A 200-ton boulder deposited by floods near Davis Creek, Davis County. Probably taken in 1930 by U.S. Forest Service. All photos from USHS collections.

"Been Grazed Almost to Extinction": The Environment, Human Action, and Utah Flooding, 1900–1940

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North Temple Street, Salt Lake City, 1908.

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On July 10, 1930, Ella M. Dale—who lived with her husband in Weber Canyon, southeast of Ogden, Utah—heard a roar outside her home that sounded like "an approaching freight train." After her husband assured her that the train was not due, Dale opened her door and watched as "a flash of lightning struck the high tension wires on the north side of the canyon and flashed along them, lighting up the entire gorge. Then the rain came down in sheets and the rocks and dirt followed it." Some 250,000 tons of debris washed down Weber Canyon that day, "with boulders piled 35 feet high and extending over a distance of 400 feet."[1]

Utah is the nation's second most arid state—only Nevada receives less moisture annually than Utah's average of thirteen inches—but flooding as a natural process has occurred in the area for thousands of years.[2] The combination of Utah's topography and erratic climate creates an ideal situation for periodic flooding. Due to seasonal disparities in precipitation, many of Utah's smaller streams remain completely dry during part of the year. Such dry water courses, along with other desert surfaces, canyons, and gullies, provide an outlet for flash flooding during periods of unusually heavy precipitation. Heavy winter snows and low spring temperatures create a snowpack susceptible to rapid melting in late spring when temperatures jump, unleashing water from an entire winter onto the valleys below. Finally, cloudburst storms can dump huge quantities of water onto already-saturated or otherwise impaired mountain watersheds, sending a wall of water and debris down canyon streambeds.[3]

The physical setting to which Brigham Young brought the initial Mormon settlers in the summer of 1847 had a long history. Natural forces, primarily wind and water, had shaped and eroded the landscape, and flooding had long been a naturally occurring phenomenon. Various cultures and peoples had lived in, explored, and used the area to which the Mormon pioneers came. These earlier peoples had exploited the natural flora and fauna, and some had developed irrigation.[4] Utah was not a virgin uninhabited wilderness in the summer of 1847, but the arrival of Brigham Young's band and the thou-

[1] *Salt Lake Tribune*, July 11, 1930.

[2] Bill Weir, *Utah Handbook* (Chico, CA: Moon Publications, 1989), 5.

[3] Robert L. Layton, "Utah: The Physical Setting," in Richard D. Poll et al., ed., *Utah's History* (1978; reprint ed., Logan: Utah State University Press, 1989), 18; Weir, *Utah Handbook*, 7.

[4] Native irrigation systems usually consisted of simple dams and gravity-fed ditches supplied by streams as opposed to the deep ditches, pipelines, and culverts that were introduced later and are still used by modern Utah farmers.

sands that followed did mark a new era for the region. Less than five years after their entrance into the Salt Lake Valley, Mormons had to cope with flooding, and in 1862 flood waters plagued much of Utah from February to June, sweeping away almost every bridge in the region and demolishing roads, fields, and homes. A continuing war against rising and rushing waters, with the damage they may bring, had begun.

From the beginning of statehood in 1896 to the beginning of World War II, Utahns greatly increased the number and means of flood control projects in their ongoing battle against inundation. During this period, they built barrier dams, catchment basins, spillways, and channel control structures, all in an attempt to establish some human control over flood waters. This period also saw the introduction of the federal bureaucracy into the local flood control effort through Civilian Conservation Corps camps and workers and the increased federal control of public lands. Unfortunately, the expansion of engineering projects and the influx of federal workers and funds failed to protect Utahns from flood waters. In many areas, Utahns had to battle the results of their own use of the land: severely impaired watersheds that increased the frequency and devastation of floods.

On July 1, 1902, Albert F. Potter, chief grazing officer of the U. S. Department of the Interior's Division of Forestry, stepped off the train in Logan, Utah. Gifford Pinchot, head of the Division of Forestry, had assigned Potter the task of surveying the mountainous forest land of eastern Utah for inclusion in federal forest reserves. Potter spent five months crisscrossing the Wasatch Mountains and Colorado Plateau from the Idaho border to Escalante. During his journey, he kept a diary noting the effects of a half century of grazing and lumbering on the condition of the region's watersheds and timberlands.[5]

Potter's diary describes countless areas that logging enterprises or local citizens had completely cut over, sometimes more than once. Descriptions such as "only trees too small for telephone poles are now left," "timber cut very clean in the places which were easily reached," and "every tree (and seedling) has been cut" are common in the diary. In the vicinity of Alta, east of Salt Lake City, Potter noted that the area "has been worked until both the ore and timber were pretty well

[5] Albert F. Potter, "Diary of Albert F. Potter, July 1, to November 22, 1902," photocopy, Special Collections, Merrill Library, Utah State University, Logan, Utah; Charles S. Peterson, "Albert F. Potter's Wasatch Survey, 1902: A Beginning for Public Management of Natural Resources in Utah," *Utah Historical Quarterly* 39 (Summer 1971): 238–53.

Top: *Debris from Manti flood of 1902, showing creek flume near center of town.* Bottom: *Main Street, Manti, after flood. The flume was actually raised four feet by debris that was pushed under it.*

exhausted. . . . It would be hard to find a seedling big enough to make a club and kill a snake."[6]

Potter also saw firsthand how overgrazing by sheep and cattle had damaged the vegetative cover of Utah's mountain watersheds. In the mountains surrounding Logan and the Cache Valley, he found areas "badly tramped out by sheep . . . [and] creek banks trampled down and barren of vegetation." Estimating that 150,000 sheep had grazed the area the previous year, Potter suggested that "the number allowed within the proposed forest reserve should not exceed 50,000." He encountered a similar scene in almost every area he visited, with the notable exception of the Uintah Indian Reservation. At the border of the reservation, Potter noted a marked change in the vegetative cover and general condition of the land. He saw good grass and plenty of trees on the reservation, which demonstrated "the difference restriction of grazing makes in range conditions."[7]

He also recorded the opinions of a number of Utahns about the possibility of establishing forest reserves. At the time of Potter's survey, forestry officials pointed to the role of trees in protecting watersheds, arguing that preserving the forests would ensure a water supply for local communities. This argument did not convince everybody, however. Potter found that support for forest reserves varied according to geographic location; people in those areas that had not historically experienced a shortage of water or timber did not feel conservation practices necessary. Not surprisingly, he also discovered a great difference in support between those who held an economic interest in sheep or cattle and those who did not.[8]

