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Hydrologic Evaluation of Garton Lake
White Sands National Monument
New Mexico

by

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Forrest R. Sprester 20 June 1980

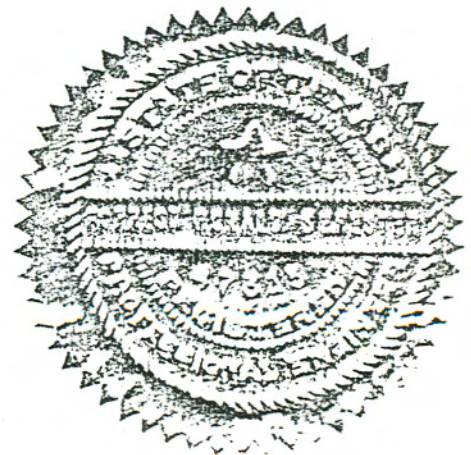


Table of Contents

	<u>Page</u>
I. Introduction	1
II. Description of the Tularosa Basin	1
Climate	3
Geology	3
Soils	4
Hydrology	4
III. Description of Garton Lake	5
IV. Finding of Investigations	9
Water Quality	9
Water Quantity	10
Pollution Potential	14
IV. Conclusions	14
Cause of Decreasing Water Quantity	14
Cause of Decreasing Water Quality	14
Cause of Decreasing Temperature	15
Pollution Potential	15
VI. Recommendations	15
VIII. Bibliography	17

Appendicies

A: Water Quality Analysis of Garton, Lake, Lake Holloman, and Lake Stinky, New Mexico	A1
B: Photographs of Garton Lake, New Mexico	B1
Oblique View of Garton Lake	B2
View of the General Well Location on Garton Lake	B3
C: Water Quality Analyses of Garton Well from 1935 through 1979	C1

Tables

1. Estimated Composition of Salts in Garton Lake Water ..	9
2. Comparison of Pollution Indicators in Garton Lake and Lake Holloman	10

Figures

	<u>Page</u>
1. Map of the Tularosa Basin, New Mexico	2
2. Area Map and Drainage Basin Surrounding Garton Lake, New Mexico	6
3. Drillers Log of Garton Well, New Mexico	8
4. Comparison of Lake Evaporation and Inflow to Garton Lake	12

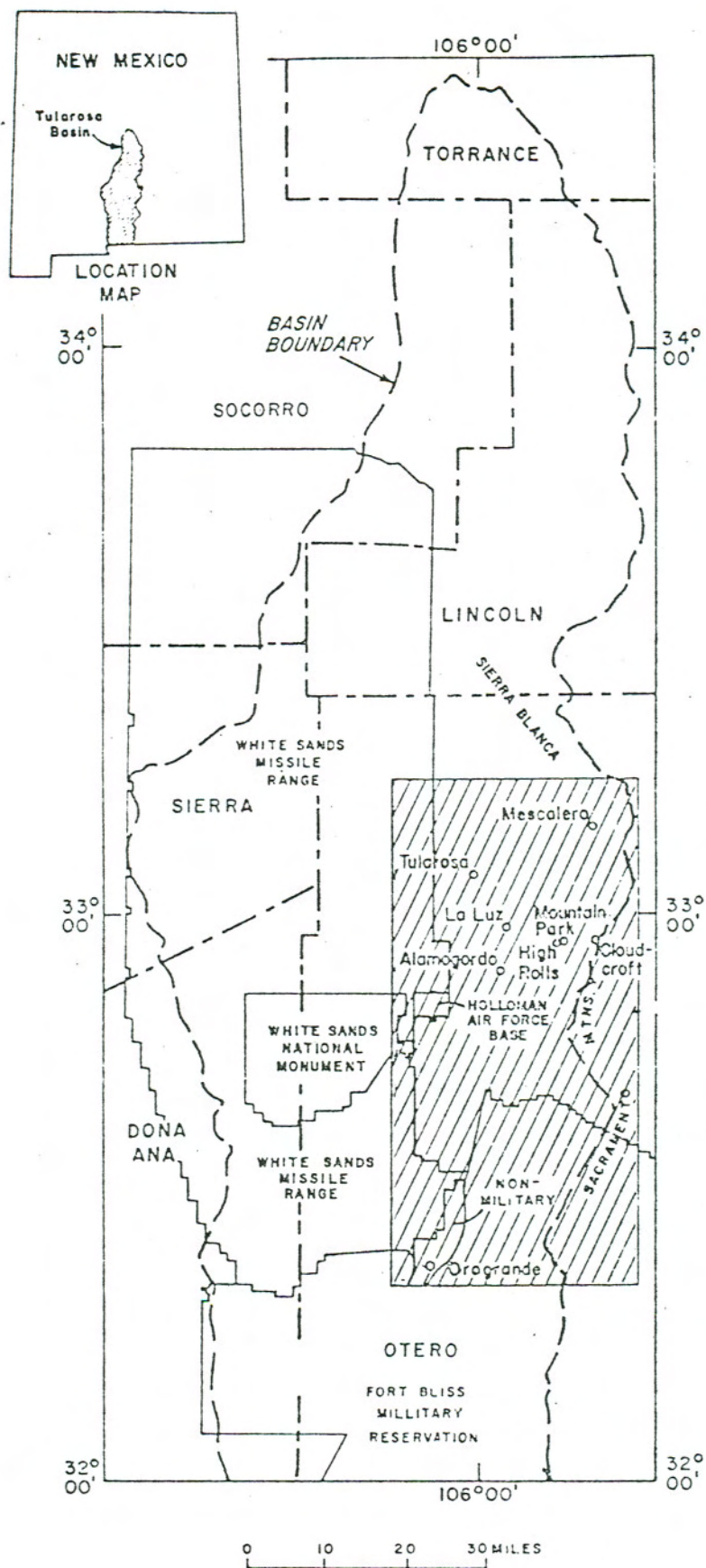


Figure 1

Map of the Tularosa Basin, New Mexico

the east by the Hueco and Sacramento Mountains, on the west by the Franklin, Organ and San Andres Mountains, on the north by a broad, high topographic divide and on the south by a narrow divide which separates it from the Hueco Bolson in Texas. The surface elevation ranges from 3900 feet to over 12,000 feet in the mountains.

Climate

The climate in the basin is typical of the arid to semi-arid regions of the southwestern United States. The average temperature ranges from 61°F in the Basin center to 45°F in the surrounding mountains. The mean annual precipitation in the basin ranges from 8.8 inches in the central portion at Oro Grande to 25.4 inches at Cloudcroft in the eastern mountain range. Precipitation on the slopes provides ephemeral flows to streams draining into the basin, or flows into alluvium at the base of the slopes. Intense thunderstorms usually occurring during the summer, produce short duration high runoff flows. The runoff is transported into playas or alkali flats where much of it evaporates.

