse. (Woodling, Tr. 1254:11-19, 1240:20-1241:9; Ramsey, Tr. 1203:9-21.) Rangen's research documentation does not evidence a need to conduct research in the raceways that could be conducted in the Greenhouse. (Ramsey, Tr. 716:8-717:8.) Rangen explained it desires to do more raceway studies because its aquaculture feed customers like to see research performed in "real world conditions." (Kinyon, Tr. 529:21-530:16; Ramsey, Tr. 1203:9-21.)

46. Rangen also stated that it made its 2011 delivery call to obtain more water to produce fish for commercial sale. Rangen did not produce any documentation evidencing an intention to compete in the commercial trout market. Rangen's executive vice president testified that Rangen avoids competing with commercial fish producers who make up the customer base of Rangen's aquaculture feed business. More than 95 percent of Rangen's aquaculture income comes from the sale of fish feed. (Courtney, Tr. 128:7-10.) Rangen has made a business decision to not lease other fish production facilities in order to avoid impairing relations with commercial producers who buy Rangen fish feed. (Kinyon, Tr. 512:6-11.) Many years ago Rangen did lease other facilities. (Tate, Tr. 878:7-16, 880:13-22.)

47. Rangen did not put on any evidence of how much more water it needs to raise more fish, or how many more fish Rangen would like to raise. Rangen's aquaculture division manager does not know how much more water would be needed to raise fish commercially, nor has he asked any of his hatchery personnel how much water, if any, is needed to raise more fish. (Kinyon, Tr. 498:12-17, 504:22-506:11.) Rangen's aquaculture expert did not review production records and could not offer an opinion on how much more water Rangen needed to raise more fish. (Smith, Tr. 831:17-835:1.) Rangen has not employed a hatchery manager or performed a formal analysis of fish production since 2003 when their last hatchery manager left. (Kinyon, Tr. 491:11-16.)

Conveyance Efficiency and Conservation Practices

48. Rangen has over the last decade produced far fewer fish than it could with its available water supply. Rangen fish production peaked in 1988 at between 25,000 and 26,000 lbs of fish per cfs. (Ex. 1147.) In 2011 Rangen produced about 10,000 lbs of fish per cfs. (Rogers, Tr. 1949:16-19.)

49. A number of options are available to Rangen to substantially increase fish production with its current water supply. Rangen orders three lots of eggs as needed to satisfy the Idaho Power contract: 125,000 eggs in March (Lot 1), 125,000 eggs in June (Lot 2), and 60,000 eggs in November (Lot 3). (Tate, Tr. 860:7-861:16.) Lots 1 and 2 are planted in the Snake River to meet Idaho Power mitigation requirements, and are subject to restrictive flow and density indices. Lot 3 is not subject to flow and density restrictions. (Woodling, Tr. 1306:24-1307:7.) The 60,000 eggs ordered for Lot 3 is far below the carrying capacity of Rangen's facility and water supply. Rangen could raise substantially more fish by ordering more eggs for Lot 3. (Woodling, Tr. 1302:5-18.)

50. Rangen could increase fish production with its current water supply by rearing more cycles of fish annually. (Woodling, Tr. 1302:5-18; Rogers, Tr. 1833:14-23, 1863:20-25.) Rangen has historically reared up to seven cycles of fish annually. (Maxwell, Tr. 323:13-15.) Rangen has in recent years reared only three cycles of fish because that is all that is necessary to meet its obligations under the Idaho Power contract.

51. Rangen could increase fish production with its current water supply by moving fish between rearing facilities at different times. (Rogers, Tr. 1824:13-24.) Doing this would, for instance, allow Rangen could raise 38,000 more fish in the Small Raceways and stay within the Idaho Power contract flow and density restrictions. (Rogers, Tr. 1826:2-6.)

52. Rangen could increase fish production with its current water supply by taking advantage of peak flows, which is the standard practice in the industry. Rangen does not time its fish cycles to take advantage of peak flows. (Ex. 3333; Roger, Tr. 1829:22-1830:15; Woodling, Tr. 1295:22-1296:6.)

