DEVELOPMENT OF EVAPOTRANSPIRATION CROP COEFFICIENTS, CLIMATOLOGICAL DATA, AND EVAPOTRANSPIRATION MODELS FOR THE UPPER GREEN RIVER

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INTRODUCTION

The project calls for field measurements of evapotranspiration (ET) and the collection of related climatic data during three growing seasons. This phase was completed in October 1985. The next year's efforts will be directed toward the analysis of the data. This progress report summarizes the three years of field data, describes efforts during the past year in analyzing data, and indicates future plans.

The Project's Objectives may be summarized as follows:

1. Develop grass and alfalfa reference crop estimation procedures for Farson and Fontenelle.
2. Develop grass and alfalfa reference crop estimation procedures along with mountain meadow ET estimation procedures for Daniel.
3. To collect detailed climatic data throughout the Green River Basin.
4. To develop methods of transferring reference crop coefficients throughout the Green River Basin in Wyoming.
5. Evaluate existing ET models for irrigated agricultural crops, phreatophytes and reservoirs for use in the area.
6. To obtain additional existing ET data applicable to the Green River Basin in Wyoming.

This listing of objectives involves a modest amount of interpretation and therefore, is slightly different than the original listing. These changes or additions are the result of the extensive experience gained in three years of work on the project.

The numerical results and any conclusions shown in this project are tentative in nature and should not be used in publications as being final in nature. Changes may result from reviews, analyses, and the use of additional

data that is only now being compiled. It is anticipated that any changes between these and data and conclusions in the final project report will be minor in nature.

FIELD STUDIES

The lysimeters and weather stations in the Green River Basin have been operated for three growing seasons--1983, 1984, and 1985. Summaries of the operation schedules of the lysimeters and weather stations are given in Tables 1-3. Evaporation pans were operated during the 1984 and 1985 growing seasons with their operation schedules shown in Table 4. The first year, 1983, is considered as a start-up year for the lysimeters during which the vegetation in the lysimeters was being established. The alfalfa and alta fescue were planted from seed during the spring of 1983 and the mountain meadow lysimeters were transplanted using sod from the surrounding fields. The installation of the lysimeters occurred in the Fall of 1982 or early Spring of 1983. All of the lysimeters during 1983 and ten of the fourteen lysimeters during 1984 and 1985 were operated to obtain a measure of the maximum water use of the vegetation for a specific water table or vegetation. During 1984 and 1985, four of the eight mountain meadow lysimeters were operated to obtain a measure of water use that might occur if irrigation were discontinued because of harvesting or the natural depletion of irrigation water as occurred in the surrounding fields. Irrigation of these lysimeters was performed until about a week prior to harvest.

The automated weather stations were operated for a longer period each year than were the lysimeters. Weather problems such as the presence of soil frost and the occurrence of snow in the late spring and early fall prohibited accurate operation of the lysimeters for dates beyond those listed in Table 1.

However, availability of the weather data will allow predictions of vegetative water use for periods in the spring and fall when lysimeter measurements were not made.

Evaportation pans were operated at selected sites during 1984 and 1985 to provide additional information useful in data analysis and ET prediction. The pan data will also be useful for checking models to estimate free water evaporation from reservoirs in the Basin.

DATA ANALYSIS

Lysimeter and pan measurements were made on a weekly schedule while climatic data was collected on a daily basis. Weekly summaries of the climatic data and monthly summaries of both the climatic and water use data have been prepared. Examples of these summaries are shown in Tables 5-11. These data will be used to develop crop coefficients, estimate consumptive use, and test and/or develop models for the Green River Basin.

In order to estimate the water depletion by evaporation from reservoirs, information for the definition of evaporation from free water surfaces in Wyoming has been developed. As a result of a separate but closely related project, analyses have been performed for determining the suitability of models for estimating evaporation and its variability in Wyoming and for defining the spatial and temporal variability of net evaporation.

The Kohler-Nordenson-Fox equation appears to be the best of the climatological equations for defining the amount and variability of evaporation in Wyoming. The equation is a combination method and requires temperature, wind, humidity, and radiation data as input. Since long-term wind, radiation, and humidity data are readily available at only four locations in Wyoming, application of the Kholer-Nordenson-Fox equation to estimates of long-term means and variability can be accomplished only if climatic data is spatially

extrapolated. Estimates using data from the automated weather stations in the Green River Basin should provide reasonable values of evaporation for the periods when the data is available.