While recording these general opinions toward conservation, Potter found that Utahns generally failed to correlate deteriorated watersheds with increased flooding and erosion. Citizens in Logan told him that they supported conservation because the large number of sheep and cattle posed a local health problem: "They think the health of the town is endangered by stock dying near the stream and by the pollution of the water by the manure and the urine. Denudation of the slope by timber cutting diminishing the water supply does not seem to alarm them."[9]

Several individuals, however, did grasp the relationship of over-

[6] Potter, "Diary," 1, 5, 10.
[7] Ibid., 3–5, 8–9, 13.
[8] Ibid.; Peterson, "Albert F. Potter's Wasatch Survey," 249–53.
[9] Potter, "Diary," 2.

grazing to increased flooding. Tom Smart of Logan informed Potter that "the most serious damage done by livestock has been packing the soil so that the water runs off in floods more than it did in former years." Professor G. L. Swendsen of the Utah State Agricultural College provided Potter with statistics on the Logan River showing that, since local deforestation and livestock damage to the range, "floods have come down earlier in the spring." Although Peter Thompson of Ephraim thought that tramping of the soil helped to increase the local water supply, he correctly admitted that denuded watersheds caused "the water to run down the canyons in place of soaking into the ground."[10]

Finally, the citizens of the town of Manti appeared to have learned a lesson from previous flooding. Potter found that after the damaging floods in 1890 local citizens had excluded all stock from Manti Canyon in hope of restoring the vegetation. Manti citizens had elected L. R. Anderson mayor of the town in 1900 after he ran on a "no more floods" platform; Anderson had then immediately petitioned President Theodore Roosevelt to set aside the Manti watershed as a forest reserve. This petition, along with the observations made during Potter's survey, led to the establishment of the Manti Forest Preserve on May 29, 1903. Complete prohibition of grazing in the Manti Creek watershed continued until 1909, and after that year federal grazing management continued the protection of the watershed.[11]

Potter's trip through Utah led directly to the establishment of most of the state's other national forests as well. Between 1903 and 1910 the Dixie, Wasatch, Ashley, and Cache forests all joined the Uinta and Fish Lake reserves, which had been established at the end of the nineteenth century. Forest officials immediately moved to restrict grazing on these new reserves; by 1910, they had reduced the number of sheep using Utah lands by almost one million, and numbers continued to fall over the next decade.[12] This success in controlling grazing did help relieve some of the pressure on overgrazed watersheds, but forest officials failed to restore ground cover and to reduce erosion. It would take several decades and several devastating floods—floods created by poor watershed conditions—before officials

[10] Ibid., 1, 9, 47.

[11] Ibid., 34; *Salt Lake Tribune*, June 8, 1953; Walter P. Cottam, *Is Utah Sahara Bound?* Bulletin of the University of Utah, Vol. 37, No. 11 (Salt Lake City: University of Utah Press, 1947), 7–9.

[12] Sheep far outnumbered cattle in Utah at the turn of the century. In 1900, there were almost four million sheep in the state, while the number of cattle remained around 350,000. Cattle actually experienced a slight rise in numbers in the first few decades of the twentieth century, peaking at a little over 500,000 in 1920 and then declining in the following years. Cottam, *Is Utah Sahara Bound?*, 4.

treated most of the state's watersheds with the same care exhibited by the citizens of Manti.[13]

Floods were common in the first two decades of the twentieth century, although they were rather minor and isolated compared to the floods of 1862. On June 12, 1908, water overflowed on west North Temple Street in Salt Lake City, flooding the street and several homes. The following day, the *Deseret News* wrote that local citizens insisted "that the city is responsible for the conditions and must be forced to recognize their rights and prevent further flooding of the vicinity."[14] People held the city responsible even though the *News* noted that railroad construction had caused the problem by cutting off a sewer connection that also served as a safety outlet for excess runoff. The city fixed the problem and public outcry dissipated, but as the size and

[13] Charles S. Peterson, "Natural Resource Utilization," in Poll et al., *Utah's History*, 660–61.

[14] *Deseret News*, June 13, 1908. In an interesting sidenote, the *Salt Lake Tribune* ran a story the same day that called the *News* coverage of this incident a "big canard." The *Tribune* noted that water had overflowed for only a distance of fifty feet and had caused "no trouble whatever." In response, the *News* called the *Tribune* an "organ of crooks." It seems that no topic was free from dispute in the frequent bickering between these two papers.

North Temple Street, 1907.

complexity of the city's sewer system increased, so would its problems and limitations in dealing with excess runoff.

During the first ten days of June 1909, high water from melting snow flooded areas along City Creek, the Jordan River, and around Utah Lake. The heavy runoff turned City Creek into a "raging, frothy, yellow stream, full of debris . . . from stumps of trees to boulders one foot in diameter. . . . The roaring of the stream can be heard from a distance of 150 feet from its banks."[15] The creek roared down North Temple Street, and city workers built five-foot-high embankments along the street to contain the flow. South of the city, Parleys Creek flooded large tracts of farmland. The high runoff washed out bridges, damaged roads, drove people out of their homes, and drowned six-year-old Matthew Desmond after he fell off a temporary bridge into the swirling waters of Mill Creek.[16]

