Sevier River Flooding 1983-1984

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The infrastructure of the Sevier River system prior to the 1983-1984 years had a significant impact on the decisions that had to be made to manage the flood flows. Beginning with the Conk Dam and Cropper right, which are the last diversions on the Sevier River, most structures were not designed for flood control. At the Conk Dam a 30" corrugated culvert type headgate was the only means to bypass water into a channel on down to Sevier Lake. Some water had been by-passed in 1980 by excavating a channel around this structure. This section was later stabilized with cobble rock at an elevation high enough that the normal equalizing pool could be maintained and at the same time flows in excess of their canal capacities would automatically be by-passed. Just upstream in the center of the town of Deseret, the State of Utah had recently constructed a new bridge across the Sevier River on Highway 257. This bridge consisted of a 16′ wide 8′ high concrete box culvert. The bridge box culvert had a center square nosed divider to strengthen the span. The next crossing upstream consisted of an 8′ corrugated pipe culvert at what was known locally as Cropper Lane. The first crossing below Gunnison Bend Reservoir was the bridge on U.S. Highway 6.

The Gunnison Bend spillway was concreted at the present site in 1904. Prior to the flooding, the State Engineer had notified the Deseret and Abraham irrigation companies that the old spillway would have to replaced due to eroding concrete and other impairments. The top of the dam was 14′ above the channel bottom. The spillway crest was at an elevation 6′ giving a surplus release of 7′ between 6′ and 13′, the maximum impoundment level. Dudley Crafts, a native of Deseret, a noted water attorney, and having a personal knowledge of the entire history of the Gunnison Bend reservoir had on several occasions stated that the Gunnison Bend spillway could bypass 2,500 cfs. In fact the spillway had bypassed the second flood caused by the failure of the Delta-Melville diversion dam located 8 miles upstream. The Delta-Melville dam for the second time failed around noon on May 20, 1910. With the knowledge that a flood was coming, the flashboards of the Gunnison Bend spillway were removed, probably with some dynamite, draining the reservoir before the contents of Delta-Melville diversion reached Gunnison Bend reservoir. Little or no record exists as to the damage or effects of the 1910 dam failure except minutes of an Abraham Irrigation company meeting stating that their share of repairing the spillway would be about $5,000.

The first failure of the Delta-Melville diversion occurred sometime after midnight June 14, 1909. Evidently no one knew that a flood was enroute, consequently the spillway was not prepared. The water added to a nearly full Gunnison Bend reservoir which overtopped the dam at the Cropper Cut. The large volume of water thus released through the break overtopped the floodplain by some three feet at the Cropper Lane crossing (See Chronicle 1911) causing immense damage to the town of Deseret and the farms. The bypass capabilities of the Gunnison Bend spillway were at odds with legendary claims. Old photographs seemed to have something different. Researching the original plans showed the stop-log piers were twelve inches wide. It can be assumed that just as the present operators had to blow the lower planks out with dynamite as had the 1910 operators. The replacing piers were thirty-two inches wide with no bull-nosing or rounded upstream face thereby reducing the spillway capacity by a significant amount. The two end bays had also been closed to strengthen the bridge over the spillway. A study of the past could have resulted in quicker and better flood management at the Gunnison Bend Reservoir.

In about 1905 LDS church authorities at Fillmore sent several of the saints on a mission to see if additional farmland could be developed upstream from Deseret. Some thought that sub-irrigation in the areas of high natural water tables might be feasible. Eventually an effort was organized to divert from the Sevier River. Each individual would apply for Deseret entry lands. As an enticement for each forty acres applied for, a lot would be given in the proposed townsite to be named Melville after James A Melville, a leader in developing irrigation projects. The United States post office department would not accept the name Melville because of the similarity in name of a post office at Millville, Cache County. The RR company had a weigh station at the site called Burton; eventually the town was named Delta as suggested by John E. Steele because the location was near a part of the delta of the Sevier River.

The original intent was to sue a part of the Hawley filling in cooperation with the Deseret Irrigation Company. The high run-off years of 1906 and 1907 gave much encouragement that the project would be successful. Another group formed the Oasis Land and Water Company and received the approval of the State of Utah to construct a Carey Act Project of some 43,000 acres. The Oasis Land and Water Company now known as the Delta Canal company acquired a one-half interest in the Hawley filing and a three-fifths interest in the Burtner dam.

Leonard J. Arrington, noted Utah Historian, recounts in *"Taming the Turbulent Sevier"* how after multiple failures of the dams and diversions of the Deseret and Abraham Irrigation companies, the companies moved eight miles upstream to build a dam 30' high and 600' long known as Sevier Bridge Dam. The dimensions of the dam described are truly astounding, however this was not Sevier Bridge Dam but is an accurate description of the Delta-Melville diversion. This writer had many questions as to why the first Burtner Dam break was so devastating to the Deseret area, and why was the flood wave much deeper than the break of 1983. This fact was noted in the 1911 Millard County Chronicle narrating how the water was three feet deep in Don A. Bishop's house at Cropper lane. The 1983 flood did not overtop the flood plane at this point. An examination of the old Burtner Dam clearly shows that it required a large body of impounded water (possibly more than 5,000 acre feet) to deliver any water into the joint Delta-Melville canal. A maximum flow depth of 5 feet in Canal A would require a body of water comparable to the capacity of the enlarged DMAD reservoir. Another mitigating factor was the 1983 high flows over a long period of time had scoured the river channel several feet lower.