53. Rangen could increase fish production with its current water supply by using the CTR raceways for production and fish rearing. (Woodling, Tr. 1299:24-1300:13.) There is not an oxygen problem at Rangen, and larger fish could be reared with the water in the CTR Raceways. (Rogers, Tr. 1827:25-1828:6.) Rangen's aquaculture expert agreed that the lowest dissolved oxygen level going

to the CTR Raceways was 6.0 or greater, which allows for additional fish to be reared. (Smith, Tr. 827:14-828:5.)

54. Rangen could increase fish production with its current water supply by carefully managing its water supply. Most aquaculture facilities carefully measure and track water flows through each rearing facility. (Rogers, Tr. 1834:14-20, 1836:6-1838:25, 1844:17-19, 1847:17-21.) Rangen's records do not consistently show an accurate capacity for its various rearing containers (Rogers Tr. 1836:6-1838:25.) The lack of reliable record keeping at Rangen indicated that Rangen is not trying to maximize the number of fish it is raising at its facilities. (Rogers, Tr. 1839:4-17.) He also testified that Rangen could use water more efficiently. (Rogers, Tr. 1839:18-22.)

55. Rangen could increase fish production with its current water supply by carefully monitoring oxygen and ammonia in its water supply, as is the standard practice for hatcheries that seek to maximize fish production. (Rogers, Tr. 1839:4-17, 1940:23-1941:4.)

56. Rangen could increase fish production with its current water supply be recirculating water through the Rangen facility. Rangen's expert Dr. Brockway analyzed the possibility of recirculating water through the Rangen facility in 1995 and deemed it a feasible solution. (Ex. 1203.) Rangen provided no evidence to demonstrate this is not a reasonable means of improving Rangen's water supply before looking to curtail junior-priority water rights.

Alternate Means of Diversion

57. Rangen hired SPF Engineering to evaluate a number of projects that would enable Rangen to augment its supply of water from the ESPA. This was undertaken in an effort to secure grant funding from the Idaho Department of Commerce. SPF Engineering identified one option to install a horizontal well at a lower elevation than the Martin-Curren Tunnel. SPF Engineering deemed this feasible and stated that it could be considered a "well deepening" of the Tunnel. (Ex. 2040 at 8.) Horizontal wells are used throughout the world to draw groundwater to the surface without the operating expenses required to pump vertical wells. (Ex. 2232.) Drilling a horizontal well at a lower elevation would increase the total supply of water available to Rangen and, unlike the Martin-Curren Tunnel, would suffer little impact from small changes in the elevation of the groundwater table. (Exs. 2198, 2247 at 21-22, 2248 at 3; Hinckley, Tr. 2245:25-2246:17.)

58. While vertical wells would not have the advantage of gravity flow, they are used by a number of fish hatcheries in Idaho and could likely be used by Rangen to augment its water supply. (Rogers, Tr. 1776:19 - 1777:22.) The ESPA in the vicinity of Rangen is abundantly productive and could feasibly be developed through construction of vertical wells in the area immediately east of Rangen. (Exs. 2206, 2247 at 28-30, 2248 at 2-4; Hinckley, Tr. 2237:18-2241:1, 2244:23-2245:16.)

59. It is feasible to pump first-use water from Billingsley Creek to the Small Raceways from near where Rangen diverts water into the Large Raceways. (Ex. 2367.) This would make the majority of the total spring discharge at the Rangen complex available to all of Rangen's raceways. This additional first-use water could be used to raise fish in the Small Raceways and then delivered to the Large Raceways as reuse water for larger fish. This would result in a more efficient use of the water available to Rangen. (Rogers, Tr. 1891:3-1892:22.) Although Billingsley Creek is not an authorized source of water under Rangen's water rights, Rangen has historically diverted and used water from Billingsley Creek for fish rearing. However, Rangen has not made efforts to make that water available to the Small Raceways.

