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REVEGETATION STUDY OF ADOBE DAM PHOENIX ARIZONA TASK 4  
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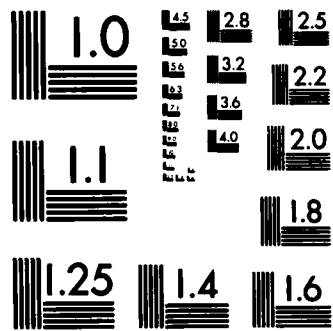
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Task No 2. "A review and Analysis of three Revegetation Projects by the U.S. Army Corps of Engineers." This report presents an analysis of revegetation projects at Dreaming Draw Dam, Cave Buttes Dam, and Bend Wash, Phoenix Arizona, and presents recommendations for arid lands revegetation.

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**Task No. 3 "Revegetation Methods for Arid Areas".**

This report presents a comparison of methods of revegetation used by the Arizona Department of Transportation, mining companies in the Phoenix area, and the Desert Botanical Garden.

**Task No. 4 "Site Characteristics."**

This report describes the site characteristics of the Adobe Dam Study Area.

**Task No. 5 & 7 Seeding Success on Topsoiled and Hard Topsoiled Slopes at Adobe Dam".**

This report presents statistical analysis of the relative success of several seeding methods used at the Adobe Dam site.

**Task No. 6 "Evaluation of three watering and Molding Techniques on Transplanted Trees at Adobe Dam."**

This report evaluated the relative success of alternative watering regimes and types of water used on transplanted trees of Adobe Dam.

**Task 8. "Final Evaluation and Recommendation on Reclamation at Adobe Dam."**

This report summarizes the findings of Tasks 2 through 7 and presents a series of specific recommendations for achieving success in arid lands revegetation projects.

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Report to the U.S. Army Corps of Engineers  
Los Angeles District

Task No. 4  
Revised - 8/18-1983

Site Characteristics

by  
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## INTRODUCTION

Revegetation success on disturbed sites is closely aligned to abiotic characteristics. Site-specific, microenvironmental conditions such as temperature and precipitation, effect revegetative success. Slope angle and aspect control radiation loads and thus temperature and evaporative demand. Soil characteristics will effect germination and growth of seeded species.

The objective of this task is to describe the abiotic site conditions for seeded areas on the downstream face of Adobe Dam. These conditions include general mesoclimatic data as well as soil characteristic for specific areas on the dam surface.

## MATERIALS AND METHODS

Climatological data documenting precipitation and temperature patterns during plant establishment (February-September 1982) were collected weekly. Sixes type minimum/maximum thermometers located inside the Army Corps' Adobe Dam compound recorded air temperature at 30 cm. above ground surface. Rain gauges, consisting of number 10 cans with a layer of mineral oil to prevent evaporation, were positioned throughout the study area. Arizona State University Climatological Laboratory provided corresponding data for two proximate weather stations. Solar input for the dam slopes and horizontal areas was assessed using potential irradiation at 34° latitude (Frank and Lee, 1966).

Soils from four study areas at Adobe Dam were compared: east dam topsoils, west dam topsoils, west rip-rap covered fill soils, and soils from a specially constructed slope of fill material. Soil samples were randomly collected along slope transects in study areas and analyzed for major soil

parameters affecting soil fertility. Percent gravel was determined gravimetrically. Texture, electrical conductivity, pH, soil cations (ammonium acetate procedure) and exchangeable ammonium-nitrogen were measured using standard methods (Black, 1965). Nitrate-nitrogen was determined by the cadmium reduction technique (American Public Health Association in 1975). Total available nitrogen was then obtained by summing ppm nitrate-nitrogen and ammonium-nitrogen. Sodium bicarbonate extractable phosphorous procedure was followed (Watanabe and Olsen, 1965).

Irregularities in the soil surface were measured as an indication of microhabitat potential. In each slope study area, the distance between the surface and a taunt line was measured at random distance points. The standard deviation of these measurements reflect surface variability, with the larger standard deviations implying rougher microterrain.

The SAS and BMDP statistical software packages were used in computer analysis of data. The general linear model for analysis of an unbalanced design was used. Statistical differences between mean values for different soil categories were evaluated with Duncan's multiple range test. Transformations were performed when necessary to meet the assumptions for analysis of variance.