In the first break, June 14, 1909, of the Burtner Dam flow records indicate 1,500 cfs coming through Sevier Bridge reservoir. This flow probably taxed the capacity of the spillway which over time failed. What happened the next year, May 20, 1910, is still clearly evident. The water master on arriving at the diversion gates saw that the canal had broken just below the headgates. The stream was eroding a miniature Grand Canyon back to the river. He undoubtedly took the only action possible. He closed the canal gates and went for help. By noon the spillway failed for the second time. This time the two companies followed a construction plan proposed the year before but was proposed too late to change the construction already in progress. The canal was extended along the bench line until the canal intersected the river channel resulting in a much smaller equalizing pond to divert into Canal A. A historical note indicated that it required capturing a portion of the flow of the river for 10 days before water was delivered to the Burtner townsite in August 1908. The average flow upstream in August 1908 was nearly 500 cfs, mostly serving Gunnison Bend Reservoir. A new outlet channel for the new diversion dam was excavated to the new spillway. The new spillway was almost identical to the two that previously failed. The new spillway also served as a drop structure to feed the natural river channel some 12 feet below.

In the winter of 1959-60, the issue of storing or using the Deseret and Abraham's 10,000 acre feet of winter water right was resolved by stipulation and the DMAD dam and reservoir was constructed. This reservoir holds 11,000 acre feet with water rights belonging to all four companies. The old spillway was retained to modify the gradient from the river release gates and the new spillway. A feature of the new DMAD spillway was that the crest was put at the full reservoir elevation, thus the capacity of reservoir to bypass water on down the river was about 700 cfs unless the reservoir was overfilled. Removing flashboards from a spillway is a dangerous and difficult task. Boards under 2 or 3 feet of water when removed by hand required a decision of whether to let go and lose the plank downstream, or hang on and maybe go with the stop log downstream. The purpose of a clean overflow crest at the maximum storage level was to eliminate the need for flashboards.

A story of how stoplogs were handled by one of the many "characters" associated with the Sevier system operation might be appropriate. It is told that when Charlie Williams needed to remove the flashboards from the Central Utah Canal diversion dam he had a "flash" pan which he hung from the top board down to the lower boards; he placed a half stick or whole stick of dynamite on the pan, and from a safe distance touched the dynamite off with his 30-06 hunting rifle. It was also said that Charlie never carried a brace and bit to drill holes to repair headgates. He just marked the holes and used his trusty 30-06 to drill the holes.

Between Sevier Bridge and DMAD only the Central Utah diversion had been modernized. There were three screw gates to drain the diversion pond. A long concrete wall was set to an elevation to serve the canal's maximum flow. With the screwgates closed, Central Utah could dry dam the river and take all the flow the canal would hold. At certain times this was their right.

The spillway at Sevier Bridge reservoir was reconstructed in 1976 by the Central Utah Water Conservancy District in exchange for a right to use any available capacity to implement the introduction of C.U.P. water into the Sevier Basin. The old spillway was some 80 feet long with the concrete crest at an elevation of 77 feet. Three feet of flashboards were on top of the crest giving the ability to store water to the 80 foot contour, which was the full storable right of 236,145 acre feet. In addition at the 60 foot contour two 5' x 12' radial gates were installed to release through the spillway. The new plans first submitted called for four 4' x 4' tunnels through the spillway at the 60 foot contour instead of the radial gates and a concrete crest at the 80 foot contour thus eliminating any flashboard problems. The irrigation companies could not accept such a structure. It meant that any time water went over the spillway it would constitute proof that they had exceeded their storage and were likely to be sued by every private landholder bordering Sevier Bridge Reservoir and the release capacity would be diminished to a maximum of 2,500 cfs. Consequently the crest was lowered 3 feet and the flashboards returned to the plan. The flashboards, however, could be raised from the catwalk with permanently attached chains. Also the 4' x 4' gate controls were reduced to two in number. The bypass capacity at Sevier Bridge reservoir was approximately 2,400 cfs less at the 80 foot contour than the 6,000 cfs possible with the old structure.

The major reservoirs above Sevier Bridge Reservoir are Gunnison Reservoir, Piute Reservoir, and Otter Creek Reservoir, storing a maximum of approximately 144,000 acre feet. All were constructed by private groups, or eventually owned by private groups, needing supplemental supplies for the existing irrigated acreage. All of the reservoirs were constructed to appropriate and conserve as much water as possible for needed irrigation water for the land under cultivation. The Commissioner's duties were to deliver to each of the diversions their full water rights when called for. They were thus required to fill the reservoirs, if possible, to conserve all possible water to satisfy the irrigation rights. The filling of Piute and Sevier Bridge causes major changes to the water rights of the users storing water in the two reservoirs. Each user of the stored water made the determination as to when and how much water was to be released to satisfy his demand. Water spilling to Sevier Lake was obviously water that could not be claimed as a right for beneficial use, otherwise the water would have been diverted. The Sevier River system was constructed to conserve as much water as possible for the primary use of irrigated agriculture. The water rights developed in a way that maximum use could be made of the water supply. Major changes in water rights are caused when the major reservoirs filled. This fact obligates the Commissioners to regulate the reservoirs to be as full as possible when the irrigation demand commences. The reservoirs were not designed for flood control purposes nor was there any plan to coordinate the river system in times of emergency. It was an *"every man for himself"* situation. The system had functioned very adequately from 1916 to 1983, a period of 76 years.