Geology

The central part of the Basin is underlain by unconsolidated bolson sediments of Quaternary age consisting of material deposited in lakes in the center of the basin, and alluvial sediments deposited around the lakes by streams. The lacustrine sediments in the basin consist mainly of silt and clay with large amounts of secondary gypsum. The groundwater in the sediment is high in total dissolved solids content due to the presence of the gypsum.

Intrusive and extrusive igneous rock are an important part of the stratigraphic sequence in the basin. Portions of the mountains and Basin have basaltic flows, dikes, and cones of tertiary age.

Soils

Soils are light in color and are primarily clay or shale. Caliche (secondary carbonate cement) is frequently found in soils in the basin. The major soil associations defined by the U.S. Soil Conservation Service are Pintura-Hueco-Wink, Yesum-Holloman, Peak or Russler, Pintura-Dona Ana-Berino and Gypsum.

Hydrology

Surface Water. The Tularosa Basin does not have a large supply of surface water, and stream-gage information is sparse for basin streams. Perennial flows do occur in small streams on the west flanks of the Sacramento Mountains near Sierra Blanca. At this time, however, none of these waters reach the National Monument with the exception of waters in the Lost River Arroyo. The Air Force has constructed a three-foot embankment across the arroyo near the Air Force Base and NPS property line which effectively prevents flow in the arroyo from reaching the National Monument.

Groundwater. Aquifers in the Tularosa Basin are in the bolson deposits and bedrock. The bolson deposits are unconsolidated to poorly consolidated in alluvial sediments. Saline water occurs in areas near

the zone where alluvium interfingers with the lake sediments and in areas where recharge to alluvium is from highly mineralized water strata. The better quality of water (less than 1000 mg/l total dissolved solids) is found near the sides of the basin in thick sections of coarse-grained alluvium.

III. Description of Garton Lake

Garton Lake is located approximately one mile southeast of the White Sands National Monument headquarters and south of U.S. Highway 70 (Figure 2) in Otero County, New Mexico. The lake covers an estimated two acres and is contained within a circular clay dike of three to four feet in height and 50 foot width (photograph 1).

Garton Lake is not natural, but was developed in 1916, when a well originally drilled for oil struck an artesian flow of warm water (94°F) issuing from an open cavity between shale seams at a depth of 890 feet. The high temperature is likely due to a geothermal source of igneous origin in contact with the water. The well was not plugged by the driller thus permitting the water at a reported flow rate of about 1100 gallons per minute to collect in a shallow pond and surrounding marsh. The well casing was partially pulled in 1936 by the NPS. The exact length of casing remaining is not known but the upper 500 feet of the casing was successfully removed. After 1936, the National Park Service allowed the artesian water to continue to flow freely into Garton Lake which by this time was down to 20 gallon per minute. The resulting oasis in the center of the semi-desert region formed a very attractive

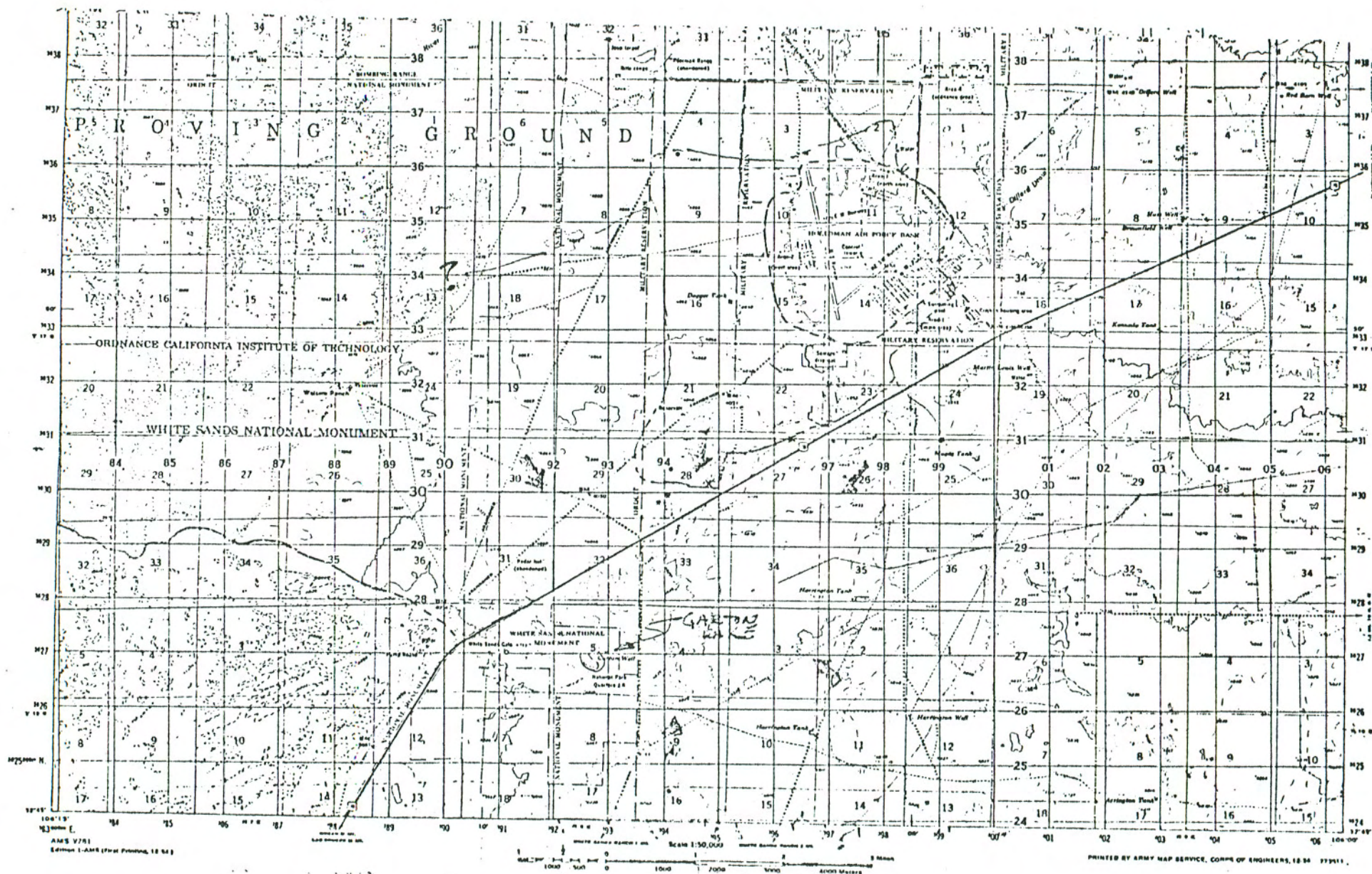


Figure 2

Area Map and Drainage Basin Surrounding Garton Lake, New Mexico

habitat for wildlife. The Park Service has since used the area for educational purposes and limited recreation.