## RESULTS AND DISCUSSIONS

Temperature data from Adobe Dam and weather stations in Deer Valley and Youngtown show a slight trend for warmer maximum temperatures at the dam (Table 1). Winter precipitation differs moderately for the three areas (Table 2). The highly localized nature of summer convection storms causes summer rainfall fluctuation.

Table 1. Weekly Max/min Temperatures.  
February through September 1982.

Week ending	Adobe Dam		Deer Valley		Youngtown	
	Max	Min	Max	Min	Max	Min
2/9	67	30	64	31	67	31
2/16	80	46	76	44	76	45
2/23	87	46	86	47	85	47
3/2	80	44	79	45	80	46
3/9	84	37	82	39	82	38
3/16	82	48	82	48	82	49
3/23	78	34	75	37	75	36
3/30	83	44	77	40	79	43
4/16	81	40	82	41	82	44
4/13	92	40	90	35	89	42
4/20	91	47	91	47	92	48
4/27	94	46	91	45	93	48
5/4	95	57	96	56	96	60
5/11	95	53	93	51	95	55
5/18	99	52	97	52	99	50
5/25	103	55	101	56	101	58
6/1	100	58	98	58	101	59
6/8	100	59	96	59	98	57
6/15	106	57	101	56	104	60
6/22	107	66	103	65	106	67
6/29	108	64	108	63	109	69
7/6	106	61	103	62	103	65
7/13	109	68	110	69	110	71
7/20	115	74	112	77	111	74
7/27	111	72	107	73	109	73
8/3	108	73	106	78	107	74
8/10	113	75	109	75	111	75
8/17	108	70	108	71	105	72
8/24	109	70	111	71	112	68
8/31	108	70	107	70	106	71
9/7	111	75	110	75	111	76
9/14	99	59	91	61	96	62
9/21	102	61	103	62	102	64
9/27	104	69	107	62	107	70

Weekly values in degrees Fahrenheit for Youngtown and Deer Valley were obtained from Arizona State University Climatological Laboratory.

Table 2. Precipitation in inches.  
February through September 1982.

Period ending	Adobe Dam	Deer Valley	Youngtown
2/10	0.45	0.21	0.11
2/17	0.51	0.48	0.50
2/24	0.53	0.29	0.15
3/2	-	-	-
3/9	-	0.06	0.71
3/17	1.49	1.05	1.33
3/23	0.26	0.15	0.18
3/31	0.32	0.54	0.24
4/6	-	-	-
4/13	0.14	0.06	-
4/21	-	-	-
4/27	-	-	-
5/6	0.21	-	0.14
5/12	0.10	0.01	0.15
5/19	-	-	-
5/24	-	-	-
6/2	-	-	-
6/8	-	-	-
6/15	-	-	-
6/22	-	-	-
6/29	-	-	-
7/7	0.12	0.18	0.55
7/13	0.05	-	-
7/19	0.08	0.04	0.07
7/27	0.45	0.33	0.30
8/2	0.46	0.11	0.64
8/10	-	-	-
8/16	0.79	0.52	0.60
8/24	0.33	2.74	1.94
9/3	-	-	0.05
9/8	0.26	0.05	-
9/14	-	0.15	0.03
9/20	-	-	0.02
9/27	-	-	-

Values for Deer Valley and Youngtown were obtained from ASU Climatological Laboratory.

Note: Precipitation is reported here on a semi-weekly basis and may include more than one rainfall event.



Although values for solar beam irradiation potentially hitting study areas (Table 3) may differ from actual irradiation, they allow comparison of solar load between locations and provide a fairly accurate measure of this site factor (Frank and Lee, 1966).

Microterrain evaluations based on the variability of the soil surface, did not differ significantly for the areas, indicating an overall uniformity of the slope surface.

Soil analyses are presented in Table 4. Texture determinations characterized the east topsoils as loams, the west topsoils as a mix of sandy loams and loams, and the two fill soils as sandy loams. Slope fill soils are lowest in clay, and highest in sand and gravel. The east topsoils are highest in clay and lowest in sand. Therefore, one would expect the east topsoils and the slope fill soils to exhibit texture-related chemical differences.