September 1982 was a month of very heavy precipitation. The consequences of the heavy rainfall were that the watershed soil mantle became saturated and the normal diversion pattern ceased. It was obvious that the reservoirs would fill before irrigation would commence the following spring. All the irrigation companies were notified that there would be no holdover credits allowed. The normal operation below Sevier Bridge Reservoir was to completely empty Fool Creek Reservoir, DMAD Reservoir, and Gunnison Bend Reservoir by the end of the irrigation season. Because of the impending runoff, the Commissioner regulated so that the lower reservoirs, DMAD and Gunnison Bend, held considerable water in the fall season. There were two reasons for doing so, to maintain the best water quality possible, and reservoirs could only discharge in flow rates dictated by the "head" necessary to move water out. Immediately after irrigation ceased a release from both reservoirs was started to dump into Sevier Lake. Water users along the Sevier River are very aggressive in protecting their water rights. The releases to Sevier Lake resulted in two very strange complaints. One group that owned the surplus waters during the winter complained that the Commissioner was dumping *their* water. The other complaint was that the two reservoirs should be emptied forthwith. The first group ultimately paid a high price for making heroic efforts to disperse excess flood waters accumulating in their reservoir and canals. The second complaint became a staple item in the many damage suits filed (i.e. emptying the two reservoirs early would have prevented the later flooding). DMAD and Gunnison Bend if emptied at anytime would have automatically filled back up to be able to release the river flow. In fact when the maximum flows reached a rate that was said to have previously occurred additional release capacity was constructed under emergency conditions. When the two reservoirs were emptied one by spillway failure, the other by breaching; this fact became the second staple in the lawsuits filed. Many individuals that sued were flooded by the natural river flows before the reservoirs were emptied. The capacity of DMAD and Gunnison Bend reservoirs of approximately 15,000 acre feet equaled less than two percent of the water released to Sevier Lake.

Releases to Sevier Lake were made starting November 11, 1982. At the time the contents of Sevier Bridge Reservoir was 73,000 acre feet below the full capacity of 236,000 acre feet. Moving water during the winter months had the possibility of ice flows. The 73,000 acre feet capacity gave some leeway to minimize damage by regulation of the bypassing water. The flows at the Sevier Bridge inlet were reported as usual to the River Forecast Center in Salt Lake City each month; October-21,400 acre feet, November-34,000 acre feet and December as being 39,000 acre feet. A total of 94,400 acre feet at a time when the snow pack was accumulating. The first official forecast of January 1, 1983 estimated that the high run-off period of April through July would be a total of 85,000 acre feet some 10,000 acre feet less than the preceding three months. The forecast became a problem to the Commissioners. The forecasts made by the National Weather Service, the Soil Conservation Service in cooperation with the Utah Department of National Resources made it impossible for the Commissioners to act independently. If the Commissioners were to act independently and release excess flows in addition to flow rates already causing damage and the official forecasts were within expectations, then the regulators (Commissioners) by their sole judgment would be the cause of the additional flood damage.

The February forecast indicated no change from the January forecasts. Flows into Sevier Bridge Reservoir were approximately 49,000 acre feet in February. The runoff for the five past months including February was more than 150,400 acre feet as compared to the 85,000 acre feet forecast to come with the snow melt season. In February all the man made problems began to become obvious. Roads and main highways were being flooded. Crossings over the river couldn't safely carry the runoff. DMAD Reservoir over filled to get the necessary "head" to bypass the flows. Had DMAD and Gunnison Bend reservoirs been empty as of February 1, they would both be at capacity March 1, experiencing problems of enough head to release the entering flows. The Conk Dam

was causing a water backup of about six inches. This in turn increased the seepage out into the cropland. A Department of Transportation Engineer phoned the Commissioner to demand reducing the flows to keep them off the highways. A Union Pacific Railroad engineer called to demand better regulation of the river. To the first the Commissioner suggested the highway department should not have constructed a major highway through the flood plain of the Sevier River. To the second it was suggested that it might be possible to turn more water if he could make his case but no way could there be less. Millard County asked to shut Gunnison Bend Reservoir off for six hours while they added a culvert to the Cropper Lane crossing. When the earth was removed next to the eight foot in diameter culvert the culvert collapsed giving unrestricted flow through Cropper Lane. At the next crossing downstream the State Highway Department stationed a man to keep the debris off the square nose divider. By the end of March the flows receded somewhat. Experts in Sanpete County stated the high water was over. With some users starting to irrigate it seemed that with normal precipitation the river could be managed as it had in the past. The most serious casualty was the West Millard Golf Course. The pasture pool addicts were "done in" for the season. The March runoff had been 80,000 acre feet. Sevier Lake had received 130,000 acre feet of water before the irrigation season started.

The March 1 forecast was the same as the February 1 forecast, a runoff into Sevier Bridge for April-July of 85,000 acre feet. The River Forecast Center stated "no major flooding is expected in Southern Utah". The Weather Bureau had tabulated the Sigurd-Gunnison inflow as 89,4000 acre feet, which apparently was a misprint. The S.C.S. quote of 47,000 acre feet should have given cause for some apprehension.

