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Wyoming's Response to the US and Tribes, Volume VI, Appendix B, Part 1

Attorney General, State of Wyoming

WYOMING'S RESPONSE TO THE UNITED STATES' AND TRIBES' PROPOSED FINDINGS OF FACT, CONCLUSIONS OF LAW, INTERLOCUTORY DECREE AND SUPPORTING BRIEFS

VOLUME VI

Appendix B

(Part 1)

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Margaret V. Hampton CLERK

DEPUTY

IN THE DISTRICT COURT OF THE
FIFTH JUDICIAL DISTRICT
STATE OF WYOMING

IN RE: THE GENERAL ADJUDICATION OF ALL RIGHTS TO USE WATER IN THE BIG HORN RIVER SYSTEM AND ALL OTHER SOURCES, STATE OF WYOMING	)))))	CIVIL NO. 4993

VOLUME 6

APPENDIX B

(PART 1)

This Part 1 of Appendix B responds to the Tribes' Proposed Findings of Fact 1 through 97. Each Proposed Finding to which Wyoming responds is reproduced verbatim on a single page with Wyoming's response thereto on the page or pages immediately following.

N.B. Wyoming has not responded to every finding of fact proposed by the Tribes but the lack of a response to a finding should not be construed as an admission of the relevance or accuracy of such finding.

Tribes' Proposed Finding of Fact:

2. The government and the Tribes relied on witnesses from the firm of Hurlbut, Kersich and McCullough (HKM), of Billings, Montana, as their experts in the first part of the practicably irrigable trust lands claim, that of identifying the arable lands (Tr. V. 10, p. 1127). The Tribes did not offer any other witnesses on this part.

Wyoming's Response:

2. It must be noted that HKM did not directly present evidence regarding arability of Indian-owned fee land. Their analysis was only with respect to lands claimed to be held in trust by the United States. U.S. Exhs. C-43 and C-226.

Tribes' Proposed Finding of Fact:

3. HKM's land classification was divided into identifying arable lands of two basic categories:

A. Lands that have never been irrigated ("future lands"), and

B. Lands, either within or without present Federal Indian (Irrigation) Projects (FIPs), that once have been irrigated or can be irrigated by existing facilities ("idle lands").

Wyoming's Response:

3. HKM did not identify arable land for "future" or "idle" lands with respect to Indian-owned fee tracts. See Wyoming's Response to Tribes' Proposed Finding of Fact 2.

Tribes' Proposed Finding of Fact:

A. Future Lands

1. Future Lands -- Soils

4. The United States and the Tribes presented their cases as to the future and idle irrigable trust lands in three basic steps. First, they submitted evidence on the soils studies and land classification conducted by HKM to identify those Reservation lands which were physically capable of sustaining irrigation without primary regard to engineering or economic evaluations, (a status they called "arable lands"). Second, they presented engineering designs, fashioned by other firms of experts, to irrigate and drain the previously identified arable lands. Third, they presented economics experts to show that arable lands for which engineering plans had been designed were practicably irrigable. (Tr. V. 11, pp. 1205-06.)

Wyoming's Response:

4. The State takes considerable exception to the methods and conclusions of the HKM arable land determinations. A summary of the deficiencies of the HKM arable lands study are presented in Wyoming's Amended Proposed Finding of Fact 18-8 and support therefor. One of the most disturbing deficiencies is HKM's lack of consideration of explicit economics in the standards and definitions. The HKM definition of arable land, the primary definition upon which the entire future lands claim is based, is ambiguous and lacks any explicit economic considerations. The HKM definition does not include a determination that sufficient income will be generated to warrant further consideration for irrigation development, which the Bureau of Reclamation considers necessary. Both Mr. Waples and Mr. Kersich of HKM define arable land as "those lands capable of sustained irrigation." U.S. Exh. WRIR C-43 (p. 28); Tr. 1101, 1145, 1152, 1295 (Kersich); U.S. Exh. WRIR C-226 (p. 40). Mr. Waples and Mr. Kersich further ambiguously define sustained irrigation as "the ability of a soil to produce a relatively high yield of crops under irrigation over a long period of time without deterioration." U.S. Exh.

WRIR C-43 (p. 31); U.S. Exh. WRIR C-226 (p. 45). The Bureau of Reclamation defines arable land with specific reference to economics. The Bureau's definition of arable land is "state of the art" in arable land determinations for irrigation:

> land which when farmed in adequate size units for the prevailing climatic and economic setting and provided with the essential onfarm improvements of removing vegetation, leveling, soil reclamation, drainage, and irrigation related facilities will generate sufficient income under irrigation to pay all farm production expenses; provide a reasonable return to the farm family's labor, management, and capital; and at least pay the operation, maintenance, and replacement costs of associated project irrigation and drainage facilities. The arable area comprises all land delineated in the land classification that will provide sufficient income to warrant consideration for irrigation development.

Wyo. Exh. WRIR SK-4 (Section 2.1.2A); Wyo. Exh. WRIR SK-5 (Section 115.2.3G) includes virtually the same definition.

Tribes' Proposed Finding of Fact:

5. The primary expert from HKM concerning the future soils studies was A. T. Kersich, who headed the firm's study effort (Tr. V. 10, pp. 1097, 1127). Mr. Kersich is president of HKM and principal-in-charge of its water resources section (id., p. 1097). He has had considerable other experience in the same kind of arable land studies on other Indian reservations and has testified as a similar project leader and expert witness for the United States in another Indian water rights case (id., pp. 1101-03, 1105-12) where his testimony formed one basis for the Master's opinion. Mr. Kersich is a registered professional engineer in the States of Wyoming, Montana, North Dakota, Utah and New Mexico, and, at the time he testified in this case, was president-elect of the National Council of Engineering Examiners (id., p. 1099; U.S. Ex. C-34). I find Mr. Kersich to be a well-qualified expert in the areas of his testimony.

Wyoming's Response:

5. Mr. Kersich's testimony regarding the arability of future lands is not within his area of expertise. The experience and qualifications of any agricultural engineer in a land classification program are of interest only in the creation and review of standards, not in the actual determination of arability. Wyo. Exh. WRIR SK-4 (Sec. 2.7.3). An agricultural engineer is totally out of his element in determining or testifying to land arability. According to Mr. Dick Piper, director of land classification for the Bureau of Reclamation, soil scientists, not agricultural engineers, certify the arable lands for the Bureau of Reclamation. Wyo. Exh. WRIR SS-A13 (Item 2). Yet in HKM's study, Mr. Kersich, who is not a soil scientist, made the final land classification determinations for future tracts in a questionable status. Tr. 3311 (Waples). There is no indication in the Record that Mr. Kersich has any previous field experience in soil science or land classification prior to his limited involvement in this case. Mr. Kersich has never mapped soils and has logged but a few holes on the Wind River Indian Reservation. Tr. 1221-1224 (Kersich).

In addition, Mr. Kersich admitted that he did not possess knowledge of the geology of the area. Tr. 1723 (Kersich). He was also confused about the exact standards that were used in arable land study. Tr. 10847 (Sommers); Tr. 1139-1149 (Kersich).

Tribes' Proposed Finding of Fact:

6. Mr. Kersich's testimony for the case was on future lands. He was supported in his testimony by two other qualified experts from HKM, Mr. Ross Waples and Mr. Robert Toedter, who both worked on the land classification standards for the historic lands as well as future lands (Tr. Vs. 38-45).

Wyoming's Response:

6. Mr. Kersich is not qualified to testify to the arability of future lands. See Wyoming's Response to Tribes' Proposed Finding of Fact 5.

Tribes' Proposed Finding of Fact:

7. Mr. Waples qualified as an expert witness in land classification and soils science (Tr. V. 38, pp. 3297, 3315; U.S. Ex. C-157). With his previous experience in personally classifying some 88,000 acres of land, he worked closely with Mr. Kersich, Mr. Toedter and other personnel from HKM to classify about 40,000 acres on the Wind River Reservation (Tr. V. 38, pp. 3288-90).

Wyoming's Response:

7. The Special Master commented on Mr. Waples' "limited" experience. Tr. 3309. Mr. Waples has no experience in Wyoming except for work done in conjunction with this case. U.S. Exh. WRIR C-157; Tr. 3289 (Waples). Nevertheless, Mr. Waples was admitted as an expert in land classification and soil science. Tr. 3315 (Waples).

Tribes' Proposed Finding of Fact:

8. Mr. Toedter was qualified to testify as an expert in agricultural engineering specializing in irrigation and drainage (Tr. V. 43, p. 3730). His background consisted of experience in land classification and drainage engineering on various irrigation projects (id., pp. 3702-07; U.S. Ex. C-230).

Wyoming's Response:

8. Mr. Toedter has no experience in land classification. His previous experience is with irrigation and drainage design, management, and scheduling. Tr. 3702-3707 (Toedter).

Tribes' Proposed Finding of Fact:

10. To evaluate these study areas for arability, BKM developed land classification standards, one set that applied to lands susceptible of both gravity and sprinkler irrigation (hereinafter "gravity lands"), and one set that applied to lands capable of sprinkler irrigation (hereinafter "sprinkler lands") (Tr. V. 10, pp. 1126-27; U.S. Exs. C-36 and C-43, pp. 10-12). Each set was site specific and was based upon land classification studies of the Bureau of Reclamation and soils surveys of the BIA and SCS.

Wyoming's Response:

10. The soil studies of the BIA and Soil Conservation Service (SCS) have little value in developing land classification standards for arability.

The Bureau of Indian Affairs' Soil and Range Resources Inventory of the Wind River Indian Reservation, published in 1962, did not evaluate arability or irrigability of Wind River Indian Reservation lands. Information contained within the mapping units related specific information about soils, but did not classify soils in terms of arability or irrigability. Wyo. Exh. WRIR SF-1 (pp. 14-15).

The Bureau of Indian Affairs' Inventory of Water Resources, Wind River Indian Reservation, Phase II - Needs and Uses, published in 1972, is a compendium of reservation history, economy, sociology and resources. No field investigations were conducted and all information contained in this report is from pre-existing studies. It was also not intended to evaluate irrigation potential but only to provide information pertinent to the protection of Indian water rights. U.S. Exh. WRIR C-50 (Sections I, II, III, V and X).

