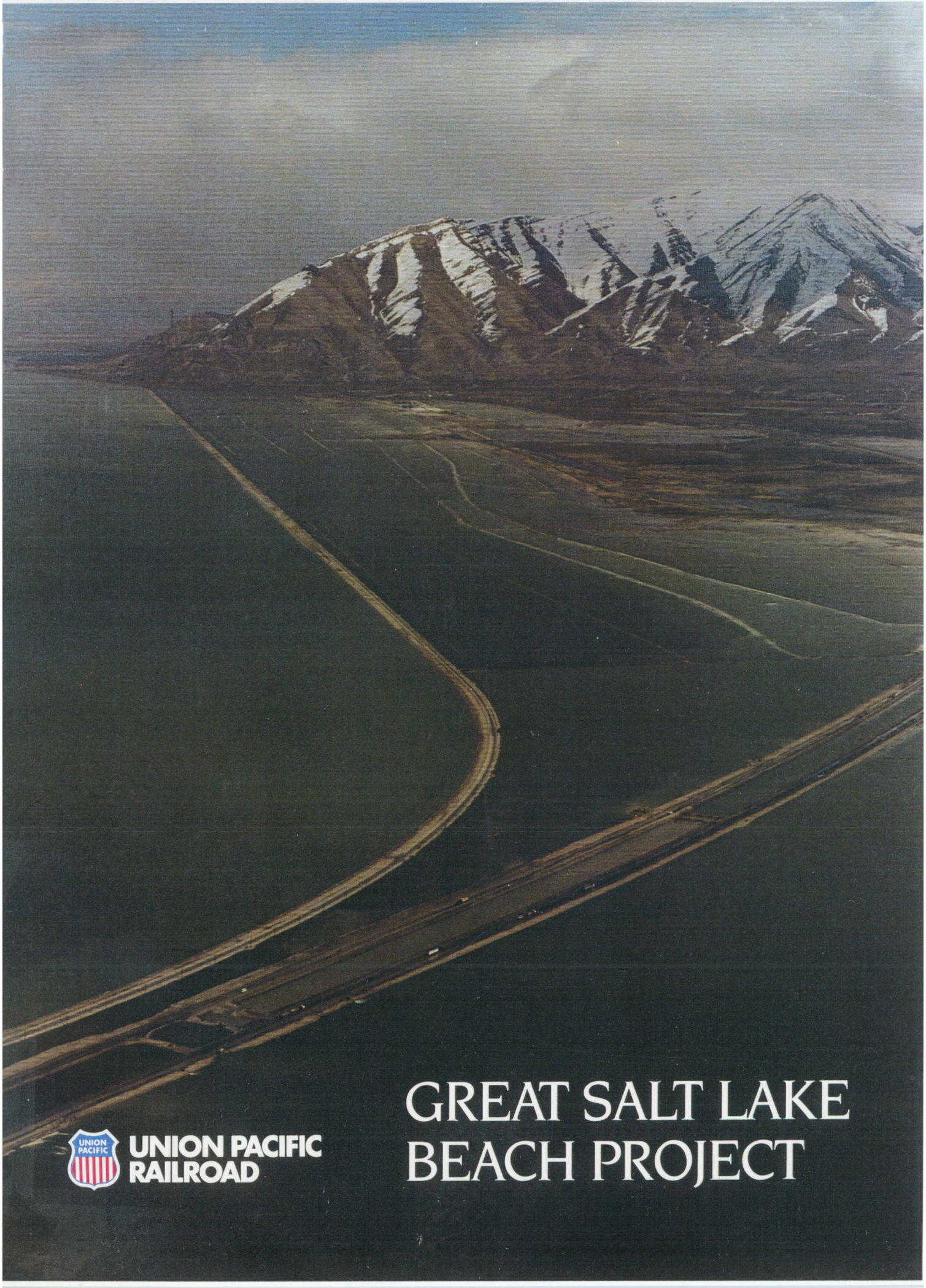
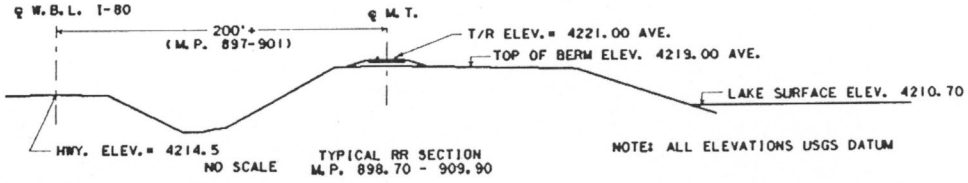
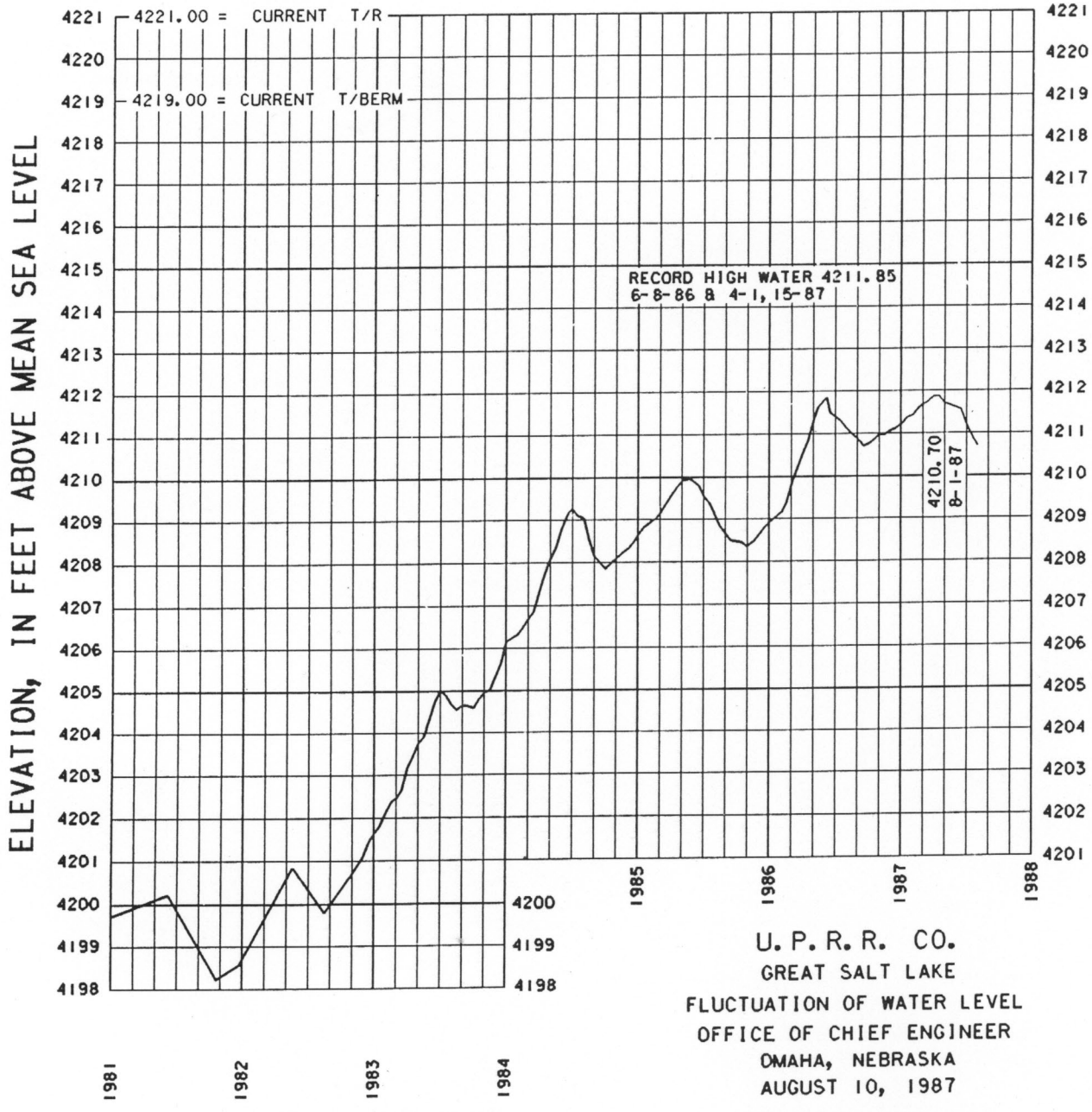