ESPAM 2.1 – Structure

60. ESPAM2.1 is a regional groundwater model of the ESPA. It is the best science available for predicting the regional effects of hydrologic changes in the ESPA. ESPAM2.1 was developed as a regional model, requiring many simplifying assumptions and generalizations, some of which compromise its ability to predict the impacts of curtailment on the discharge of groundwater at specific, local discharge points like Rangen. (Ex. 2247 at 6, 32; Ex 2401 at 37.)

61. The ESPAM2.1 model domain is larger than the area of common ground water supply. (IDAPA 37.03.11.050.) ESPAM2.1 is programmed to predict an impact to every model cell from a hydrologic change in any single model cell. Consequently, ESPAM2.1 predicts an impact to Rangen from groundwater withdrawals that occur outside the area of common groundwater supply. (Brendecke, Tr. 2561:22-25.)

62. ESPAM2.1 represents the Rangen spring complex and the surrounding geology in highly simplified form, omitting key features and that could make substantial differences in the predicted effects of curtailment. (Ex. 2247 at 29; Ex. 2401 at 45.) Observations of ESPA geology show that it is highly complex, comprised of overlapping fractured basalts interspersed with sedimentary

deposits, with hydraulic characteristics that can vary substantially over short distances. (Ex. 2247 at 6, 8, 9.)

63. The ESPA terminates along the Hagerman Rim, including at Rangen. ESPAM2.1 represents the aquifer as continuing westward another 1.7 miles beyond the Hagerman Rim at Rangen. (Ex. 2213.)

64. ESPAM2.1 is comprised of a single layer of model cells of uniform vertical and horizontal dimensions. It is unable to represent the geologic contact between the ESPA and the underlying low-permeability sediments that is the major control of the location and elevation of spring discharges along the Hagerman Rim, including at Rangen. (Ex. 2226; Ex. 2247 at 6, 44.)

65. Transmissivity is a parameter that represents the ability of water to move through aquifer materials. It is calculated as the product of hydraulic conductivity (an intrinsic property of the aquifer material) and the saturated thickness of the aquifer. (Ex. 2247 at 38; Ex. 2401 at 26.) ESPAM2.1 assumes constant transmissivity and specific yield within each model cell. These assumptions result in substantial misrepresentation of localized flow conditions in some parts of the aquifer, such as along the Hagerman Rim. (Ex. 2401 at 10.) The ESPA thins in the area along the Hagerman Rim and would therefore be expected to have a lower transmissivity closer to the rim. Yet ESPAM2.1 transmissivities increase in magnitude closer to the Hagerman Rim. In some of these areas, the ESPA has zero saturated thickness and groundwater movement is restricted to the low-permeability underlying sediments. (Brendecke Tr. 2576:18-2577:24; Ex. 2247 at 18, 38, 39; Ex. 2401 at 26, 32.)

66. ESPAM2.1 is implemented in MODFLOW which is based on a porous media flow paradigm. It is likely that fracture or conduit flow, more than porous media flow, dominate hydraulic behavior in the ESPA. This is particularly important when looking at localized areas, such as individual springs along the Hagerman Rim, where aquifer thinning occurs and preferential flow pathways become increasingly important. (Brendecke, Tr. 2040:7-8, 2606:22-2607:10; Exs. 2401 at 32, 2226, 2203.)

67. Important water budget inputs to the aquifer, such as seepage from canals and laterals, are represented in ESPAM2.1 by constant factors. (Ex. 2401 at 27). Some of these inputs have changed over time, including seepage from the NSCC east of Rangen. The constant seepage percentage assumed in ESPAM 2.1 is a source of error, and this error is ultimately reflected in the model calibration parameters. (Contor, Tr. 2913:16-25.)

