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LAND MANAGEMENT SURVEY

L. M. UNIT 7

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LAND MANAGEMENT UNIT SEVEN

ENGINEERING REPORT

Submitted by:

Allen Stamm,
Engineering Aide

September, 1937

UNM 1589

CONTENTS

	Page
GENERAL DESCRIPTION OF THE UNIT	
I. Location	1
II. Area and Boundaries	1
III. Topography and Elevation	1-2
IV. Vegetative Types	2
V. Erosion	3
VI. Geology	3
PRECIPITATION AND RUNOFF - CLIMATOLOGICAL DATA	4
EROSION CONTROL AND WATER SPREADING PROJECTS	4-5
SPECIAL PROJECTS	5-6
AGRICULTURAL DEVELOPMENTS	6-6A
PROJECTS NEEDING NO IMMEDIATE TREATMENT	7
GENERAL DISCUSSION	8-9-10
ROAD EROSION	11
AGRICULTURE	12
COST SUMMARY	12
PROPOSED WORK PLAN	13
INDEX OF PROPOSED PROJECTS	14-18

UNM1590

GENERAL DESCRIPTION OF THE UNIT

I. Location

Land Management Unit Sever is located in the south central part of the Navajo Reservation. The greater portion, or 874,675 acres is in Navajo County with the balance of 49,407 acres in Apache County, all in Arizona.

That portion of the unit north of the $35^{\circ}30'$ parallel of latitude and west of the $110^{\circ}00'$ meridian of longitude was made part of the Reservation by an Executive Order on December 16, 1862. That portion south of the $35^{\circ}30'$ parallel, except for railroad and other patented land which has not yet been conveyed to the United States Government, was included in the Reservation by the Congressional Act of June 14, 1934. Practically all of the unit has been surveyed; the oldest survey was made in 1882 and approved in 1883 and was made on that land included by the Congressional Act of June 14, 1934. Rock and wooden markers were used and only few of these can now be found and identified. Subsequent surveys are marked with iron corners; at the present time accurate locations of land lines are very difficult to make for these reasons.

II. Area and Boundaries

The computed acreage of this area is 924,082 acres. The boundaries are usually well defined and easy to follow in the field. The south boundary of the Navajo Reservation is the southern limit of this unit and is fenced. The unit is bounded on the West by Units 5 and 6, on the North by Unit 4, and on the East by Units 10 and 17.

No changes in the present boundaries are recommended at this time. There appears though to be some movement of people and stock into Units 4 and 17 in the northern part of the area.

III. Topography and Elevation.

The elevation varies from approximately 5,300 feet to 7,500 feet. In the climatological chart on page is

UNM 1591

given the elevations or approximate limits in elevation for various sections of the unit. The northern portion is an extension of Black Mesa with cliff recessions caused by the resistant Mesa Verde caprock and the softer underlying clays and shales. South of the mesas the terrain is characterized by rolling planes broken by innumerable mesas, buttes, and peaks which form the Hopi butte volcanic field. In the extreme southern portion of the unit there are the high escarpments and broken badlands of the Painted Desert geologic formation. The principal drainages of the unit are the Jeddito, Coyote, Bida Hochee, and Cottonwood washes. All of these drain in a southwesterly direction except Coyote Wash which flows to the northwest. The Jeddito Wash fans near the 35° 30' parallel of latitude in quadrangles 16 and 64. Coyote Wash fans in Unit 5 near the western part of quadrangle 64 where an agricultural development is proposed. The Bida Hochee Wash can be handled feasibly by diverting it a few miles south of Indian Wells while Cottonwood Wash may possibly be diverted later below its junction with drainage 4.7.

IV. Vegetative Types

The vegetation of this unit can be broadly grouped into four main classifications; grassland, browse, woodland, and waste. All lands as inaccessible, barren, and barren with weeds have been termed waste. (See the table below.)

Vegetative Types

Forage Types	Surface Acres	Percent of Area	Forage Acres	Carrying Capacity	Percent of Carrying Cap.
Grassland	468,468	50.70	78,862	31,544	61.68
Weeds	2,304	.25	123	49	.10
Sagebrush	62,748	6.79	11,595	4,638	9.07
Browse	157,846	17.08	19,673	7,869	15.39
Woodland	192,085	20.79	17,599	7,039	13.76
Waste	37,906	4.10	0	0	0.00
Cultivated	2,725*	.29	0	0	0.00
Total	924,082	100.00	127,852	51,139	100.00

*This figure does not agree with the acreage obtained by Agronomists for their figure includes only the actual acreage farmed.