UNION PACIFIC
RAILROAD
GREAT SALT LAKE
BEACH PROJECT

UNION PACIFIC RAILROAD COMPANY

GREAT SALT LAKE PROJECT

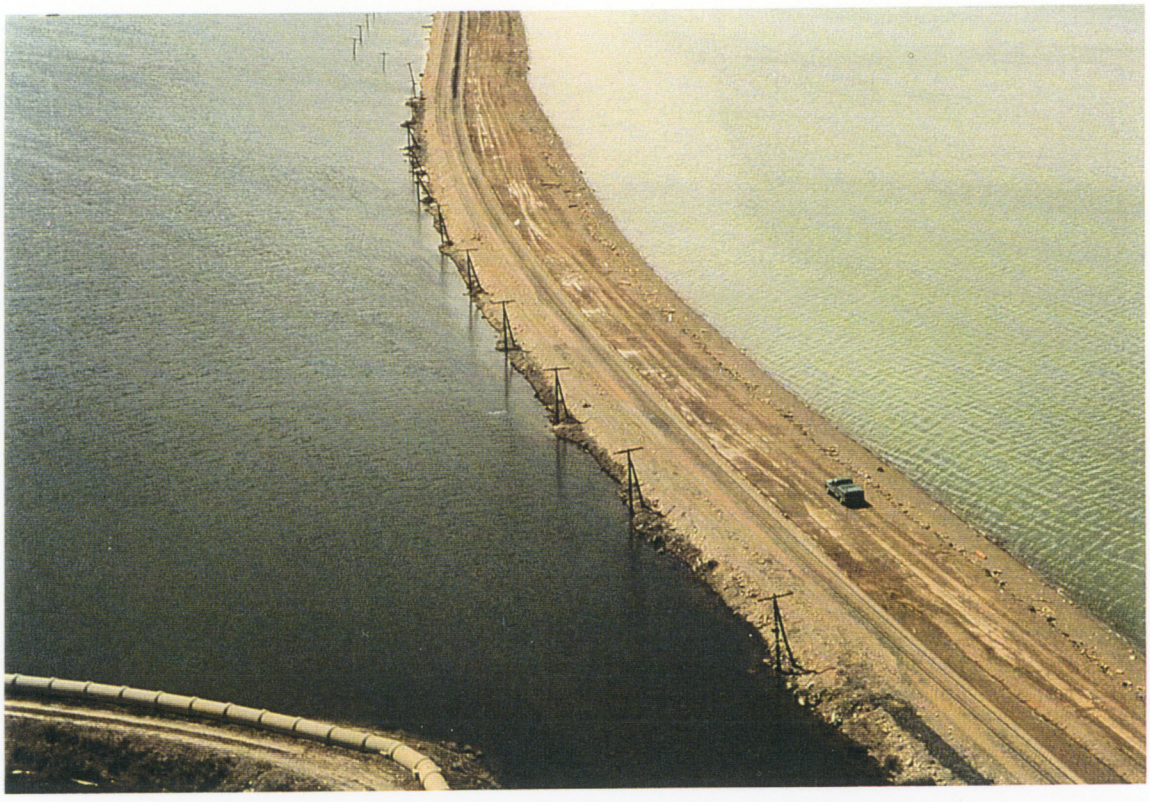
Year	Min. Lake Elevation	Max. Lake Elevation	Location M.P. to M.P.	Track Work			Beach Construction			Total Cost
				T/R Elevation Begin	T/R Elevation End	Cubic Yards Ballast Req'd.	Beach Elevation Begin	Beach Elevation End	Cubic Yards Emb. Req'd.	
1873		4211.70	897.0-911.0							
1963	4191.50		897.0-911.0							
1981	4191.50	4211.70	897.0-911.0							
1982	4191.50	4211.70	897.0-911.0							
1983		4205.90	897.0-911.0	4208-10	4211.25	58,874	N/B	4208.00	1,232,550	$ 6,398,400
1984	4205.90	4209.15	897.0-911.0	4211.25	4216.00	183,065	4208.00	4214.00	2,087,400	$10,201,156
1985	4208.35	4209.90	897.0-911.0	4216.00	4216.00	0	4214.00	4215.00	500,000	$ 1,913,885
1986	4208.90	4211.80	897.0-911.0	4216.0	4221.0	155,000	4215.00	4219.00	1,280,000	$ 5,868,034
1986	4208.90	4211.80	881.4-896.5	4214-18.5	4218.50	40,275	N/B	4217.00	341,330	$ 4,278,112
TOTAL						437,214			5,441,280	$28,659,587