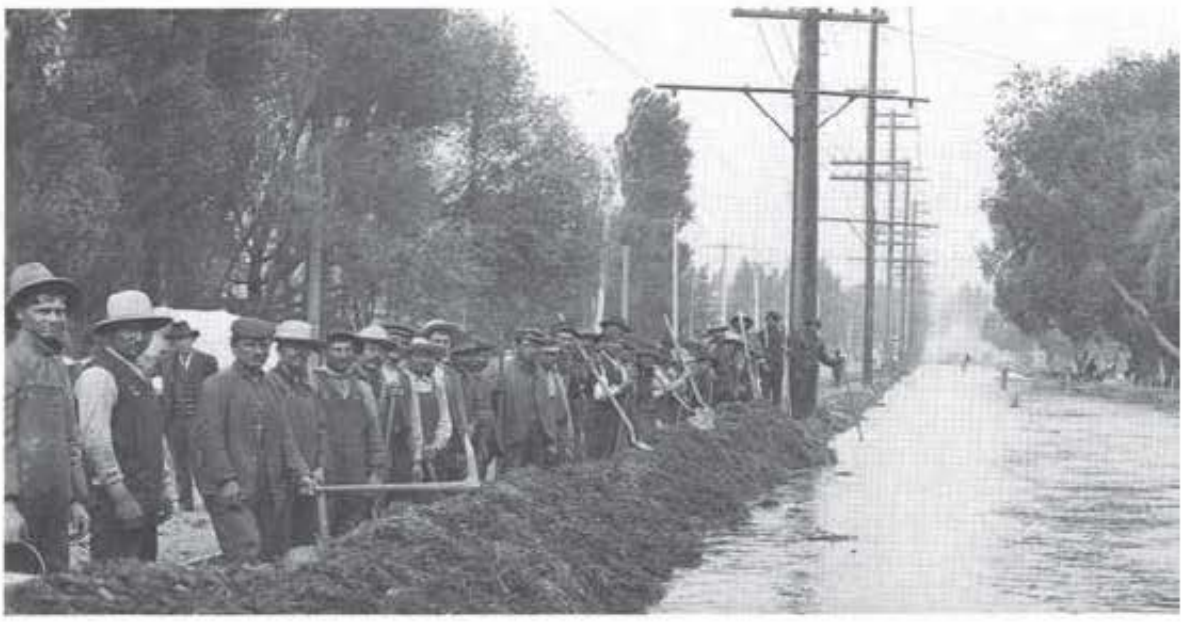
Throughout Salt Lake City, channels, canals, and conduits exacerbated the flood problem. Residents had originally built these structures for irrigation, and the city had later expanded and maintained them in order to improve the water supply throughout the city. These artificial water courses also served an additional function, helping channel excess water from the steep canyons east of the city to the Jordan River. However, when the water level rose above the capacity of such structures, they only served to complicate the problem.[17]

During the floods of 1909, a number of these artificial water

[15] *Salt Lake Tribune,* June 5, 1909.

[16] *Deseret News,* June 5 and 9, 1909; *Salt Lake Tribune,* June 6, 9, and 10, 1909.

[17] For more information on the construction of canals and conduits for water supply, see Fisher Stanford Harris, *100 Years of Water Development,* Report Submitted to the Board of Directors of the Metropolitan Water District of Salt Lake City, April 1942, Special Collections, Merrill Library.



courses filled with silt and debris and failed to function properly. The canal on 900 South filled so fast that it flooded the entire neighborhood in its vicinity. On 1000 South, the canal on the north side of the street was able to channel excess water to the Jordan River, but blockage in the canal on the south side was so bad that it caused the water to flow back on itself. This reverse flow, unable to travel very far uphill, soon cut a new channel straight through a number of backyards, giving homeowners riverfront property they were unaware that they had.[18]

This 1909 flooding brought renewed criticism of public officials. Writers and editors at the *Deseret News* sharply criticized public officials for their lack of foresight. After a few members of the city council viewed the damage on June 5, a writer in the paper commented sardonically: "Of course they are all full of plans for the prevention of any similar trouble in the future—one such plan being the deepening and enlarging of the surplus canal. The flooded inhabitants are thus invited to forget this year's distress in the contemplation of next year's promise."[19] The staff of the *News* also suggested that the authorities should "blow up" several dams that Salt Lake and Davis County officials had allowed gun clubs to build at the mouth of the Jordan. These obstructions "set the water back, obstruct the flow, and materially aid in clogging up the channel of the river."[20] The reactive nature of the city councilmen's promises—acting after the fact—and the lack of

[18] *Deseret News*, June 5 and 9, 1909.

[19] *Deseret News*, June 5, 1909. The surplus canal referred to carried water from the Jordan River south and west of Salt Lake City directly to the Great Salt Lake, thus, designers hoped, helping to alleviate high water running through the heavily populated parts of the city.

[20] *Deseret News*, June 9, 1909.

North Temple Street, Salt Lake City, 1907.

Second South, Salt Lake City, 1909.

foresight on the part of county officials in allowing such development typify the relationship between humans and the flood problem in Utah.

In contrast to city and county officials of the time, the editors of the *Deseret News* showed rare insight in examining and understanding the larger picture. They argued that the chief lesson of the 1909 flood "is the necessity for reforestation of the canyons and of all the mountain slopes," so that "each year the danger will become more remote and improbable." Here—during a time when attempts to combat floods focused almost entirely on physical alterations and artificial controls of streams and rivers—was a novel idea. Why not repair the forested watersheds where most of the flood waters originated in order to reduce debris and flow? Unfortunately, as the editorial went on to note, the time was just not right for such a change: "Legislators manifest an unexplained lack of interest in this grave and vital problem, while the apathy of the people in relation to it is scarcely less remarkable."[21]

The severity of the *News*'s criticisms should be tempered by the fact that no one had yet established a firm connection between watershed conditions and flooding. In addition, legislative and public concern for flooding as a hazard, along with support for flood control, fluctuated with the unpredictable nature of flooding in Utah. The apathy referred to by the *News* most likely stemmed from the fact that most Utahns failed to perceive the possibility of future flooding. The fact that the *Salt Lake Tribune* called the June 1909 floods "Worst Flood

[21] Ibid.

in History of Zion" implied a forgetfulness—or ignorance—regarding the floods of 1862.[22]

Flooding two months later in the vicinity of Manti seemed to prove the *News* editorial's points regarding reforestation. In August 1909, heavy rains caused flooding "in adjacent canyons to both the north and south of Manti Canyon, while the latter was not perceptibly affected."[23] Local citizens, of course, had protected Manti Canyon from all grazing since the 1890 flood, and the inclusion of the area in the Manti-LaSal forest reserve in the first decade of the twentieth century helped continue the program of protection. Although it appeared that restriction of grazing had paid off in this localized case, a widespread effort to restore Utah's watersheds remained more than twenty years away.

In 1917, Salt Lake City officials decided to end their flood problems once and for all. They diverted City Creek, which had long been a flood hazard, into an underground conduit designed to carry flows from the mouth of City Creek Canyon to the Jordan River at North Temple Street. The diversion of City Creek followed other projects completed earlier: Red Butte Creek, which entered an underground conduit at the junction of 1100 South and 1200 East; Emigration Creek, which entered a conduit near Westminster College; and Parleys Creek, which entered an underground conduit that extended northwesterly to intersect the combined Red Butte-Emigration conduit near State Street on 1300 South. From there, a conduit along 1300 South carried the combined flow into the Jordan River. Officials designed all of these underground diversions to carry runoff and excess flows directly to the Jordan River without traveling—at least above ground—through the heart of the city. All of these diversions opened new land for development and functioned adequately during years of normal high water.