Monthly and annual means, standard deviations, and highest and lowest evaporation and net evaporation values have been calculated for seven Wyoming stations. The lowest monthly values for net evaporation are often negative, especially during winter months, indicating an excess of precipitation over evaporation.

REFERENCE CROP ANALYSES

The first two objectives of the project involve the application of the current practice of first estimating a suitable reference crop ET and then the use of suitable crop coefficients to estimate specific crop ET at a particular time and location. This system of estimating ET is in widespread application in irrigation scheduling and water resource studies throughout the world. The system has not been adapted to mountain meadows as found in the Green River Basin. This discussion involves measurements and analyses performed to address objectives 1 and 2.

The term reference crop ET was coined to make the term Potential ET more meaningful, specific and easier to apply. Reference crops used are alfalfa with about 8 inches or more of top growth, representing the upper limit of ET from an aerodynamically "rough" crop (Jensen, et al. 1971). Grass is the other widely used reference crop and is commonly assumed to be from about 3 to 6 inches in height, actively growing, completely shading the ground and not short of water (Doorenbos and Pruitt, 1977). The grass definition to a large extent probably represents ET from the grass "alta fescue" because original data was probably secured from that grass grown in lysimeters. Both "alfalfa" and "grass" related reference crop ET are discussed in detail by Burman,

et al. (1983). In addition, the International Commission on Irrigation and Drainage states that a reference crop should be "a given well-adapted crop selected for comparative purposes" (n.a. 1985).

The definitions pose particular problems because the practical use of the reference crop system requires that a suitable method of estimating reference crop ET for the Green River be developed and that the coefficients be determined for the forage crops grown in the area. The alfalfa or grass definitions are troublesome because alfalfa is commonly grown in the Farson and Seedskadee areas only; it is rarely grown in the Pinedale area. At the start of the project, it was not known how well "alta fescue" would grow at the elevations encountered in the Green River area of Wyoming. The recent statement that the reference crop selected be "well-adapted" makes the selection much more difficult. To make certain that future estimates of ET from mountain meadows are consistent with other estimates from a river system that ranges from high altitudes to sea level, the selection and use of a crop for reference crop ET is extremely important and additional criteria are needed.

To provide additional criteria, an investigation using calculations of a bulk crop resistance using the Penman-Monteith form of the combination methods was used. Equation (1) below was proposed by Monteith (1965).

$$ET = \frac{Rn - G + \rho C_p \dfrac{e_s(T) - e}{r_a}}{\Delta + \gamma\left(1 - \dfrac{r_c}{r_a}\right)}$$

Where Rn is net radiation in MJ day^{-1}, G is soil heat flow in MJ day^{-1}, ρ is air density in Kg m^{-3}, C_p is the specific heat capacity of air in KJ Kg^{-1} $°C^{-1}$, e is vapor pressure in KPa, T is temperature in °C, Δ is the slope of

the saturation vapor pressure-temperature curve in KPa $^{\circ}C^{-1}$, γ is the psychrometer constant in KPa $^{\circ}C^{-1}$, r_a is aerodynamic resistance in sm^{-1} and r_c is in sm^{-1} and is discussed below.

This represents an extension of the original definition where the resistance r_c was a diffusive resistance within the leaves of a plant. r_b is defined as a bulk resistance involving all plant resistances. It is hoped that the bulk resistance r_b for a reference crop of a specific type will be the same for many locations. There are many species of grasses and it is doubtful if a single species would be adapted to the wide range of elevations encountered in the Green-Colorado River drainages. In fact, grass-like plants such as sedges and rushes may be useful in definitions of grass reference crop ET. If investigations show that an adapted grass for high elevation areas has the same resistance as a grass adapted to low elevations, then both grasses are suitable for selection as a reference crop and consistency for ET estimates for a wide range of conditons should result. In many ways, this amounts to bridging the gap between the definitions of reference crop and potential ET. In addition to the specification that the crop selected should be a specific adapted crop, it would also specify a consistent resistance value.

The resistance has the units of seconds per meter. Perhaps the inverse called conductance having the units of velocity is more meaningful. A resistance of zero only has meaning during daylight hours. Any resistance selected on a daily or longer basis is therefore, greater than zero. Any appreciable depletion of soil moisture will result in an increase in resistance and is contrary to definitions of reference crop ET.