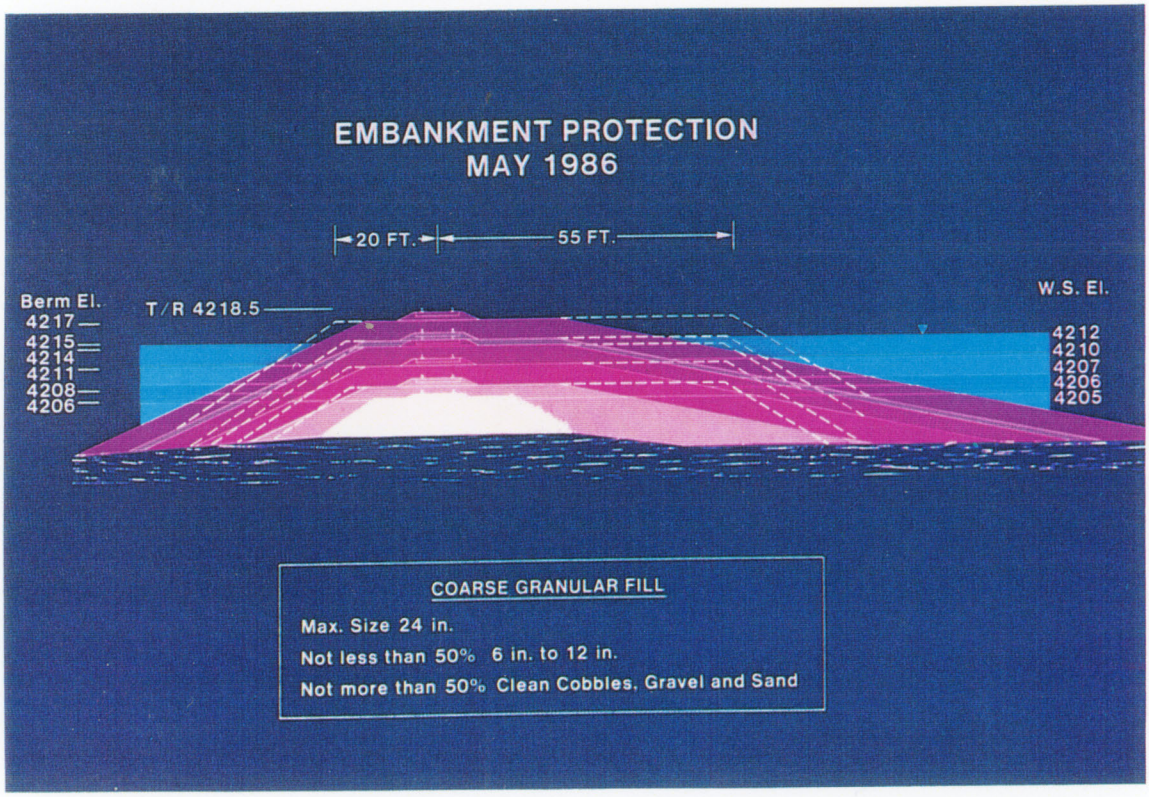


U. P. R. R. CO.
GREAT SALT LAKE
FLUCTUATION OF WATER LEVEL
OFFICE OF CHIEF ENGINEER
OMAHA, NEBRASKA
AUGUST 10, 1987

DRG. NO. DR-0095
(OLD C. E. . NO. 83148)



An aerial view (facing west) of the beach, embankment and raised track.



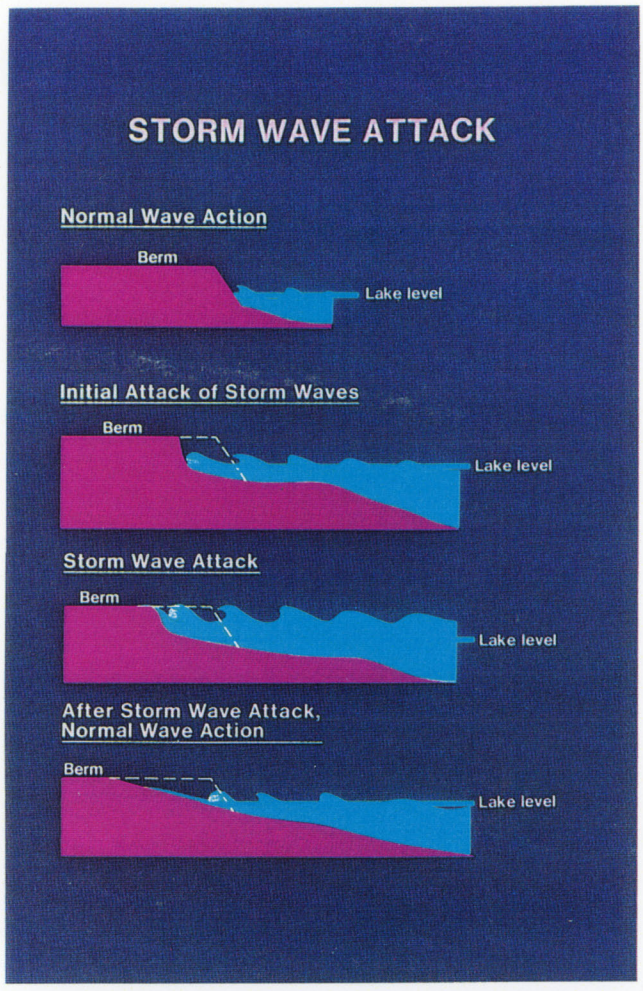
Cross sectional view shows several phases of construction since Sept. 1983.

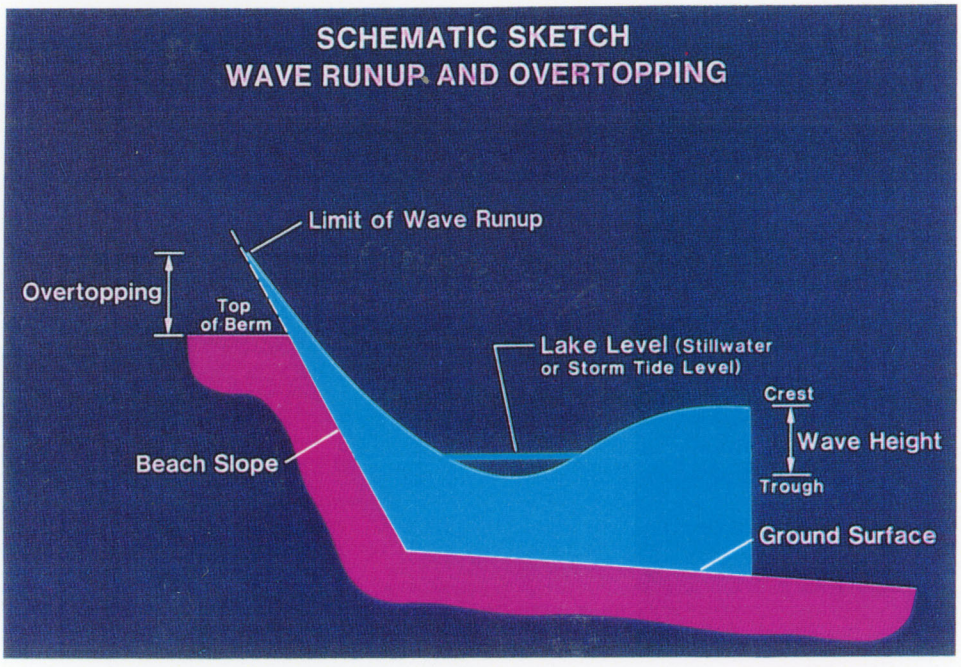
View westerly of material before complete beaching effect has taken place.

View easterly of beach after all of the material has been pulled out into the lake by wave action to 6:1 slope.

Bulldozers were used to widen the embankment and extend the beach into the lake.

Two 40 car unit trains of 100 ton, 50 Cubic Yard Air Dump cars hauled material to the project site. The material was side dumped and initially pushed away from the tracks with a Jordan Spreader.





The storm wave attack design utilizes natural wave action to create a beach which is the most effect way to dissipate the energy from damaging waves similar to those shown in top picture on previous page.

Westward facing photo taken prior to beginning construction of the beach and raising the track.

Taken prior to the beach project, this photo shows an example of sandbagging in an attempt to stem severe erosion caused by wave action.

Recent Events

Over the years, since 1873 when the Great Salt Lake reached its highest level with its surface at an elevation of 4211.5 feet above sea level, this body of water seemed to evidence a general downward trend. The lake reached its lowest elevation in 1963 when it fell to near 4,191 feet.

From 1963 to 1977, the lake rose slightly over 10 feet to an elevation of 4,202. It then began another slight decline. These events did not seem to be particularly significant since the lake level regularly fluctuated over a range of about 10 feet with yearly fluctuations of approximately 1.7 feet from spring to autumn being the average.