The SCS conducted a soil survey of the Riverton area in 1963-67. This report does not contain information necessary to determine arability or irrigability of new lands. In 1974, the SCS published the Soil Survey of the Riverton Area. The majority of the field work was performed in 1963-67. The primary intent of this publication was to provide information concerning the use and management of soils which occur within part of the Wind River Basin. Part of this report is devoted to management of irrigated soils and the general response of soils to irrigation. Capability groupings were also provided showing the general suitability of soils for most kinds of field crops. This system does not take into account landforming or reclamation projects which may be required. U.S. Exh. WRIR CF-1 (pp. 1-2, 31-40).

The HKM land classification standards, without justification, are significantly relaxed relative to the Bureau of Reclamation standards. In addition to their failure to consider economics (see Wyoming's Response to Tribes' Proposed Finding of Fact 4), HKM's standards vary from the Bureau of Reclamation's in several other important aspects, including:

1. Depth to barrier of seven feet in the Bureau of Reclamation standards versus six feet for the HKM standards. Wyo. Exh. WRIR SK-10; U.S. Exh. WRIR C-36A.

2. The maintenance by the Bureau of a 40-acre minimum size for sprinkler irrigation; 40 acres was also used as a minimum by HKM but later relaxed when hand-moved or solid set sprinklers were considered. Wyo. Exh. WRIR SK-10; U.S. Exh. WRIR C-36A.

3. The maximum slopes allowed as a general rule for the Bureau of Reclamation were 5 to 8% for sprinkler and gravity with the exception that minor areas of steeper topography could be included for sprinkler irrigation. The HKM land classification standard for slope ranged as high as 20% under sprinkler irrigation. Wyo. Exh. WRIR SK-10; U.S. Exh. WRIR C-36A; Tr. 11043-11044 (Sommers).

4. The Bureau of Reclamation only used Classes 1, 2 and 3 on the Muddy Ridge Area; the Bureau of Reclamation did not include Class 4, though HKM did. Wyo. Exh. WRIR SK-10; U.S. Exh. WRIR C-36A; Tr. 1442 (Kersich).

5. The Bureau of Reclamation drainage manual sets forth a minimum standard for hydraulic conductivity of 0.2 inches per hour. Tr. 3912 (Toedter); Wyo. Exh. WRIR SS-A-15 (p. 118). Mr. Toedter established a hydraulic conductivity standard of 0.1 inch per hour as a minimum to maintain the water table below the root zone. Tr. 3737-3738 (Toedter).

6. The Bureau of Reclamation defines barrier as any stratum having one-fifth of the weighted average hydraulic conductivity of the strata above it. Tr. 10781-10782 (Sommers); Wyo. Exh. WRIR SS-A15 (p. 118). Mr. Toedter defined barrier as hard sandstone, shale or a stratum with one-tenth of the weighted average hydraulic conductivity of the strata above it. Tr. 3759, 3762 (Toedter).

7. The Bureau of Reclamation in the Riverton area has found that drain spacing of less than 350 feet is generally uneconomical. Tr. 11157 (Sommers); Wyo. Exh. WRIR SF-2. Considering the parameters of depth to barrier and hydraulic conductivity, Mr. Toedter established a drain spacing minimum of 200 feet. Tr. 3739 (Toedter). Lands which cannot meet the 200-foot

drain spacing minimum standard cannot, in Mr. Toedter's opinion, economically support lower-valued crops. Tr. 3898 (Toedter). The drainage costs for land with a 200-foot drain spacing are $1600.00 per acre. Tr. 3893-3898 (Toedter). In addition, the cost for the five future projects was considered a project cost instead of an on-farm cost and resulted in an increase of the classification of some lands by one or two classes. Tr. 3898-3911 (Toedter).

Thus, the Bureau of Reclamation land classification standards and definitions, widely (and locally) accepted as state-of-the-art, were significantly relaxed by HKM. This is especially without justification in the geologically complex Wind River Basin and severely impairs the reliability of the conclusions of the United States' experts.

Tribes' Proposed Finding of Fact:

11. Mr. Kersich classified the future lands of the six study areas either Class 1, 2, 3, 4, 5 or 6. Lands in each class are described generally as follows:

Class	Description
1	High quality for irrigation and would yield high crop returns with minimum production or management costs.
2	Good quality with only minor deficiencies.
3	Fair quality lands with some more serious problems than Class 2 lands.
4	Marginal quality for irrigation and used mainly for shallow-rooted crops or pasture.
5	Placed in a deferred status pending further classification investigation. (No lands were so included by HKM.)
6	Do not meet minimum requirements to be classified as arable. (U.S. Ex. C-43, pp. 8-9.)

Wyoming's Response:

11. HKM land classes vary considerably from the land classes in the "state-of-the-art" Bureau investigations. Mr. Kersich used an ambiguous definition of land class which lacks explicit economic considerations: "a category of lands having similar physical and economic characteristics which affect the suitability of land for sustained irrigation." U.S. Exh. WRIR C-43 (p. 29); U.S. Exh. WRIR C-226 (p. 41). The Bureau of Reclamation defines arable land classes with specific reference to economics:

> a designation for a body of land, within a specific project, having soil, topography, and drainage characteristics which result in a similar economic level of suitability for irrigation. Land classes are mutually exclusive; i.e., pertinent factors are arranged in discrete, nonoverlapping, and determinate groups or divisions in the classification and represent relative levels of payment capacity.

Wyo. Exh. WRIR SK-5 (Section 115.2.3M). The definition contained in Wyo. Exh. WRIR SK-4 (Section 2.1.2G) is very similar.

Tribes' Proposed Finding of Fact:

12. HKM conducted its investigation of the future study areas on a modified semi-detailed level of intensity (Tr. V. 10, p. 1156), as defined by minimum standards of the Bureau of Reclamation for such work (U.S. Ex. C-43, p. 14). This varied from the Bureau of Reclamation semi-detailed criteria by increasing the number of augered holes greater than six feet in depth in every arable section of land (id., p. 15). HKM personnel reviewed the previous studies by other investigators including the Bureau of Reclamation. Mr. Kersich, Mr. Toedter, Mr. Waples and other HKM personnel working under their direction all used the land classification standards developed for this project by these three experts (Tr. V. 10, pp. 1119-21, 1127). They studied the future lands areas from the standpoint of soil texture; structure; depth to sand, gravel, bedrock or zones restricting water movement; and alkalinity or salinity (U.S. Ex. C-43, p. 15). HKM experts evaluated topography by general slope, size and shape of field (id.). They appraised soil drainage with the view to anticipated irrigation conditions, including such factors as the water table rising into the expected root zone, depth to barrier, and the position and proximity of the studied field to other arable lands (id.).

Wyoming's Response:

12. The second sentence of this Proposed Finding of Fact: "This varied from the Bureau of Reclamation semi-detailed criteria by increasing the number of augered holes greater than six feet in depth in every section of arable land" is a misquote and should read: "An attempt was made to auger at least one hole deeper than six feet in every arable section." U.S. Exh. C-43 (p. 15) (emphasis added). If the attempt referred to in U.S. Exh. C-43 (p. 15) was made, it was unsuccessful. In reality, there are many, many sections of arable land without holes deeper than six feet. Wyo. Exhs. WRIR SS-45A-E thru 54A-E.

In addition, the Tribes' comparison of the HKM level of detail to the Bureau minimum criteria is of no consequence. In reality, the level of detail of the Bureau studies on the Reservation far exceeds the level of detail of the HKM study. The drainage investigation intensity for the North Crowheart area was about 40 arable acres per hole or pit based on 18,631 acres and 468 holes and pits, nearly all of which are 6 feet or deeper. The Bureau's drainage investigation for the five areas roughly corresponding to the HKM study areas for future projects has an intensity of about 57 acres per hole, nearly all of

which are 6 feet or deeper. Wyo. Exh. WRIR SS-9; Wyo. Exh. WRIR SK-9A (p. 8); Wyo. Exh. WRIR SF-2 (pp. 14, 24, 33, 39, 49); Wyo. Exh. WRIR SS-6 (pp. 3, A1). HKM utilized a total of 325 holes over 5 feet for the 84,000 arable acres, for an average intensity of over 250 acres per hole. U.S. Exh. WRIR C-43, (pp. 15-16). Thus the HKM intensity of holes 5 feet and greater is only one-fourth the intensity of the Bureau investigation of holes 6 feet and greater.

Tribes' Proposed Finding of Fact:

13. To develop the soils profiles of these future lands, in addition to reviewing the existing records of bored lands, HKM bored one 10-foot hole for the predominant land form in each section and as many 5-foot holes as the land classifier deemed necessary for accurate classification (U.S. Ex. C-43, p. 15). One hundred ninety-seven borings between 5 and 10 feet in depth and 357 borings of 5 feet or less were augered and logged, and 9 backhoe pits were dug in representative soils (id., p. 16). One hundred seventeen deep holes were drilled and logged (id.).

Wyoming's Response:

13. There is no testimony or evidence in the Record that HKM bored a 10-foot hole for the predominant land form in each section. In addition, the HKM land classification determined considerably more acreage with considerably less investigation intensity than the Bureau of Reclamation. See Wyoming's Response to Tribes' Proposed Finding of Fact 12.

Tribes' Proposed Finding of Fact:

15. Soils in the field were subjected to 11 infiltration tests and 22 hydraulic conductivity tests, all for the purpose of developing soil permeability characteristics (U.S. Ex. C-43, p. 16). The drainage studies of the future lands were conducted by Mr. Toedter to determine whether it was necessary to install drainage systems to supplement natural drainage (id., pp. 16-18; Tr. Vs. 43-45).

Wyoming's Response:

15. The 22 hydraulic conductivity tests were all run on only 4 of the total 23 soil textural classes used by HKM. The remaining values were estimates. Tr. 3913-3914 (Toedter); Wyo. Exh. WRIR BT-1. Contrary to the context of this proposed finding, Dr. Mesghinna, not Mr. Toedter, acted as the drainage engineer in this litigation. In addition to determining that the drainage standards were met in the land classification program, Mr. Toedter's only responsibility was to determine the average depth to barrier and hydraulic conductivity within study areas of allegedly uniform conditions. This information was transmitted to Dr. Mesghinna, who was referred to as the drainage engineer by Mr. Toedter and counsel for the United States, for his use in drainage engineering and design. Tr. 3823-3827 (Toedter). For additional support, see United States' Proposed Findings of Fact 33 and 125.