Table 12 is a summary of preliminary calculations of Bulk Resistance r_b values for 1984 data collected in connection with this project and data from

other references for two locations which have supporting data relevant to the Green River area. Objective 7 calls for the collection of such data and of course, implies that the data be used.

The data involves an extremely wide range of elevations and climatic variations. The South Park sites were at an elevation of about 9400 feet above sea level. The Green River sites vary from about 6400 feet to 8000 feet above sea level and Davis, California is located at about 50 feet above sea level. Obviously, temperature conditions would be much different over such a wide range of elevations.

An inspection of Table 12 shows that Alta Fescue under conditions found in the Green River area has a significantly higher r_b than both the mountain meadow vegetation and the clipped grass found at Davis. This may be a result of the frequent clipping it received or the grass may not grow well at high altitudes.

The remainder of the r_b resistance data is remarkably consistent for the wide range of conditions encountered. This is especially true for the months when grass is very active in its growth, namely, the months of June and July. During these months, the grass most nearly fits the growth definitions for reference crop ET. It should be mentioned again that much of the vegetation found in "mountain meadows" is composed of grass-like plants such as sedges and rushes. r_b values for months early in the growing season may be influenced by cold conditions often found at high elevation although the data in Table 12 do not indicate such. Higher r_b values in August and September may be caused by maturation and/or dry soil conditions. The suggested values are lower than measured, but adjustments to actual conditions can easily be made using crop coefficients. The differences between actual and potential may also be included in suitable crop coefficients.

NEXT YEAR'S ACTIVITIES

The main activity will be two fold. First, extensive data analyses according to the objectives of the project will occupy a major part of project activities. Second, the writing and assembling of information for the final report will require extensive effort.

The lysimeters, weather stations, and fencing will be removed from their field locations in the Green River Basin if additional uses do not develop before the summer of 1986.

PERSONNEL

Dr. John Borrelli resigned from the University of Wyoming and accepted a position as Head of the Department of Agricultural Engineering at Texas Technical University. Tom Crump finished his graduate program at the University of Wyoming. Del Baird and Greg Kerr have been making most of the trips to the Green River Area to collect field data. Angela Vassar has been performing most of the computer programming and data management.

REPORTS AND PAPERS

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Table 1. Operation Summary of the Green River Basin Lysimeters.

Lysimeter Location	Site ID	Crop	1983 Start	1983 Stop	1984 Start	1984 Stop	1985 Start	1985 Stop
Farson	2A	Alt.Fes.	Jun 3	Oct 7	Apr27	Oct23	May21	Oct 7
Farson	2B	Alfalfa	Jun 3	Oct 7	Apr27	Oct23	May21	Oct 7
Merna	3A	Mtn.Med.	May25	Sep30	May17	Oct11	May22	Oct 9
Merna	3B	Mtn.Med.	May25	Sep30	May17	Oct18	May22	Oct 9
Horse Cr.	3C	Imp.Med	May25	Sep30	May15	Oct18	May22	Oct 7
Horse Cr.	3D	Mtn.Med.	May25	Sep30	May15	Oct18	May22	Oct 9
Horse Cr.	3F	Imp.Med.	May25	Sep30	May15	Oct18	May22	Oct10
Horse Cr.	3F	Imp.Med.	May25	Sep30	May15	Oct18	May22	Oct10
Daniel	4A	Alfalfa	May25	Sep30	May16	Oct11	May22	Oct 8
Daniel	4B	Alt.Fes.	May25	Sep30	May16	Oct11	May22	Oct 8
Daniel	4C	Mtn.Med.	May25	Sep30	May16	Oct11	May22	Oct 8
Daniel	4D	Mtn.Med.	May25	Sep30	May16	Oct23	May22	Oct 8
Seedskadee	6A	Alfalfa	Jun 1	Oct 6	Apr27	Oct23	May21	Oct 8
Seedskadee	6B	Alt.Fes.	Jun 1	Oct 6	Apr27	Oct23	May21	Oct 8

Table 2. Lysimeter Operation to Measure Actual Evapotranspiration

Lysimeter Location	Site ID	Dates Irrigation Was Discontinued 1984	1985
Merna	3B	Aug 9	Jul18
Horse Cr.	3C	Jul19	Jul18
Horse Cr.	3E	Jul19	Jul18
Daniel	4D	Jul11	Jul 7

Table 3. Operation Summary of Green River Basin Weather Stations.