Values for electrical conductivity, an indirect measure of salinity, did not indicate saline conditions often associated with desert soils and were not significantly different for test areas. Values for pH differed significantly between slightly alkaline topsoils and moderately alkaline fill materials. Arid soils are typically alkaline, and the pH for these soils is not a problem for desert-adapted plant species.

Nitrogen, often the limiting factor in plant growth, is generally low in the tested soils. Topsoils, as expected, were higher in total available nitrogen, with the east area topsoils significantly higher than the two fill soils.

Phosphorous values obtained at Adobe Dam are low in comparison to agricultural soils, but within the range for "virgin" (nonagricultural) soils (Tisdale and Nelson, 1975). Quantities present should be sufficient to support native vegetation.

TABLE 3. Potential daily solar irradiation in Langleys ( $\text{gm cal/cm}^2$ ) on horizontal and  $22^\circ$  slope with SSE aspect  $34^\circ$  latitude.

Period	Surface	
	Horizontal	Slope
2-02/2-06	483.9	733.3
2-07/2-19	540.7	771.3
2-20/3-06	609.8	813.4
3-07/3-20	684.8	853.2
3-21/4-18	760.3	886.7
4-19/5-02	830.9	911.1
5-03/5-17	940.8	930.6
5-18/5-31	977.2	930.2
6-01/6-21	1001.4	928.1
6-22	1014.0	926.0
6-23/7-12	1001.4	928.1
7-13/7-27	977.2	930.4
7-28/8-09	940.8	930.6
8-10/8-24	891.4	925.0
8-25/9-08	830.9	911.1
9-09/9-22	760.3	886.7
9-23/9-27	684.8	853.2

Values for this table from Frank and Lee (1966).

TABLE 4. Mean values for soil types tested at Adobe Dam as determined by Duncan's multiple range test. Note: Values in same rows followed by same letter are not significantly different at the 0.05 level.

	Soil Types				Texture Class	Range values for all areas	
	East topsoils	West topsoils	Rip-rap covered fill soils	Fill soils from specially constructed slope		Sandy loam	Loam
	Losses	Sandy loams and loams	Sandy loams	Sandy loams		Min	Max
Percent sand	49.95 A	55.78 B	65.85 C	70.37 D	44.60	73.50	
Percent clay	18.67 A	14.42 B	13.12 C	10.37 D	8.90	21.60	
Percent gravel	19.77 A	20.07 A	36.69 B	52.37 C	14.30	61.10	
Electrical Conductivity <sup>a</sup>	1.35 A	1.42 A	1.35 A	1.00 A	0.60	3.40	
pH	7.82 A	7.79 A	7.97 B	8.50 C	7.60	8.70	
Nitrate nitrogen in ppm	15.80 A	14.62 A	8.92 A	7.00 A	1.20	24.50	
Ammonium nitrogen in ppm	9.23 A	4.94 B	3.52 B	3.70 B	3.10	15.20	
Total nitrogen in ppm	25.12 A	19.56 AB	12.44 B	10.70 B	4.30	31.30	
Phosphorous (NaHCO <sub>3</sub> ) in ppm	4.62 AB	5.94 A	2.42 C	3.30 BC	2.00	9.80	
Sodium in ppm	278.40 A	203.60 A	236.60 A	586.00 B	107.00	586.00	
Exchangeable Sodium Percentage	2.44 A	2.04 A	2.74 A	6.47 A	1.16	3.47	
Calcium in ppm	7150.00 A	6930.00 A	6155.00 B	6350.00 B	5575.00	7300.00	
Potassium in ppm	190.80 AB	302.40 B	236.60 A	137.00 C	137.00	581.00	
Magnesium in ppm	545.60 A	377.60 B	550.40 A	584.00 A	311.00	654.00	

<sup>a</sup>Electrical Conductivity in mmhos/cm. Values >4 indicate saline conditions.  
<sup>aa</sup>Exchangeable Sodium Percentage values >15% indicate sodic soils.

High sodium levels can be problematic. Many species are sensitive to excesses and high amounts deteriorate soil structure, reducing porosity and water infiltration. Although the slope fill soils are significantly higher in exchangeable sodium percentage (ESP). Values determined at Adobe Dam are insufficient to warrant concern. The other soil cations; magnesium, calcium and potassium, are present in adequate quantities and deficiencies are not expected. Calcium levels reported here are within normal expected ranges for arid, slightly alkaline soils (Chapman, 1965).