However, flooding during the same year that officials diverted City Creek into an underground channel illuminated the inherent problems of these conduit systems.[24] On April 25 and 26, 1917, heavy rainstorms

[22] *Salt Lake Tribune*, June 5, 1909. For more on perception and flooding see Robert William Kates, *Hazard and Choice Perception in Flood Plain Management* (Chicago: University of Chicago, Department of Geography, 1964), 104–34, and Gilbert F. White, *Choice of Adjustment to Floods* (Chicago: University of Chicago, Department of Geography, 1964), 1–41. For a discussion of perception and hazards in general, see Charles Perrow, *Normal Accidents: Living with High-Risk Technologies* (New York: Basic Books, 1984).

[23] C. L. Forsling, *A Study of the Influence of Herbaceous Plant Cover on Surface Runoff and Soil Erosion in Relation to Grazing on the Wasatch Plateau in Utah*, United States Department of Agriculture Technical Bulletin No. 220 (Washington, D.C.: Government Printing Office, 1931), 8.

[24] *Flood Plain Information: Jordan River Complex, Salt Lake City, Utah* (Sacramento: U.S. Department of the Army, Sacramento District, Corps of Engineers, 1969), 9. I realize that "normal" is a somewhat loaded term here, but what I mean is the levels of high water common each spring along the Wasatch Front when the snowpack melts and mountain streams reach their peak flows. Any number of conditions—a wet spring, a record snowpack, a late melt, etc.—can bring on higher than normal conditions, and it is under such conditions that the limits of this system become apparent.

combined with a melting snowpack to send flood waters pouring out of the canyons east of Salt Lake City. The volume of water was so high that a number of culverts, canals, and conduits filled to capacity or became clogged with debris, and the overflow ruined lawns, spoiled gardens, and filled basements throughout the city. One city resident, George W. Hoggan, expressed anger at city authorities who claimed that the flooding "can't be helped." Hoggan responded: "If the city does not make an outlet for the waters, I shall call my own men and do so."[25]

City water officials did what they could to alleviate the flooding; city workers tried to divert water from Red Butte Creek into the canal along 1300 South, but that too had filled to capacity. W. P. Gillespie, assistant supervisor of streets and irrigation for the city, summed up one part of the situation by observing that the "major part of the trouble is caused by the conduit through which the Emigration canyon stream runs being too small for the volume of water it is being called upon to carry." Indeed, according to the *Salt Lake Tribune:* "One thing has been learned by the street department flood fighters during the present high water. It is that the conduits of the various streams are too small for flood season."[26]

This incident illuminates the major flaws of this type of flood control. When high water or obstructions cause artificial waterways to exceed their capacity, the water will continue to flow downstream. But it will overflow onto streets and farms and into houses and businesses—the very structures built on the land made available because of the streams' diversion underground. Unfortunately, for Salt Lake City and County officials (as well as officials in other urban Utah areas) the solution was not to examine other alternatives but to expand and improve their conduit and sewer system. The inherent limits of such a system would remain a problem.[27]

Luther M. Winsor, a firm believer in flood control works, once noted that "flood control in Utah as a definitive project began in 1922."[28] Winsor, a Utah native, graduated from the Utah State Agricultural College in 1911 with a degree as an irrigation engineer, the

[25] *Salt Lake Tribune,* April 26, 1917.

[26] *Deseret News,* April 26, 1917; *Salt Lake Tribune,* April 28, 1917.

[27] It is important to bear in mind that most of the diversion canals and conduits were originally constructed before much flood data existed and also prior to the evolution of flood predicting. Therefore, these engineers must have relied heavily on guesswork in deciding a conduit's needed capacity. However, even the reliance on flood prediction and the accumulation of years of flood data have not solved the problem of limited capacity.

[28] L. M. Winsor, "Flood Situation in Utah," in Slack W. Winburn, comp., *Water Resources,* Report to the Utah State Planning Board, 1934, TMs, Special Collections, Marriott Library, University of Utah, Salt Lake City, Utah, 1.

Erosion in Emigration Canyon.

first such degree conferred in the state and, quite possibly, the country. From 1913 until 1934, the state of Utah employed Winsor as an irrigation specialist, and although Winsor primarily concerned himself with irrigation, his expertise and experience involved him in the development of flood control programs throughout the state in the 1920s and 1930s.[29]

Winsor believed 1922 to be a pivotal year because in that year federal and state agencies came together to build a diversion dam across Salt Creek, near Nephi. The U.S. Bureau of Agricultural Engineering, cooperating with the Utah Experiment Station and the Utah Extension Service, built a 1,500-foot-long dike across the creek on the east side of Mount Nebo to check the flow of sand, gravel, rocks, and floating flood debris. The local irrigation company financed the venture, which proved successful, leading to similar structures the following year at Chalk Creek near Fillmore, at Corn Creek near Kanosh, and at Shoal Creek near Enterprise.[30]

In 1923 devastating floods struck Willard, Farmington, and other canyons along the Wasatch Front north of Salt Lake City. On August

[29] L. M. Winsor, *Irrigation and Flood Control* (Murray, Utah: R. Fenton Murray, 1963), i–iv.
[30] Winsor, *Irrigation and Flood Control*, 22; Winsor, "Flood Situation in Utah," 1.