Station Location	Site ID	1983 Start	1983 Stop	1984 Start	1984 Stop	1985 Start	1985 Stop
Rock Springs	1	Apr22	Oct 4	Apr31	Nov13	Apr14	*
Farson	2	Apr23	Oct 5	Apr31	Nov15	Apr14	*
Merna	3	May 7	Oct 5	May 1	Nov14	Apr14	*
Daniel	4	May13	Oct 5	Apr31	Nov14	Apr14	*
Big Piney	5	May 7	Oct 5	May 1	Nov13	Apr14	*
Seedskadee	6	Apr23	Oct 5	May 1	Nov13	Apr14	*
Mountain View	7	Apr22	Oct 4	May 1	Nov13	Apr14	*

* Station operation not stopped at date of report.

Table 4. Operation Summary of Evaporation Pans.

Location	1984 Start	1984 Stop	1985
Merna	May31	Oct18	May23 Oct 9
Daniel	May23	Oct11	May23 Oct 8
Seedskadee	May30	Oct17	May22 Oct 8

Table 5. Monthly Averages of Climatic Data (Green River Project - 1983) Station - Rock Springs.

Month	Max Temp (F)	Min Temp (F)	Max RH (%)	Min RH (%)	Solar Radtn (LY)	Wind Run (MI/DY)	D/N Wind Ratio	Dew Pt (F)	Total Precip (IN)
Apr	55	30	98	42	458	178	1.39	32.7	.16
May	60	32	96	34	590	202	1.45	31.2	1.34
Jun	73	41	96	28	640	153	1.57	40.1	1.34
Jul	84	46	91	18	621	150	1.47	39.5	.87
Aug	88	51	93	17	582	136	1.42	44.8	.59
Sep	74	40	87	21	492	175	1.58	33.5	.35

Table 6. Monthly Averages of Climatic Data (Green River Project - 1984) Station - Rock Springs.

Month	Max Temp (F)	Min Temp (F)	Max RH (%)	Min RH (%)	Solar Radtn (LY)	Wind Run (MI/DY)	D/N Wind Ratio	Dew Pt (F)	Total Precip (IN)
Apr	50	24	93	42	428	200	1.33	24.5	.55
May	69	36	81	23	568	233	1.57	29.3	.43
Jun	75	41	80	21	573	172	1.55	33.1	.83
Jul	86	50	83	17	615	153	1.55	40.6	.79
Aug	84	50	83	18	526	139	1.49	41.0	.94
Sep	69	37	86	24	451	169	1.44	32.8	1.57
Oct	54	26	90	28	319	163	1.39	23.2	.24
Nov	47	23	96	38	214	203	1.31	24.2	.24

Table 7. Monthly Averages of Climatic Data (Green River Project - 1985) Station - Rock Springs.

Month	Max Temp (F)	Min Temp (F)	Max RH (%)	Min RH (%)	Solar Radtn (LY)	Wind Run (MI/DY)	D/N Wind Ratio	Dew Pt (F)	Total Precip (IN)
Apr	60	28	80	20	546	196	1.64	18.8	.12
May	72	36	78	15	615	164	1.65	24.1	.43
Jun	81	45	56	16	687	170	1.55	24.0	.63
Jul	89	52	73	11	617	131	1.62	34.2	.39
Aug	85	45	43	11	628	115	1.61	19.9	.04
Sep	68	35	82	18	439	139	1.86	24.3	.91

Table 8. Average Daily ET for Lysimeter 4A.

1983		1984		1985	
Date	ET (in)	Date	ET (in)	Date	ET (in)
7/09	0.00	5/17	0.00	5/23	0.00
7/15	0.20	5/23	0.08	5/29	0.17
7/22	0.16	5/30	0.14	6/05	0.25
7/29	0.19	6/06	0.14	6/12	0.20
8/04	0.00	6/13	0.13	6/19	0.31
8/10	0.23	6/21	0.18	6/26	0.42
8/19	0.12	6/27	0.39	7/03	0.33
8/24	0.43	7/06	0.27	7/10	0.33
9/02	0.19	7/13	0.29	7/17	0.48
9/11	0.21	7/18	0.54	7/24	0.49
9/16	0.13	7/26	0.19	7/31	0.28
9/24	0.18	8/02	0.20	8/07	0.26
9/30	0.11	8/08	0.16	8/14	0.23
		8/16	0.21	8/20	0.16
		8/22	0.16	8/28	0.20
		8/29	0.17	9/06	0.25
		9/05	0.18	9/12	0.24
		9/12	0.18		
		9/19	0.13		
		9/26	0.10		
		10/04	0.09		
		10/11	0.10		
		10/18	0.07		

Table 9. Weekly Averages of Climatic Data (Green River Project)
Station - Rock Springs.