68. ESPAM2.1 can predict the effect of hydrologic changes on water flows at the Rangen cell, but it cannot distinguish between flows from the Martin-Curren Tunnel, the Lower Springs, and other springs in the area. The total groundwater discharge at Rangen is represented in ESPAM2.1 with a single drain at elevation 3138 ft. The actual discharge elevation of the Martin-Curren Tunnel is 3150 ft, and the actual discharge elevation of the Lower Springs is approximately 3100 ft. The single-drain representation restricts ESPAM2.1 to a single, total discharge for the Rangen model cell (Ex. 2247 at 43; Ex. 2401 at 28.)

69. In MODFLOW, upon which ESPAM2.1 is based, flow from a drain is a linear function of the modeled groundwater level in the drain cell. (Ex. 2401 at 32; Ex. 2247 at 43.) With this and the assumption of constant transmissivity, ESPAM2.1 is structurally incapable of representing relationships other than linear ones, limiting its ability to accurately predict future impacts where non-linear aquifer responses occur. (Ex. 2248 at 9.)

70. The sum of observed flows of springs represented in ESPAM2.1 fails to account for 907 cfs of ungaged reach gains to the Snake River between Buhl and Lower Salmon Falls, 350 cfs of which are not physically identified with any specific location along the River. These gains are represented in ESPAM2.1 using simple averages of flow conditions through the reach, resulting in a poor match with observed gains. (Ex. 2247 at 46, 49, 84, 85.)

ESPAM2.1 – Uncertainty

71. ESPAM2.1 predictions are subject to several sources of uncertainty, including conceptual uncertainty, uncertainty in input data (including targets used for calibration), and parameter uncertainty. (Ex. 2401 at 35.)

72. Conceptual uncertainty arises from the fact that ESPAM2.1 may not, and specifically does not in the Rangen area, reflect important aspects of actual hydrologic and hydrogeologic conditions. (Ex. 2401 at 37.)

73. Uncertainty in input data results in part from the fact that many of the input data used in developing ESPAM 2.1 had to be estimated or were imprecisely measured. Uncertainty in the water budget translates to uncertainty in calibrated transmissivity. (Contor, Tr. 2882:19-2883:8.) Calibration to uncertain water levels, spring flows, etc. introduces additional uncertainty into model results. (Contor, Tr. 2860:16-2861:19.)

74. Parameter uncertainty arises because multiple combinations of calibrated parameter values may lead to the same or very similar levels of overall model

calibration. (Ex. 1277 at 6; Ex. 2401 at 10.)

75. The uncertainty analysis of ESPAM2.1 conducted by the IDWR addressed only parameter uncertainty. (Ex. 1277 at 3; Wylie, Tr. 2922:3-12.)

76. Calibration of ESPAM2.1 did not address conceptual or input data uncertainty. Well-calibrated models may not be appropriate for addressing questions that were not posed to the model or available in the calibration data. (Contor, Tr. 2875:16-2876:1, 2878:13-22.)

77. Conceptual uncertainty can be evaluated by developing and comparing alternative conceptual models. To illustrate this point, Dr. Brendecke prepared partial alternative conceptual models that included selective modifications to ESPAM2.1 to illustrate some of the impact of the termination of the primary aquifer at the Hagerman Rim, the multiple elevations of spring discharge occurring in the Rangen area, and the absence of the primary aquifer in the Hagerman valley. (Brendecke, Tr. 2707:24-2708:6, 2909:25-2910:11.) These ESPAM2.1 variations produced results that differed by 20 percent from the curtailment predictions simulated by ESPAM2.1. (Ex. 2403 at 12; Brendecke, Tr. 2642:1-11.)

ESPAM2.1 – Rangen Area

78. ESPAM2.1 is the best science available for evaluating regional effects of hydrologic changes on the ESPA. When evaluating the effect of curtailment on a single model cell, and especially when attempting to evaluate the effect of curtailment on a single groundwater discharge site within a single model cell, it is appropriate to consider the local hydrogeology and the effects of the simplifying assumptions within ESPAM2.1 that may affect its predictions.