13 a thunderstorm of exceptional violence hit northern Utah, dumping more than one inch of rain on the cities and mountains east of the Great Salt Lake. The resulting flows of water and debris killed nine people and caused extensive damage.[31]

Willard, a few miles south of Brigham City, was hit hardest, as a one- to three-foot layer of mud and boulders covered 155 acres, including several town blocks. A roiling mass of water, mud, boulders, and other debris had emerged from Willard Canyon: "The old creekbed was filled with mud and gravel . . . the state highway . . . covered with about seven feet of earth, boulders, and mud [and] the city of Willard was almost wiped off the map." When this mass of water and rubble hit the apex of an old alluvial fan on which the town was built, it split in two. One portion moved south and spread over a wide area, and the other followed an old stream course through the north part of town. The flow laid waste to prime farm land, tore apart the power house at the mouth of Willard Canyon, and demolished the home of Mrs. Mary Ellen Ward, killing two of the occupants.[32]

A similar mass of water and wreckage rolling out of Farmington Canyon struck the town of Farmington, leaving "devastated homes, seven deaths, debris covered fields, and a gloom stricken county" in its wake. Mr. and Mrs. W. J. Wright of Ogden were camping in the canyon with four boy scouts when the deluge swept them all to their deaths. It took three days of constant searching to find the bodies amidst all of the rubble. The other casualty in Farmington occurred when Arnold Christensen overexerted himself rescuing his family from the flood. The flood at Farmington lacked the intensity of that at Willard but still crested at ten feet and spread one hundred feet across as it emerged from the canyon mouth.

A third mud and debris flow emerged from the canyon of Rex Creek in north Centerville, south of Farmington. Hyrum Ford, whose farm lay directly in the torrent's path, "heard the roaring waters, but before he could get out of the barn, he together with the cows and barn were swept down the stream." The water swept the barn away, but Ford managed to extricate himself from the flow. His home was not so fortunate, as the flood "filled his home nearly to the second floor with silt and gravel and left a ridge over the county road to a depth of over five feet and more than one hundred yards long. Boulders of

[31] *Deseret News*, August 14, 15, and 16, 1923; Joshua Hughes Paul and F. S. Baker, "The Floods of 1923 in Northern Utah," *Bulletin of the University of Utah* 15 (March 1925): 3–7.

[32] *Box Elder News*, August 14 and 17, 1923; Paul and Baker, "Floods of 1923," 11–15.

unbelievable size and large trees were hurled down by the flood waters."[33]

In response to this destruction, citizens of Willard and Farmington, under the direction of Luther M. Winsor, set about the next year to build flood control works along the mountain streams above each town. In each community, local water users joined with the Utah Highway Commission, the county commissioners, and local railroad lines to pay for the ventures. These cooperative groups built diversion dams to direct flood waters into shallow catchment basins where the water could slow and drop the heavier part of its load of debris. Over the next several years, this type of flood control expanded throughout the state.[34] Unfortunately, the citizens of Farmington, Willard, and other communities throughout the state failed to recognize the underlying factors that had intensified the flooding of 1923. Even the diversion dams and catchment basins so recently completed could not hold back debris-laden flood waters intensified by deteriorated watersheds.[35]

Two concerned individuals did argue that impaired watersheds had played a role in the flooding at Willard and Farmington. J. H. Paul, a professor of natural science at the University of Utah, and F. S. Baker, an employee of the U.S. Forest Service, spent a year and a half studying the condition of the land in the canyons above each town. In March 1925 the two men published a report that concluded "any reduction, from either overgrazing or fire, in the density of the natural cover of vegetation, rapidly increases the likelihood of serious erosion."

Paul and Baker studied several different factors involved in the 1923 floods. First, they dismissed the argument that the amount of rainfall had been unusually high. Although the storm that caused the flooding had been violent, the two men concluded that similar storms were "not rare in the mountains." Paul and Baker then turned to an extensive study of the vegetative cover and general conditions of Willard and Farmington canyons.

In Willard Canyon the two men found that little erosion had taken place along the east-west portion of the canyon. They found this section covered with brush—oak, serviceberry, and maple—and con-

[33] *Davis County Clipper,* August 17, 1923; Paul and Baker, "Floods of 1923," 11–15.

[34] Winsor, *Irrigation and Flood Control,* pp. 22–25; Winsor, "Flood Situation in Utah," 1–2.

[35] Of course, this is even assuming that such structures worked at their optimum level. After all, flooding can be so unpredictable as to flow right by diversion dams, and catchment basins can only hold so much debris before they are full.

Above: *Erosion caused by overgrazing, probably Davis County, 1930.*

Right: *Mud flow from flood in Centerville, 1927.*

siderable stands of timber. But further up the canyon, after it turns to the south, Paul and Baker discovered wide, deep gullies where water had carved channels on its way down the canyon walls. Rocky ridges marked two areas at the canyon head; the other, more gentle slopes were covered by only "scanty stands of alpine fir, which in the past have been more dense; heavy logging is evident, and reproduction has been subnormal." The men noted that the channels the water had cut seemed to follow locally overgrazed and overforested places on the slopes.

In Farmington Canyon, Paul and Baker found similar conditions. Near the ridgetop on the north side of the canyon "over-grazing is locally severe," with "vegetative cover . . . far below normal." As in Willard Canyon, the two men also found places heavily covered with brush and trees that had experienced little erosion during the flooding.

From the evidence in the two canyons, Paul and Baker concluded that "fires and over-grazing bring about disastrous floods," and they noted that even small patches of bare ground near ridgetops could funnel torrents of water onto the land below. Even if the lower part of a canyon—as was the case in Willard Canyon—retains a heavy brush and timber cover, this only serves to add debris to a flow that begins on depleted upper slopes. The two men also recognized the contribution of excessive logging to flooding. According to their research, even small stands of timber can help prevent serious erosion, and even "large, firm weeds and grasses (mountain sunflower, lupine, horse mint, and similar plants), suffice to prevent the initiation of erosion on all but the steepest slopes." To combat future flooding, Paul and Baker recommended two basic steps: protection and revegetation of critical areas in the local watersheds, and county government ownership and regulation of the most critical land. But it would take another series of destructive floods just five years after the publication of their study for these ideas to gain widespread acceptance and for public officials to do something.[36]

Overgrazing and timber cutting were not the only ways that people in Utah altered the environment and increased flooding. By 1904, three large copper smelters were in operation in the Salt Lake Valley, all located between Murray and Midvale, south of Salt Lake City. One by-product of the smelting process was a toxic sulfur dioxide gas that the smokestacks emitted into the air. When weather conditions were just right, southerly winds and rains brought the poison all the way to the Salt Lake City limits. Local farmers complained of dead animals and extensive crop damage, and a particularly steady series of winds in June 1904 devastated a wide swath of country, even "burning trees." The farmers did not take this lying down. They held a series of meetings in the fall of 1904 and brought a large suit against the copper companies in the winter of 1905. Almost two years later, in November 1906, the farmers won their case, and the resulting decision effectively slowed copper smelting in the Salt Lake Valley until plants cleaned up their emissions.[37]

Although there exists no direct evidence that sulfur dioxide gas poisoned the forests along the Wasatch Mountains, the Garfield Smelter across the valley, which was not affected by the 1906 decision,

[36] Paul and Baker, "Floods of 1923," 4–20.