Mo	Dy	Yr	Max Temp (F)	Min Temp (F)	Max RH (%)	Min RH (%)	Dew PT (F)	Solar Radtn (LY/DY)	Total Precip (IN/WK)	Wind Run (MI/DY)	D/N Wind Ratio
5	03	83	53.3	31.5	100	48	34.8	456	.59	174	1.5
5	10	83	59.3	31.1	88	26	26.4	601	.00	235	1.4
5	17	83	46.8	26.3	99	53	28.8	493	.39	234	1.3
5	24	83	63.7	31.6	100	32	33.1	641	.24	195	1.5
5	31	83	75.6	38.3	95	19	35.1	686	.28	145	1.6
6	07	83	64.6	39.9	100	50	45.2	528	1.06	124	1.4
6	14	83	68.9	40.3	99	29	40.2	650	.28	178	1.5
6	21	83	77.5	40.4	88	16	33.2	778	.00	171	1.7
6	28	83	79.2	45.2	95	21	41.5	622	.00	147	1.6
7	05	83	76.4	40.8	99	23	38.2	594	.12	149	1.4
7	12	83	82.7	45.2	95	18	40.0	669	.16	174	1.5
7	19	83	86.1	43.5	79	12	31.0	679	.04	156	1.6
7	26	83	83.6	51.0	94	23	48.2	511	.55	131	1.4
8	02	83	88.6	51.7	89	15	43.7	631	.00	136	1.5
8	09	83	93.4	52.7	90	12	43.5	633	.00	119	1.3
8	16	83	88.3	56.0	95	18	49.5	576	.20	142	1.5
8	23	83	83.1	51.4	99	24	49.4	555	.39	144	1.4
8	30	83	56.0	43.3	88	12	34.4	549	.00	137	1.4
9	06	83	78.9	45.9	89	26	41.7	497	.16	175	1.4
9	13	83	78.2	40.3	95	17	36.2	553	.04	160	1.7
9	20	83	71.8	36.5	73	14	21.8	539	.00	233	1.8
9	27	83	72.0	35.2	88	21	31.1	458	.16	136	1.5
10	04	83	63.3	38.7	96	37	39.6	339	.20	183	1.4

Table 10. Weekly Averages of Climatic Data (Green River Project) Station - Rock Springs.

Mo	Dy	Yr	Max Temp (F)	Min Temp (F)	Max RH (%)	Min RH (%)	Dew PT (F)	Solar Radtn (LY/DY)	Total Precip (IN/WK)	Wind Run (MI/DY)	D/N Wind Ratio
4	12	84	47.7	26.1	91	44	24.7	389	.08	263	1.2
4	19	84	61.3	25.1	91	25	24.0	515	.04	167	1.3
4	26	84	46.1	24.1	92	52	25.9	356	.28	224	1.3
5	03	84	47.6	25.5	96	44	26.4	486	.12	219	1.6
5	10	84	60.2	28.6	78	21	21.3	552	.00	240	1.7
5	17	84	74.0	35.9	87	24	34.6	552	.16	213	1.6
5	24	84	72.7	42.4	77	20	31.6	594	.20	241	1.6
5	31	84	74.7	37.0	74	18	28.9	608	.04	211	1.4
6	07	84	64.9	35.4	89	32	33.3	512	.31	212	1.5
6	14	84	69.7	37.3	91	22	32.9	566	.43	177	1.5
6	21	84	79.3	44.0	80	14	34.3	563	.00	159	1.7
6	28	84	83.7	44.4	64	12	29.6	706	.00	143	1.7
7	05	84	84.5	44.4	75	15	33.9	684	.08	191	1.6
7	12	84	87.5	47.7	86	14	38.7	611	.08	148	1.6
7	19	84	88.8	48.8	69	12	32.8	647	.00	135	1.4
7	26	84	85.6	53.9	95	25	50.8	543	.63	152	1.6
8	02	84	84.0	54.9	92	26	50.5	546	.16	138	1.5
8	09	84	86.8	47.0	84	13	37.0	592	.00	115	1.6
8	16	84	86.5	52.6	83	19	44.9	479	.16	120	1.4
8	23	84	81.4	51.4	93	22	44.7	509	.59	126	1.5
8	30	84	81.9	49.3	72	18	35.6	532	.08	182	1.4
9	06	84	78.9	41.4	79	17	31.5	494	.63	195	1.6
9	13	84	71.4	45.7	74	29	37.6	430	.28	244	1.5
9	20	84	77.5	39.9	92	17	37.6	463	.24	115	1.5
9	27	84	56.3	29.9	94	34	29.9	408	.47	170	1.4
10	04	84	63.4	28.9	92	24	28.7	375	.00	100	1.4
10	11	84	69.3	33.1	85	16	26.0	388	.00	136	1.6
10	18	84	43.8	22.9	88	34	18.5	278	.08	240	1.4
10	25	84	37.5	10.3	96	37	14.8	303	.04	113	1.1
11	01	84	43.1	22.5	97	37	20.6	258	.12	175	1.1
11	08	84	49.2	24.2	96	36	25.1	210	.24	214	1.3