However, during 1982 and 1983, the lake rose from slightly over 4,198 to nearly 4,206 a total of 8 feet, with an unprecendented 5-ft. increase occurring between late 1982 and mid 1983. The previous record raise in one season was 3.4 feet in 1907. Much of this increase was due to two unusually wet winters, with heavy mountain snowpacks followed by rainy, cooler-than-normal summers. The combination of excessive amounts of moisture and less-than-normal evaporation resulted in the raising lake levels.

An 11-mile portion of the former Western Pacific main line lying along the south shore of the lake from Mile Post 899, just east of Burmester, to Mile Post 910, just west of Garfield, was threatened by the raising lake level. Western Pacific records indicate that this stretch of track was originally constructed on a level grade in 1902. However, over the years subsidence and settlement occurred with the result that at Mile Post 901.4, the low top of the rail elevation was at 4,207.9 feet. As the lake depth was increasing, it became apparent that something must quickly be done to protect and raise the line.

Early in 1983, Union Pacific initiated plans to protect the trackage along the south shore of the Great Salt Lake. The lake level was 4203.6 by May, 1983, and the projection was that it would reach an elevation of 4205. At elevation 4203, even with low wind velocity, the wave action was coming over the track, saturating the ballast, and shunting the signals. The wave action was also jetting through voids in the rip-rap and the fill material was being migrated out from under the track.

In June, 1983, Union Pacific started the first project to raise the beach and rail. The project called for a top of rail elevation of 4210, with a berm (beach) elevation of 4207. The berm would extend 35 feet out into the lake. By the time the project was nearing completion in December, 1983, it was decided to raise the top of rail an additional one foot because of continuing projections of higher lake elevation. This additional one foot put the top of rail at 4211, and the beach at 4208.

Early in 1984, with the lake still rising, UP started the next phase of the project which called for raising the track to an elevation of 4213 and the beach to 4210.8. This project was completed in April, 1984. Even before this phase was completed, it was evident the beach would have to be raised to an elevation of 4214 and the top of rail to 4216. This project was approved and work started in March, 1984.

During 1985, the railroad raised the beach one additional foot to an elevation of 4215.

The Great Salt Lake is divided by the Southern Pacific Railroad causeway into the north and south arms. Because of this restriction a differential of 42 inches in elevation between the two arms existed with the south arm, where the UP trackage is located, being higher.

With the State of Utah under heavy pressure from local industry and municipal utilities to do something, State officials approved a project to breach the Southern Pacific causeway with a 300-foot-long bridge. The project was accomplished in August, 1984. At the time of the breach, the elevation of the south arm was 4209.05 and the north arm was 4205.60. By October, 1985, the two arms were within six inches of being equalized, which is the best that could be expected.

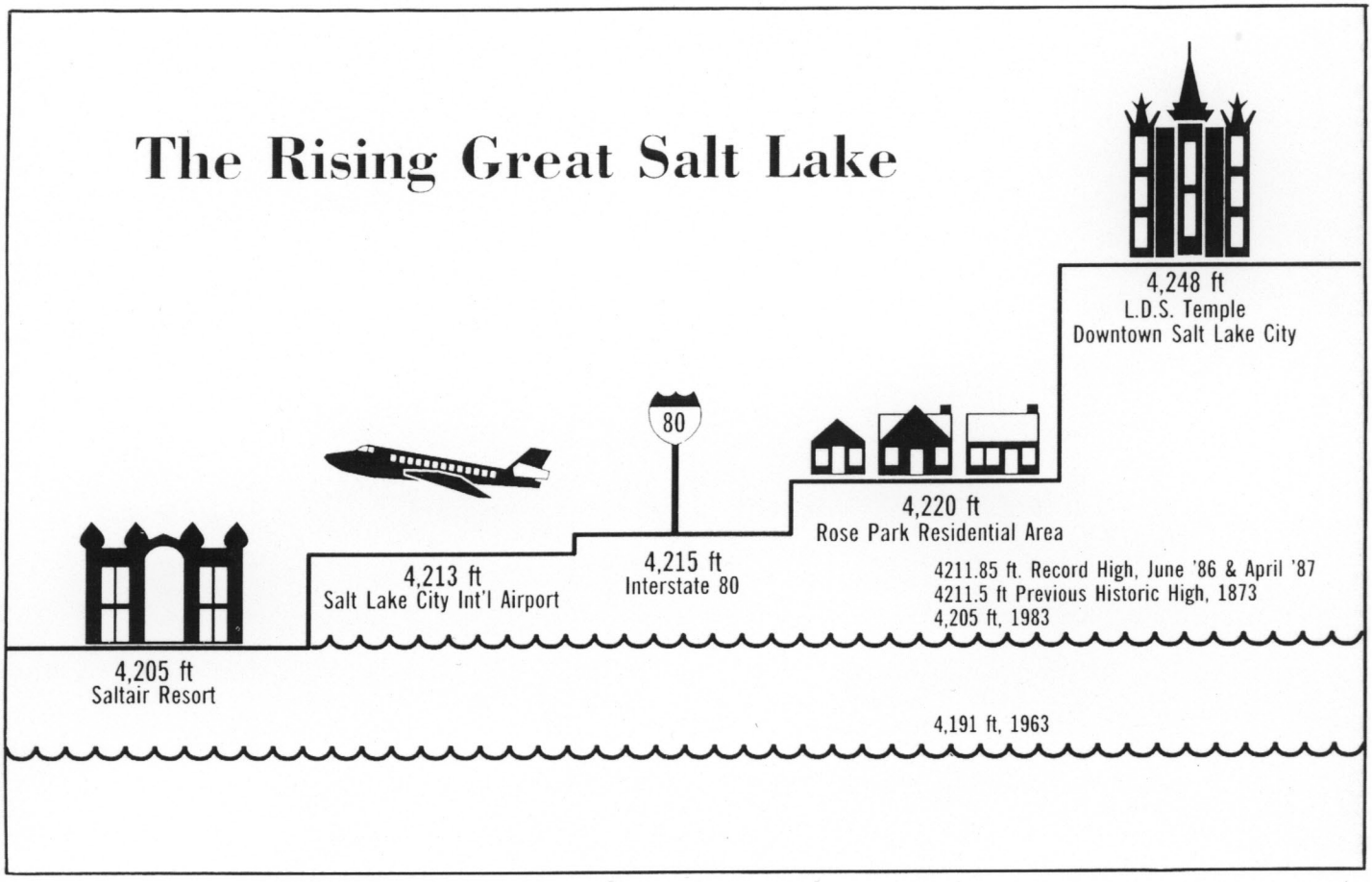
With continuation of the wet cycle, the railroad started yet another berm raising project in May, 1986, to take the berm to an elevation of 4217 and the track to 4219 feet above sea level. The lake reached an all-time record level of 4211.8 in early June, 1986.

During a heavy storm on June 7, 1986, the Amax Co. dike broke allowing Great Salt Lake water to flow up against the UP main line as far west as Timpe, M.P. 886.7 and caused the railroad to extend the berm raising project an additional 10 miles between M.P. 896.5 and M.P. 881.4. This west beach project will raise the top of rail between Burmester, M.P. 897.1, and Delle, M.P. 871.6, to an elevation of 4218.5 and widen the existing shoulder.