Tribes' Proposed Finding of Fact:

17. Both Mr. Fowkes and Mr. Sommers reviewed much of the HKM data but spent limited time in the field on the Reservation (Tr. V. 120, pp. 10869-70). The thrust of their testimony was to question the amount of arable land that HKM identified. Mr. Fowkes testified that, in his view, HKM had not done sufficient field testing to account for the geologic complexity that he said existed within the Reservation (Tr. V. 116, pp. 10560-63). His testimony was general in nature, and Mr. Fowkes presented no acreage totals he felt should be deleted from those identified as arable by HKM. Mr. Sommers questioned the specificity and completeness of the HKM land classification standards (Tr. V. 119, pp. 10843-54) and the accuracy of some HKM data in some cases (Tr. V. 121, p. 10938). Mr. Sommers relied on two primary factors in deleting land from HKM's totals. First, he relied on the findings of a Bureau of Reclamation study. This study was for gravity irrigation only. It was performed almost 20 years ago. Particularly since HKM used this same Bureau study as a supplement to their own intensive field effort, I find Mr. Sommers' testimony in this regard to be unpersuasive. Second, Mr. Sommers testified that each parcel without a 6-foot hole should be deleted, because there was not sufficient information to determine depth to barrier. Mr. Sommers is not a drainage engineer and did not have a drainage engineer working with him.

Tribes' Proposed Finding of Fact:

His "six-foot-hole-in-every-parcel" standard does not take into account the possibility of cut banks, or other alternative means for assuring that barrier is at least six feet. Nor did it allow for the judgment of the only drainage engineer to testify -- Mr. Toedter of HKM -- as to depth to barrier in major land forms. Given the expertise of HKM and the vast amount of work they did, I reject Mr. Sommers' suggestion that still more work by HKM was needed to make arability determinations. Mr. Sommers summarized his revisions to the HKM conclusions on the various classes of arable lands within the six study areas in State's Ex. SS-255, which shows a total of 50,640 acres arable by gravity and 48,910 acres arable by sprinkler.

Wyoming's Response:

17. Mr. Fowkes is eminently qualified to testify on geologic complexity and soils of the Wind River Indian Reservation. His expertise, with over 25 years experience, is evaluating the sufficiency, accuracy and reliability of soils-related work. He did just that in evaluating the HKM land investigation. Tr. 10537, 10556, 10602-10610 (Fowkes); see also Wyoming's Amended Proposed Finding of Fact 18-9 and support therefor.

Mr. Sommers is equally qualified to testify and evaluate the work done by HKM. Mr. Sommers has far more experience in soils and land classification than either Mr. Waples, the United States' soils witness, or Mr. Kersich, the United States' agricultural engineer who testified regarding arability. Mr. Sommers has classified over 410,000 acres in his career, for purposes including strip mine reclamation, with over 82,000 acres in Wyoming. Wyo. Exh. WRIR SS-A2. Mr. Waples, who has classified less than 130,000 acres of land, testified that:

> The actual mechanical process (of testing lands to determine the potential quality of soils and lands for strip mining reclamation) is all but identical . . . the same exact parameters that go into irrigation, into drainage.

Tr. 3287 (Waples). See also Wyoming's Amended Proposed Finding of Fact 18-9 and support therefor.

There is no indication in the record that Mr. Kersich has any previous field experience in soil science or land classification prior to his limited involvement in this case. Mr. Kersich has never mapped soils and has logged but a few holes on the Wind River Indian Reservation. Tr. 1221-1224 (Kersich). Mr. Kersich is not qualified to testify to land arability. See Wyoming's Response to Tribes' Proposed Finding of Fact 5.

Mr. Sommers relied on many more than just two factors in evaluating the HKM arable land base. The State evaluation of arable lands is a synthesis of many work products on the Wind River Indian Reservation. This includes information from HKM, the Bureau of Reclamation, and field work conducted by State experts. For educational and informational purposes, Mr. Sommers reviewed many published studies and references of the Bureau of Reclamation including Wyo. Exhs. WRIR SS-A3, SS-A4, SS-A6, SS-A7, SS-A8, and SS-A9; Tr. 10794-10801, 10869-70, 10912, 10937 (Sommers).

In the absence of an opportunity to perform a new study, a procedure was recommended by Mr. Fowkes and followed by Mr. Sommers. The procedure involved evaluating the HKM arable land base by taking their data and supporting information at face value and supplementing

that with additional information from Bureau of Reclamation and State investigations, then comparing those three sets of information. This included the Bureau of Reclamation maps and logged hole information as well as all of the HKM and State information. Thus, Mr. Sommers considered all available information, not just that to support a particular desired result. Tr. 10643-10648 (Fowkes); 10869-10870, 10912-10914 (Sommers).

The first of the two factors which the Tribes claim Mr. Sommers relied upon, the Bureau of Reclamation study, was utilized by the State in its evaluation of arable lands and is a reliable source. The Bureau is widely recognized as the authority on arable land classification and its methods are state-of-the-art. See Wyoming's Amended Proposed Finding of Fact 15-3 and support therefor. Although completed in the 1960s, the quality of the investigation is more important than its date since soil characteristics of native lands do not change within a matter of decades. Although soil science and land classification methods have improved, no major refinements have been made since the early 1960s. The Bureau of Reclamation has not significantly changed its general instructions regarding land classification since 1953. Compare Wyo. Exhs. SK-4 and SK-5. Even more

importantly, the Bureau of Reclamation in the Riverton area has used basically the same standards since the early 1960s, both on and off the Reservation. The Bureau classification standards used for the Wind River Indian Reservation in the early 1960's do not significantly differ from those used in 1978 on Muddy Ridge. Compare Wyo. Exhs. SF-1 and SK-10.

Mr. Sommer's testimony regarding the States' use of the Bureau of Reclamation study is even more persuasive for at least four reasons:

1. The Bureau Study is considerably more intense than the HKM study. The Bureau of Reclamation specifically instructs land classifiers that "the number of examinations and analyses should be increased as necessary to meet specific objectives or with the complexity of the area." Wyo. Exh. WRIR SK-4 (Section 2.6.5). Because of geologic complexity and the complex nature of drainage problems on the Reservation, the Bureau has found it necessary to conduct a more intensive investigation than usual for a semi-detailed investigation. Its 1964 drainage studies on the Reservation were characterized as: "Although this investigation is of a semi-detailed

nature, every effort was made to find the depth of soil to the shale or sandstone barrier and to determine the permeability of the soil." Wyo. Exh. WRIR SF-2 (p. 6). The drainage investigation intensity for the North Crowheart area was about 40 arable acres per hole or pit based on 18,631 acres and 468 holes and pits, nearly all of which are six feet or deeper. The Bureau's drainage investigation for the five areas roughly corresponding to the HKM study areas for future projects has an intensity of about 57 acres per hole nearly all of which are over six feet. Wyo. Exh. WRIR SS-9; Wyo. Exh. WRIR SK-9A (p. 8); Wyo. Exh. WRIR SF-1 (pp. 14, 16); Wyo. Exh. WRIR SF-2 (pp. 14, 24, 33, 39, 49); Wyo. Exh. WRIR SS-6 (pp. 3, A1).

The HKM investigation is of far less intensity than the Bureau of Reclamation found necessary for the Reservation. HKM utilized a total of 325 holes over five feet for the 84,000 arable acres, for an average intensity of over 250 acres per hole. This is approximately only one-fourth the intensity of the Bureau investigation of holes six feet and greater.

HKM classified as arable about 30,745 acres previously classified as arable by the Bureau of

Reclamation. For the HKM drainage investigation to determine arability and average hydraulic conductivity and depth to barrier on these lands, Mr. Toedter relied on about 379 Bureau of Reclamation drainage investigation holes and pits six feet or deeper and about 96 HKM holes six feet or deeper. This converts to an intensity of about 65 acres per hole. These lands were classified as arable by HKM and Bureau of Reclamation and were also determined arable by the State of Wyoming. HKM classified also as arable about 22,170 acres (gravity) previously classified nonarable by Bureau of Reclamation. For the HKM drainage investigation, Mr. Toedter relies on about 62 HKM holes six feet or deeper on these lands. This converts to an intensity of about 358 acres per hole. These lands, classified as arable by HKM but nonarable by the Bureau of Reclamation, have less than one-fifth the investigation intensity of lands classified arable by both HKM and Bureau of Reclamation.

2. The Bureau study is in support of only about 31,000 of HKM's claimed 84,000 acres and is in conflict of over 22,000 acres claimed arable or HKM but <u>nonarable</u> - <u>Class 6</u> by the Bureau. HKM classified

as arable about 20,499 acres (gravity) which are not within the Bureau of Reclamation study areas. For the HKM drainage investigation, Mr. Toedter relied on about 30 HKM holes six feet or deeper on these lands. This converts to an intensity of about 684 acres per hole six feet or deeper. These lands, classified as arable by HKM but outside of Bureau of Reclamation study area, have less than one-tenth the investigation intensity of lands classified arable by both HKM and Bureau of Reclamation. The State of Wyoming determined about 7,791 of these 42,669 acres to be arable under gravity irrigation. U.S. Exh. WRIR C-241A; Wyo. Exh. WRIR SS-9; Wyo. Exhs. WRIR SS-44-A through E, SS-46-A through E; U.S. Exhs. WRIR C-147A, C-147B, C-147C; U.S. Exhs. WRIR C-148-1 through C-148-30.

3. HKM did utilize the Bureau of Reclamation study, but only used that portion which was in support of HKM conclusions. Only select Bureau of Reclamation information was considered in the arable lands study for future projects. This is evidenced by the fact that of the 78 Bureau of Reclamation and HKM holes with barrier less than six feet (more than half these

holes were logged by the Bureau) within lands classified as arable by HKM, only six of these holes were considered in the determination of arability and average depth to barrier. U.S. Exh. WRIR C-241A; Wyo. Exhs. WRIR SS-45 A-3 through SS-54 A-E; U.S. Exhs. WRIR C-147A and B; U.S. Exhs. WRIR C-148-1 through C-148-30. In addition, only select information provided in the Bureau of Reclamation 1961 semi-detailed drainage investigation was used by HKM in their drainage study. Only 392 holes out of 925 total Bureau of Reclamation drainage borings and pits were used by Mr. Toedter in this analysis. U.S Exhs. WRIR C-241A and B; Wyo. Exh. WRIR SF-2.