The small lake is located in ancient lake sediment. The Drilling Log (Figure 3) shows lake sediment makes up the first 883 feet of material beneath the lake. Below this depth the remnants of the pre-basin formations are found to be sandstone, clay, limestone and shale. The surface soils are highly gypsiferous with clay. The embankments of the lake consist of clay which likely was excavated from a borrow pit located at the base of the Sacramento Mountains. The bottom of the lake is also lined with a thin layer of clay. The combination of the clay embankment and gypsum layers is the reason the water does not rapidly percolate downward leaving a dry lake bed. The embankment also creates a barrier preventing surface runoff from adjacent areas from reaching and mixing with the lake water. The area surrounding the lake has very little relief. From U.S. Geological Survey maps and a ground survey, the land surrounding the lake is the lowest point for miles in all directions. The drainage basin is shown on Figure 2.

The temperature and flow rate has steadily decreased since 1937. By the Spring of 1980, the temperature was down to 75°F and the flow rate to less than 10 gallons per minute. This is believed to be from two reasons. First, the artesian water is running out, having expended a large volume of water which previously was under pressure. The loss in volume accounts for some loss in heat. Second, the well is not cased for some length of the well and sloughing of the weak valley fill

LOG OF TWIN BUTTES, T. 18 S., R. 8 E., NEPM.

Albuquerque, New Mexico
(Supplied this company, if
needed, etc.)

0-793 ft.	Valley Alluvial, clays and s.s.
793-797	Red sandstone
797-802	clay and s.s.
802-821	limestone
821-846	Red limest.
846-853	Hard lime (red)
853-889	Soft green shale, gas pocket
889-902	Open cavity, artesian water *
902-907	Brown shale, flowing oil, gas, the best free oil showing
907-909	light thin limest.
909-913	Diana and Germanish clays
913-926	limestone, red, gas
926-950	limestone, hard, red
950-957	limestone
957-915	Shale and thin limest., red
915-952	Hard lime
952-953	soft brown shale, flowing oil
953-959	tough gray lime

* The artesian water comes from an artery,
was first encountered in well number 2, 210 ft
on west

No. 2 well log shows the same rock
formations with gas and oil sufficient to flow out
with the slush, substantially the same as at
well No. 1.

1/10/69

Twin Buttes well is now known as Garton Well.
It is located close to the center of Sec. 5,
T. 18 S., R. 8 E., NEPM.

STRATIGRAPHY (OIL AND GAS PROSPECTS IN THE TWIN BUTTES VALLEY)

COPIES

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Figure 3
Drillers Log of
Garton Well, New Mexico

material into the well is very likely plugging the opening. Given time, these two process will eventually cause the well to cease flowing.

IV. Findings of Investigation

The findings of water quality, quantity and pollution potential are presented below.

Water Quality

The quality of Garton Lake water is considered to be poor. Analyses performed on a grab sample collected by NPS personnel in February, 1980 indicates the water is brackish having a total dissolved solids content of 10,369 mg/l. The approximate composition of the dissolved solids is shown in Table 1.

Table 1
Estimated Composition of Dissolved Solids in
Garton Lake Water

Dissolved Solids	Percent	Milliequivalents-per-Liter Bar Graph																														
NaCl	72	<table border="1"><tr><td colspan="2">ANIONS</td><td colspan="2">Cl⁻ 95.8 meq/l</td><td colspan="2">SO₄²⁻ 72.9 meq/l</td></tr><tr><td colspan="2">CATIONS</td><td colspan="2">Na⁺ 81.6 meq/l</td><td>Ca⁺⁺ 41.4 meq/l</td><td>Mg⁺⁺ 15.4 meq/l</td></tr><tr><td colspan="2"></td><td colspan="2"></td><td></td><td>OTHER 26.4 meq/l</td></tr><tr><td colspan="2"></td><td colspan="2"></td><td></td><td>K⁺ 0.9 meq/l</td></tr><tr><td colspan="2"></td><td colspan="2"></td><td></td><td></td></tr></table>	ANIONS		Cl ⁻ 95.8 meq/l		SO ₄ ²⁻ 72.9 meq/l		CATIONS		Na ⁺ 81.6 meq/l		Ca ⁺⁺ 41.4 meq/l	Mg ⁺⁺ 15.4 meq/l						OTHER 26.4 meq/l						K ⁺ 0.9 meq/l						
ANIONS			Cl ⁻ 95.8 meq/l		SO ₄ ²⁻ 72.9 meq/l																											
CATIONS			Na ⁺ 81.6 meq/l		Ca ⁺⁺ 41.4 meq/l	Mg ⁺⁺ 15.4 meq/l																										
						OTHER 26.4 meq/l																										
						K ⁺ 0.9 meq/l																										
CaSO ₄	18																															
MgSO ₄	8																															
Others	3																															
Total	100																															

One sample each was taken from Lake Stinky and Lake Holloman near the overflow point of Lake Holloman. These samples were analyzed and compared with the results of analysis a sample of Garton Lake water.

Several chemical constituents were selected as pollution indicators. The indicator constituents are very soluble and usually remain in solution unless removed by treatment or precipitate out naturally over time. Table 2 shows the comparison of these constituents.

Table 2
Comparison of Pollution Indicators in
Garton Lake and Lake Holloman

Constituent	Milligrams per liter		
	Lake Garton	Lake Holloman	Lake Stinky
Boron	< 0.5	2.3	1.3
Ammonia as N	< 0.2	1.9	1.9
Fluoride	3.6	1.6	1.1

Boron is a constituent of proprietary cleaning compounds used in domestic and industrial cleaning compounds. Although there may be a loss of Boron through precipitation, it still would clearly be detectable if Garton Lake were contaminated by Lake Holloman water. The analysis of Garton Lake water indicates Boron was below the detection limit of 0.5 mg/l.

Ammonia is also a constituent normally found in wastewaters such as Lake Holloman. Ammonia, given time, will decompose into nitrates, nitrites and nitrogen. Still, waters contaminated by sewer effluent would very likely have Ammonia above the detection limit of 0.2 mg/l.