79. There are a number of conceptual and structural limitations of ESPAM2.1 in the Rangen area, including:

a) ESPAM2.1 simulates groundwater levels that are above the land surface in the Rangen cell and nearby model cells. (Exs. 2213; Ex. 2247 at 76, 79.)

b) ESPAM2.1 simulates groundwater flow in the model cells immediately west and south of Rangen that is the opposite of the observed flow direction. (Ex. 2247 at 42, 76; Hinckley, Tr. 2456:15-25.)

c) ESPAM2.1 simulates Snake River reach gains in the Rangen area that reflect very little of the observed, large seasonal fluctuations in those gains

(Hinckley, Tr. 2485:5-23.)

d) ESPAM2.1 simulates a clear, linear relationship between groundwater levels west of Rangen and the discharge from the Rangen model cell, whereas actual measurements show no relationship at all between Rangen discharge and the disconnected water-bearing zones to the west. (Ex. 2248 at 7, 11.)

e) ESPAM2.1 systematically simulates the seasonal low flow as occurring three months earlier than it actually occurs. (Ex. 2219; Hinckley Tr. 2482:8-11.) Systematic errors in the seasonal timing of Rangen flows compromise the ability of ESPAM2.1 to confidently predict the impact of curtailment on beneficial uses like fish production that have cyclic water demands. (Exs. 2219, 2247 at 48; Hinckley, Tr. 2480:25-2483:3.)

80. Inaccuracies and uncertainties in the ESPAM2.1 representation of the ESPA at Rangen produce uncertainty in ESPAM2.1's predictions of the impact of curtailment on water flows at Rangen. (Ex. 4001 at 24; Contor, Tr. 2883:7.) Some sources of uncertainty are likely to produce random errors in the predicted impacts, but others are identified with systematic errors, creating a bias toward over-prediction of the impacts at Rangen. (Hinckley, Tr. 2447:8-14, 2477:2-22, 2481:22-2483:3, 2486:11-2487:8.)

81. The conceptual and structural limitations of ESPAM2.1 are evident in the errors (or "residuals") between simulated and observed hydrologic conditions in the Rangen area. (Ex. 2300.)

a) ESPAM2.1 predicts discharge from the Rangen cell that is consistently smaller than was measured through the 1980s and consistently larger than was measured through the 2000s. (Ex. 2300.) This systematic error is apparent in most of the spring discharges modeled by ESPAM2.1 along the western edge of the ESPA. (Ex. 1273E, 1273F.) It was acknowledged by several experts at hearing, including Rangen's experts. (Brockway, Tr. 2369:8-2370:20.)

b) The systematic error in prediction of Rangen flows by ESPAM2.1 ranges from an average under-prediction of 6.1 cfs in the first eight years of the calibration period to an average over-prediction of 4.7 cfs in the last 10 years of the calibration period. (Ex. 2424.) These errors raise doubt as to the accuracy of model predictions for specific locations such as the Martin-Curren Tunnel and springs at Rangen. (Ex. 2401 at 10; Brendecke, Tr. 2587:21-2588:1; 2646:3-7.)

c) A possible explanation for these systematic calibration residuals is un-modeled improvements in North Side Canal Company laterals in the late 1980s and again in the late 1990s which reduced seepage of surface water from canals and ditches off of the "W Lateral" immediately east of Rangen. (Brendecke, Tr. 2595:15-2597:20; Ex. 1416 at 54:6-12; Ex. 2396.) The distinct changes in error correspond to episodes of conveyance system improvement by Northside Canal Company as found by Director Dreher in his 2005 Order: ". . . decreases in the springs supplying the Rangen hatchery facilities can be correlated with repairs made to the facilities of the North Side Canal Company to reduce losses of surface water to ground water from the canal company's facilities above those springs in 1987, 1998, and 2000." (*In The Matter of Distribution of Water to Water Rights Nos. 36-15501, 36-02551, and 36-07694*, Second Amended Order, FF 23 at 6 (May 19, 2005).) ESPAM2.1 assumes constant seepage percentages over the modeling period; a change in the local water budget could contribute to the systematic over-prediction of flows at Rangen. (Brendecke, Tr. 2584:5-2585:17.) Dr. Wylie confirmed that ESPAM2.1 assumes constant seepage percentages over the modeling period and that a change in the local water budget could in fact contribute to the systematic over-prediction of flows at Rangen. (Wylie, Tr. 2913:3-25; Ex. 1416 at 53:21-54:18.)