In many cases, the information upon which Mr. Toedter relied is subjectively selected to support conclusions of arability. Had all available information been considered in the drainage investigation to determine arability, many areas classified as nonarable by the Bureau of Reclamation, and subsequently by the State of Wyoming, would have been classified as Class 6 by HKM. See Wyoming's Amended Proposed Finding of Fact 18-6 and support therefor.

The second of the two factors which the Tribes argue that Mr. Sommers relied upon, the "six-foot-hole-in-every-parcel" standard, is either a misconception or a

misrepresentation by the Tribes of Mr. Sommers' testimony. Tracts without six-foot holes were only excluded if classified as Class 6 by the Bureau or if outside the Bureau study areas. Tr. 10894, 10985, 11059-11060 (Sommers); see also Wyoming's Amended Proposed Finding of Fact 18-10 and support therefor. There is no evidence (i.e., soil logs) regarding the use of cut banks and general observations of the morphology of the land which HKM utilized in their study. U.S. Exhs. WRIR C-228A, B and C. In fact, the Bureau of Reclamation in its drainage manual specifically states that "each hole or cutbank used in a particular drainage study should be completely logged so the description of soil characteristics has maximum usefulness in identifying and correlating similar soils." Wyo. Exh. WRIR SS-A15 (p. 115).

Furthermore, one need not be a drainage engineer to determine depth to barrier nor to evaluate and provide information on texture, the representativeness of holes, the evidence of a water table and the intensity of observations, all of which are important factors in a drainage investigation. Tr. 10876, 10937, 10996-10997 (Sommers). Finally, contrary to the text of this Proposed Finding of Fact, Mr. Toedter did not do any drainage

engineering, nor was he admitted as a drainage engineer. Dr. Mesghinna acted as the drainage engineer and was referred to as the drainage engineer by Mr. Toedter and counsel for the United States. Tr. 3823-3827 (Toedter). See also Wyoming's Amended Proposed Finding of Fact 18-2 and support therefor; United States' Proposed Findings of Fact 33 and 125.

Tribes' Proposed Finding of Fact:

19. While there may be additional arable trust land on the Reservation, it is clear that the study of the future project areas was an intensive and long investigation, conducted parcel-by-parcel, and no similar study was made of other lands except as shown herein under historic lands.

Wyoming's Response:

19. The HKM investigation is of far less intensity than the Bureau of Reclamation found necessary for the Reservation. HKM utilized a total of 325 holes over five feet for the 84,000 arable acres, for an average intensity of over 250 acres per hole. U.S. Exh. WRIR C-43 (pp. 15-16). This is approximately only one-fourth the intensity of the Bureau investigation of holes six feet and greater. With a comparison of these two levels of intensity, the HKM study is of considerable less reliability than the Bureau of Reclamation study. See Wyoming's Amended Proposed Finding of Fact 18-4 and support therefor.

The remainder of the verbage is this proposed Finding has no relevance whatsoever.

Tribes' Proposed Finding of Fact:

20. I therefore find that there are 84,469 acres of arable land in the six study areas of future lands, broken down by study area, class and type of irrigation as follows:

A. In the North Crowheart study area there are 47,876 acres of arable land. (U.S. Exs. C-43, p. 27; C-44; and C-45.)

B. In the South Crowheart study area there are 7,984 acres of arable land. (U.S. Exs. C-43, p. 27; C-46; and C-47.)

C. In the Big Horn Flats study area there are 19,644 acres of arable land. (U.S. Exs. C-43, p. 47; C-48; and C-49.)

D. In the Riverton East study area there are 4,691 acres of arable land. (U.S. Exs. C-43, p. 27; C-50; and C-51.)

E. In the Owl Creek study area there are 253 acres of arable land. (U.S. Exs. C-43, p. 27; and C-52.)

F. In the Arapahoe study area there are 4,016 acres of arable land. (U.S. Exs. C-43, p. 27; C-53; and C-54.)

Wyoming's Response:

20. The numerous deficiencies and inconsistencies of the HKM land classification and drainage investigation are discussed in detail in Wyoming's Amended Proposed Findings of Fact 15-1 et seq. and 18-1 et seq. and support therefor. As a result of the State's arable land evaluation, the arable acreage on the Wind River Indian Reservation is as follows:

	Arable Acres	
Unit	Gravity	Sprinkler
North Crowheart	30,190	27,730
South Crowheart	5,010	5,310
Big Horn Flats	10,820	10,090
Riverton East	2,280	3,000
Arapahoe	2,160	2,780
TOTAL	50,460	48,910

Tribes' Proposed Finding of Fact:

23. Dr. Mesghinna is a supervising engineer for Stetson Engineers, specializing in irrigation systems design, drainage and hydrology. He holds a Ph.D. from Utah State in irrigation and drainage. He has worked on a variety of water resource projects including designing irrigation systems and determining crop water requirements on other Indian reservations. He grew up on an irrigated farm. His experience and particularly his testimony impressed me with his thorough professionalism and expertise. I find he is a well-qualified expert in irrigation systems design and engineering, irrigation construction costs, drainage, and water requirements (Tr. V. 45, pp. 4003-12).

Wyoming's Response:

23. Dr. Mesghinna modified the cost estimating curves of the U. S. Bureau of Reclamation Instructions, Series 150, Appendix A, Chapter 3 Estimating Data for Pumping Plants even though the manual states the cost curves represent typical costs for irrigation pumping plants. Dr. Mesghinna failed to include costs for items such as mobilization, insurance, bonding, drain channel stabilization and road relocation. In addition, he did not use realistic values for engineering costs. Tr. 13352 (Sostrom); Wyo. Exhs. FSO-4A, FSO-4B. Dr. Mesghinna has not designed a project in Wyoming or a project which has been constructed. Tr. 4008-4018 (Mesghinna).

Tribes' Proposed Finding of Fact:

24. Dr. Mesghinna designed and established water requirements and costs for five projects, corresponding to five of the study areas of arable land testified to by HKM Engineers. These five projects are North Crowheart, South Crowheart, Arapahoe, Riverton East and Big Horn Flats. He designed the on-farm systems to use side-roll or hand-moved sprinklers, served by a pipe network and pumping stations drawing water from canals which receive water from the rivers. The projects are described in detail in U.S. Ex. C-245.

Wyoming's Response:

24. The terms "design" or "designed" should be used with caution. The State of Wyoming finds project "design" to have progressed to the feasibility study level. Tr. 4770, 4873-4874 (Mesghinna), 13580, 13581, 13585 (Sostrom); 8457 (Bliesner). Dr. Mesghinna has limited experience in design for actual construction and no previous experience in Wyoming. See Wyoming's Response to Tribes' Proposed Finding of Fact 23.

Tribes' Proposed Finding of Fact:

25. Dr. Mesghinna's testimony showed his thorough familiarity with the lands in question, and a conservative and reliable approach to engineering feasibility.

Wyoming's Response:

25. Dr. Mesghinna only had time to become familiar with the Reservation in a general nature due to the vastness of the Reservation and distances of travel required. In his five to eight days on the Reservation he would have had to observe:

1. Approximately 60,000 acres of historic lands for which he supplied cropping pattern data to Mr. Dornbusch.

2. About 70,000 acres of the Midvale Irrigation District on which he also observed cropping patterns as well as drainage problems.

3. About 84,000 acres HKM determined to be arable on which Dr. Mesghinna determined a conceptual irrigation project. Tr. 4308, 4612 (Mesghinna).

Tribes' Proposed Finding of Fact:

27. I find that all five of the proposed projects designed by Stetson Engineers are well designed and practical from an engineering perspective, but, for reasons discussed later, are unnecessarily expensive.

Wyoming's Response:

27. The design and costs estimated to date are merely results of intermediate estimates for a feasibility study and are far short of design for construction including working drawings. Tr. 13697, 13338, 13354, 13389, 13581, 13600 (Sostrom); 4770, 4873-4875 (Mesghinna); 8456 (Bliesner). The United States and Tribes left out costs which should have been included, therefore, the costs of the United States were not over-estimated. Tr. 13351, 13353, 13338 (Sostrom); see Wyoming's Amended Proposed Finding of Fact 18-22.

Tribes' Proposed Finding of Fact:

29. Dr. Mesghinna in designing the future projects restricted his design to Class 1 through 3 lands, discarding all lands classified as 4 or 6 by HKM. He also discarded some lands from his plans because of remoteness and further reduced the acreage by 5% to account for roads, buildings, etc. Where special drainage or improvement was necessary to correct land deficiencies, he included these in his plans. Additionally, the United States' economists instructed Dr. Mesghinna to omit other lands because of costs. As a result, the acreage of arable land found in each project was reduced as follows (U.S. Exs. SRF-3, Table 8, p. 27; C-245, pp. 24-33; id., Table 24, p. 42):

	Arable	Net Acreage Under Design
North Crowheart	47,876	38,773
South Crowheart	7,984	4,695
Arapahoe	4,016	3,808
Riverton East	4,691	3,814
Big Horn Flats	19,644	2,670
TOTAL	84,211	53,760

Wyoming's Response:

28. Class 6 or nonarable lands were included in the projects. These lands cannot be practicably irrigable acreage since they are not even arable. Wyo. Exhs. WRIR FM-1249A through 1255A. See Wyoming's Amended Proposed Findings of Fact 15-2 and support therefor. See also Report of Special Master Elbert P. Tuttle, Arizona v. California, (No. 8, orig.) (Feb. 22, 1982) p. 164, wherein the Special Master concluded that Class 6 or nonarable land included within the proposed projects should be excluded from consideration for water rights.

There are locations within the fields laid out by Dr. Mesghinna on U.S. Exhs. WRIR C-249 through C-255 where the natural terrain or topographic features are restrictive to sprinkler irrigation. These areas will require additional costs for land leveling or are not irrigable at all due to excessively steep or irregular terrain, and intermittant streams or gulleys. Tr. 13255-13276 (Sostrom).

Acres of Topographic Restrictions:

North Crowheart Unit	607.5 acres
South Crowheart Unit	57.5
Big Horn Flats Unit	62.6
Arapahoe Unit	151.7
Riverton East Unit	139.9
Total	1019.2

Tr. 13417-13423 (Sostrom); Wyo. Exh. WRIR FSO-1.