UNM 1592

CLIMATOLOGICAL DATA*

UNM 1593

Area or Station	Elevation	Ave. Annual Precipitation	Ave. Annual Temperature	Maximum Temperature	Minimum Temperature	Ave. Date First Killing Frost	Ave. Date Last Killing Frost	Ave. Length of Growing Season
Southern Extremity	5350-5400	9½"	54°	101°	-10°	Oct. 15	May 15	150
Northeast Extremity Balah Kai Mesa	7400-7500	16"-17"	45°	94°	-15°	Oct. 5	May 25	130
Western Extremity Jedito Wash	5250-5300	9"	55°	101°	-10°	Oct. 15	May 20	145
Indian Wells	5770	10"-10½"	53°	100°	-11°	Oct. 13	May 23	140
White Cone Flats	6200-6300	12½"	51°	99°	-12°	Oct. 12	May 21	135
Top Mesa Opposite Keam's Canyon	6500	12½"-13"	50°	98°	-13°	Oct. 12	May 27	135

2A

*These figures are estimates based upon ^{elevations} ~~data~~, vegetation and previous reports submitted on Land Management Units No's 4, 5, and 6.

V. Erosion

Wind erosion is moderate and severe on most of the farms but since recurrent floods bring sand and silt to replace that material blown away, it is not a critical problem. Very few gullies were found cutting through agricultural areas; however, some very serious heads are advancing into Farm 27, Quad. 61 which will be handled by Card 3 and into Farm 22, Quad. 15 which will be controlled by Card 8. We might also mention the headcutting caused by the Coyote Wash where it flows into the Jeddito as shown on Card 10. In the vicinity of Bala Kai Mesa a number of small farms are threatened by gully erosion, but we feel it will not be feasible to treat this vicinity for it would be necessary to provide expensive drop structures which could not be justified.

Critical range areas threatened by sheet and gully erosion are shown on Cards 9, 22, 8, and 24, with those areas shown on Cards 15, 11, 28, 25, 21, 17, 12, 14, 16, 7, and 2 classified as semi-critical. The majority of these projects are located along Cottonwood and Bida Hochee Washes where heads are advancing into the side drainages and valleys on either side. Not all of the outlined projects can be rated as "A" feasibility ofr costs per acre benefitted will be rather high on some; this is clearly shown on each individual card and summarized on the charts on pages 15, 16, 17, 18. For a further discussion of each quadrangle and certain areas where treatment is not justified, see GENERAL DISCUSSION.

VI. Geology

A very complete geological report on Unit 7 has been written by Mr. Tom Meeks, Junior Geologist. Since this report is essentially technical in substance and does not include anything pertinent to engineering structures, we have not used it here; should the reader wish, he may find it in the report submitted by the Range Brance.

PRECIPITATION AND RUN-OFF

Precipitation records have been kept at Keams Canyon for a number of years, while a station at Jeddito has been read by the trader there during the last six years. Other rainfall records are available from Winslow, Tuba City, Chin Lee, Kayenta, Fort Defiance and St. Michaels. From this data and estimates made on Units 4, 5 and 6 a climatological chart has been made for various sections of the unit, giving the elevation, average annual precipitation, average annual temperature, maximum temperature, minimum temperature, average date of first killing frost, average date of last killing frost and average length of growing season. This chart is on page 203.

Run-off calculations were made of the Jeddito, Bida-Hochee and Cottonwood Washes since on these drainages diversion and irrigation projects are planned. This information was secured by querying Navajo informants who showed previous high-water marks which they had observed during former years. From these high-water marks and the slope of the channel bottom, estimates were made as to floods expected at the various diversion sites. This data is shown on the project cards for the various agricultural and diversion possibilities.

EROSION CONTROL AND WATER SPREADING PROJECTS

With reference to the engineering map and numbering of the drainages, the conventional system has been used.: Number 1 for the Coyote Wash, Number 2 for the Jeddito Wash, Number 3 for Keams Canyon Wash and Number 4 for Cottonwood Wash. Proceeding upstream the drainages on the left are progressively numbered 1.1, 1.3, etc., while those on the right are numbered 1.2, 1.4, etc. Gullies of any size flowing into the side washes are given one more decimal, then numbered in the same manner so that the first gully flowing into 1.1 from the left is called 1.1.1, the second on the left 1.1.3, while those on the right are 1.1.2, 1.1.4, etc.