82. ESPAM2.1 simulates groundwater levels in the Rangen area that are systematically lower than measured groundwater levels. This under-prediction of groundwater level is approximately 20 ft in the ESPAM2.1 calibration well nearest to Rangen. (Ex. 2247 at 68; Exs. 2301, 2302.) The calibration of ESPAM2.1 adjusts transmissivity and drain conductance parameters to provide an acceptable match with measured water levels and spring discharges. Where modeled water levels are too low relative to the measured values, as occurs in the Rangen area, model calibration requires that transmissivities and drain conductances be correspondingly higher to achieve the desired discharge. This results in the model-simulated impact of increases in aquifer water levels resulting from curtailment of junior groundwater pumping being exaggerated with respect to spring and tunnel discharge. (Brendecke, Tr. 2647:17, 2648:15; Ex. 2401 at 31.)

83. Comparisons of measured Rangen groundwater discharge with measured ESPA groundwater levels show the discharge to be less sensitive to changes in groundwater levels at lower (more recent) groundwater levels. Consideration of current aquifer conditions (since 2000) indicates that aquifer discharges such as Rangen will be less responsive to changes in ESPA water levels than may have

been true in the 1980s and 1990s. (Exs. 1284 Appx. C; Ex. 2248 at 10; Exs. 2204, 2205.)

84. Comparing measured aquifer water levels with measured groundwater discharges at Rangen indicates ESPAM2.1 over-predicts the impacts of curtailment. (Ex. 2401 at 32.)

a) As represented in ESPAM2.1 (and required in MODFLOW), the change in flow from a drain due to a change in water level in the cell hosting the drain is the product of the drain conductance and the water level change. (Ex. 2401 at 26; Ex. 2296). ESPAM2.1 predicts the effect of junior groundwater pumping on flows at Rangen by calculating the change in groundwater level and applying the drain conductance shown on Exhibit 2197.

b) The calibrated Rangen drain conductance of ESPAM2.1 is 4.85 cfs/ft and the ESPAM2.1-predicted change in flow from the Rangen drain, resulting from curtailment of junior groundwater use across the entire model domain, is 17.9 cfs. (Ex. 1319 at 72; Ex. 2248 at 9; Ex. 2401 at 32; Tr. 2602:1). This demonstrates that ESPAM2.1 predicts a 3.69 foot increase (17.9/4.85) in water level at the Rangen drain cell from curtailment of junior groundwater use across the entire model domain. By the same calculation, ESPAM2.1 predicts a 3.48 foot increase (16.9/4.85) in water level at the Rangen drain cell from curtailment within the area of common groundwater supply.

c) The observed conductance of the Rangen cell, based on the relationship between measured groundwater levels in nearby wells and measured total water flows at Rangen, is roughly 3 cfs per 1 foot change in aquifer level. (Ex. 2248 at 10-11.)

d) The observed conductance of the Martin-Curren Tunnel, based on the relationship between measured water levels in the Rangen Monitoring Well and measured flows from the Tunnel, is 1.37 cfs/ft. (Ex. 1319 at 27; Ex. 2205; Brendecke, Tr. 2605:19-2606:2.)

Effect of Curtailment on the Martin-Curren Tunnel

85. As presently configured, ESPAM2.1 predicts that curtailing all groundwater use junior to July 13, 1962, across the entire model domain would increase total groundwater discharge to the Rangen model cell by 17.9 cfs at steady state. This would require the permanent curtailment of groundwater irrigation of 565,026

acres. (Ex. 1319 at 72.)