The fields laid out in U.S. Exh. WRIR C-251 for Big Horn Flats overlap onto both sides of the State highway right-of-way. Thus, there are 10.37 acres not physically irrigable which are not included within the above summary.

Certain land within the fields on U.S. Exh. C-255 for the Riverton East Unit are nonirrigable strictly from an engineering point of view. Without considering the arability of soils, the fields contain 109.4 acres of land physically not irrigable and 30.5 acres of land which would only be irrigable after intensive land leveling. Tr. 13269-13276 (Sostrom); Wyo. Exh. WRIR FSO-2G. The physically nonirrigable topographic features in the Riverton East Unit, within the State's arable land base and Dr. Mesghinna's fields, is 16.5 acres. Tr. 13296, 13423 (Sostrom); Wyo. Exhs. WRIR FSO-3, FSO-2G.

Portions of the fields in U.S. Exhs. WRIR C-249 through C-255 were laid out on lands classified nonarable by both the United States' and State of Wyoming's soil scientists. Tr. 4449, 4479 (Mesghinna); see also Wyoming's Amended Proposed Findings of Fact 18-8 and support therefor; Wyo. Exhs. WRIR FSO-2A through FSO-2G and FM-1249A through FM-1255A

The State of Wyoming presented evidence that the following acres of arable land are within the proposed projects as summarized in the following table:

Units	Arable Acres
North Crowheart	21,063.8
South Crowheart	3,347.3
Arapahoe	2,485.4
Riverton East	1,876.6
Big Horn Flats	1,169.1
Total	29,993.2

Tribes' Proposed Finding of Fact:

29. For all lands within his irrigation systems, Dr. Mesghinna reviewed the soils information provided by HKM including raw data. Dr. Mesghinna developed the relevant soil characteristics -- including water-holding capacity and intake rate -- needed for proper design (U.S. Ex. C-245, pp. 16-17), thereby properly connecting the soils and engineering components of the study.

Wyoming's Response:

29. Wyoming's experts criticized the water holding capacities and intake rates by criticizing the information upon which the values were computed. See Wyoming's Response to United States' Proposed Finding of Fact 125. During his testimony, Mr. Sommers differed with Dr. Mesghinna on soils with significant amounts of coarse fragments:

> Therefore, through no fault of his own [Dr. Mesghinna] had to make assumptions. He made assumptions that the soil texture directly over the gravel continued down into the gravel and by doing so he overestimated available water holding capacity by up to 60 percent.

Tr. 10960. This overestimation of available water holding capacity occurs on roughly 50 to 60 percent of the arable land base. Tr. 10959-10960 (Sommers). Furthermore, Dr. Mesghinna stated that available water holding capacity is of "paramount" importance in system design. Tr. 4109 (Mesghinna).

Tribes' Proposed Finding of Fact:

30. While the State questioned the irrigability of some of the lands classified by HKM (see Findings 16-17 supra), they did not do an independent soils examination of those soils or combine engineering work with soils work to correct deficiences. In light of the exclusions from the arable base made by Dr. Mesghinna, and after hearing the testimony of all the witnesses and weighing their credibility, I find that from a standpoint of soils science and engineering, the 53,760 acres for which Dr. Mesghinna planned projects are practicably irrigable.

Wyoming's Response:

30. The State of Wyoming did do an independent soils examination of the future lands and found numerous errors and deficiencies. The exclusion of lands by Dr. Mesghinna based on engineering design have little relevance to arability. See Wyoming's Response to Tribes' Proposed Findings of Fact 16 and 17; see also Wyoming's Amended Proposed Findings of Fact 18-8, 18-10 and support therefor.

Tribes' Proposed Finding of Fact:

31. Dr. Mesghinna also determined the water requirements to irrigate these acres. He used accepted formulas for computing crop water needs and irrigation efficiencies. He used a cropping pattern based on crops actually grown in the area (U.S. Ex. C-245, pp. 5-7).

Wyoming's Response:

31. The cropping patterns proposed by the United States and Wyoming for the future projects are compared in Wyo. Exh. WRIR EJ-8. The cropping patterns proposed by the two parties are similar with the following exceptions:

1. Wyoming proposed the planting of dry beans instead of corn and corn silage, because it is impractical to grow corn using hand-move sprinkler systems as proposed by the United States. Tr. 14719-14720 (Jacobs).

2. The State of Wyoming used slightly different proportions of alfalfa to correspond with the present cropping patterns in the region. Tr. 14721 (Jacobs).

Although differences in the assumed cropping patterns are not major, the Court should adopt the cropping pattern proposed by Wyoming based upon the superior qualifications of its experts in this area. Furthermore, the Court should consider the following:

1. Mr. Dornbusch's cropping pattern is based solely upon a published report by Mr. Doug Agee and interviews in the Riverton area. Tr. 5824-5826, 5855.

2. However, Mr. Agee testified that Mr. Dornbusch assumes that corn will be grown at elevations where growing seasons are not adequate. Tr. 15313.

3. The only record of Mr. Dornbusch's interviews are the sketchy notes depicted in Wyo. Exh. WRIR ED-16. Tr. 5826.

4. Mr. Dornbusch could not even testify as to the cropping distribution of the people he did interview. Tr. 5833.

The United States' contention that 5900 feet is the proper break point between highland and lowland areas is based solely upon Mr. Dornbusch's interpretation of one page in a BIA report. Wyo. Exh. WRIR ED-17, p. 19, and the scantily documented interviews referred to above. Tr. 5846-5854. The evidence supporting Wyoming's proposed break point of 5,500 feet is overwhelming. Dr. Jacobs testified that he based this break point upon extensively documented farm interviews, conversations with Soil Conservation Service personnel, reports from HKM Engineers, and an analysis of climatological data concerning degree days needed to grow corn at higher elevations. Tr. 14722. Furthermore, Dr. Jacobs testified

that the same report used by Mr. Dornbusch to justify 5,900 feet, if properly interpreted, suggests that 5,500 feet is a more appropriate break point. Tr. 14913.

Furthermore, Mr. Clarence Fowkes, testified that the proper break point between highland and lowland areas should be 5,500 feet. Tr. 10638-10641. Mr. Doug Agee, testifying on behalf of Wyoming, also suggested it would be difficult to grown corn at elevations above 5,500 feet, as proposed by the United States. Tr. 15324.

Finally, "Criterion for Selection of Project Study Areas" prepared by HKM Associates on behalf of the United States used 5,500 feet as the dividing line between highland and lowland areas. Wyo. Exh. WRIR ED-15.

Based upon this overwhelming evidence, there is no recourse but to conclude that 5,500 feet is a more reasonable break point between highland and lowland areas for purposes of analysis than the 5,900 feet proposed by Mr. Dornbusch.

The cropping pattern proposed by the United States and Wyoming are summarized as follows:

CROPPING PATTERNS
Cropping Pattern (%)

Crop	Lowlands		Highlands	
	U.S.	Wyo.	U.S.	Wyo.
Malt Barley	5	18	17	15
Nurse Barley	16	14	16	14
Alfalfa	67	57	67	71
Beans	-	11	-	-
Corn Silage	5	-	-	-
Corn Grain	7	-	-	-

Dr. Mesghinna based his climate zones and evapotranspiration estimates on very general data and inappropriate cropping patterns. More reliable data must be generated to accurately calculate evapotranspiration by the Jensen-Haise formula. See Wyoming's Amended Proposed Finding of Fact 18-18 and support therefor. The result of this calculation is dependant upon the correct selection of climatic data for application in the Jensen-Haise formula, the cropping pattern and the growing season. See Wyoming's Amended Proposed Findings of Fact 18-18, 18-27 and 18-28 and support therefor.

The use of questionable data for solar radiation analysis, air temperature, precipitation, soil temperature, climatic-elevation breaks and cropping patterns used by the United States' consultants results in a compounding of probable errors for determining the

climatic zones and net irrigation requirements. Thus, the United States' average net irrigation requirement is of little practical value for any application other than a feasibility level study. See Wyoming's Amended Proposed Findings of Fact 18-18, 18-27 and 18-29 and support therefor, see also Wyoming's Response to Tribes' Proposed Finding of Fact 32.

On-farm efficiency can vary with wind velocity resulting in about 5% additional sprinkler loss for winds averaging 10 to 15 miles per hour as compared to a range of 0 to 4. Dr. Mesghinna used wind velocities measured at Riverton for determining on-farm efficiency. Riverton climatic conditions are not representative of the majqrity of the proposed future projects which generally lay on plateaus of higher elevation and closer to the mountains. Tr. 4146 (Mesghinna). The on-farm efficiency is very dependent upon the water holding capacity of the soil which has been shown to have been determined using unreliable soils information. Tr. 4124, 4513 (Mesghinna).

Adoption of an overall efficiency of 50% satisfies the uncertainties in efficiencies developed by the feasibility level study. See Wyoming's Amended Proposed Findings of Fact 18-19 and 18-20 and support therefor.

Tribes' Proposed Finding of Fact:

32. Dr. Mesghinna identified and mapped seven climatic zones on the Reservation, based on local weather station and soil temperature data (U.S. Ex. C-245, p. 5).

Wyoming's Response:

32. The use of the general climatic zone map is questionable to determine effective precipitation for lands up to 60 miles away from the rain gauge. See Wyoming's Amended Proposed Finding of Fact 18-18 and support therefor and Wyoming's Response to Tribes' Proposed Finding of Fact 31.

The State of Wyoming agrees that U.S. Exh. C-244 is adequate for a feasibility level study. However, local climatic conditions may vary significantly within the broad climatic zones developed from seven locations of recorded data. Dr. Mesghinna relied on climatological data gathered from seven weather stations in or near the Wind River Indian Reservation. Based only on the microclimates existing around these seven stations, Dr. Mesghinna established climatic zones to cover all the land within the five proposed irrigation projects. Tr. 4026, 4042-4043 (Mesghinna); U.S. Exh. WRIR C-244.

One of the key elements of climatic data necessary to determine evapotranspiration, and in turn crop consumptive use, is solar radiation. Tr. 4027 (Mesghinna). The sole basis for the solar radiation analysis performed by Dr. Mesghinna was data gathered from the Lander Airport

concerning the ratio of actual to possible sunshine. Dr. Mesghinna did not even receive the actual data from the airport but rather received an interpretation of that data prepared by HKM. Dr. Mesghinna did not know who gathered the original data or what calculations were done to "interpret" it. Nor was he aware that the Lander Airport stopped gathering this type of data in 1972 because the National Weather Service considered the accuracy of it questionable. Tr. 4592-4600 (Mesghinna); Wyo. Exh. WRIR FM-6.