As of April 1, the Soil Conservation Service increased their predicted April-July flow in acre feet to 135,000. The snow pack had increased but the streamflow started to subside a little. A graphic picture did show that for the first time the water content of the snow courses exceeded other wet year snow packs such as 1973 and 1980. The National Weather Service stated, "Forecasts are similar to flows experienced during the 1980 runoff season". The run off during April was less than half of the March runoff giving some relief to the anxiety of the past several months. Subtracting the April runoff of 38,000 out from the previous forecast of 135,000 acre feet left a very manageable amount of water to be regulated. The May forecast was slightly increased over the April 1 forecast, however the snow pack had a tremendous increase from April 1 to May 1, at a time when runoff usual reduces the snowpack. The Sevier River system was about to experience a raging monster that none of the forecasting units seemed to be aware of. A special forecast June 1, 1983 was received several days into the month of June. The flood had long been underway.

The floods were "God" created but the problems were man caused. As early as January the Commissioner on the lower Sevier requested that he be notified whenever additional releases from upstream reservoirs were made. There was never as much as a phone call to the lower Commissioner that additional water was being released. The attitude seemed to be that Delta stole their water and that the upper river was only too happy to give Delta more than they could handle. One story going around was that the Desereters, when coming up for air, would only say "more water". The only statement that calmed the laughter was, "and Delta is up to the State Engineer's Office filing on every excess bucket full that came". The last part of the joke is still to come. Now, some seventeen years later, the upper river users are up to the State Engineer's Office trying to file on the so-called surplus water.

As previously noted every man made structure along the Sevier River was causing problems. The counties were reluctant to remove any crossings or major bridges. The State Department of Transportation was fighting local entities to save their bridges. The Union Pacific Railroad was cutting the centers out of trestles and digging channels to pass the water and debris downstream to other entities. The Juab Lake control structure overtopped sending the waters downstream. Relating two instances show some of the problems. East of Richfield, along the Glenwood Road, the water south of the road, which acted as restriction, was a few feet higher than the water surface on the north side. A battle was shaping up between some who were insisting the road be breached, and people on the north side who thought the extra water would flood them. At Deseret those living upstream of the bridge over the river on the state highway were insisting the bridge be breached sufficient to let the water flow unrestricted, while those below were adamant that such action not take place. The problem was that those below were not convinced that any increase in flow would only be of short duration and that the water level would return to the previous level. The Commissioner drove by the first battle but was at the second. Even though the responsibility of ordering the breach belonged to the county no one was there to exert the county's responsibility. First one group then the other demanded that the Commissioner do something. Finally the Commissioner ordered the bridge be by-passed over the top and excavated around each end.

By the middle of May it became obvious to the Commissioner that the worst flooding was still to come. There was no way the two lower reservoirs could bypass the water still to come. The County Administrator called for meetings with the U.S. Corp of Engineers for advice and direction. The Commissioner was not invited. As a result no one at the meeting knew what the flood conditions were. The Water Commissioner had adopted a policy of notifying the water users and dam owners every night of the current status of the flooding. This disconnect between water users and the county was quickly resolved. When returning from the next trip along

the river, the Commissioner was intercepted by the Sheriff's Department. His pickup truck was taken to the County Road Barn and the Commissioner taken home. The next morning when taken to his truck, he found a new county radio and frequencies installed. The Millard County Sheriff chauffeured the Commissioner on several trips. He could cover the key river stations twice as fast as normal. The Sheriff also assigned a deputy to report the gage readings at Sevier Bridge Reservoir daily. The remarkable effort of the Millard County Road Department to aid by getting personnel and equipment to the crisis points was exceptional.

By May 28, the flows entering Sevier Bridge Reservoir were higher than was possible to release. Forecast estimates of irrigation and past records all became redundant. The first rush of floodwater washed out many diversion structures including nearly all of the Sanpitch River diversions below the Gunnison Reservoir. 1922 had been the standard of flooding expected. The 1983 flow rates were three times the flow rates of 1922. The amount of water by Gunnison during May was about equal to the total forecast for May, June, and July. Another 360,000 acre feet were still to come in June and July.

Downstream it was also obvious that the structures could not bypass the flows to come. Around the clock efforts were made to construct additional spillways. The Intermountain Power Project with their many construction contractors and engineers came to the aid of the embattled water users. Two additional spillways were constructed at the Gunnison Bend Reservoir. The 1910 replacement piers were dynamited completely out. Additional bypass capacity was constructed by the Intermountain Power Project (IPP) at the Central Utah Water Company diversion. To this point in time sand bagging at the abutments was the extent of measures taken at DMAD. The water secretary of the companies inquired of the Commission why most of the emergency work was taking place at Gunnison Bend. In the Commissioner's opinion DMAD was a recently constructed system and should be better able to accommodate the conditions to come. A historical review of past emergencies would have given a much better perspective on managing the flood at the DMAD site.