86. As presently configured, ESPAM2.1 predicts that curtailing all groundwater use junior to July 13, 1962, within the area of common groundwater supply would increase total groundwater discharge to the Rangen cell by 16.9 cfs at steady state. This would require the permanent curtailment of groundwater irrigation to 479,203 acres. (Ex. 1319 at 73.)

87. Many of the limitations and uncertainties of ESPAM2.1 are not neutral or random, but create a systematic bias toward over-prediction of the impact of curtailment on flows at the Rangen model cell and the Martin-Curren Tunnel specifically. (Hinckley, Tr. 2510:18, 2513:21; Brendecke, Tr. 2587:22, 2739:9-16, 2666:25-2667:1-9, 2774:17-2775:15.)

88. ESPAM2.1's systematic over-prediction in flows at Rangen under current conditions (since the early 2000s) suggests ESPAM2.1 also over-predicts the effect of junior pumping on flows at Rangen. (Ex. 2401 at 11; Hinckley, Tr. 2447:8-23.)

89. Comparison of measured aquifer water levels with measured discharges at Rangen indicates ESPAM2.1 over-predicts the impacts of curtailment. The predicted effect of curtailment within the area of common groundwater supply (16.9 cfs) represents a 3.48 foot change in level of the groundwater table (based on the ESPAM2.1 assumed ratio of 4.85 cfs/1 ft—Ex. 2197). The observed ratio between measured water levels and measured discharge (3 cfs/1 ft—Ex. 2248 at 10) indicates a 3.48 foot change in water level will produce a 10.4 cfs change in flow at the Rangen model cell. This is consistent with Hinckley's opinion, based on structural limitations and uncertainties in ESPAM2.1, that the accrual from curtailment to the Rangen model cell will likely be on the order of 8-12 cfs. (Hinckley, Tr. 2518:9-13.)

90. Only a portion of the increase to the Rangen cell will accrue to the Martin-Curren Tunnel. Using measurements of flows from the Martin-Curren Tunnel taken by the IDWR between 1993 and 2009 (Ex. 2401 at 21), a regression equation was developed to relate total flow reported by Rangen to the flow from the Tunnel only. Taking into account the 15.9% error in Rangen's water measurements, available data indicates that 63% of the total increase to the Rangen cell will accrue to the Martin-Curren Tunnel. (Ex. 3654 at 3.) Thus, of the likely 10.4 cfs change in total flows at Rangen, 6.6 cfs will accrue to the Tunnel.

91. This is corroborated by the observed 1.37cfs/ft relationship between the measured water level in the Rangen Monitor Well and the measured flow from

the Martin-Curren Tunnel. By this calculation, a 3.48 foot change in the level of the groundwater table, as a result of curtailment within the area of common groundwater supply, will produce a 4.8 cfs change in flow at the Martin-Curren Tunnel.

92. Based on the indicated bias of ESPAM2.1 toward over-prediction of the impact of curtailment on total groundwater discharge at Rangen, coupled with the proportion of total discharge which has been found to occur at the Martin-Curren Tunnel, the effect of the unlimited curtailment sought by Rangen is likely to be substantially less than predicted by ESPAM2.1. (Hinckley, Tr. 2518:9-13; Brendecke, Tr. 2667:5-9.)

93. Use of the regional ESPAM2.1 to predict aquifer water level changes resulting from curtailment, and applying those changes to the observed local relationship between water-level change and Martin-Curren Tunnel discharge at Rangen, produces a likely impact to the Tunnel on the order of 5 to 7 cfs. This is consistent with Dr. Brendecke's opinion that the accrual to the Curren Tunnel is likely to be "in the neighborhood of 6 to 7 cfs." (Tr. 2667:9.) It is also consistent with Hinckley's estimate (8-12 cfs to the Rangen cell) when scaled down to reflect the 63% portion of the total Rangen discharge that applies to the Martin-Curren Tunnel (5 to 7.6 cfs). (Hinckley, Tr. 2518:9-13.)