Additional climatic data is required to evaluate long term water requirements to design and size irrigation facilities before estimating the costs. Tr. 12159, 12227 (Bishop). See also Wyoming's Amended Proposed Findings of Fact 18-17 and 18-18 and support therefor; United States' Supporting Brief at 332.

Tribes' Proposed Finding of Fact:

33. Dr. Mesghinna determined diversion requirements month-by-month, and climatic zone-by-climatic zone for each of the five projects. The requirements for each project varied depending upon the climatic zones, distance the water had to travel and crop mixes. The unit diversions and total diversions by project were as follows:

	Acreage	Unit diversion (Acre-feet/acre/year)	Total diversion (Acre-feet/year)
North Crowheart	38,773	3.81	147,767
South Crowheart	4,695	4.29	20,137
Arapahoe	3,808	4.39	16,720
Riverton East	3,814	4.60	17,536
Big Horn Flats	2,670	2.70	7,212
TOTALS	53,760		209,372

Dr. Mesghinna identifed (U.S. Ex. C-245, pp. 24-33) the sources of water for these projects as follows:

North Crowheart: Big Wind River

South Crowheart: Big Wind River

Arapahoe: North Fork Popo Agie

Riverton East: 17,040 acre-feet per year from Big Wind River and 496 acre-feet from Little Wind River

Big Horn Flats: 4,748 acre-feet per year from the Big Wind River and 2,464 acre-feet per year from the Little Wind River.

The total diversion requirement for the 53,760 acres testified to by Dr. Mesghinna is 209,372 acre-feet per year This is a diversion requirement, not a consumptive use

Tribes' Proposed Finding of Fact:

requirement. The larger portion of this water will return to the stream to be used again by downstream users.

Wyoming's Response:

33. The climatic zones, efficiencies, crop mix, water requirements and acreage are all in error. See Wyoming's Amended Proposed Finding of Fact 18-1 et seq. and support therefor. Furthermore, the net irrigation requirement, an essential element in the quantification of reserved water rights, is not provided. Compare Wyoming's Amended Proposed Decree (Appendix 1); cf., Arizona v. California, 439 U.S. 419, 422 (1979): Wyo. Stat. § 41-3-104; Basin Electric Power v. State Board of Control, 578 P. 2d 557 (Wyo. 1978).

The following table summarizes evidence which was submitted by the State of Wyoming regarding future project acreage and water requirements prior to economic analysis. Tr. 13296 (Sostrom); Tr. 13705 (Bishop); Wyo. Exh. WRIR FFB-3; Wyoming's Amended Proposed Findings of Fact 18-16 and 18-21 and support therefor, and Appendices 3 and 11. The evidence submitted by the State of Wyoming subsequent to economic analysis is that no future project is economically feasible.

Future Project	Acres	Diversion Requirement (AF)	Net Irrigation Requirement (AF)
Arapahoe Unit	2,485.4	9,257.9	4,629.0
Big Horn Flats Unit	1,169.1	4,114.0	2,057.0
North Crowheart Unit	21,064.8	75,591.0	37,795.5
Riverton East Unit	1,876.6	7,031.9	3,516.0
South Crowheart Unit	3,347.3	12,429.5	6,214.8
Subtotal	29,943.2	108,424.3	54,213.1

Tribes' Proposed Finding of Fact:

34. The State contested these diversion requirements. Mr. Bishop testified that, with a different crop mix emphasizing irrigated pasture and total efficiencies for water use of about 50%, reductions in water use could be made (see, e.g., Tr. V. 133, pp. 12188-97). Mr. Bishop, however, assumed that the average efficiencies for the five projects were in the 35% range (id., p. 12237). In fact, Dr. Mesghinna testified that his canal conveyance efficiencies ranged from a low of 60% to a high of 77%. The on-farm application efficiencies through sprinkler irrigation range from 66 to 67% and the distribution efficiency from the canals to the farms is 95%. The total efficiency is determined by multiplying the three percentages by each other. (U.S. Ex. C-245, Table 12, p. 15.) Using North Crowheart, the largest project, as an example, with conveyance efficiency of about 75%, application of 66% and distribution of 95%, the total efficiency is 47.32%, not significantly different from the 50% efficiency goal stated by Mr. Bishop.

The total diversion for the five projects of 209,372 acre-feet per year amounts to a water duty of 3.9 acre-feet per acre. This is less than the statutorily permitted water use in Wyoming. It is also less than typical actual use in the area, including the Midvale Irrigation District. Dr. Mesghinna testified that the requirement for the proposed projects "is quite low as compared to what is going on right now" (Tr. V. 47, p. 4327). His study of the neighboring Midvale system shows over

Tribes' Proposed Finding of Fact:

5 acre-feet per acre even with recent improvements (Tr. V. 52, pp. 4676-78).

Wyoming's Response:

34. The diversion requirements identified by the United States' consultants are in error. See Wyoming's Amended Proposed Findings of Fact 18-1 et seq. and support therefor; see also Wyoming's Response to Tribes' Proposed Findings of Fact 31 and 32.

Tribes' Proposed Finding of Fact:

35. I find that the total system of canals, pipe network, and sprinkler irrigation is as efficient or more efficient than the standards of irrigating in the area and is a reasonable combination to use in designing these projects to determine whether acreage is practicably irrigable, and in determining water use. I further find that the water reasonably required to irrigate these 53,760 acres is a diversion of 209,372 acre-feet per year.

Wyoming's Response:

35. The inadequate climatic data, cropping pattern, inadequate soils information for determining water holding capacity, variable application efficiencies, and unreliable method and lack of data for determining the conveyance efficiency renders the United States' water diversion estimates only reliable to cost the systems for a feasibility study. See Wyoming's Amended Proposed Findings of Fact 18-17, 18-18 and 18-19 and support therefor.

A greater overall project efficiency is not only reasonable but required in this age of water shortage. Wyoming recommends the adoption of the acreage, net irrigation requirement and the required diversions on Wyo. Exh. WRIR FFB-3. See Wyoming's Amended Proposed Findings of Fact 18-20 and 18-21 and support therefor.

Tribes' Proposed Finding of Fact:

36. The Tribes retained experts who designed irrigation projects for two areas excluded by the United States. These are Big Horn Flats Extension and Stagner Ridge. The designs were done by Keller Engineers. Irrigation designs were done by Mr. Ron D. Bliesner, and Dr. Jack Keller, with drainage designed by Dr. Lyman Willardson. Mr. Bliesner has had extensive experience in sprinkler irrigation design and operation as a sales and design engineer for a major manufacturer of such equipment, as manager of a major irrigated farm and as a consultant (Tr. V. 93, pp. 8250-60). Dr. Keller is the head of the Department of Agricultural and Irrigation Engineering at Utah State University and has had worldwide experience in irrigation engineering (Tr. V. 97, pp. 8729-44). Dr. Willardson is a professor of agricultural and irrigation engineering at Utah State with long experience in the Bureau of Reclamation and is an internationally recognized authority on drainage (Tr. V. 95, pp. 8567-75). I find them all to be highly qualified agricultural and irrigation engineers.

Wyoming's Response:

36. Dr. Willardson, prior to this litigation, had no experience in Wyoming and has not designed a large-scale drainage system which has been carried through to construction. Mr. Bliesner and Dr. Keller have no previous experience in Wyoming prior to their involvement in this case. Tr. 8259 (Bliesner); Tribes' Exh. 23. Dr. Keller only spent about 12 hours in the field on Big Horn Flats and 20 to 30 hours reviewing the Stetson work. Tr. 8811 (Keller).

Tribes' Proposed Finding of Fact:

37. Big Horn Flats is one of two major areas of arable land where most land was omitted from the United States claim. HKM identified 19,644 acres of arable land in the Big Horn Flats Unit. Dr. Mesghinna included only 2,670 acres of this total in his irrigation development plan, leaving 16,974 acres of arable land without an irrigation system. He initially planned irrigation for a larger portion of this land, but at the direction of the government economists excluded it. As far as engineering was concerned, Dr. Mesghinna testified "engineering wise, they [Big Horn Flats Extension and Stagner Ridge] are solid. They are good, no problem" (Tr. V. 135, p. 12409; see also Tr. V. 47, pp. 4322-23).

38. Keller Engineers designed an irrigation development plan for 9,073 acres of the 16,974 omitted by Dr. Mesghinna. The system is designed primarily for center pivot sprinklers with three fields utilizing side-roll laterals. Water is diverted from Bull Lake Creek downstream of Bull Lake Dam and pumped through a steel pipeline to a canal at elevation 6,330 on Big Horn Flats. Water is transferred by pumping plant or gravity turnout into pipeline networks that supply the center pivot and side-roll systems. The system is described in detail in Tribes' Ex. 13, pp. 3-19. The system is characterized by high efficiency

Tribes' Proposed Finding of Fact:

in water use, minimal drainage requirements, high quality lands, but higher initial costs per acre and higher pumping and energy costs than in the Mesghinna systems. The total diversion requirement is 22,349 acre-feet annually to irrigate 9,264 acres.

Wyoming's Response:

37. The arable land base for the Big Horn Flats Extension suffers from the same deficiencies as the arable base for the United States' five future projects. See Wyoming's Amended Proposed Findings of Fact 18-1 et seq. and support therefor. Mr. Bliesner relied on the United States' arable land base in designing the two additional projects. Tr. 8268-8276 (Bliesner). In addition, Mr. Bliesner's on-farm system design includes many fields with topographical or cultural features which would reduce the actual acres under irrigation. Tr. 13279-13301 (Sostrom); Wyo. Exhs. WRIR FSO-5, FSO-6A, FSO-6B and FSO-6C. Mr. Sostrom prepared maps and tabulations of those acres within the Tribes' two additional projects which fall within the State's arable land base. Tr. 13297-13301 (Sostrom); Wyo. Exhs. WRIR FSO-6A, FSO-6B, FSO-6C and FSO-7. The arable acreage in the Tribes' two additional projects is 6,131.1 acres.