Sodium Fluoride is added to the Holloman AFB potable water to aid in the prevention of dental carries. Some Fluoride may precipitate in

the form of a Calcium or Magnesium salt due to the relatively large concentrations of these ions in the lake waters. The Base water plant records indicate Fluoride levels range from zero to 2 mg/l. These levels are well below the 3.6 mg/l of Fluoride measured in Garton Lake. The natural occurrence of Fluoride often is associated with volcanic or fumarolic gases, which supports the view that the Garton Lake water was heated by a geothermal source of igneous origin.

There are other chemical constituents that could be used to support the conclusion that there is no cross-connection between Lake Holloman and Garton Lake. But these three constituents are considered to be sufficient.

The detailed water quality analyses for Garton Lake, Lake Holloman and Lake Stinky are shown in Appendix A.

Water Quantity

Assuming the well is producing 10 gallons per minute, this represents 16.2 Ac-Ft per year entering the lake. The lake was estimated to be 2 acres in surface area. Thus if no loss of water occurs through evaporation or percolation, approximately 96 inches of water will be added per year. Lake evaporation is 67.1 inches per year for the Tularosa Basin. At first glance, this means that there is a net gain of water to Garton Lake every year. The rate of evaporation fluctuates from month to month with the highest rate occurring in June. Because the well is producing a steady flow of water, the water level must fluctuate with evaporation. Figure 4 shows the monthly average lake evaporation

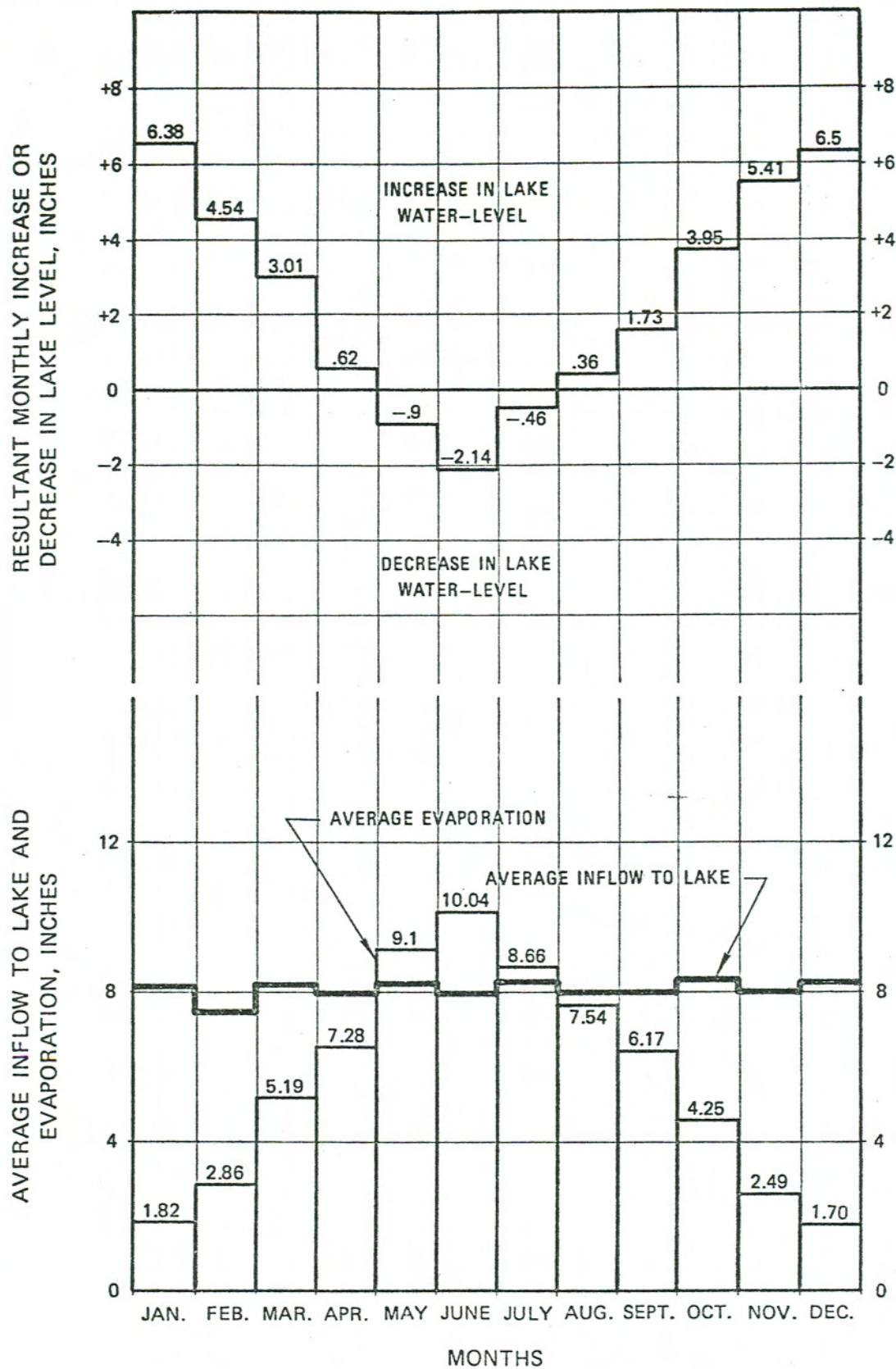


FIGURE 4

COMPARISON TO ESTIMATED INFLOW
TO THE LAKE VERSUS LOSS DUE
TO EVAPORATION

and average inflow to the lake. The difference between these two averages shows the changes in water level of the lake. According to Figure 5 the water level will decrease in May, June and July due solely to evaporation.

As evidenced by the photographs, there is a considerable amount of vegetation in and around the lake. Therefore, water is also lost through plant transpiration. Also, standing water and marshland surrounding the lake indicates some loss of water due to seepage through or under the embankment.

The evapotranspiration losses of water cause the dissolved solids concentration to increase. In 1976 the total dissolved solids concentration was measured to be 3800 mg/l as compared to 13,000 mg/l in February, 1980. As the total dissolved solids concentration increased, the salt tolerance of the stocked fish was exceeded and a fish-kill occurred.

In the late 1970's explosives were used to clear debris that had accumulated over the wellhead. The use of the explosives possibly caused further failure of the walls of the uncased portion of the well. The obstructions created by the explosion has likely reduced flow. Since the well water must pass more slowly through the mud and rocks in the well, the water has more time to cool than in the past. In addition, the well has been flowing for almost 70 years causing considerable reduction of water in the aquifer. This loss has reduced internal pressures with a resultant decrease in temperature.