Effect of Curtailment on Beneficial Use of the ESPA

94. Curtailment over the entire ESPAM model domain would immediately and permanently eliminate beneficial groundwater use of 1.23 million acre-feet/year that is presently used to irrigate 565,000 acres. The ESPA is not being mined by groundwater pumping, and the amount of groundwater stored in the ESPA is substantially above the natural, pre-irrigation levels. (Brendecke, Tr. 2568:16-2570:23.) Groundwater levels in the Rangen area have increased slightly as the ESPA recovers from the record drought of the early 2000s, and appear to be stable. (Ex. 1250.) Thus, curtailment will eliminate sustainable groundwater use.

95. Of the 1.23 million acre-feet/year of water use that would be eliminated under model-wide curtailment, the Rangen cell is predicted to receive 12,958 acre-feet/year at steady state conditions, or 1% of the amount curtailed. (Ex. 1319 at 72; Ex. 2395; Brendecke, Tr. 2563:16-2564:14.) Assuming 6 cfs will accrue to the Martin-Curren Tunnel, Rangen would receive 4,344 acre-feet/year, which is less than four-tenths of 1% of the curtailed groundwater.

96. The portion of the curtailed groundwater that does not accrue to Rangen would accrue to other connected river reaches, springs, and base flows, including

those on which there are no water rights or diversions, those on which there are no delivery calls, those on which approved mitigation plans are already in place, and those on which diversions occur only under water rights junior to the curtailed rights, and at times when there is no need for additional water by any water users on those reaches. (Ex. 1319 at 6; Ex. 2403 at 8; Brendecke, Tr. 2567:18-25, 2568:1-9.)

Trimline

97. In prior conjunctive management cases the zone of curtailment has been limited to junior-priority water rights for which at least 10% of the curtailed water is predicted to accrue to the senior. In other words, if ESPAM predicts that less than 10% of the water from a given groundwater well will accrue to the senior at steady state, the well is excluded from curtailment. The line that demarcates the zone of curtailment is commonly referred to as the "trimline."

98. Constraining curtailment of junior groundwater pumping to a smaller geographic area than that represented by the ESPAM domain is a reasonable means of addressing model uncertainty. (Hinckley, Tr. 2489:9-25, 2510:20-2511:13, 2538:25-2539:11.)

99. Use of a trimline will result in a smaller benefit to Rangen. IDWR staff prepared a table with various trimline scenarios showing the ESPAM2.1 predicted impact to the Rangen model cell. (Ex. 1319 at 51.) The following table is updated to show the likely impact to the Martin-Curren Tunnel, based on findings of fact 85-93 above which indicate roughly 36% (6 cfs out of 16.9 cfs) of the ESPAM2.1 predicted increase to the Rangen cell is likely to accrue to the Tunnel:

Area of Curtailment	Curtailed groundwater irrigation (acres)	ESPAM2.1 predicted response at Rangen model cell (cfs)	36% likely to accrue to the Martin-Curren Tunnel (cfs)	Acres curtailed per cfs of benefit at the Martin-Curren Tunnel
Model Boundary	565,026	17.89	6.44	87,732
Area of CGWS	479,203	16.94	6.10	78,578
0.2% trimline	257,673	16.15	5.81	44,319
1% trimline	160,389	14.55	5.24	30,620
1.5% trimline	154,270	14.32	5.16	29,925
1.7% trimline	108,543	11.84	4.26	25,465
2% trimline	67,093	9.31	3.35	20,018
3.5% trimline	26,694	5.71	2.06	12,986
5% trimline	12,346	3.35	1.21	10,237
10% trimline	24	0.01	0.00	6,667

RESPECTFULLY SUBMITTED this 21st day of June, 2013.

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CERTIFICATE OF MAILING

I certify that on this 21st day of June, 2013, the foregoing document was served on the following persons in the manner indicated.

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