Critical erosion control and water spreading areas in Unit 7 are shown on cards numbers 8, 9, 24, and 22. These areas are very badly over-grazed, with serious heads and gully erosion beginning in many places. General treatment will cost from 25¢ to 50¢ an acre and consist of horse-shoe water conservation and water spreading dams and dikes, small earth diversion

UNM1595

dams and dikes, scattered rock and wire spreaders and small rock drops and checks. Except for contour furrows and dykes, it is suggested that no work be done on gullies less than 2 feet deep since we believe that range control will partly stabilize these smaller gullies.

It must be remembered that treatment only in the valleys and on the gentler slopes will be feasible. The cost of treatment will approach \$2.00 an acre on land actually treated, with indirect benefits to the steeper slopes and rougher land.

Semi-critical erosion control and water spreading areas are shown on cards numbers 2, 7, 14, 15, 16, 12, 17, 21, 25, 11, and 28. All of these projects are located within Unit 7. Card No. 11 in quadrangle 64 is located in Land Management Unit 5, but was not covered at the time the survey was made. Card No. 27, located in Land Management Unit No. 17, will be affected by work which may be done on the drainage above. Should the water expectancy in Cottonwood Wash be decreased by treatment within Unit 17, it will be feasible to construct an earth fill diversion dam flooding approximately 450 acres of grass land. Should no work on this drainage within Unit 17 be planned, a larger water expectancy will necessitate a higher dam than that now planned.

Feasibility numbers A, A-B, and B have been given the various projects from an engineering standpoint and are shown in the cost summary. The "A" projects should be constructed first, with the others following.

SPECIAL PROJECTS

Card No. 1 will be the repair and maintenance of rock and earth structures constructed by the S.C.S. and E.C.W. on the Keams Canyon Wash in the vicinity of Burnham's Dam. Card No. 13 will be the construction of an earth fill stock water tank within the project outlined on Card 12. A buck pasture is planned in the northern portion of the project, and this stock water tank is needed in this vicinity. We have allowed \$1,500 for its construction.

Card No. 18 refers to the repair of the spillway on tank H-194. This tank is owned by Mr. Stiles, the trader at Castle Butte Station. No work is planned here unless the

Government acquires the structure and the checkerboarded land in its vicinity. Card No. 3 provides for the construction of a 600' dike at the lower end of Farm No. 27, to prevent heads from advancing north through the farm and into range and grassland above.

Card No. 20 provides for an earth fill diversion in a gully ten feet deep and thirty feet wide, diverting water onto Farm No. 12; allowing three acres of expansion with five acres of land now being farmed also benefitted.

AGRICULTURAL DEVELOPMENTS

Jeddito Project

Card No. 6, known as the Jeddito project, provides for the construction of a 20' high partial diversion dam to utilize the live water flow of one to one and a half cubic feet per second. Navajo and Hopi informants state that this live stream never dries out and during the summer months the flow is at its peak, with a smaller discharge during the spring and fall months. We have allowed for the subjugation of 180 acres under this project. A maximum flood flow of 800 to 900 cubic feet per second may be expected and to by-pass this flood a spillway opening 30' x 5-1/2' must be allowed.

A tentative plan will necessitate a canal handling 20 to 30 cubic feet per second in order that the small flow at the end of expected floods may be used. We suggest a controlled opening in order that no more than the designed flow will reach the main canal. Six box turn-outs will be needed, feeding the six laterals to the south of the main canal, each lateral to be designed for two cubic feet per second. A sluiceway may be necessary in the diversion dam, with an auxiliary spillway on the north possible advisable.

Under this tentative plan the diversion dam and dikes will cost \$2,500; main canal, laterals and box turn-outs, \$700; with subjugation costs on 180 acres, \$2,160; or a total cost of \$5,360. No accurate survey has been made of the land under the diversion and after a topographic map is made, as we have suggested, it is possible that an entirely different plan may be followed.

To justify this project we can assume a per acre benefit of \$70 to \$80 which, with 120 acres receiving live water, shows a \$9,000 justification.