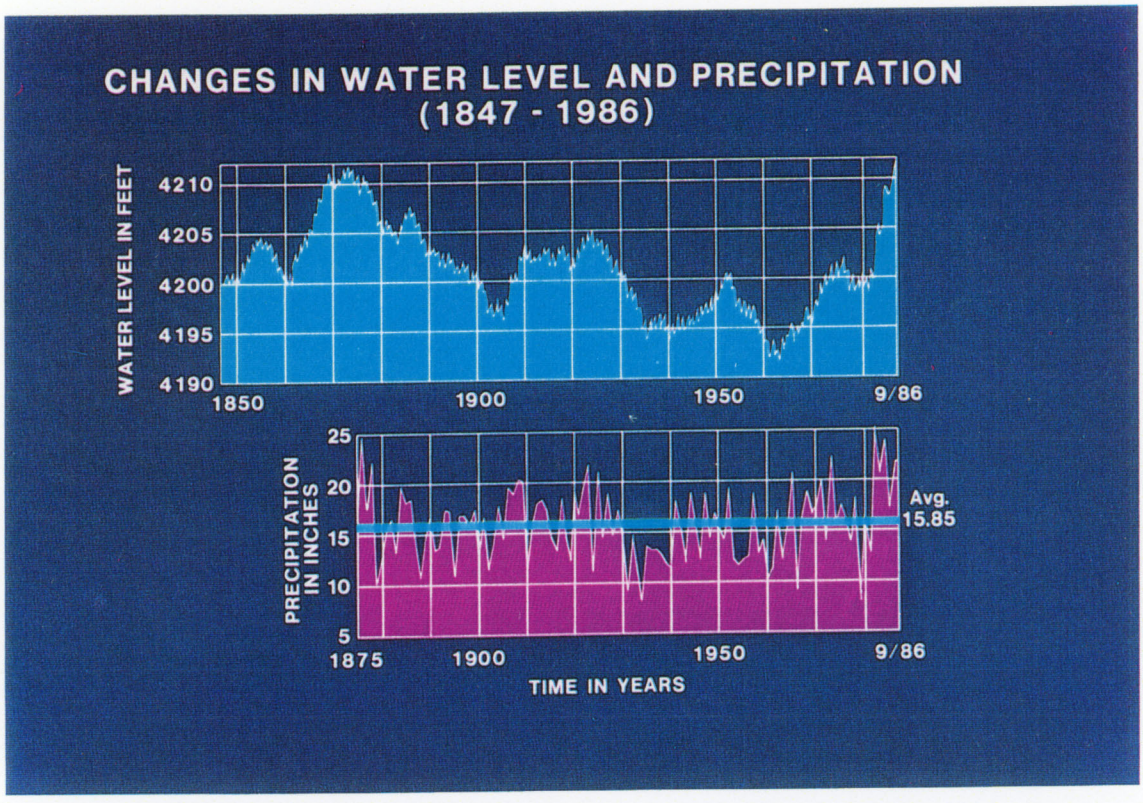
With completion of the 1986 projects on the beach, UP will have spent approximately $29 million since 1983 in its effort to maintain this trackage above the rising water of the Great Salt Lake.

A plan was developed during 1984 and 1985 to relocate this section of the main line out of the lake bottom, and right-of-way was acquired for the project. The relocated main line would have started at Erda, M.P. 755.58, and tied into the old Warner branch line at M.P. 6.8. This project called for construction of 8.11 miles of new main line track and rehabilitating 6.8 miles of the branch. The project was estimated at $10,000,000 based on 1984 dollars.

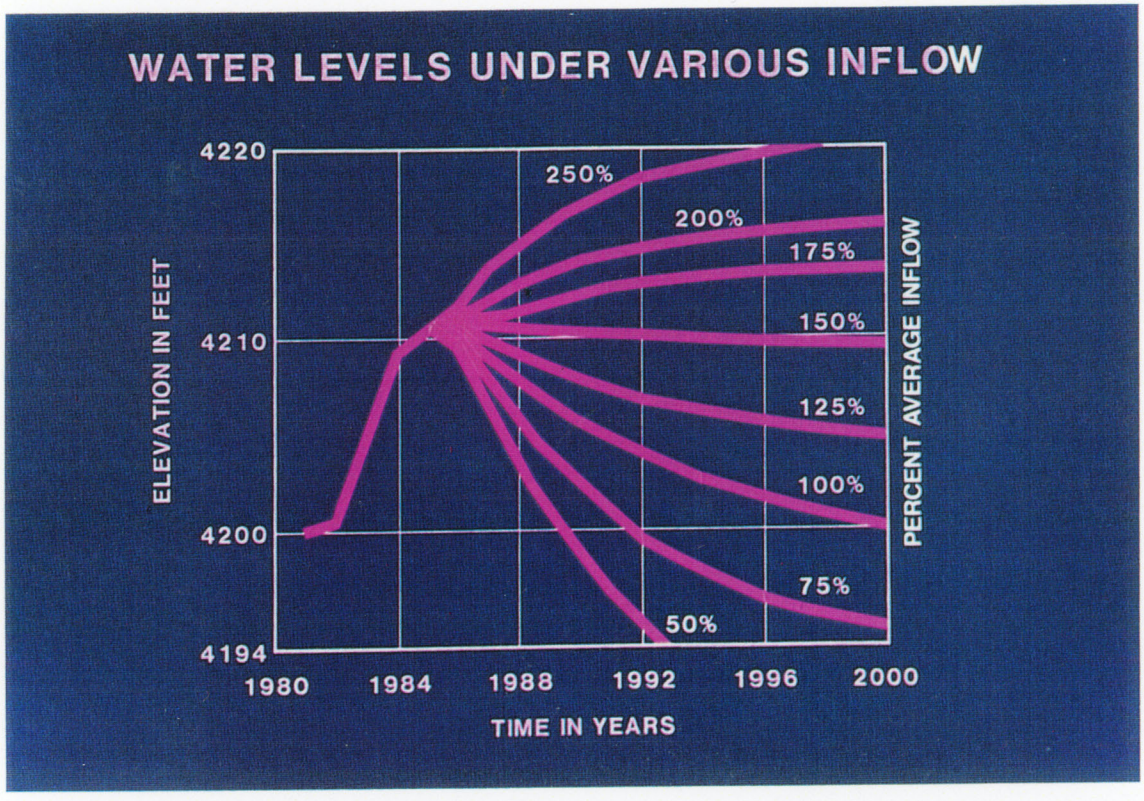
With failure of the Amax dike and the flow of lake water against our main line as far west as Timpe, M.P. 886.7, this scenario would require the acquisition of additional right-of-way and would be economically questionable because of topographical barriers.