Table 11. Weekly Averages of Climatic Data (Green River Project)
Station - Rock Springs

Mo	Dy	Yr	Max Temp (F)	Min Temp (F)	Max RH (%)	Min RH (%)	Dew PT (F)	Solar Radtn (LY/DY)	Total Precip (IN/WK)	Wind Run (MI/DY)	D/N Wind Ratio
4	26	85	45.8	24.0	85	26	15.9	467	.00	261	1.6
5	03	85	74.9	30.5	69	13	19.8	663	.08	105	1.7
5	10	85	70.4	36.8	69	18	21.4	565	.16	178	1.6
5	17	85	64.6	34.6	75	16	20.5	598	.16	205	1.3
5	24	85	75.9	36.9	91	13	29.2	663	.04	119	1.7
5	31	85	77.5	38.2	85	12	27.0	633	.00	178	2.0
6	07	85	93.6	41.3	96	9	28.7	755	.00	164	1.7
6	14	85	81.9	46.4	39	11	19.8	749	.00	193	1.5
6	21	85	84.2	48.6	34	11	20.6	761	.00	176	1.5
6	28	85	75.0	39.8	80	27	30.2	571	.63	145	1.6
7	05	85	91.5	47.2	66	9	25.7	689	.00	138	1.6
7	12	85	94.4	56.1	51	9	28.9	626	.04	127	1.5
7	19	85	88.8	53.5	81	11	38.5	582	.00	131	1.5
7	26	85	82.9	52.1	95	15	41.5	585	.35	134	1.7
8	02	85	84.3	50.2	70	12	31.9	607	.00	127	1.8
8	09	85	85.2	45.5	39	11	19.6	684	.00	179	1.8
8	16	85	79.2	42.0	46	12	18.8	647	.04	156	1.7
8	23	85	85.7	44.2	52	10	20.6	614	.00	108	2.0
8	30	85	91.4	45.5	35	9	19.9	558	.00	33	1.0
9	06	85	81.1	46.5	65	13	28.3	521	.08	112	1.6
9	13	85	70.1	35.9	81	16	25.3	438	.47	127	2.2
9	20	85	69.5	36.7	84	20	27.8	402	.24	136	1.8
9	27	85	60.6	29.3	87	20	20.5	420	.12	186	1.9
10	04	85	56.2	23.1	63	19	11.3	448	.00	165	1.4

Table 12. Summary of Bulk Resistance Calculations, October 1985, Provisional Values, Green River ET Project.

Location	May	June	July	Aug	Sept	Comments
Merna	89	46	105	774		Mtn. Mead. Potential 1984
Daniel	95	77	103	153	153	Mtn. Mead. Potential 1984
South Park	99	69	100	202	120	Ave. Data, Kruse and Haise
AVERAGES	94	64	123	349	136	
Davis, CA	97	95	112	140	150	Ten Yr. Ave., Clipped Gr.
Daniel	483	226	146	165	123	Alta Fescue, Clipped 1984
Farson	276	165	165	203	121	Alta Fescue, Clipped 1984
Seedskadee	110	116	139	149	129	Alta Fescue, Clipped 1984
AVERAGES	290	169	151	172	124	
Ref. Crop	95	65	120	120	135	Proposed for Green River Area