UNM1597

Bida-Hochee Project

Card No. 19, known as the Bida-Hochee Project, consists of a complete earth fill diversion dam 15' high by 50' wide, approximately, to divert flood waters onto 137 acres to the southwest of the diversion dam. The diversion dam and auxiliary spillway on the east side will cost approximately \$500, with the main canal and seven box turn-outs, \$2,300; subjugation of 137 acres, \$1,096, or a total cost of \$3,896.

Farm No. 6, estimated by the agronomist to be 112 acres, will receive water over the lower portion. Pending a topographic survey we have estimated 137 acres to be benefited but do not know how much of this will lie within Farm No. 6. No accurate estimate of the water expectancy at the diversion site can be made at present for size of floods will depend entirely on the amount of work done above.

Water for this project will originate in drainages 4.13.13 and 4.13.2, with a smaller flow from 4.13.5, 4.13.7 and 4.13.9. It is probable that by subjugating 137 acres all water can easily be handled. However, should larger flows be found, expansion to the south can easily be followed. One and one-half miles below the diversion site is a rock outcropping in the channel of the wash and it may be advisable to by-pass excess water from the project onto the rock outcropping in this vicinity.

Coyote Wash Project

Card No. 10, at the junction of the Coyote and Jeddito Washes is called the Coyote Wash Project and was examined within Unit No. 5. At that time we believed the water expectancy too great to be handled by the available land in this vicinity. After our study of L.M.U. No. 7 we believe that most of the larger floods can be diminished by works shown on Card No. 12. Cards numbers 14 and 15 will also lower the flood expectancy somewhat. It is suggested that an earth fill diversion dam be constructed on Coyote Wash, diverting floods to the north and west, with several dikes needed to prevent water from again concentrating in the Jeddito Wash. 100 acres of agricultural land will be subjugated at \$15 an acre, with the entire project costing \$2,500. Some very critical heads are advancing from the Jeddito Wash into this area and will eventually cut through the entire section. Although this is a critical project, we have given it "B" feasibility for the cost per acre benefitted may be a little large. This project and that shown on Card No. 12 should be worked within a coordinated plan.

UNM 1598

PROJECTS NEEDING NO IMMEDIATE TREATMENT

Card No. 23 is self-explanatory. Should the work as shown on Card 22 prove effective and vegetative recovery secured, it may be feasible to divert drainage 4.7 to the south or to divert the main Cottonwood Wash just below its junction with 4.7 onto the same land. This diversion must wait until the spreading area below it to the south and west is in better shape, for at present numerous gullies and rivulets cut the entire area, and spreading would be inadvisable.

Card No. 26 does not suggest any work at present but recommends a further investigation in four or five years to determine if the heads in this vicinity are active. These heads may become partly stabilized should an effective range control program be secured. For this reason no cost estimate has been made of construction needed to handle them.

Card No. 4, comprising 25,000 acres in the vicinity of White Cone and extending west of White Cone approximately 8 miles, does not show a cost estimate. Serious gullying is found in the side drainages to the north and south with a few small heads found in the main valley itself. No water escapes from this area and for this reason we feel that it is advisable to defer treatment which would diminish water reaching the stock water tanks. It is hoped that by proper range control, stabilization of the smaller gullies can be secured. It is suggested that this project be examined again in several years and if, at that time, revegetation has not resulted, some mechanical treatment may be advisable.

Card No. 5 is comparable with Card No. 4. No water escapes this area and although gullying is found on the side slope, we feel that treatment is not advisable.

GENERAL DISCUSSION

Quadrangles 13 and 56

In quadrangles 13 and 56, in the vicinity of Balakai Mesa, small head two to four feet deep are prevalent. No suitable spreading area is found in this vicinity and the only treatment might be scattered brushwood. After discussion with the Range Management and the Forestry representatives we have provided for no work in this section. Practically the same situation exists in the head waters of drainage No. 5. However, since all water is utilized at its fan in quadrangle, 60, no work has been allowed.

Quadrangle 60

In quadrangle 60 Cards Numbers 4, 5, and 2 cover most of the southern section. No treatment is recommended on drainages 2.14.3 or 2.14.5, where all water is utilized and no serious erosion problems are found. Along the Jeddito Wash in the northwestern portion of quadrangle 60, slopes are excessive and spreading area is unsatisfactory for handling escaping water. Headcutting is found in this vicinity but the agronomist and other representatives feel that work cannot be justified.