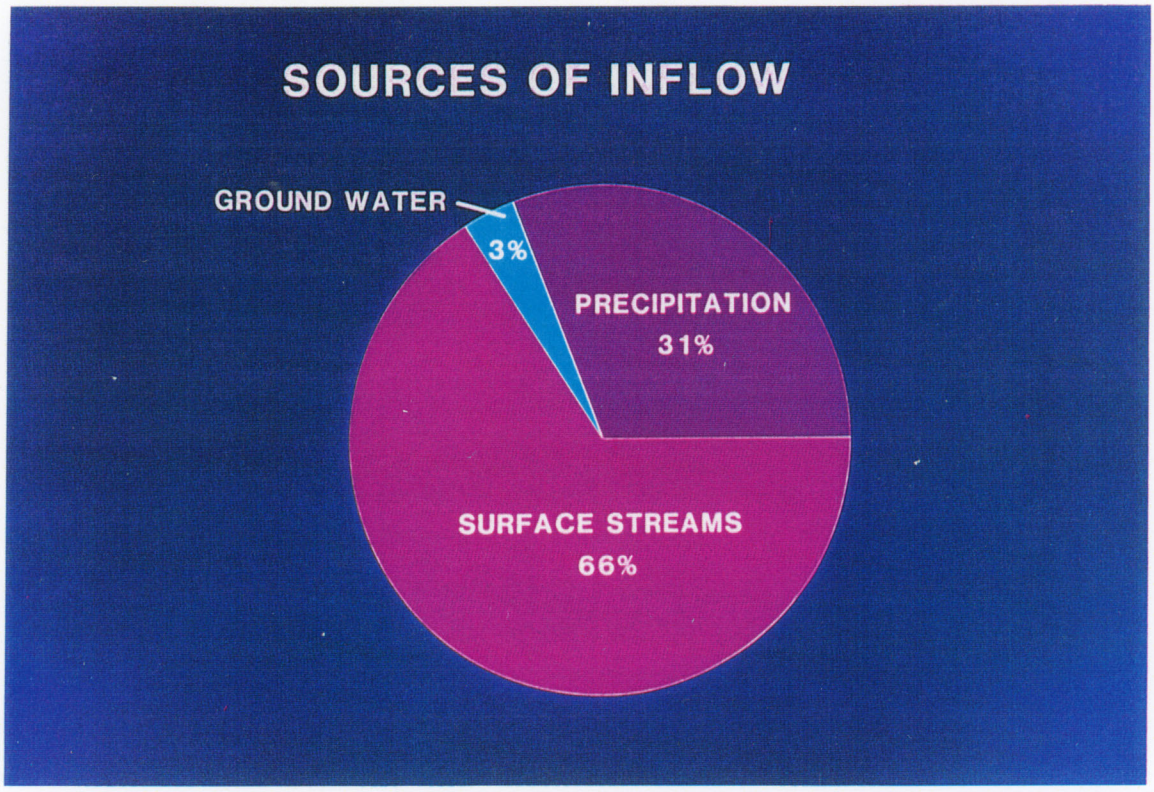
Elevation comparisons for various landmarks in the Salt Lake City area.



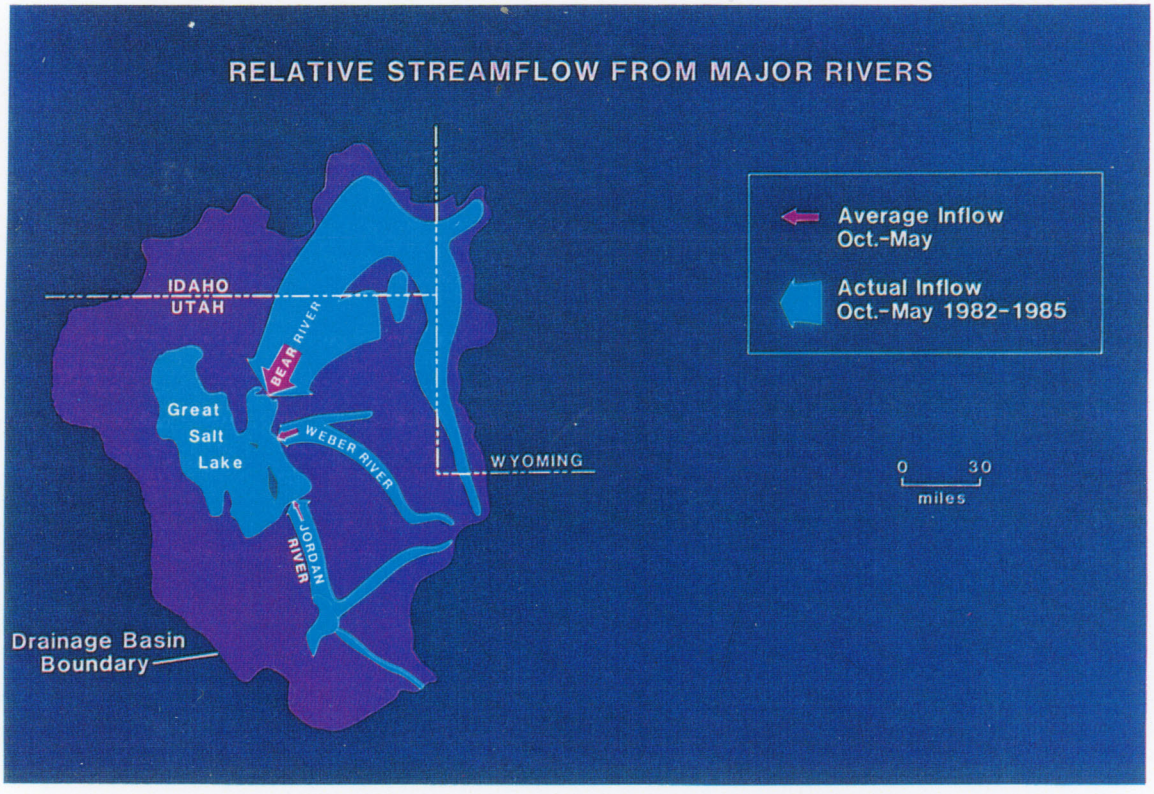
Relationship of Precipitation and Lake levels.



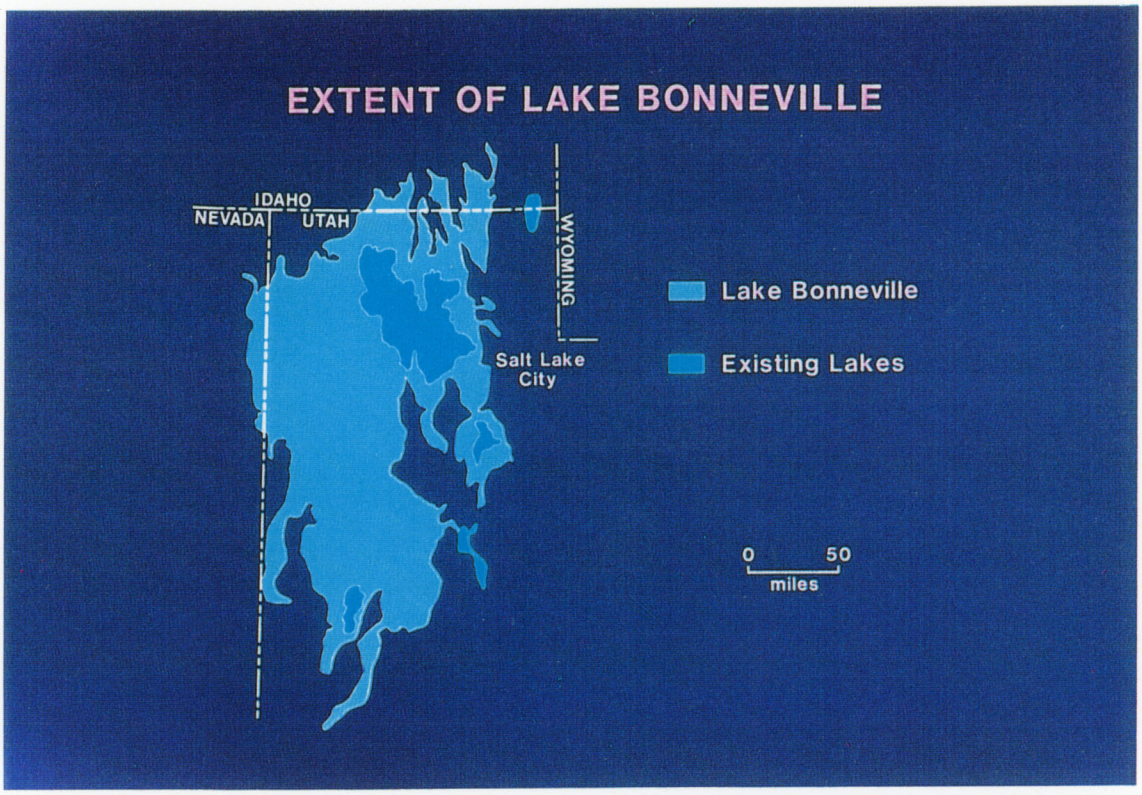
Various increases in inflow could effect Lake level.