The size of the flood continued to increase. The USGS flows based on the measuring conditions that existed were difficult at best and did not account for approximately 10,000 acre feet more water than indicated entering Sevier Bridge Reservoir in the month of June. The water level at Sevier Bridge Reservoir continued to rise above the rights to store causing damage to farmland around Fayette. The three companies above Sevier Bridge; Westview, Gunnison-Fayette, and Dover were all by-passing their water allotments into Sevier Bridge Reservoir. These rights not only had a right to store downstream in Sevier Bridge Reservoir but also by a peculiarity of the Sevier River Decree were guaranteed their water, if needed, above any water belonging to the storage companies owning Sevier Bridge Reservoir.

On the night of June 15, 1983, DMAD reservoir was at a gage height of 70.73 feet. This was 4.73 feet above the "full" reservoir level. Gunnison Bend was at a gage height of 13.24 feet, which was at the point of overtopping the western dam east of the diversions. The original elevation of the dam was 14.0 feet, however using the dam top as a road for years had caused settling in several spots. Both reservoirs were at the maximum level possible. At 5:00 AM the watermaster in charge of DMAD called the Commissioner to say that something was wrong at the DMAD Reservoir. The water level below the river gates had dropped by several feet. The old Delta-Melville spillway which had been modified to act as a drop structure had been examined two days before. There was considerable concern because two almost identical structures had failed in this section of the river. The examination increased the apprehension as to the soundness of the structure. The surging flow imparted a vibration to the drop structure. The flow rate could almost be rated by sound. No measures could be taken to reinforce the drop because there was no way to reach the structure with machinery. The entire area was super saturated by the high water levels. The Commissioner immediately knew the cause of the lowered water levels. The old spillway had washed out. A later examination of both old spillways showed that the pounding and vibration caused the soil under the spillways to melt away eventually allowing a considerable part of the flow to go under the structure. The pressure differential on the floor of the spillways cause the floor to shear from the abutment wing-walls. The remnants of the 1910 and the 1983 structures were almost identical. The wing-walls were nearly intact and the floor and aprons were in the hold created by the scouring below.

The Commissioner told the watermaster to get the water users representative and examine the situation while the commissioner headed up the river to see if there were any signs that the flows might be declining. If the flows were down some, Sevier Bridge Reservoir could be regulated to hold without causing additional upstream damage. The river upstream was not receding but appeared to be increasing. Up until this time the water users and County Officials were informed each night of the river conditions. In addition anyone calling the Commissioner received a full report. It was the opinion that if the community knew in detail of the circumstances many people would take sensible action to lessen any impact of disaster. Several measures were immediately taken. The Millard County Sheriff's Posse was mobilized and stand-by calls were made by the County for National Guard help. In the opinion of the Commissioner one action was taken that was not helpful. A radio gag of sorts was placed on the radio traffic, supported by the thought that the serious circumstances would cause some panic. Instead of panic there was now a lot of opinion that *"no news was good news"*. The County Director of Emergencies was

completely left out of the loop. The Cedar City unit of the National Guard was on a standby basis to aid in any disaster but was never informed. Through other channels the National Guard unit at Nephi was called to take flood control measures.

The State Engineer and the Director of Dam Safety flew in to make an inspection and review the situation. The Delta problem was one of many over the State that needed their expertise. In particular was the mountain slide at Thistle, which required the work of their entire staff. A suggestion was made that the most helpful item possible would be a request by the State Engineer for the major reservoirs above Sevier Bridge Reservoir to maintain their present levels. Any drop in the flood stage would allow the local water users to hold at Sevier Bridge in order to give time to take some measures that might prevent a flood disaster. So much for cooperation along the Sevier River. Piute reservoir released 4,700 acre feet in excess of the natural flow of the river from June 15th to June 20th, and the Gunnison Reservoir lowered the water level some 20 inches during this same period. The cascade causing erosion stabilized for a few days. June 22, the flows were increasing and the erosion accelerated back toward the DMAD spillway. By the morning of June 23, 1983, the cascade was moving toward the spillway at a rate of one foot per minute. The erosion reached the DMAD spillway at 12:55 PM. The DMAD spillway moved into the channel at 12:59 PM releasing an estimated 30,000 cfs over the next three hours. The average flow for June 23, 1983 was 13,100 cfs.

The flood wave took out the fill at both ends of the bridge on US Highway 6 some three miles below DMAD Reservoir. Highway 6 west of Hinckley was already underwater. West Millard was therefore isolated from all traffic except from the east. The Union Pacific Railroad was cut at the crossing near a site that once was a railroad town named Riverside. Trash clogging the trestle holding the flumes to carry water to the North Carey Act lands west of the river caused sections to be washed away. The Sutherland Bridge was overtopped, as were all crossings. The Commissioner had to drive north, take the Dog Valley road, thence to Nephi, south to near Holden, thence west a trip of more than 100 miles just to cross the Sevier River. Gunnison Bend Reservoir was breached at the Cropper Cut preventing a combination of both reservoirs to form another gigantic flood wave. The town of Deseret was inundated with water three feet over their lawns, gardens, and farms. All basements were filled and some old houses with the original adobe walls had parts melted away. This is just a brief notation of the considerable damage caused.

Even before the DMAD spillway failed some lawyers were busy compiling instances of possible liability. The overfilling of Sevier Bridge Reservoir and forecasts in May showing 289% of average and June forecast of 618% of average when the actual flows in progress were more than 1200% of average. The 600% of average equaling 235,000 acre feet would have presented no problems of regulation, but to the lawyers a 600% indicated negligence to anticipate even though the maximum flood had been in progress for several days before the forecast was issued.