Card No. 2 in the southeastern corner of the quadrangle provides for the construction of a few scattered erosion control dams. We feel that extensive work in this area would be inadvisable for water from this section is needed on Farm No. 27 in quadrangle 61.

Quadrangle 15

Card No. 8 in quadrangle 15, allows for the construction of a diversion dike below Farm No. 22, diverting water to the southwest and for the construction of an earth diversion dam, which will benefit Farm No. 46. Between Farm No. 46 and a windmill two and one-half miles to the southwest, a series of spreaders should be constructed to allow recovery in this vicinity, this is shown on the same card. At Points D and E in the south-central portion of quadrangle 15, earth diversions are possible but the cost per acre benefitted cannot justify their construction at this time. Should agricultural land approach a value of \$80 an acre, a further investigation should be made at these points.

UNM 1600

Quadrangle 64

In quadrangle 64, Cards numbers 9, 10, 11, and the southern portion of Card No. 7, are located. Within Card No. 9, at points A, B, and C, we have allowed a total of 500 acres of contour furrowing. Should this prove effective, a larger area may be covered. Sheet erosion is critical in this vicinity and since slopes are small, a plan is suggested whereby allwater will be held within the project. Heavy machinery, with tractor, terracer, rotary scraper can be justified here. Along drainages 1.4 to 1.10, inclusive, no work can be done for soils are poor and slopes very steep.

Quadrangle 22

In quadrangle 22 a possible diversion might be located 2-1/2" south and 9-1/2" west of Quadrangle corner 35°35 x 110°15'. This would benefit approximately 3 acres lying to the west of the diversion site and since the cost would be around \$200, we could not justify this project unless flood irrigated land is valued around \$70 an acre.

Drainages 2.6.2, 2.6.4 and 2.6.6 cannot be handled for no spreading area is available. Drainages 1.1 and 1.3.1 fan with water well utilized. In the southern portion of this quadrangle the Chin Leo geological formation, known as the Painted Desert, begins, with no work possible in this section.

A pumping station has been suggested in the vicinity of Dilkon. However, a water analysis shows a very high percentage of sodium chloride salts. Consequently, no further survey was made of the suggested project.

Quadrangle 61

Along the Bida-Hochee Wash, between drainages 4.13.2 and 4.13.11 in quadrangle 61, no treatment is planned, for little range land is threatened and all water can be utilized at the Bida-Hochee project, as shown on Card No. 19. In the southern portion of the Unit, along either side of the Cottonwood Wash, some very large heads have begun cutting into the side slopes. These heads have progressed from Cottonwood Wash from half to two-thirds of a mile in some instances, with numerous smaller heads between. (See GENERAL DESCRIPTION, V. Erosion.) From these large heads smaller gullies extend over almost the entire country. Soils appear to be heavy but analysis shows them of "B" agricultural and range classifications.

UNM 1601

Cards numbers 22 and 24 allow for the construct on of earth dams and dikes in this vicinity, with no work suggested except where gullies and rivulets are less than 6' deep..

At a point 7.5" S and 7.9" W of quadrangle corner 110°00' x 35°30' a storage site was examined on drainage No. 4.13.13. This site has been suggested by several people. However, since all water spreads on Farm No. 6 and no water is escaping, it is obvious this site is impractical. The slope of the channel above the suggested location of the storage dam is over 1% and to obtain a reservoir capacity of two acre feet a dam approximately 5' high by 60' wide would be needed. We cannot possibly justify this dam from any viewpoint.

Quadrangle 58

As mentioned before, under Erosion Control and Water Spreading Projects, Card No. 27 is located within L.M.U. No. 17. This project and that shown on Card No. 28 are within quadrangle 58. Card No. 28 provides for the construction of earth diversion dikes to spread water in drainages 4.10, 4.12, 4.14 before they concentrate in the main Cottonwood Wash.

ROAD EROSION

Some serious road erosion is found over parts of this Unit; however the outlined projects will in most all instances handle and control the small gullies and rivulets which are beginning in these sections. We believe that only in quadrangle 60 should additional money be allocated for the construction of small structures to control the gullies which have begun along the numerous trails and roads near White Cone and west of White Cone. A summary is given below by quadrangles showing the project cards which include trails needing treatment.