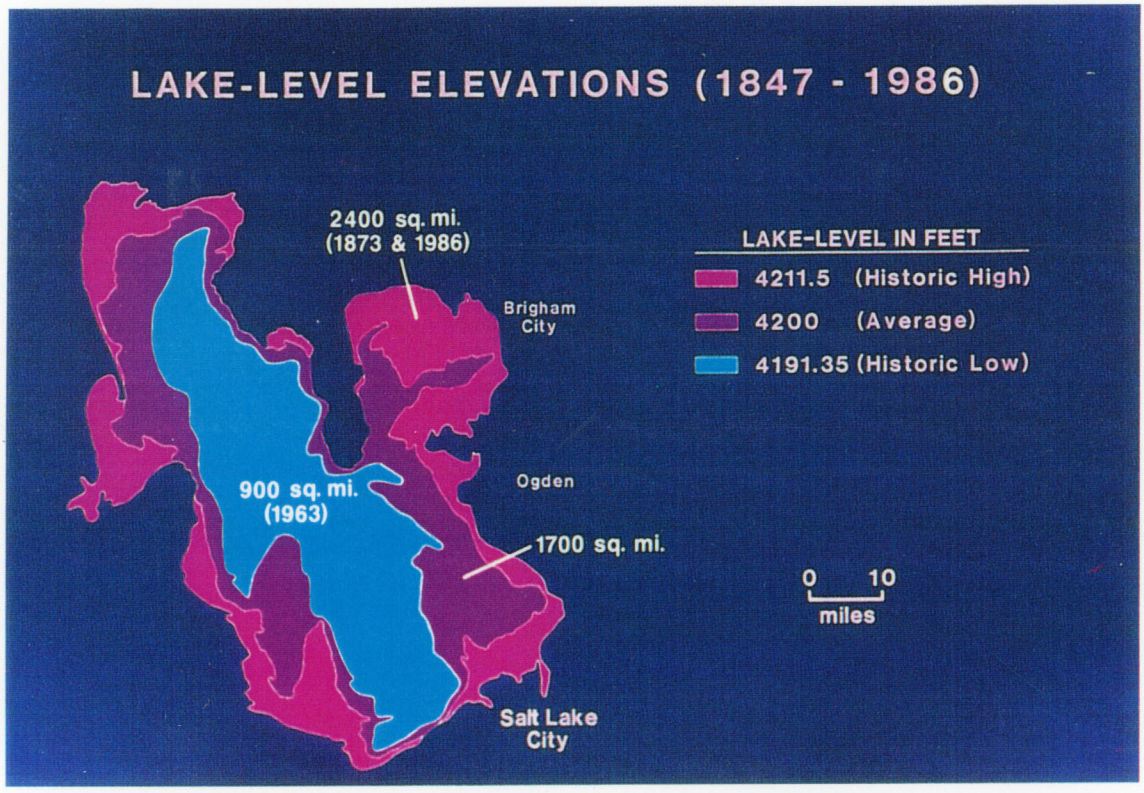
Percentage breakdown for various sources of inflow.



Major rivers provide the majority of inflow to the Great Salt Lake.



Lake Bonneville came into existence some 18,000-25,000 years ago.



Changes in lake-level elevation increase the Lake's size substantially.

History

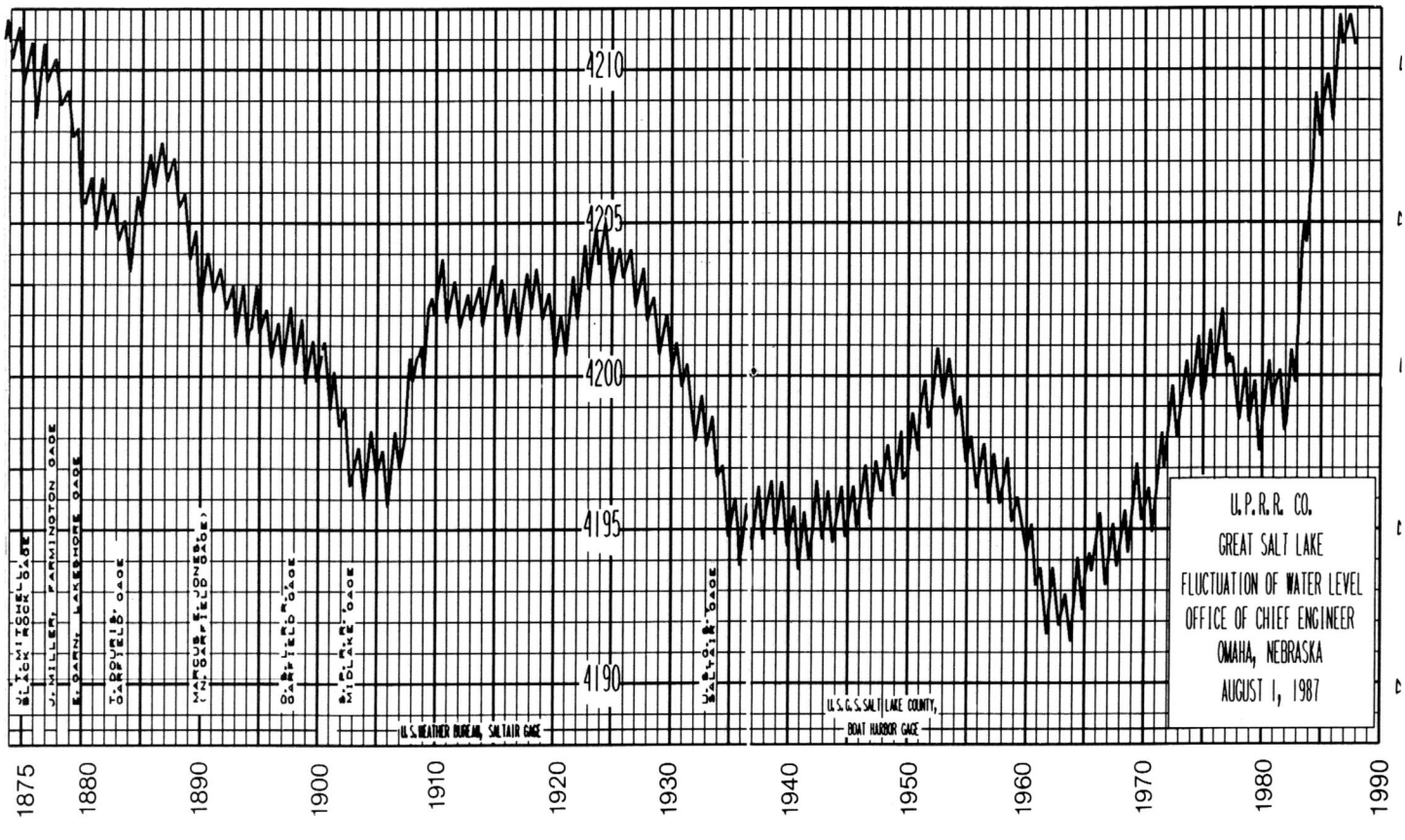
The Great Salt Lake, as we know it today, is one of the principal geographic features of the Union Pacific West. This saline inland sea, lying just west of the Wasatch Mountains, is the remnant of ancient glacial Lake Bonneville.