Pollution Potential

The surface elevations between Lake Holloman and Garton Lake were measured. Lake Holloman is approximately 10 to 12 feet above Garton Lake. However, the lakes are separated by 2-1/4 miles of desert. If Lake Holloman Dam should experience a catastrophic failure and were all the wastewater released from the lake, the water would probably be spread thinly over four to five square miles of desert. It is very unlikely the resulting shallow depth of water would over-top the embankment surrounding Garton Lake. The artesian pressure of the well will also prevent Holloman wastewater from entering the deep aquifer.

V. Conclusions

The conclusions of the evaluation are presented below.

Cause of Decreasing Water Quantity

The water well has been free-flowing for nearly 70 years. This considerable loss of water has decreased the aquifer pressure resulting in decreased flows.

Cause of Decreasing Water Quality

The amount of water presently reaching the surface per year does not exceed the annual rate of evaporation for the two-acre lake. However, the rate of evaporation does exceed inflows during May, June

and July. Combined with losses due to evapotranspiration and seepage, the quantity of water reaching the lake is not sufficient to maintain the existing area of the lake. If no action is taken, Garton Lake will likely be dry during summer months in future years and partially refill in winter months.

Cause of Decreasing Temperature

The actual damage to the well from the use of explosives is not known. However, the shock of the explosion possibly resulted in collapse of upper portions of the well. The increased resistance of the longer path, due to obstructions in the well, provides more time for the water to lose heat and decreases in pressure cause cooling as well.

Pollution Potential

From the water quality analyses of the lakes no pollution from Air Force activities could be found. Given the distance between the lakes and artesian pressure of the well, future contamination is not considered likely.

VI. Recommendations

The primary problem identified by NPS and Environmental Health Service is the decreasing water quality and quantity in Garton Lake. In order to improve both, the following steps must be taken immediately. The well must be relined as soon as possible and the surface area of the lake reduced.

The present technology of relining wells is better than that available in 1936 and used by the NPS. A possible solution would be to fill the well with bentonite and essentially redrill and set new casing. The new casing should be of a smaller diameter than the original well casing to assure that it will fit into the remaining casing. The space between the new casing and the old must be cemented to seal any future or existing paths, other than the new well casing, through which the water may reach the surface.

The surface area of Garton Lake must be reduced. This could be accomplished by constructing a clay dike through the center of the lake. The reduction in size will cause the inflow of water to be larger than the losses due to evapotranspiration and seepage. The exact surface area desired depends on the precise temporal goals of the NPS and availability of water. The remaining portion of the lake could be used as a salt marsh receiving the overflow from the first half during low evaporation months. After pumping out and refilling the reduced lake, water quality would soon reach that previously observed (i.e. 3000 mg/l Total Dissolved Solids) and salt tolerant fish could again be stocked in the lake.

VII. Bibliography

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7/6/2

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MAR 77 503P

? S NEW (W) MEXICO (F) CENTRAL (F) NORTHWEST

8 1. NEW (W) MEXICO (F) CENTRAL (F) NORTHWEST

? T 8/6/1

8/6/1

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? T 8/5/1

8/5/1

ANNUAL REPORT JULY 1, 1976 THROUGH OCTOBER 31, 1977

MEXICO UNIV.; ALBUQUERQUE. BUSINESS ASSISTANCE AND RESOURCE
N.L.A. ECONOMIC DEVELOPMENT ADMINISTRATION; WASHINGTON, DC. OFFICE OF
CHNICAL ASSISTANCE.

0585L2 FLD: 13B, 5C, 43B, 91J GRAI7908

977 124P

GRANT: EDA-08-06-01774

ONITOR: EDA-78-0150

ABSTRACT: THE OVERALL LONG-TERM GOAL OF BARC IS THE IMPROVEMENT AND
IMULATION OF THE ECONOMIC BASE IN NEW MEXICO COMMUNITIES BY
SISTING BUSINESSPEOPLE, PUBLIC OFFICIALS, OTHER GROUPS AND
DIVIDUALS IN MAKING SOUND DECISIONS RELATED TO ECONOMIC GROWTH AND
VELOPMENT. EMPHASIS HAS BEEN PLACED UPON IDENTIFYING AND ASSISTING
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FEA/6-77/101 NTIS PRICES: PC A22/MF A01

USE OF BRACKISH GROUND WATER RESOURCES FOR REGIONAL ENERGY CENTER
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VELOPMENT;

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PHOTOGRAPHIC MAP, NEW MEXICO
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GJBX-67(79) (V.1) NTIS Prices: PC E10/MF A01
AERIAL RADIMETRIC AND MAGNETIC SURVEY: TULAROSA NATIONAL
PHOTOGRAPHIC MAP, NEW MEXICO
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LA-7217-MS NTIS Prices: MF A01
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6/6/4
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6/6/11