Tribes' Proposed Finding of Fact:

38. Keller Engineers designed an irrigation development plan for 9,073 acres of the 16,974 omitted by Dr. Mesghinna. The system is designed primarily for center pivot sprinklers with three fields utilizing side-roll laterals. Water is diverted from Bull Lake Creek downstream of Bull Lake Dam and pumped through a steel pipeline to a canal at elevation 6,330 on Big Horn Flats. Water is transferred by pumping plant or gravity turnout into pipeline networks that supply the center pivot and side-roll systems. The system is described in detail in Tribes' Ex. 13, pp. 3-19. The system is characterized by high efficiency in water use, minimal drainage requirements, high quality lands, but higher initial costs per acre and higher pumping and energy costs than in the Mesghinna systems. The total diversion requirement is 22,349 acre-feet annually to irrigate 9,264 acres.

Wyoming's Response:

38. The Tribes' proposed irrigation project on Big Horn Flats suffers from numerous deficiencies. These are:

1) An inadequate drainage analysis, see Wyoming's Amended Proposed Finding of Fact 19-6 and support therefor.

2) Inclusion of nonarable land, see Wyoming's Amended Proposed Finding of Fact 19-4 and support therefor; see also Wyoming's Response to Tribes' Proposed Finding of Fact 37.

3) Inaccurate climatological data used to compute net irrigation requirements, see Wyoming's Amended proposed Finding of Fact 19-9 and support therefor.

4) Errors in system design, see Wyoming's Amended Proposed Finding of Fact 19-10 and support therefor.

5) Errors in cost estimation, see Wyoming's Amended Proposed Finding of Fact 19-13 and support therefor.

6) Overestimation of water requirements, see Wyoming's Amended Proposed Finding of Fact 19-12 and support therefor.

Tribes' Proposed Finding of Fact:

39. Mr. Bishop, one of the State's engineering consultants, not an economist, testified that he considered the Big Horn Flats Extension infeasible from an economic viewpoint because the initial costs are over $2,000 per acre and water must be pumped more than 400 feet in height (Tr. V. 133, p. 12171).

Wyoming's Response:

39. Mr. Bishop is a Civil Engineer with expertise in water resources engineering through a great amount of exposure and experience in the cost evaluating and engineering analysis of irrigation projects in Wyoming. He is an unquestionable authority on the evaluation of a proposed project such as the Tribes' Big Horn Flats Extension. Tr. 12168, 12171, 12173, 12191-12194, 12207, 12269 (Bishop). See Wyoming's Amended Proposed Findings of Fact 19-11, 19-13, 19-16 and support therefor. In fact, Mr. Bishop understated the difficulty in pumping to Big Horn Flats by referring to the elevation head. The total dynamic head of 490 feet by comparison is equal to the maximum total head of the 70 irrigation pumping plants used to develop the cost estimating curves in the U.S. Bureau of Reclamation Series 150, Appendix A, Chapter 3, Estimating Data for Pumping Plants. Figure 6 of this estimating guide used 70 irrigation pumping plants with a range of 15 feet to 490 feet total head to develop the estimating curves used by Mr. Sostrom, Dr. Mesghinna, and Mr. Stetson. Tribes' Exh. 13; Tr. 4185-4190 (Mesghinna); 5519, 5526 (Stetson); 13617, 13328 (Sostrom); Wyo. Exh. WRIR HS-15.

Tribes' Proposed Finding of Fact:

41. Dr. Keller testified as to Big Horn Flats that there is nothing out of the ordinary in terms of lifts, soils, or technology in irrigating it (Tr. V. 97, pp. 8788-98). He testified that "[t]here's land just like it being irrigated just like we propose to irrigate that land" (id., p. 8798).

Wyoming's Response:

41. There is no evidence in the Record to indicate that the land Dr. Keller was referring to is indeed similar with respect to growing season, economic returns, soils or drainage. Big Horn Flats is definitely "out of the ordinary" with respect to irrigation construction costs in Wyoming. Tr. 12168, 12173, 12192-12195, 12207, 12269 (Bishop).

Tribes' Proposed Finding of Fact:

42. None of the State witnesses testified that from an engineering or soils science perspective there was any difficulty in irrigating the Big Horn Flats Extension.

Wyoming's Response:

42. Nonarable is included in the proposed Big Horn Flats Extension Project. See Wyoming's Amended Proposed Finding of Fact 19-4 and support therefor, see also Wyoming's Response to Tribes' Proposed Finding of Fact 37.

Mr. Sostrom prepared maps and tabulations of those acres within the fields laid out by Mr. Bliesner that would restrict irrigation due to topographic features. Tr. 13279-13301 (Sostrom); Wyo. Exhs. WRIR FSO-5, FSO-6A and FSO-6B.

Mr. Sostrom testified to the difficulty and additional cost to construct the 72 inch diameter pipeline from Lilly Pond to the top of Big Horn Flats. Both the pipeline and the very large pumping plant at Lilly Pond

. . . have high construction costs. Tr. 12195 (Bishop); Tr. 13622-13624, 13616-13619 (Sostrom); Wyo. Exh. WRIR FSO-4A. See Wyoming's Response to Tribes' Proposed Finding of Fact 38.

Tribes' Proposed Finding of Fact:

43. I find that from an engineering and soils science perspective the 9,073 acres for which Keller Engineers designed an irrigation project (out of the 16,974 arable acres for which no project design was completed by Stetson Engineers) are practicably irrigable and that a water duty of 22,349 acre-feet per year is reasonable.

Wyoming's Response:

43. There are problems with arability and engineering on Big Horn Flats Extension. See Wyoming's Response to Tribes' Proposed Finding of Fact 38. Furthermore, land cannot be practicably irrigable without an economic analysis wherein benefits exceed costs. See Wyoming's Amended Proposed Findings of Fact 15-9 through 15-5 and support therefor.

Based on the evidence, the Court finds Wyoming's economic analysis of the feasibility of the proposed Big Horn Flats Extension and Stagner Ridge analysis to be persuasive. The benefit-cost ratios presented in Wyo. Exh. WRIR EJ-4, Part II, Table 12, p. 14, clearly demonstrate that the cost of the proposed projects far exceeds the expected benefits. The Court should further consider the fact that these two projects are located on lands for which Dr. Mesghinna considered designing irrigation projects. After considering the high costs of bringing these land into production and after consultation with the United States' economist, he rejected these two projects as being infeasible. Tr. 8276-8277 (Bliesner); Tr. 4301, 4322-4323, 4350 (Mesghinna). Thus, the United States did not claim water rights for these lands having examined them and concluded that they are not practicably irrigable. Having been rejected by the United States and

the State of Wyoming, a much higher test of acceptability must be shown for these two projects. The Tribes' evidence fails to meet this test.

Tribes' Proposed Finding of Fact:

45. Keller Engineers developed an irrigation project for 897 acres of the 1,500 arable acres on Stagner Ridge. The system is designed for center pivot sprinklers. Water is diverted from the North Crowheart Canal. The details are shown in Tribes' Ex. 13, pp. 20-23, and accompanying maps.

Wyoming's Response:

45. The proposed irrigation development on Stagner Ridge suffers from the same deficiencies as Big Horn Flats Extension with the exception that the State found the lands to be arable. See Wyoming's Amended Proposed Findings of Fact 19-1 et seq. and support therefor, see also Wyoming's Response to Tribes' Proposed Finding of Fact 38.

Tribes' Proposed Finding of Fact:

47. Stagner Ridge shares some of the characteristics of the Big Horn Flats Extension -- use of pipes and low pressure sprinklers to irrigate arable land on a well-drained table. However, for Stagner Ridge, conveyance systems and pumping plants that have already been planned for North Crowheart can be utilized by increasing this capacity and adding a booster pump (Tribes' Ex. 13, pp. 20-23; Tr. V. 93, pp. 3343-52).

Wyoming's Response:

47. The proposed Stagner Ridge project is totally dependent upon the construction of the North Crowheart Unit proposed by the United States. Tr. 12195 (Bishop).

Tribes' Proposed Finding of Fact:

48. Mr. Bishop, for the State, testified "[i]f North Crowheart is to be built in its entirety, then Stagner Ridge becomes reasonably attractive" (Tr. V. 133, p. 12195).

Wyoming's Response:

48. Wyoming has determined that the North Crowheart Unit is not feasible for the ranges of discount from 4% to 7-1/8%. Since the North Crowheart Unit is not feasible and the Stagner Ridge Unit is totally dependent upon the North Crowheart Unit, the Stagner Ridge Unit is not feasible. Tr. 12168 (Bishop); see Wyoming's Amended Proposed Findings of Fact 18-34 and 19-16.

Tribes' Proposed Finding of Fact:

50. There was considerable disagreement among the engineers as to the costs of the projects.

Wyoming's Response:

50. The economists looked at the feasibility of Big Horn Flats Extension and Stagner Ridge and two of them rejected those projects after the construction costs for these two projects were developed by the engineers. Tr. 4301, 4322, 4350 (Mesghinna); 8276 (Bishop); U.S. Exh. WRIR C-245' Tribes' Exh. 13; Wyo. Exh. WRIR FSO-4.

The evidence shows that in regard to the five future projects proposed by Stetson Engineers, three engineers developed construction costs; of those, the ones developed by the Tribes' were lowest, Wyo. Exh. WRIR FSO-4.

Mr. Bishop's testimony states the conclusion of Wyoming's evaluation of the costs developed by Mr. Bliesner for the five future units.

> My general conclusion on the Bliesner assignment was that be obviously had a predetermined objective in mind. He reduced the costs of several of the items involved in the five Mesghinna projects and came up with an overall reduced cost for each of those projects based on reductions which, in my view, are questionable.

Tr. 12190 (Bishop) (emphasis added).

Tribes' Proposed Finding of Fact:

52. Stetson's costs are shown at pp. 19-23 of U.S. Ex. C-245 and are summarized as dollars per acre in Table 24 of the same report (at p. 42) as follows:

	Dollars Per Acre				
Description	North Crowheart	South Crowheart	Arapahoe	Riverton East	Big Horn Flats
On-Farm System	166	168	179	193	159
Pipe Network	424	303	402	310	371
Pumps & Pumping	207	337	138	366	608
Canals & Related Structures	326	528	511	297	---
Drainage	380	324	430	477	547
Engineering & Contingencies	334	373	370	363	382
Total Investment	1,837	2,033	2,030	2,006	2,067
O&M	6.84	12.62	12.62	12.62	7.99
Energy Cost	12.27	23.38	5.73	24.58	37.90
Demand Cost	2.38	4.20	1.12	4.45	7.50
Total Operation	21.49	40.20	19.47	41.65	53.29

reductions in cost of as much as 10% might be reasonable for bulk purchases (id., p. 4377).