The soils at Adobe Dam present no major limitations to adapted plant species. East area topsoils appear most favorable, followed by the west area topsoils, the rip-rap fill soils, and lastly the slope fill soils. Although the slope fill soils appear less fertile, they do not preclude vegetation establishment. However densities may be lower than on the more favorable growth medium provided by topsoiling.

#### Habitat Characteristics and Vegetation of Surrounding Natural Areas

The Adobe Dam project has two different potential natural habitats adjacent to the site. These are the Skunk Creek flood plain and the surrounding small hills. Most of the flood plain has been disturbed by agriculture and, therefore, is represented by either newly abandoned fields dominated by annual weeds, or old abandoned fields that have, over time, reverted to a creosote bush and bursage association. Annual grasses are found on all of these locations following winter rains. The soils in the flood plain area have been disturbed and, therefore, have little structure. They are mostly sandy loams and, as shown in later tasks where borrow soils are analyzed, are only slightly alkaline and thus suitable for most lowland desert plants.

The surrounding hills have been little disturbed. They have shallow, loamy sand soils, that are slightly alkaline and mixed with rocks of many sizes. Rocks on these slopes make up over 35% of the surface cover. Vegetation on these natural slopes is dominated by brittlebush and bursage with some creosote bushes. Foothill palo verdes visually dominate some of the slopes but their density does not equal that of brittlebush or bursage. The angle of the slopes are between 15 and 20° with variable aspects, a result of the smallness of the hills. Aspects similar to the south side of Adobe Dam are represented. The great diversity of habitats created by the rockiness of the surface permits development of a wide variety of winter annuals following precipitation events.

#### Future Potentials for the Dam

It is unlikely that in the next few decades the surfaces prepared on Adobe Dam will develop a natural vegetation similar to the adjacent "natural" areas. The primary reason for this is that there are no areas on Adobe Dam that have a rocky surface with adequate soil. The dam has rip-rap surfaces, both with a thin topsoil layer and with no topsoil. The topsoil has been leveled with little microtopographic variability as shown earlier, and the rip-rap has insufficient soil. Over time, soil may infiltrate the rip-rap creating a suitable seeding habitat for native species. The smoothed topsoil will also erode increasing microtopographic variability. The brittlebush used in the seed mix may give an impression of naturalness to the Adobe Dam slope but the irregularity and courseness of the natural hills has not been created at the dam and thus the likelihood of species such as palo verde invading the dam surface is small.

The flat area to the south of the dam may eventually look natural. Planting of mesquite and blue palo verde in this area creates an unnaturalness but the natural vegetation that will invade, i.e, creosote bush, creates a monotonous and unaesthetic plant cover. Some creosote bush have been transplanted to speed this process. However, compaction of the surface in the area south of the dam will also act as a deterrent to invasion by natural desert species other than those ephemerals that will grow following winter rains. Much greater planning of surface areas is needed if the revegetation design is intended to create or permit establishment of a "natural" vegetation cover.

#### RECOMMENDATIONS

Compilation of climatological data aids in developing revegetation plans. Weather stations near the site to be revegetated should be consulted and seasonal rainfall and temperature patterns obtained. This information should be utilized to plan the plant species to be used and to schedule revegetation operations.

Comparison of the solar irradiation loads for different slope aspects and inclinations quickly identifies high radiation areas. Reduction of slope angle and controlling the aspect can greatly reduce the solar load. Then engineering designs necessitate high radiation loads, the severity of the solar environment can be mitigated by the use of drought and high temperature resistant plant species. Providing a rough microterrain can also provide shade for young specimens as the vegetation becomes established. It is further recommended that different seed lists be considered for harsher sites (such as southfacing slopes) that receive high radiation loads.

Soil analyses are critical when preparing a seed list. Analyses identify problematic soil conditions which may be tolerated by some, but not other plant species. The use of nontolerant species can result in barren areas, subject to erosion and dust hazards. Furthermore, if analyses show severe problems in chemical or physical factors, corrective ammendments or topsoiling may be required to ensure revegetative success.

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