AD-662 780 OFSTI Prices: PC A05/MF A01

WEATHER ELEMENTS IN THE TULAROSA BASIN

JUL 60 95P

Appendix A

Water Quality Analyses of Garton Lake,
Lake Holloman and Lake Stinky, New Mexico

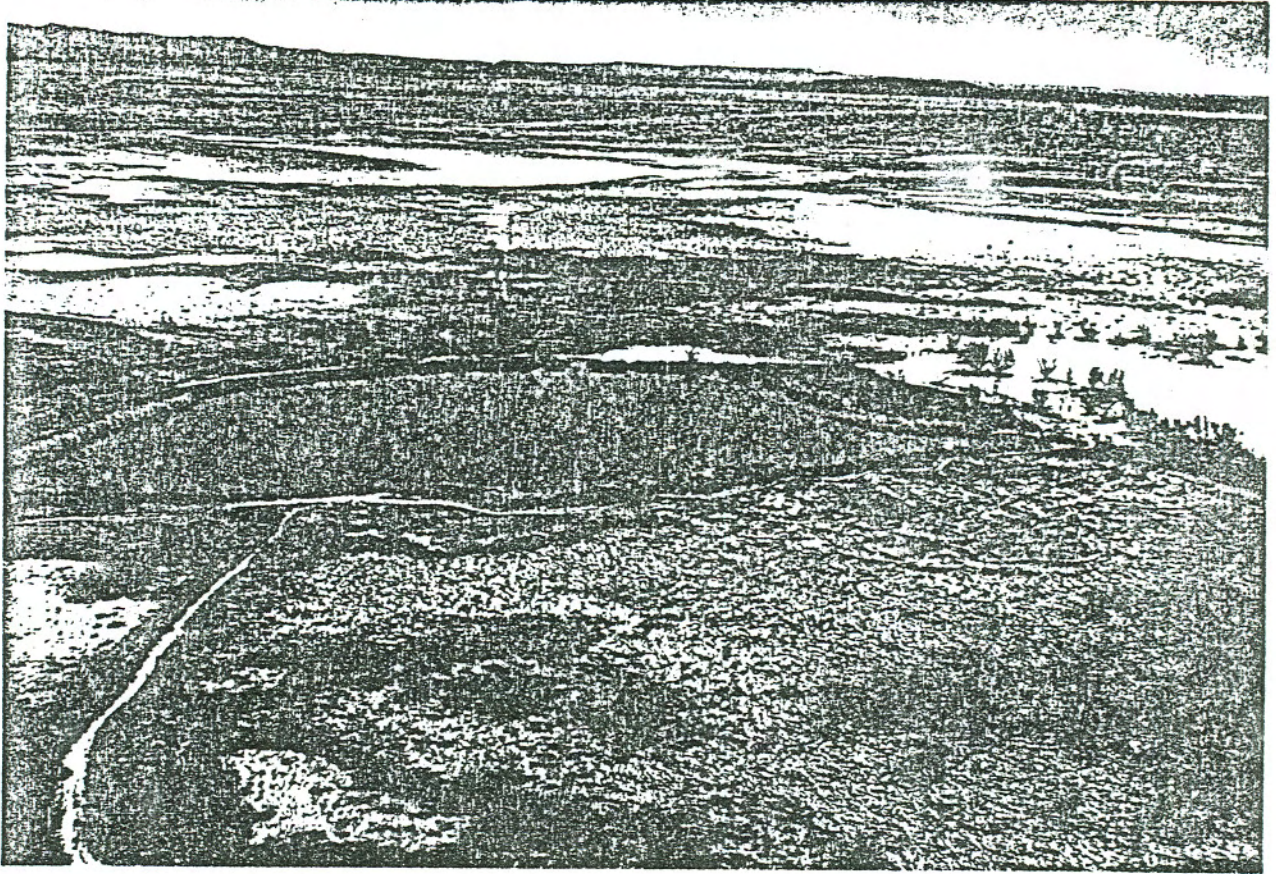
2. LABORATORY PERTINENT ANALYSIS			3. LAB SAMPLE NUMBER 48751-53			4. REQUESTOR SAMPLE NO 801X055					
SAMPLE COLLECTION INFORMATION						5. DATE RECEIVED BY LAB 19 Feb. 80		6. DATE ANALYSIS COMPLETED 4 March 80			
7. SITE DESCRIPTION OverFlow Area - ~~San Antonio~~ Laketown						ON-SITE ANALYTICAL RESULTS					
8. SITE LOCATION NO 9/1000000310000		9. FLOWRATE AT SITE 0 00058 GAL/MIN		10. WEATHER 0 00041		16. WATER TEMP 00210 °C		17. PH 00400 UNITS			
11. COLLECTION DATE/PERIOD 25 Jan 80		12. COLLECTORS NAME Mint Foreman		19. RESULTS OF OTHER ON-SITE ANALYSES							
13. SAMPLING TECHNIQUE Grab		14. PHONE NUMBER 8-867-3303									
15. REASON FOR SAMPLE SUBMISSION NPDES * Special Sample											
ANALYSES REQUESTED AND RESULTS											
PRESERVATION GROUP A			752 PRESERVATION GROUP F (60)			753 PRESERVATION GROUP G (53)					
PARAMETER	TOTAL	MG/L	PARAMETER	DISS	TOTAL	µG/L	PARAMETER	TOTAL	MG/L		
Chemical Oxygen Demand	00340	.	ARSENIC	01000	01062	.	BORON	01022	2300. ^{µg/l}		
Total Organic CARBON as C	00680	.	BARIUM	01000	01007	21000.	BORON, Dissolved	01020	2300. ^{µg/l}		
		.	CADMIUM	01025	01027	60.	CHLORIDE	00930	9900.		
PRESERVATION GROUP B			CHROMIUM			01030	01034	450.	COLOR	00080	175 Units
OIL & GREASE FREON-IR Method	00560	.	CHROMIUM Hexavalent		01032	450.	FLUORIDE	00951	1.6		
		.	COPPER	01040	01042	64.	Residue Fil-trable (TDS)	00515	23270		
751 PRESERVATION GROUP C (5)			IRON			01046	01045	2100.	Residue Non Filt (SS)	00530	.
AMMONIA as N	00640	1.9	LEAD	01049	01051	450.	Residue	00500	.		
NITRATE as N Cd Reduct. Method	00620	2.1	MANGANESE	01056	01055	426.	Residue Volatile	00505	.		
NITRITE as N	00615	2.02	MERCURY	71890	71900	25.	Specific Conductance	00095	29,500 ^{µmhos}		
TOTAL KJELDAHL NITROGEN as N	00625	.	NICKEL	01065	01067	250.	SULFATE as SO ₄	00945	8100.		
PHOSPHORUS Ortho PO ₄ as P	70507	.	SELENIUM	01145	01147	210.	SURFACTANTS MBAS as LAS	38260	0.3		
PHOSPHORUS as P	00665	2.2	SILVER	01075	01077	58.	TURBIDITY	00076	2 Units		
		.	ZINC	01090	01092	450.					
PRESERVATION GROUP D			CALCIUM as Ca			00915	00916	1119. ^{mg/l}			
CYANIDE	00720	.	MAGNESIUM as Mg	00925	00927	1776. ^{mg/l}					
CYANIDE Free, Amenable to Cl ₂	00722	.	POTASSIUM	00935	00937	159.1 ^{mg/l}					
		.	SODIUM	00930	00929	11440 ^{mg/l}					
PRESERVATION GROUP E						PRESERVATION GROUP J					
PARAMETER	TOTAL	µG/L				PARAMETER					
PHENOLS	32730	.									
1. ORGANIZATION REQUESTING ANALYSIS USAF Hqsp/SCPM HOLLAMAN AFB, NM. 88330						CHEMIST MW H. OT 358 ^W BS					
						REVIEWED BY [Signature]					
						APPROVED BY [Signature]					