[37] *Deseret News*, February 8, 1905, November 5, 1906; Leonard J. Arrington and Gary B. Hansen, *"The Richest Hole on Earth": A History of the Bingham Copper Mine* (Logan: Utah State University Press, 1963), 18–19.

provides evidence of how a copper smelter can destroy the environment surrounding it. At the turn of the century, the Kennecott Company built the $10 million Garfield Smelter at the north end of the Oquirrh (ironically, an Indian word meaning "wooded mountain") Range, twenty-two miles west of Salt Lake City. The smelter sat at the mouth of Coon Canyon, once an important source of timber for Salt Lake City. Poisonous gases emanating from the plant soon purportedly killed "almost every vestige of spruce, maple, and oak, and the canyon stream began to flow black with the accumulated top soil of ages," resulting in serious flooding from the canyon.[38]

In 1927, officials at the Garfield Smelter called on none other than Luther M. Winsor to help them solve the problem of flooding in Coon Canyon. With Winsor's assistance, the company built a huge flood control barrier with a crest eighty-three feet above the streambed. A year later, accumulated debris behind the barrier forced the company to raise the height of the structure to one hundred feet and make provisions for raising it higher as needed. Certainly, the Kennecott Company had incurred an unexpected expense by situating its smelter at the mouth of Coon Canyon.[39]

On July 10, 1930, heavy thunderstorms hit Weber, Davis, and Salt Lake counties. The cloudburst storms left ruin over a 150-mile stretch along the Wasatch Front, from Spanish Fork Canyon north to the Idaho border. All along the Front, streams of muddy water and debris emerged from mountain canyons, and high water out of Emigration, Red Butte, and Parleys canyons plagued Salt Lake City.[40]

In Centerville and Farmington, citizens declared the flooding worse than that of 1923. In those two communities, mud and water covered farm land—including a portion of Hyrum Ford's farm again—and roads, up to depths of thirteen feet. Mrs. Eugene Ford barely escaped her home with her three young daughters before a ten-foot-high wall of water demolished it. Herbert Streeper watched while the flood carried his car and garage along for almost one hundred feet. On the highway at the mouth of Steed Canyon in Farmington, passengers in three cars narrowly escaped with their lives as mud poured over their vehicles, burying them to the roofs. In Farmington,

[38] Cottam, *Is Utah Sahara Bound?*, 24.

[39] Winsor, *Irrigation and Flood Control*, 23. In 1938, the company did have to raise the level of the barrier another fourteen feet. By 1947, Walter Cottam estimated that Kennecott had spent at least one-tenth of the value of the smelter on flood control. Cottam, *Is Utah Sahara Bound?*, 24.

[40] *Deseret News*, July 12, 1930.

mud, rocks, and gravel buried Mr. and Mrs. Ronald Olsen to their necks. Mr. Olsen described what had happened:

> It happened so quickly we didn't know what it was all about. . . . We heard a terrific clap of thunder and my wife and I rushed to the porch on the south side of the house. The next thing we knew we were flipped 20 feet. . . . We heard the roar of water. Our home seemed to leap right at us. The porch fell right on us, pinning us to the earth. Then came a wall of water and mud and sand. We couldn't breathe. It seemed to stop as suddenly as it started. I can't figure out yet why we were not killed.[41]

A month later, from August 10 to 14, heavy rainstorms again battered the Wasatch Front, and the flooding resumed. Debris-laden water demolished twenty homes in Bingham, leaving an eight-foot layer of mud through much of the town. Walls of water and debris once again washed out roads and damaged crops in Farmington and Centerville.[42] State Senator George H. Ryan was traveling to Ogden when a storm hit Centerville on August 11. Ryan described the scene:

> Fertile acres were covered by a mass of chocolate-colored waters, about the consistency of a heavy paint. . . . Acres of orchard trees passed over the road on the muddy flood. One moment you would see a corn patch, or an onion field. Then the flood would sweep across it and lay it low, burying it under a sea of mud. . . . The flood seemed to come in surges of red mud—waves perhaps a couple feet high would sweep across the deposits that had been left by preceding waves, leaving still more debris.[43]

These new storms and mudslides had hit as soon as cleanup crews had removed the debris from the previous storm. Mudslides and flooding also struck Ogden and Provo; one mudslide dammed the Provo River, creating a temporary artificial lake. On August 12, the floods claimed their only victim when a car overturned on a mud-slick road south of Mona, crushing fifteen-year-old Dean Johnson of Salt Lake City, who was riding on the running board. Over the next few days, floods struck new areas in Magna, Mona, and Pleasant Grove. Finally, on September 4, the last of the flooding hit Davis County, again burying roads and fields in Centerville and Farmington under water, mud, and debris.[44]

The repeated heavy thunderstorms that summer created the most extensive and damaging flooding statewide since 1862. Estimates placed damages at well over $1 million, including the ruin of some of the state's best farmland. Governor George H. Dern pleaded with

[41] *Salt Lake Tribune,* July 11, 1930.
[42] *Deseret News,* August 11, 1930; *Salt Lake Tribune,* August 10 and 12, 1930.
[43] *Salt Lake Tribune,* August 12, 1930.
[44] *Deseret News,* August 13, September 5, 1930; *Salt Lake Tribune,* August 13 and 14, 1930.

Utah citizens to donate money for flood relief in Davis County and throughout the state.[45]

The destructive and recurrent nature of the floods also prompted Governor Dern to appoint a special commission to study Utah's flood problem. Dern placed eighteen men on the commission—engineers, geologists, forestry and range management specialists, ranchers, orchardists, farmers, businessmen, and lawyers, "with an efficient church leader and engineer [Sylvester Q. Cannon] as chairman."[46] Dern instructed the commission to study "the recurring floods in Davis County and other parts of the State . . . to ascertain whether any flood prevention measures are feasible. Such a study must necessarily include the cause of the floods as well as the remedies."[47] It took less than four months for the commission to finish its investigation and publish its findings. The resulting study, *Torrential Floods in Northern Utah, 1930,* discussed in detail the causes behind the flooding and proposed a number of possible solutions.