Many experts looked at the DMAD section known locally as the "Notch". Breaching at that point would have taken the pressure off the DMAD spillway but with no way to control the flows through the breach, the results below would have been the same as the failure of the DMAD spillway. Grandfathers told their sons of the 1909 and 1910 breaks. The sons have told their sons and these sons were not about to tolerate being dumped on again. The physical damage could be repaired but the physiological damage would be irreparable. If events had allowed time to construct a controlled release there were no problems that could not have been solved. The Soil Conservation Service offered to commit funds to control the flood. Their solution was to place rocks of at least thirty inches in diameter side by side across the channel, then fill with smaller rock above the large rock until a back water could be established. The scheme had a provision that no work would be attempted without a S.C.S. supervisor in place and they would have complete control of the project. They didn't tell the users how they could place the rocks from two sides of the stream more than a quarter of a mile apart and reach the middle. The Army Corp of Engineers sent a team to Delta with maps showing places the water could be dispersed. They pointed to the Fool Creek Reservoirs, which were already full. Trying to rip rap the channel by placing large boulders would increase the erosion as each rock was placed. The only solution proposed was to armor one side and start filling with rock towards the armored side. One plan proposed by local individuals was to dynamite the one hundred-foot vertical clay bank above the flood plane and thus dam the flow. This plan didn't go beyond grabbing the tiger by the tail. However the Commissioner, with local leaders, spent most of the night consulting with a powder expert. Four days to dig the holes then load and blow. The bank would not topple as a chuck of earth explained the powder man but would flow out like flour. This was the last desperate plan proposed before the spillway failed. It was explained by many that the water should have been released before the flood danger existed.

Once the system failed the multitude of claims commenced. The Union Pacific Railroad put in a claim. There were plenty of counter claims available. The trash and cut timbers were dropped into the river just as everyone above was doing. Trestle timbers were found in DMAD Reservoir and some made it through the entire system. Some logs were located even below Deseret. The Union Pacific Railroad assigned the events as history, dropping

the claims and proceeded to repair their system as rapidly as possible. All the claims below DMAD Reservoir used the fact that DMAD and Gunnison Bend reservoirs should have been drained before the floods started. Staying drained would have required removing both dams prior to the floods. There was no clamor to leave the dams out after the floods. The other basis of negligent management was the breaching Gunnison Bend Reservoir directed the water at the damaged parties. The dams spilling, and outlet works were all some two feet lower than the surrounding bench lands. The water was going down the flood plain regardless. Breaching only had the effect of moving some water out ahead of the floodwaters from DMAD Reservoir to reduce the size of the flood wave below.

Immediately after the DMAD Reservoir failure, plans were started to rebuild the system. First Sevier Bridge Reservoir had to be lowered to allow time enough to capture the flow of the river long enough to rebuild several structures. It was discovered that the screw-gates at the lower gatehouse at Sevier Bridge Reservoir had a few more inches to go before attaining maximum openings. There were three holes in the roof of the gatehouse to accommodate the gate stems. The gate stems did not jibe with the holes. It required considerable chiseling to match the holes with the stems to allow another six inches of opening on each gate. The diversion structures needing repairs or replacement were the McIntyre diversion, Leamington diversion and canal, Lynndyl siphon, DMAD spillway and river gates, Gunnison Bend spillway and Cropper cut, Oasis siphon, and a new Conk Dam. Many highways and bridges also needed repair. Financing was obtained from several sources including interest free loans from the Utah Board of Water Resources. It was indicated that plans could be placed for bid and construction of the major spillways started September 1 and be completed by January 1, 1984. The Commissioner was consulted about features that hindsight pointed out could be improvements to the system. The specific requests were for a relatively large increase in release capacity at Sevier Bridge and Gunnison Bend reservoirs and the ability to release at least 3,000 cfs at DMAD before the storage capacity was reached. The old DMAD spillway made it impossible to react to flood waters enroute. The old spillway was a 100 foot crest at contour elevation of 66 feet, which was the full capacity contour of the reservoir. The ability to bypass floodwater at DMAD Reservoir was totally dependent on building "head" sufficient to accommodate the flow rates entering the reservoir.