DEHL FORM NOV 76 1

NON-POTABLE WATER ANALYSIS

2. LABORATORY PERFORMING ANALYSIS			3. LAB SAMPLE NUMBER 48754-56 00009			4. REQUESTOR SAMPLE NO 8007-8447 00029				
SAMPLE COLLECTION INFORMATION						5. DATE RECEIVED BY LAB 19 Feb 80		6. DATE ANALYSIS COMPLETED 4 March 80		
7. SITE DESCRIPTION Gorton Lake						ON-SITE ANALYTICAL RESULTS				
8. LOCATION NO 967000000269000		9. FLOWRATE AT SITE 0 00058 GAL/MIN		10. WEATHER C 00041		15. WATER TEMP 7 00010 °C		17. PH 00490 UNITS		
11. COLLECTION DATE/PERIOD 25 Jan 80		12. COLLECTOR'S NAME USAF NEWBORN 12 14. PHONE NUMBER 8-867-3303		13. RESULTS OF OTHER ON-SITE ANALYSES						
13. SAMPLING TECHNIQUE Grab						14. PHONE NUMBER				
15. REASON FOR SAMPLE SUBMISSION NPDES: Special Sample						TO RULE OUT CROSS CONTAMINATION OF NATURAL HABITAT				
ANALYSES REQUESTED AND RESULTS										
PRESERVATION GROUP A			755 PRESERVATION GROUP F (60)			756 PRESERVATION GROUP G (53)				
PARAMETER	TOTAL	MG/L	PARAMETER	DISS	TOTAL	µG/L	PARAMETER	TOTAL	MG/L	
Chemical Oxygen Demand	00340	.	ARSENIC	01000	01001	.	BORON	01022	4500. ^{µg/l}	
Total Organic CARBON as C	00680	.	BARIUM	01005	01007	41000.	BORON, Dissolved	01020	4500. ^{µg/l}	
		.	CADMIUM	01025	01027	27.	CHLORIDE	00940	3400.	
PRESERVATION GROUP B			CHROMIUM			COLOR				
PARAMETER	TOTAL	MG/L	01030	01031	450.	00080 45 Units				
OIL & GREASE FREON-IR Method	00560	.	CHROMIUM Hexavalent	01032	450.	FLUORIDE 00951 3.6				
154 PRESERVATION GROUP C (52)			COPPER			Residue Fil-terable (TDS)				
PARAMETER	TOTAL	MG/L	01040	01042	420.	00515 10369.				
AMMONIA as N	00610	4.2	IRON	01046	01045	4100.	Residue Non Filt (SS)			
NITRATE as N Cd Reduct. Method	00620	4.1	LEAD	01049	01051	450.	Residue 00500			
RITE as N	00613	4.02	MANGANESE	01056	01055	450.	Residue Volatile 00505			
TOTAL KJELDAHL NITROGEN as N	00625	.	MERCURY	71890	71900	45.	Specific Conductance 00093 13000 ^{µmhos}			
PHOSPHORUS Ortho PO4 as P	70507	.	NICKEL	01065	01067	450.	SULFATE as SO4 00945 3500.			
PHOSPHORUS as P	00665	4.2	SELENIUM	01145	01147	410.	SURFACTANTS MBAS as LAS 38260 0.1			
		.	SILVER	01075	01077	26.	TURBIDITY 00076 2 Units			
		.	ZINC	01090	01092	450.				
PRESERVATION GROUP D			CALCIUM as Ca			PRESERVATION GROUP J				
PARAMETER	TOTAL	MG/L	00915	00916	828. ^{mg/l}	PARAMETER				
CYANIDE	00720	.	MAGNESIUM as Mg	00925	00927	225. ^{mg/l}				
CYANIDE Free, Amenable to Cl2	00722	.	POTASSIUM	00935	00937	42. ^{mg/l}				
		.	SODIUM	00930	00929	1877. ^{mg/l}				
PRESERVATION GROUP E			PHENOLS			PRESERVATION GROUP J				
PARAMETER	TOTAL	µG/L	327.30			PARAMETER				
1. ORGANIZATION REQUESTING ANALYSIS USAF HOSPITAL/SGPM WLOMAN AFB NM 88330						CHEMIST Mw Per 57 mw seg BS REVIEWED BY MAJOR J. L. BSC SHELLEY ASSURANCE APPROVED BY D. B. B. B.				

Appendix B
Photographs of Garton Lake, New Mexico



Oblique View of Garton Lake, WSNM,
New Mexico Taken in 1978 by
the National Park Service



View of the General Well Location on
Garton Lake, WSNM, New Mexico
Taken in 1978 by the
National Park Service

Appendix C

Water Quality Analyses of
Garton Well from 1935 through 1979

NEW MEXICO
COLLEGE OF AGRICULTURE AND MECHANIC ARTS
STATE COLLEGE, NEW MEXICO

AFF

DEPARTMENT OF CHEMISTRY

DIVISIONS

W. BURKIN, PROFESSOR
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CHEMISTRY AND CHEMICAL ENGINEERING
EXPERIMENT STATION RESEARCH
STATE CHEMICAL LABORATORY

March 29, 1935

Mr. Tom Charles
Alamogordo, New Mexico

Dear Mr. Charles:

Early in the year you sent us a sample of water from the Artesian well near the White Sands. Since our earlier report on this sample, we have gotten time to make a more complete analysis which gave results as follows:

		In parts per 100,000
Constituents determined		
Silica (SiO_2)		3.6
Iron and aluminum oxides (R_2O_3)		1.7
Calcium (Ca)		94.7
Magnesium (Mg)		8.9
Sulfates (SO_4)		311.5
Chlorides (Cl)		288.0
Total soluble matter	911.1	
Probable combinations		
Calcium sulfate (CaSO_4)		321.9
Magnesium sulfate (MgSO_4)		44.5
Sodium sulfate (Na_2SO_4)		70.9
Sodium chloride (NaCl)		474.8
Silicate (SiO_2)		3.6
Iron and aluminum (R_2O_3)		1.7
		917.4

The only constituents which might have medicinal value are the magnesium sulfate and the sodium sulfate which ~~alone~~ with the rather large amount of sodium chloride or common salt would cause this water to have laxative effects if used in any very considerable quantities. Since this water is most too high in mineral matter to be useful for irrigation and ordinary purposes, it may be of some value as a mineral water as mentioned above and if there is sufficient quantity of



TREASURY DEPARTMENT

UNITED STATES
PUBLIC HEALTH SERVICE

14th Ave. & Lake St.
San Francisco, Cal.

April 4, 1935

OFFICE OF
The District Engineer

Tom Charles, Custodian
White Sands National Monument
Alamogordo, N. M.

Dear Mr. Charles:

I have your letter of April 1st enclosing chemical analyses of a sample of water from the artesian well near the monument. I have reviewed the analyses and find them so high in mineral content that it seems to me it is out of the question to even consider the well as a source of domestic water supply. The Drinking Water Standards we usually follow give for water supplies of the most satisfactory quality:

Sulphate (SO ₄)	250	parts	per	million
Magnesium	100	"	"	"
Chlorides	250	"	"	"
Iron (Fe)	not to exceed	.3	"	"
Total solids	not more than	1000	"	"

For like constituents in the artesian well water we find:

3115	parts	per	million	of	sulphates
89	"	"	"	of	magnesium
2880	"	"	"	of	chlorides
9111	"	"	"	for	total solids

Although the Drinking Water Standards apply to a water free of taste and we know that waters having more minerals than those referred to by the Standards are used, nevertheless the artesian well water has such large amounts of minerals that it is not only unsatisfactory for drinking purposes but it is unsuitable for use in steam boilers of any kind. There is no method of treating this water whereby it can be made suitable for drinking and other domestic purposes. I do not imagine that the public in general would drink water of this kind although some might use it for their health.