The commission outlined three main causes behind many of the 1930 floods: uncommonly heavy rainfall, topography and geological conditions favorable to runoff, and scant vegetation—due to overgrazing, overlogging, and fire—on portions of the watersheds. The commissioners concluded that heavy rainfall "may be expected in any year and at rather short intervals." After all, "such storms occurred only seven years apart, in 1923 and 1930, and four times during the summer of 1930." In their examinations of the state's topography, the men noted the numerous short, steep canyons along the Wasatch Front—some canyons drop 4,500 feet in less than four miles—that "greatly encourage sudden rapid surface run-off from rapid downpours of rain." The commissioners explained that humans had no way to control or change the weather or topography of the region. This left depleted plant cover as "the only one of the three factors contributing to the floods over which man can hope to exercise any control of consequence."

In studying scant vegetation and its role in flooding, the commission focused its attention on the canyons of Davis County, north of Salt Lake City. They found in these canyons great variation in the vegetative

[45] *Deseret News,* August 16, 1930; *Salt Lake Tribune,* August 12, 1930.

[46] Luther M. Winsor, "Control of Floods in Mountain Streams," circa 1934, 1–2, L. M. Winsor Papers, MS 98, Box 1, Folder 6, Special Collections, Merrill Library; *Torrential Floods in Northern Utah, 1930,* Report of the Special Flood Commission Appointed by Governor George H. Dern, Agricultural Experiment Station Circular No. 92 (Logan: Agricultural Experiment Station, Utah State Agricultural College, 1931), 5–6.

[47] *Torrential Floods in Northern Utah,* 1930, 5, 7, 31–34.

cover. Dense brush, chiefly scrub oak, covered the slopes of the main parts of the canyons. At the heads of the canyons, the commissioners noted "dense stands of aspen, sagebrush and brush patches of chokecherry, snowberry, and other shrubs, but with little or no undercover." The men found the high ridges at the canyon heads in the worst condition: "almost barren or . . . only scrubby stands of sagebrush . . . also considerable areas of practically barren watershed having only a scattered stand of shrubs, or of niggerhead [now called western coneflower], lupine, and other weeds." From the character of the canyons and the remnants of certain species, the commissioners concluded that the depleted areas "formerly had a much heavier stand of grasses, weeds, snowberry, and other shrubs." They blamed the depletion on overgrazing, fire, and the overcutting of timber, each of which had contributed to the overall destruction of the watersheds. Overgrazing had removed the grass and shrub cover from the soil that helped anchor the ground in place; excess logging and uncontrolled fires had removed the trees and undergrowth that served as important breaks and checks to erosion. The commissioners concluded that if the original plant cover in the Davis County canyons had been in place, "the flooding in that section from the rains of 1930 would have been far less serious, if not prevented."

The commissioners went on to provide an agenda for flood-plagued communities to follow and to recommend four major policies for Davis County and the rest of the state.[48] First, the commission recommended that either the state or federal government acquire control of all critical watershed lands. This would allow for the proper implementation of a program to restore plant cover, the subject of the final three proposals. To allow for and aid in watershed rehabilitation, the commissioners recommended the exclusion of domestic grazing animals from critical lands, combined with the seeding and planting of suitable grasses, weeds, shrubs, and trees. Finally, the commissioners recommended the establishment of effective fire prevention and suppression measures to help reduce future denudation of the land.[49]

The importance of these suggestions should not be overlooked. Finally, a statewide investigative commission had argued for significant

[48] At the same time that Dern's commission was involved in studying the floods, William Peterson, director of the USAC Extension Service, was involved in the debate over whether to turn federal land in the West over to the various states. Peterson used the rampant flooding of 1930 as an argument for continued federal control. Congress passed the Taylor Grazing Act four years later, withdrawing federally owned western lands from public entry. For more on Peterson's role in developing this policy, see Kevin Dean Hatfield, *The Tail Wags the Dog: State Versus Federal Control in the Public Domain Debate, 1929–1934* (M.A. thesis, Utah State University, 1994).

[49] *Torrential Floods in Northern Utah, 1930*, 19–22.

changes in land-management practices. Of course, recommendations in a report and actual acceptance and execution of such recommendations are two different matters, and Utahns could not restore the local watersheds overnight. Yet the findings and recommendations of Governor Dern's commission marked a change in the approach toward Utah's flood problem and also provided a model that would prove beneficial in the years to come.

One immediate result of the commission's report was a bill passed by the 1931 state legislature that provided for the reorganization of the State Land Board. This bill charged the new board with the "responsibility of studying the problem of flood prevention and control in Utah and taking initial steps toward putting a constructive program into operation."[50] The board immediately engaged the director of the Intermountain Forest and Range Experiment Station, C. L. Forsling, to supplement the work of Governor Dern's commission and make an extensive survey of Utah flooding.

Forsling, a member of his staff, and two professors from the Utah State Agricultural College in Logan reported their findings to the board in January 1933, echoing the findings of the 1930 flood commission. The foursome had studied twenty-seven different rivers and watershed areas throughout the state looking for connections between depleted plant cover and flooding. They discovered that loss of plant cover played a role in flooding in twenty-three of the areas and in sixteen had been "the major factor giving rise to conditions favorable for flood runoff." Like the commission, Forsling and his associates listed overgrazing, fire, and heavy cutting of timber as the chief causes of the depletion of plant cover. But they also recognized the contribution of more minor factors—the clearing of land for cultivation and the building of roads and trails, for example—in this depletion.

Finally, Forsling raised in his report an important issue for Utah's flood problem after 1930. The researchers studied three communities that depended extensively on the use of local range lands for their economic survival. This dependence was great enough to make the "drastic adjustment necessary to bring more rapid improvement [to the local watersheds] less acceptable than occasional floods."[51] This kind of economic dilemma (or economic possibility), which can force individuals to accept the risk of flood damage, would increase in

[50] Winsor, "Control of Floods in Mountain Streams," 2.

[51] C. L. Forsling et al., *Utah Flood-Erosion Survey Report, 1933*, TMs, Special Collections, Merrill Library, 2–8, 12–13.

importance as urban areas expanded and the factor of human choice began to play a more prominent role in flood damage.

The year after Forsling made his report to the State Land Board, he and two associates published a brief study titled *Floods and Accelerated Erosion in Northern Utah*. In the study, the three men examined in depth the same 1923 and 1930 Davis County floods that had captured the attention of the flood commission. Their conclusion differed from that of the commission in that they placed sole blame for the excessive flooding on watershed conditions, discounting the contribution of topographical factors and uncommonly heavy rains.