During the hectic days trying to stabilize the DMAD spillway, a National Guard truck loaded with large boulders cut the corner at the river outlet gates. The truck duals dropped from the concrete box wall onto the first threaded gate shaft, bounced to drop exactly on the second, and then to the third shaft. The next bounce took the truck to the top of the box wall and then to the road as if the road had included the structure as a logical part of the transportation system when taken at sufficient speed. DMAD Reservoir required a new spillway, repair of the outlet gates, and major construction to stabilize the channel system from the river gates to the river channel below. The river gates outlet channel was stabilized by hauling all the many truckloads of riprap used in the effort to save the DMAD spillway to ramp down to the river gradient. The riprap was tied by a level concrete bar poured at intervals down the slope. This not only locked in the riprap but also kept the flow at a level depth as it came down the slope. A local machine shop operator was able to straighten and re-thread the gate stem. The Division of Water Resource Board allocated the interest free money to rebuild the two spillway designs for the two spillways and prepared to supervise the construction of the two sites. A Bureau of Reclamation design using a series of rows of three-foot high teeth down the apron to de-energize the flows was selected for DMAD. Twenty five stoplogs sections eight feet in width were to be installed upstream of the spillway crest into which three feet of stoplogs could be inserted to make it possible to control the flows up to the 66 foot reservoir contour. As work progressed the Commissioner noted that twenty-five three feet high by three feet wide teeth were placed on the crest of the spillway. Thus for the first three feet of flow depth the spillway had only a one hundred foot width. Considering the effect of end contractions of the teeth the effective width would be less than seventy-five feet. Inquiries of the supervising engineer elicited firm statements that the spillway would bypass 3,000 cfs at the 66 foot contour. Curves furnished by the Bureau of Reclamation show that the flow would be approximately 1,500 cfs with the top row of teeth in place and 3,000 cfs without the top row of teeth. Measurements indicated that the spillway as constructed could only bypass 1,300 cfs. Another limiting factor was the depth over the crest of three feet was water flowing in a sub-critical regime. The information was passed on to the DMAD board. The board had previously approved the spillway design so nothing could be done about the discrepancy at the present time. The spillway was due for completion before January 1, 1984. The contract had a clause that in the event it appeared the completion date was in jeopardy the contractors were to employ extra personnel and go to a twenty four-hour workday. The river inflow at the Gunnison Gaging Station was averaging more than 50,000 acre feet per month. Any slippage of the construction schedule invited disaster. This information was given to the construction engineers and the water companies. The water companies had recently hired a new water secretary who acted as the day-to-day liaison between the contractors and the water companies. No inspector or some capable person was hired to represent only the irrigation company's interests. The Division of Water Resources Engineers had wanted to assume control of the river flows but were denied by the lower water companies, where most of the construction was taking place.

Repeated warnings were given to the irrigation companies and the construction forces that water was going to be turned out of Sevier Bridge regardless. The Commissioner could not allow the users above to be deliberately flooded just because the contractors were behind schedule. It seemed to the Commissioner that the on-site engineers were representing the contractors economic interest and disregarding other water users concerns. At this point some strange proposals were made. One of the engineers in charge suggested overfilling Sevier Bridge Reservoir. The Commissioner's designated duties would not allow such a plan. It was then proposed a dam be constructed just above the Gunnison Reservoir, because those people owed the engineer a favor. This would be the highest priced land in Utah for the people of Delta to damage. It would be easier to add a few men to finish the spillway on schedule. The next suggestion was that the siphons used over the Thistle slide could be purchased for $25,000 and put over the DMAD Dam to keep the water levels low. All of these proposals were nothing more than an attempt to shift a small additional expense that was the obligation of the contractors to the DMAD water users. The final demand was that the companies select the point were the dams would be breached to save the new construction. The irrigators would thus lose next year's crops just for the contractor's benefit. An emergency meeting was called to resolve the issues. The Commissioner did not officially represent the DMAD water users. Controlling the flow of the river during construction phase had to consider other users on the river. At the meeting all of the solutions were discussed. The Commissioner could only report that he had ordered a substantial increase of more than 600 cfs to be released from Sevier Bridge Reservoir that morning. The new releases would be at DMAD Reservoir by Christmas morning. The contractors unable to escape their obligations were equal to the challenge. When the water arrived they were able to bypass the flows.

Gunnison Bend Reservoir faced nearly the same problems, only a single bid was received; however the spillway design was much simpler. The entire release capacity would be through stoplog sections. The stoplogs in three of the sections were bolted together and lifted by screw mechanisms. In the remaining sections hook brackets were bolted to each stoplog. A winch could hook each end of the lowest log and the two winches raised in unison would lift the entire section from the bottom of the reservoir to the highest elevation needed. The work at Gunnison Bend Reservoir proceeded rather smoothly. The new spillway was placed in the same location as the old spillway. The construction foreman frequently touched base to maintain good public relations. At Thanksgiving, several dignitaries were given a very nice box of quality chocolates. The Commissioner was included. The construction was taking place a few feet below a small sort of cofferdam. By building a more substantial cofferdam across the narrow channel leading to the new spillway a considerable amount of water could be impounded to allow a little more time for construction. The Commissioner had mentioned this to the construction foreman a few days previous to the emergency meeting, however, he thought the extra work was not necessary. After the emergency meeting a meeting at the channel entrance to the spillway was arranged. The meeting was to be with the engineer representing the Division of Water Resources, the DMAD water secretary, the construction foreman, and the Commissioner at 5:00 PM. The Commissioner was on time and so were the other parties except they stopped down in the works to discuss something before coming up to the site of the proposed cofferdam. There must have been a lot to discuss. The three men didn't walk the next seventy-five yards to the neck of the channel for more than an hour. Some wild schemes were again proposed; breach the west dam, or build a dam more than a quarter of a mile across the reservoir bottom to isolate the west side of the reservoir from the east side. The 150 foot cofferdam would accomplish the same result. The Commissioner informed them the water was on the way and it was their problem to solve. It was gratifying to note that later that night large bulldozers and carryalls were building the cofferdam. The Commissioner didn't get a box of chocolates for Christmas, as did the others.