Quad. 15 - Some road erosion along the Jeddito Wash. Will not be practical to treat this; however some road erosion within Card 8. No additional money allocated.

Quads. 13 & 56.
Some erosion in the vicinity of Bali Kai Mesa but not enough to bring a crew in.

Quad. 60 - Semi-serious road erosion in the vicinity of White Cone and to the west of White Cone; also within project outlined on Card 5. Since we have deferred treatment on these two cards, 4 and 5, we have allowed \$400 for treatment within these areas. ----- \$400

Quad. 64- Handled by Card 9.

Quad. 22- Handled by Cards 14, 15, and 12.

Quad. 61 -Handled by Cards 22 and 24.

Quad. 58- No erosion within L.M.U. 7.

Quad. 63 and Quad. 62 - Badlands and Painted Desert formation.
No treatment.

Total in addition to Project Cards ----- \$400

AGRICULTURE

Below is given a table taken from the Agronomy report of Mr. E. A. Nicholson. A, B, and C classifications denote the varying fertility of the flood irrigated farms.

CLASSIFICATION OF AGRICULTURAL LAND

Sub- Unit	Class	P R E S E N T F A R M L A N D					E X P A N S I O N		
		A	B	C	G*	Total	A	B	Total
1	Flood	181	80	1	6	268	23	5	28
2	"	780	35	.	5	820	71	-	71
3	"	202	34	-	-	236	24	-	24
4	"	215	1	-	-	216	101	-	101
Total		1,378	150	1	11	1,540	219	5	224

*Saccatone Pasture.

For crops raised, farming practices, yields, etc., see the Agronomy report of Mr. E. A. Nicholson.

COST SUMMARY

From the Agronomy report the subjugation cost will be \$8,339 which represents bordering, leveling, terracing, spreaders, etc. on present and potential farm land. This is shown in the COST SUMMARY on Page of this report for each sub-area. In L.M.U. 5 an agricultural project is outlined on Card 10 with subjugation of 100 acres to cost \$1,500. This gives us the total of \$9,839 shown under subjugation costs and inclosed in brackets.

Erosion Control and Water Spreading Projects -----	\$21,765
Special Projects -----	2,410
Agricultural Developments (Exclusive of subjugation)-\$	7,000
Subjugation -----	\$ 9,839
Treatment Road Erosion -----	\$ 400
Total -----	\$41,414

PROPOSED WORK PLAN

In the index the Erosion Control and Water Spreading Projects and the Special Projects have been classed as critical, and semi-critical with Card 20 called secondary. Critical Erosion Control and Water Spreading Projects are very badly overgrazed and serious sheet and gully erosion has begun. Range control is suggested within these critical areas with construction of engineering structures to begin at once.

Semi-critical Erosion Control and Water Spreading Projects may be deferred until after the critical areas are handled. It may be best to wait until range control allows a recovery on the spreading grounds before work is begun with only the serious heads treated at present. With a stock control program we may expect an appreciable increase in volume and density of vegetation with water spreading proportionally more effective and danger from gullying at the lower end of the spreading grounds materially decreased.

Concerning the three agricultural developments, we have given the Jeddito Project feasibility rating A-1, for with its live water supply it should be one of the finest on the Reservation. The Bida Hochee Project is called A for at a very small cost an earth fill diversion dam can be constructed to flood land under the project. The Coyote Project is classified as B for the cost per acre benefitted will be a little high. Before construction begins topographic surveys should be made of these three projects.

An outline of the Proposed Work Plan is given below:

- I. Immediate Treatment: Cards 3 and 8.
- II. Immediate consideration of the critical range areas:
Cards: 24, 22 and 9.
- III. Immediate and careful consideration of the Agricultural Development shown on Card 6 as the Jeddito Project with secondary consideration of these on Cards 19 and 10.
- IV. Construction on the Semi-critical Erosion Control and Water Spreading Areas to be followed according to their feasibility numbers.
- V. A planned maintenance program to be carried on in conjunction with periodical checks of new erosion developments and careful observations made as to range recovery and gully healing affecting projects which may develop.

INDEX OF PROPOSED PROJECTS

The following index should be self-explanatory, all projects having been given a separate card with each card numbered. Each project is classed by quadrangles, sub-units, acreage, priority, feasibility and with its cost divided as to that justified by erosion control and water spreading benefits. On the 1"-to-the-mile engineering overlay which has been made with the Agronomy map the projects are outlined with card number and project number given.