The three focused on the vegetation in Davis County's Ford Canyon, beginning with the former dominant plant cover. By examining similar nearby canyons, as well as undamaged parts of Ford Canyon, they determined that dense stands of bunchgrasses interspersed with sagebrush had once dominated the Ford Canyon landscape. In the summer of 1930, however, only scattered, stubby remains of small shrubs predominated. All other plants had "been grazed almost to extinction by midsummer of that year." Even worse than this scattered vegetation was the fact that fully one-fourth of the area at the canyon's head lay practically bare. The researchers compared Ford Canyon with nearby Centerville Canyon. In 1930, Centerville Canyon had retained a thick cover of vegetation, especially at the canyon's head, and had not been a source of flooding. Since Centerville Canyon closely resembled Ford Canyon topographically and had received similar amounts of rainfall, Bailey, Forsling, and Becraft concluded that overgrazing—leading to the depletion of plant cover—had been *the* causative factor in the flooding.[52]

Following the studies of the 1930 floods, two developments marked an increase in concern for Utah's watersheds. In 1933, public officials in Davis County established the Davis County Experimental Watershed as an experiment in flood control through the improvement of vegetative cover. Over the next fifteen years, this project, located in the Wasatch National Forest, would prove a model for watershed rehabilitation.[53]

[52] Reed W. Bailey, C.L. Forsling, and R.J. Becraft, *Floods and Accelerated Erosion in Northern Utah*, U. S. Department of Agriculture Miscellaneous Publication No. 196 (Washington, D.C.: Government Printing Office, 1934), 13–21. Bailey worked as a professor of geology at Utah State Agricultural College, and Becraft worked as an associate in range management at the Utah State Agricultural Experiment Station. It is almost certain that this published study resulted directly from the work Forsling had done for the land board.

[53] A. Russell Croft, "History of the Davis County Experimental Watershed," TMs, Special Collections, Merrill Library.

A year later, Congress passed the Taylor Grazing Act, withdrawing some 173 million acres of federal lands in the western states from public entry. The flooding of the 1920s and 1930 had helped to cement the support of Utah's governor and congressional delegation for this reversal of public land policy.[54] Under this new act, the Grazing Service began to restrict and supervise grazing on much of Utah's range land. By 1940, officials had reduced the number of sheep grazing on Utah's land by almost one million from the 1930 level of almost three million and had stabilized the cattle population at around 450,000. The Taylor Grazing Act helped to hasten the restoration of Utah's watersheds.[55] Also in 1934, Salt Lake City commissioners made it unlawful for individuals to drive animals into the city's watersheds. City commissioners instructed animal control officials to impound any loose cattle or sheep found in those areas.[56]

Along with the newfound concern for watershed lands, the 1930s saw the continued expansion of flood control works throughout Utah. As part of the program to combat the depression, federal officials had established twenty-six Civilian Conservation Corps (CCC) camps in Utah by 1933, and camp members devoted the majority of their time to building flood control works.[57] CCC labor built and improved spillways and structural controls in Box Elder and Davis counties; built a series of rubble masonry spillways and barriers on Salina Creek, Escalante Creek, La Verkin Creek, Ash Creek, Hurricane Creek, and the Virgin River; and built a series of channel control structures on the Santa Clara River.[58]

At the foundation of this expansion of flood control works lay notions of human domination of the environment. The words of Luther M. Winsor, who outlined and supervised the flood control works programs for all CCC camps, best illustrate this attitude. When discussing the extensive work of the 1930s, he noted that both Salina Creek and the Virgin River had "been placed under control" by the construction of flood control works. In addition, Winsor stated that

[54] For a complete treatment of this, see Stanford J. Layton, *To No Privileged Class: The Rationalization of Homesteading and Rural Life in the Early Twentieth-Century American West*, Charles Redd Monographs in Western History, No. 17 (Provo: Brigham Young University, 1988). Layton includes the flooding along the Wasatch Front as one of four factors that came together in the 1930s to change federal land policy.

[55] Peterson, "Natural Resource Utilization," 662; Cottam, *Is Utah Sahara Bound?*, 4.

[56] *Revised Ordinances of Salt Lake City, Utah, 1934*, secs. 1500, 1550.

[57] Winsor, *Irrigation and Flood Control*, p. ii; Peterson, "Natural Resource Utilization," 662; Kenneth W. Baldridge, "Reclamation Work of the CCC," *Utah Historical Quarterly* 39 (Summer 1971): 265–85.

[58] Winsor, "Flood Situation in Utah," 1–3.

"at Washington, the town has been protected from floods which formerly swept and menaced the entire town."[59]

This attitude accurately reflects the general feeling in Utah on the eve of World War II. It seemed to Utah residents that they were well on their way to alleviating future damage from flooding. Although many had grown to understand the connection between watershed conditions and exacerbated flooding and had taken steps to repair this critical land, Utahns had not lost their love for flood control structures; the first four decades of the twentieth century marked a flurry of construction of such works. These flood control structures had inherent weaknesses, however. Physical solutions such as conduits and channels had already demonstrated their limited potential. Barriers and catchment basins could also fail to protect life and property and had proven ineffective against the increased flood flows of 1923 and 1930. Such problems with physical solutions would continue.

Efforts at watershed restoration and the expansion of flood control works overshadowed another factor in Utah flooding, one that would remain mostly unrecognized until after World War II: floodplain development. The rapid (and almost entirely uncontrolled) population growth and city expansion in the decade and a half after 1940 would exacerbate already-existing problems and create new ones—such as the replacement of absorbent benchlands with non-absorbent asphalt and roofs. The sheep and cattle are mostly gone from the canyons along the Wasatch Front, and the role of these watersheds in Utah flooding has been diminished or eliminated, but development in these same canyons has continued, and so have the floods. Unfortunately, the problem of canyon and floodplain development has not received even a fraction of the attention that watersheds received during the first half of the century. Utahns need to address the issue of floodplain development with the same energy and insight that was applied to the problem of watershed depletion some seventy years ago.

[59] Winsor to Slack W. Winburn, August 7, 1934, in *Water Resources;* Winsor, *Irrigation and Flood Control*, p. ii; Winsor, "Flood Situation in Utah," 2–3.