Gunnison Bend Reservoir being the funnel at the end of the Sevier River system had to adjust to whatever happened above. For nearly 100 years users above passed their flow problems downstream. The pioneers who had survived on suckers and jackrabbits when the dam failed and their grandsons of 1983 had to the present times been able to cope with the *"every man for himself"* nature of the river system. As the flows increased it became apparent they were going to experience something new. The two additional bypasses were completed, each a few hours before the dam would have over-topped. The first emergency spillway was completed during the night just in time to prevent a dam failure. The abutments of the old spillway were sloughing. The dam at the Cropper Cut was also sloughing.

The reconstruction of Gunnison Bend Reservoir proceeded smoothly. The new spillway was also to serve as a county bridge into the Sherwood Shores housing development. Reconstruction costs were shared by the county and the irrigation companies. Inspection on behalf of the irrigation companies evidently was done by the four-company water secretary and the Division of Water Resources Engineer. No job ever turns out perfect. A twelve-inch pipe was installed at the lowest level through the Cropper Cut. No explanation of the reason was ever given. One or two of the "I" beams holding the stoplogs were not vertical. The lowest 4" x 12" x 8' flashboards in two sections had to be cut short to fit the lowest slot. Conversely in adjacent sections the stoplogs had to be cut short to be able to start them in the slots and great care had to be taken when placing them in the lower part of the section lest they pop out at one end. Two other problems surfaced later. The stoplogs were of a soft pine.

The water pressure caused several to break. Eventually they had to be replaced with fir planks. No riprap was placed in the approach channel next to the new concrete work. After the 1984 high water it was discovered that a very large hold had formed just above the concrete apron.

The 1984 flows entering Sevier Bridge Reservoir were very high throughout the winter averaging more than 50,000 acre feet per month. The January 1, 1984 forecast was for 240,000 acre feet April-July, the high water months. Statistical analysis gave forecast results that totally ignored current conditions. The physical conditions along the river were different. The river and nearly every tributary were scoured to rock formations. The soil mantle was saturated. Consequently any precipitation drained rapidly into the river system. A June 1, 1984 forecast for May through July was still 153,380 acre feet short of actual flows into Sevier Bridge Reservoir. 1984 was an even larger flood year than 1983. Gunnison Bend Reservoir was the only major facility in the lower zone that was not overfilled. It was obvious that existing foresight mechanisms were not adequate for flood planning.

By and large the 1984 floods were very well managed. Some regulation at Sevier Bridge Reservoir was necessary because of ice conditions during the winter and maximum flows at the many construction sites were a limitation in some instances. On March 19, releases out of Sevier Bridge Reservoir were cut to the minimum possible so that all the cofferdams could be removed and all necessary channel work could be completed. Releases were increased March 23 to a maximum that didn't jeopardize finishing work on the spillways, siphons, bridges, and highways in progress.

After the 1984 runoff two important projects remained. The Sevier Bridge spillway had to be modified to increase the discharge capacity. The outlet tunnel also needed extensive repairs. The other major item was the removal of *"that infernal row of teeth"* on the crest of the DMAD spillway. The DMAD Reservoir over filled nearly two feet to bypass the 1984 flows. Because of the intense controversy over the DMAD spillway capacity at the 66-foot contour of the reservoir the Commissioner contacted the USGS hydrologist serving the area to take independent measurements. His measurements confirmed that only 1,300 cfs could be bypassed instead of the 3,000 cfs requested. Even after the 1984 floods the Division of Water Resources Engineer was reported as saying the Commissioner lied about the flow capacity. That part of the arguments died with the confirmed measurements by the USGS hydrologist. The irate DMAD groups were told they had accepted the design and construction. This fact was a major source of controversy. The spillway design was copied from a Bureau of Reclamation bulletin; the construction was supervised by qualified Division of Water Resources engineers, and approved by the Utah State Engineer. After which the water users gave their approval and accepted the operation and liability. The DMAD water users were the least knowledgeable about the engineering but ended up with all the responsibility and liability of operating the structure safetly.

The Division of Water Resources informed the DMAD organization the top row of teeth could not be removed for safety reasons. The Bureau of Reclamation individual consulted knew that many of the Bureau of Reclamation structures of this type of design didn't have the top row of teeth. A letter was received by the Division of Water Resources that removing the teeth would not jeopardize the safety of the structure. It is not known by this writer, if permission was granted by the State Engineer to remove the teeth, however the DMAD people hired a concrete contractor to remove the teeth. The teeth were removed forthwith. The DMAD Water Secretary, who had faithfully followed the instructions of the Division of Water Resources Engineers, knew nothing of the removal until the bill was submitted to his office.

Now seventeen years later, the problem facing the water uses is how to bypass a maximum possible flood or a significant part thereof. Under the new latest dam safety criteria all the spillways are lacking in capabilities to bypass the required amount.

Personal Note: Maybe there is no value to be found analyzing the past events. But to this writer there is one value that he believes can benefit anyone. Many lawsuits and claims were filed to make someone pay for the damages caused by the floods. In nearly every case I gave affidavits stating facts regarding the events. Three very lengthy depositions were taken of me. Of course in each case I took an oath swearing to tell the truth. In the last legal action some thirteen years after some of the depositions were taken, the attorneys had gone over every word of the depositions and affidavits. I was called as a hostile witness by the plaintiffs. Questions were asked about statements made in the depositions. It can all be summed up as *"thank God for the truth"*. I would never have been able to remember a lie.