All of the other divisions have given their full cooperation in both the field and office toward the preparation of this report with particular credit due the soil, range, and agronomy representatives for their help in choosing the projects suggested.

Submitted by:

Allen Stamm,
Engineering Aide.

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COST SUMMARY - PROPOSED PROJECTS L.M.U.#7

Card No.	Quad. No.	Sub-Unit	Project No.	Acres	Cost Erosion Control	Cost Water Spreading	Cost* Subjugation	Priority	Feasibility	Description
1 ✓	13	1	Special Proj.#1 Y	200-R 17-F	\$250	\$ 100		Secondary	A-B	Repair & maintenance of rock & earth structures in K. Canyon Wash
2 ✓	60-61	2	E.C. and W.S. #1	13,500-R	\$700	\$335	--	Semi-critical	A	Scattered treatment utilizing small earth structures & spreaders
8 ✓	15	2	E.C. and W.S. #2	65-F 1,500-R	\$ \$600		Diversions \$700	Critical	A-1	Protection farms No. 46 & 22 & water spreading to west benefiting 1,500 A.
7 ✓	16-64	2-3	E.C. and W.S. #3	1100 acres Jeddito Fan	\$750	\$750	--	Semi-critical	A	Water spreading project utilizing earth structures at Jeddito Fan.
6 ✓	15	2	Agricult. Develop. #1	180-F		Diversion dam:\$2500 Canal&Turnouts:\$700	\$2160		A-1	Utilization of live water in Jeddito Wash irrigating 180 acres.
4 ✓	60	2	--	25,000 R	No treatment at present. This project includes White Cone Flats and vicinity and water is all utilized. Gullying present but may become stabilized.					
5 ✓	60	2	--	4,250 R	No treatment at present. All water used. Gullying rather serious but may become partly stabilized.					
9 ✓	64	3	E.C. and W.S. #4	20,500 R	\$1,250	\$1,250	--	Critical	A	Badly overgrazed. Sheet and gully erosion beginning. Contour furrowing & earth structures suggested.
14 ✓	22	3	E.C. and W.S. #5	5,200 R	\$ 500	\$ 500	--	Semi-critical	A-B	Contour furrowing - 150 acres. Small earth structures and diversion dykes & wire spreaders.
15 ✓	22	3	E.C. and W.S. #16	625-R	\$ 125	\$ 125	--	Semi-critical	A-B	Gully advancing into 600 acre flat Provide 2,000' spreaders

*Subjugation Costs included in Agronomy Report. Do not duplicate.

R - Range E.C. - Erosion Control
F - Farm W.S. - Water Spreading

UNM 1607

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COST SUMMARY - PROPOSED PROJECTS L.M.U. #7

Card No.	Quad. No.	Sub-Unit	Project No.	Acres	Cost Erosion Control	Cost Water Spreading	Cost Subj- gation	Priority	Feasi- bility	Description
3	61	4	Special Proj. #4	70-F	\$ 210	--	\$ (700)	Critical	A	Dyke at lower end of Farm #27 to control head cutting. Dyke will be approximately 600' L. 3 H.
20	61	4	Special Proj. #5	8-F	Diversion to farm #12 \$200		\$ (64)	Secondary	A-B	Diversion dam across gully 10' D 30' W to divert water to Farm #12 and allow 3 acres expansion.
19	61	4	Agricul. Develop. No. 2	137-F	Diversion Dam-\$500 Canal & Turnouts, \$2,300		(1096)		A	Diversion Bida Hochee Wash to west benefitting Farm #6. 112 acres and allowing 25 A expansion
23	61	4	--		Should work as shown on Card #22 prove effective and recovery of vegetation secured, it may be possible to divert drainage 4.7 to the south or divert the main Cottonwood Wash below junction with drainage 4.7 onto land to south and west.					
26	61	4	--		Heads are cutting back slowly on either side of Cottonwood Wash. These may become partly stabilized with recovery in vegetation. Investigate in 5 years. No work recommended at present.					