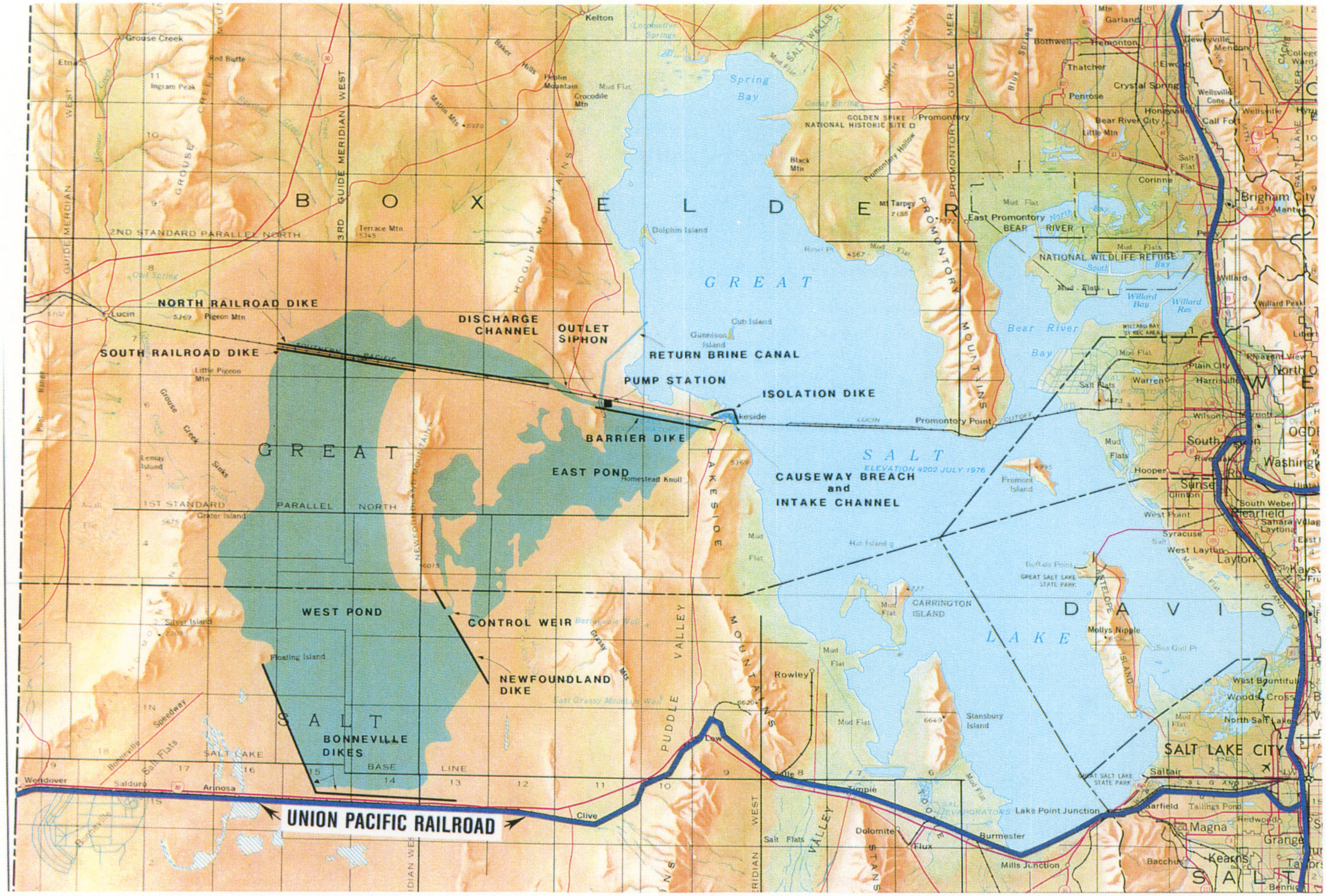
Old Lake Bonneville, which came into existence some 18,000–25,000 years ago, covered over 20,000 square miles and at its deepest point, had a depth of 1,000 feet. In the cool, moist climate of the glacial period, the lake eventually filled the Bonneville Basin, eventually overflowing the basin's rim through what is known today as Red Rock Pass in southern Idaho, draining to the Pacific Ocean via the Snake River. (As a matter of interest, Union Pacific's line between Ogden, Utah, and McCammon, Idaho, goes through Red Rock Pass near Swan Lake, Idaho.)

As the glaciers receded, the Bonneville Basin underwent a general climate change. The moist cool weather of the glacial period gradually became dryer and warmer until it reached the more arid stage we see today. After the initial drainage phase lowered Lake Bonneville's original level, the change in climate plus the lack of many major tributaries served to gradually reduce the size of the lake. The continuing reduction in size, coupled with the lake's lack of an outlet, served to increase the salinity of the remaining body of water which is now called the Great Salt Lake.

The first white man to visit the Great Salt Lake was fur trapper Jim Bridger who floated down the Bear River, one of the lake's principal tributaries, in late 1824. Later expeditions by Colonel John C. Fremont and Captain Howard Stansbury explored and mapped the area for the U.S. Army.

Fluctuations in Great Salt Lake levels, 1875–Present.




NORTH RAILROAD DIKE
SOUTH RAILROAD DIKE
DISCHARGE CHANNEL
OUTLET SIPHON
RETURN BRINE CANAL
PUMP STATION
ISOLATION DIKE
BARRIER DIKE
EAST POND
CAUSEWAY BREACH and INTAKE CHANNEL
WEST POND
CONTROL WEIR
NEWFOUNDLAND DIKE
BONNEVILLE DIKES
UNION PACIFIC RAILROAD
GREAT SALT LAKE
ELEVATION 4202 JULY 1976
BOX ELDER
DAVIS
GREAT SALT
SALT LAKE CITY
Lakeside
Promontory Point
Spring Bay
Bear River Bay
Wendover
Lucin
Clive
Lake Point Junction
CARRINGTON ISLAND
Stansbury Island
ANTELOPE ISLAND
Gunnison Island
Dolphin Island

Cover Picture

An eastward aerial view of the Union Pacific mainline (embankment on the left) and Interstate highway along the south shore of the Great Salt Lake showing how expansion of the lake has surrounded both railroad and highway.