Since this source will not be satisfactory for either domestic purposes or for irrigation, about the only use that can be made of it is for bathing.

Sincerely,

H. B. Fomon

H. B. Fomon
Sanitary Engineer
In Charge

HBF:R
c.c. to Mr. Pinkley

UNITED STATES
DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE
White Sands

NATIONAL MONUMENT

3-28-26

OFFICE OF THE CUSTODIAN

19

Dear Mr Pinkley;

Inclosed is copy of a wire to Mr Burney,
in answer to one which I received from him late, last night.

I could not answer the questions as to elevation
etc because some of the boys borrowed my map of the Garton
area, made by Attwell & Gordon. Atleast I think that is where it
went; I would like very much to get another if your office
can spare one.

Burney's suggestion of a new well is a poor bet;
there have been scores of wells drilled out there and there never
was one that could be used for any thing except this artesian
well.

Yours very truly -

Tom Charles

TELEGRAM TO BUREAU

This well only artesian water ever found in this valley, many failures. Temperature 94 degrees, flow estimated 1000 ^{gal} per minute. Estimated pressure 32 lbs per square inch. Site of Administration building about 10 feet lower than outlet of ⁴⁰¹⁰ artesian well. Elevation ~~approximately~~ about 4000 feet.

All this information on map made by ^{attest and} H Gordon, January, 1935. ^{reported}

Can see no reason why abundance of hot water with ~~marked~~ medicinal value with gravity flow should not be possible, practicable and highly desirable for all uses except drinking. This water not

perfect but I know of no other probable source of any nearly as good.

9:30 P.M. Mch 27, 1936

To A. W. Burney, Acting Chief Engineer

409 Underwood Bldg, Nat'l Park Service

San Francisco, Calif

N3043

White Sands National Monument
P. O. Box 458
Alamogordo, New Mexico

November 26, 1963

Mr. Lester W. Bean, Jr.
5702 Joe Herrera Road
El Paso, Texas

Dear Mr. Bean:

We are sorry that it took so long to locate the water analysis of the water at Canyon Lake which you were interested in obtaining.

ANALYSIS OF WATER AT CANYON'S WELL

Material	Grains per Gallon
Calcium Carbide	3.21
Magnesia	4.25
Calcium Sulphate	124.78
Magnesia Sulphate	53.53
Calcium Chloride	none
Magnesia Chloride	none
Silico-iron	1.34
Incrustating Solids	195.34
Alkali Carbide	none
Alkali Sulphate	60.42
Alkali Chloride	248.26
Alkali Nitrate	none
Organic Matter	none
Non-Incrustating	308.99

Hugh P. Seattle
Acting Superintendent

From Top File "Geology"

Analyses of Water from Cotton Well, White Sands National Monument

H. M. S. U.
Los Cruces
Aug. 12, 1964

G. W. Feltin
Nov. 29, 1935

Richard & Son
Denver, Colo.
1929

Component	P.P.H.*	P.P.H.	P.P.H.
Calcium		947	759
Magnesium	1,662	89	283
Sodium	2,050	N.R.	N.R.
Potassium	50	N.R.	N.R.
Carbonate	32	N.R.	N.R.
Bicarbonate	78	N.R.	N.R.
Chloride	4,218	2,660	3,450
Sulfate	2,150	3,115	3,033
Silica	N.R.	36	50
Iron & Aluminum Oxides	N.R.	17	N.R.
TOTAL	10,240	9,111	7,500

pH 7.1
EC x 10⁶ 16,000

Sodium - adsorption
- ratio 17.7

Residual sodium
carbonate 0

Sodium percentage 63.3

* P.P.H. = Parts per million
N.R. - Not Reported

Two earlier, undated analyses are in the files, but the information is garbled and difficult to interpret.

jrd 6/6/65

Tularosa Basin

The Garton well (18S.8E.5.144) is in the Tularosa Basin on the White Sands National Monument grounds, about a mile east of the Sands themselves. It was drilled as an oil test before 1929, but the exact date is not known. This well flows naturally at the surface.

In a letter dated June 5, 1965, Donald A. Dayton, Superintendent of the White Sands Monument, said.

The hole had a 15 inch, a 10 inch, and an 8 inch casing at the surface in 1937. In July 1937, the casings were broken when an attempt was made to pull the casings. The casing was evidently offset at the break. Cratering occurred and the project of relining the well was abandoned. A copy of the log is attached.

The flow is said to have been 1100 gallons per minute initially. An estimate in 1937 placed the rate of flow at ten to twenty gallons per minute. We suspect the present rate is about half of that figure. It is sufficient to maintain two acres of open lake and several acres of marsh.

In 1937 the temperature of the water was reported as 96°F. A measurement at the well head earlier this year gave a reading of 92°F.

The driller's log by George E. Moffett follows:

0-783	Valley fills, clays and gypsum
783-797	Red sandstone

797-802	Clay and gypsum
802-821	Limestone
821-846	Red limes
846-858	Hard lime (red)
858-889	Soft green shale, gas pockets
889-892	Open cavity, artesian water
902-907	Brown shale, flowing oil, gas, the best free oil showing
907-909	Light thin limes
909-913	Brown and greenish clays
913-926	Limestone, red, gas
926-930	Limestone, hard, red
930-937	Limestone
937-945	Shale and thin lime, red
945-952	Hard lime
952-953	Soft brown shale, flowing oil
953-989	Tough gray lime

The measurements in table 29 for December 12, 1965, were made in the pond near the well. The average temperature of the water near the well was 89°F, the maximum at a depth of about 15 ft was 92.7°F, and the shallow pond, remote from the well, had an average temperature of 52°F. Air temperature was 64°F.

Table 29 - Field data for Pecos River basin

Location	Date	Discharge (gpm)	Temperature (°F)	pH	Specific conductance (micromhos)	Density gm/ml	H ₂ S ppm	NH ₃ ppm	SiO ₂ ppm
Montezuma Hot Springs (17N.13E.36.440)	1-3-66	5.8	131.3	8.8	790	.974	1	0.3	78
Garton Well (18S.8E.5.144)	12-17-65	---	92.7	7.1	5000	.995	0	3.4	20