PROPOSED PROJECTS L.M.U. #5

11	64		E.C. and W.S. #14	225-G	\$100	\$100		Semi-critical	B	If work Jeddito carried through and Card #9 done, this project may be advisable. Provide 3 earth dams.
10	64		Agricul. Develop. No. 3	100-F 525-G	\$500	\$500	\$1,500	Critical	B	If Card #12 done, this project may be practical. Diversion Jeddito Wash flooding 500 A Range and 100 A. Farm.

PROPOSED PROJECT L.M.U. #17

27	58		E.C. and W.S. #15	450-G	\$390	\$390	--	Semi-critical	B	If work in L.M.U.#17 carried through, possible to divert Cottonwood Wash onto 450 acres Grassland.
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UNM 1608
16

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COST SUMMARY - PROPOSED PROJECTS L.M.U. #7

Card No.	Quad. No.	Sub-Unit	Project No.	Acres	Erosion Control	Cost	Water Spreading	Cost	Subj-gation	Priority	Feasibility	Description
16	22	3	E.C. and W.S. #6	450-R	\$150	\$150		--	Semi-critical	B	Very badly overgrazed. Treatment may not prove effective unless at very high per acre cost.	
12	22-61	3	E.C. and W.S. #7	31500R	\$2,000	\$2000		--	Semi-critical	A	Water conservation dams, contour furrowing & spreaders. Small heads lower portion. Project must be stopped.	
13	61	3	Special Proj. #2	3750-R	Construction of Stock tank - \$1,500				Critical	A	Buck pasture will be located in northern portion project on Card 12 Tank needed for stock water.	
17	22	3	E.C. & W.S. #7	750-R	\$100	\$100		--	Semi-critical	A-B	Water conservation dam below. 6' Head & 3 - 200' spreaders will protect 750 acres Range.	
18	22	3	Special Proj. #3	200-R	Repair of Stock Tank, H -194 - \$150				Semi-critical	A-B	Tank owned by Stiles. If acquired by Govt, should have spillway repaired.	
21	61	4	E.C. & W.S. #9	900-R	\$300	\$300		--	Semi-critical	A-B	Heads cutting on either side of Bida Hochee Wash into excellent valleys. Provide spreaders & earth dikes.	
22	61-62	4	E.C. & W.S. #10	16500-R	\$2,550	\$2,550		--	Critical	B	On either side Cottonwood Wash. Heads cutting into side valleys & serious gully & sheet erosion.	
25	62	4	E.C. & W.S. #12	475-R	\$100	\$100			Semi-critical	A-B	Small gullies cutting badly into valley. Control will be by earth work & several spreader fences.	
28	58	4	E.C. & W.S. #13	1900-R	\$600	\$600			Semi-critical	A-B	Cutting along Cottonwood Wash valley into side drainages. Provide 10 earth diversion dykes.	

E. C. Erosion Control
W. S. Water Spreading

UNM 1609

5

COST SUMMARY BY SUB-UNITS AND TYPES OF PROJECTS L.M.U. #17

Sub-Unit	Water Spreading Projects			SPECIAL PROJECTS				Agricultural Development				
	Critical	Semi-Critical	Total	Critical	Semi-Critical	Secondary	Total	Diversion	Card & Turnouts	Subjugation	Total	Total
One	--	--	--	--	--	\$350	\$ 350			\$ 380)	--	\$ 350
Two	\$ 1,900	\$ 2,535	\$ 4,435	--	--	--	--	\$2,500	\$ 700	(\$4,684)	\$3,200	\$ 7,635
Three	\$ 2,500	\$ 5,750	\$ 8,250	\$1,500	\$150	--	\$1,650	--	--	(\$ 799)	--	\$ 9,900
Four	\$ 6,100	\$ 2,000	\$ 8,100	\$ 210	--	\$200	\$ 410	\$ 500	\$2,300	(\$2,476)	\$2,800	\$11,310
L.M.U. #5	--	\$ 200	\$ 200	--	--	--	--	Water Spreading	\$1,000	(\$1,500)	\$1,000	\$ 1,200
L.M.U.#17	--	\$ 780	\$ 780	--	--	--	--	--	--	--	--	\$ 780
TOTAL	\$10,500	\$11,265	\$21,765	\$1,710	\$150	\$550	\$2,410	\$3,000 \$1,000	\$3,000	(\$9,839)	\$7,000	\$31,175

*Engineering Project Cards do not show all subjugation costs. For a complete allocation, see Agronomy Report of E. A. Nicholson:

UNM 1610

18