Wyoming's Response:

52. The Court finds that the appropriate per acre capital construction costs to be used to determine the practicable irrigability of the United States' five proposed projects are as follows:

Project	Capital Construction* Cost/Acre
North Crowheart	2,448
South Crowheart	2,722
Arapahoe	2,902
Riverton East	2,413
Big Horn Flats	2,046

* These costs are not annualized and do not include annual construction, operation and maintenance costs.

These costs were derived by taking the per acre capital construction costs calculated by Mr. Sostrom, found in Wyo. Exh. WRIR FSO-4, and adding to these figures additional costs for canal lining and road construction as stated in Wyo. Exh. WRIR FSO-4B.

Although the costs calculated by Dr. Mesghinna and Mr. Sostrom for on-farm system, pipe network, pumps and pumping plants, canals and related structures and drainage were virtually the same, a variation from (-)15% to (+)16%, the Court should find Mr. Sostrom's overall figures more reliable for the following reasons: (1) Mr. Sostrom included in his costs a mobilization fee of 6.17%

which represents the cost of mobilization, bonding and insurance. This is a construction cost which must be considered. Dr. Mesghinna, however, failed to include this in his costs. Tr. 13352-13353 (Sostrom); Wyo. Exh. WRIR FSO-4A at pp. 2, 24, 28, 36 and 41; (2) Mr. Sostrom included costs for canal lining and road construction which were ignored by Dr. Mesghinna. Tr. 13328-13335 (Sostrom); (3) Dr. Mesghinna failed to include any contingency costs for the on-farm system, which are necessary for a feasibility level study. Tr. 13574-13575 (Sostrom); (4) Dr. Mesghinna's relatively low figure of 25% for engineering and contingencies was not supported by any rationale or justification. Mr. Sostrom used a figure of 35% for engineering and contingency. He based this on ASCE Guide No. 45; consultation with a Mr. Goldman, an instructor at a construction management cost estimating seminar; discussions with Mr. Floyd Bishop; and finally, his many years of experience cost estimating large construction projects in Wyoming. (Tr. 13251-13255, 13351-13355, 13447-13483 (Sostrom). Mr. Sostrom's 35% figure is more reflective of local construction conditions. However, even this figure may be low in light of the questionable accuracy of the climatic data and arable land base upon which Dr. Mesghinna was forced to rely.

As part of Mr. Bliesner's work for the Tribes, he redesigned the pump stations, substantially lowering their cost and effectiveness. He also estimated costs for on-farm systems, pipe network and energy for the United States' five proposed projects which were substantially lower than both Dr. Mesghinna's and Mr. Sostrom's. Compare Tribes' Exh. 13 with U.S. Exh. WRIR C-245 at p. 42 and Wyo. Exh. WRIR FSO-4. The Court finds Mr. Bliesner's redesign and recosting unreliable since Mr. Bliesner developed his new figures without ever investigating Dr. Mesghinna's designs for South Crowheart, Arapahoe and Big Horn Flats. His cost estimates are based on a limited investigation of about 15% of the land in the North Crowheart and Riverton East Units. This very cursory review may explain why his cost figures are so divergent from those of Dr. Mesghinna and Mr. Sostrom.

Dr. Willardson, who also testified for the Tribes, eliminated a substantial portion of the drainage designed by Dr. Mesghinna. Dr. Willardson did this despite the fact that he originally assisted Dr. Mesghinna in developing the procedure and design criteria which Dr. Mesghinna used for the drainage system. Tr. 8575-8577, 8635 (Willardson). Dr. Willardson spent a total of approximately 20 hours on the Wind River Indian Reservation observing the United States' five proposed

projects, a coverage of 2,500 acres per hour, before deciding to completely revamp the drainage system Dr. Mesghinna designed his system over a period of two years of intensive work. Tr. 8694, 8706-8707, 8712 (Willardson). The Court should find Mr. Willardson's redesigns totally unpersuasive because of the abbreviated analysis.

Although the reduction in size of the irrigation system designs of Dr. Mesghinna to conform to the State's arable land base will likely result in an increase in per acre capital construction costs, the Court should conclude the increase will not be significant and therefore feel comfortable relying on Mr. Sostrom's per acre costs. Tr. 4486-4492 (Mesghinna); Wyo. Exh. WRIR FSO-4 and FSO-4B.

Tribes' Proposed Findings of Fact:

53. The Tribes' experts, Keller Engineers, objected to these costs as unrealistically high in four principal areas, pipe networks, pumping plants, drainage and contingency. Their testimony on costs is summarized at pp. 24-34 of Tribes' Ex. 13.

Wyoming's Response:

53. See Wyoming's Amended Proposed Finding of Fact 18-22 and support therefor; see also Wyoming's Response to Tribes' Proposed Finding of Fact 52.

Tribes' Proposed Findings of Fact:

54. Keller Engineers redesigned the sizes of pipes in sample portions of the pipeline networks using a computerized pipeline size optimization program, proprietary to themselves, which they have used in other projects. They also included volume discounts on pipe prices, which had not been used by Stetson. They also used an average sprinkler pressure of 45 pounds per square inch (psi) rather than the 55 psi utilized by Stetson. They testified that all of these changes are in accord with practices successfully used in the area.

These changes resulted in a 23% savings on pipeline costs. Because only sample sections had been redesigned they reduced this to a 15% savings as a conservative estimate. They arrived at an 8% reduction in on-farm costs through volume purchase, but reduced this to 5% as a conservative estimate. As to sprinkler pressure, Mr. Bliesner testified that 40 psi (rather than the 45 psi Keller used for this work) are in successful use. (Tribes' Ex. 13, pp. 24-27; Tr. V. 94, pp. 8355-67.)

Wyoming's Response:

54. Mr. Bliesner only used a small sample to analyze all of Dr. Mesghinna's work, thus the analysis is of questionable reliability. Tr. 8356, 8455, 8556 (Bliesner).

Mr. Bliesner's testimony of the purpose of their study immediately makes the results of the study suspect. Tr. 12190-12192, 12269-12273 (Bishop).

> Our original instruction was to see if there was a possibility of reducing costs on the system designs that were completed by Stetson. Apparently the final costs that had come in were higher than accepted by the Tribes.

Tr. 8262 (Bliesner).

Tribes' Proposed Findings of Fact:

55. The Tribes' engineers had an even greater disagreement with Stetson's pumping plant costs. The Stetson costs were based on Bureau of Reclamation estimating techniques which assumed enclosed pumping plants with, among other things, concrete superstructures, highly automated controls, fenced-in parking lots, etc. In Keller Engineers' opinion such plants are unnecessary for projects of this size and their costs are not typical of the costs of pumping for plants actually being built for commecial irrigation. Keller redesigned the pumping installations "on the basis that we would build them in commercial agriculture" (Tr. V. 94, p. 8370), using shade structures rather than concrete buildings. A typical pumping station as designed by Keller is shown in Tribes' Ex. 13, Figure 1, p. 8. The difference was significant, a reduction of 60% of the capital cost for pumps and pumping stations. (Tribes' Ex. 13, pp. 28-29.)

Wyoming's Response:

55. Mr. Bliesner stated that the cost estimating techniques of the Bureau of Reclamation are reasonable for pumps and prime movers. Tr. 8370 (Bliesner). The Bureau of Reclamation, Series 150, Appendix A, Estimating Data For Pumping Plants states the estimating curves represent typical costs for irrigation pumping plants. The State of Wyoming has shown pumping plant costs in Wyo. Exhs. WRIR FSO-4, FSO-4A; Tr. 13314-13316, 13328. 13616-13617 (Sostrom). See Wyoming's Amended Proposed Finding of Fact 18-22 and support therefor. Dr. Mesghinna stated he used the Bureau of Reclamation Instructions Series 150, Appendix A, rather than rely upon prices obtained from dealers. Tr. 4189, 4190 (Mesghinna).

Tribes' Proposed Findings of Fact:

56. The Tribes' engineers also disagreed with the amount of drainage planned by Stetson (Tribes' Ex. 13, pp. 29-32; Tr. V. 95, pp. 8567-631; V. 96, pp. 8635-727). The Tribes' principal witness on this aspect of the case was Dr. Lyman Willardson, professor of agricultural and irrigation engineering at Utah State University. Dr. Willardson has been for many years an international consultant on drainage problems (Tr. V. 95, pp. 8568-72). I find that Dr. Willardson is an eminently qualified and experienced drainage engineer.

Wyoming's Response:

56. The Court is unable to rely on the conclusions of Dr. Willardson regarding drainage and drainage design on the proposed five future projects for the following reasons:

1: His methods are arbitrary;

2. His entire field effort, covering more than 50,000 acres, took place over a period of 20 hours;

3. Dr. Willardson relied on the drainage investigation data developed by Mr. Toedter and was unaware of the inadequacies of that data;

4. Soil profiles could not be precisely located in the field; and

5. He was unaware of the actual intensity of the HKM drainage investigation and would be uncomfortable with the reliabilitiy of his own conclusions if he was aware of the actual investigation intensity.

See Wyoming's Amended Proposed Finding of Fact 19-7 and support therefor.

Dr. Willardson testified he had reviewed the Stetson drainage design by working with Dr. Mesghinna and later performing preliminary calculations which showed Dr. Mesghinna's calculations were correct. Then after a hurried visit to about 80% of the land in the field he contradicted his earlier concurrence. Tr. 8580, 8602 (Willardson).

Further doubts arise to the results of the Tribes' drainage analysis, in light of Dr. Willardson's testimony that Mr. Bliesner asked him to look at the drainage work done by Stetson Engineers. This must be coupled with the fact that Mr. Bliesner had a predetermined objective to lower costs in mind. Tr. 8578 (Willardson); Tr. 8263 (Bliesner).

Tribes' Proposed Findings of Fact:

57. Dr. Mesghinna had planned a project to remove all excess water by drainage pipes during the irrigation season. It was Dr. Willardson's opinion, after reviewing the documentation and walking the land, that while this provided a clearly workable system, it is "excessive" and unnecessarily raises the price of the project. In his opinion natural drainage and drainage beyond the growing season will make a major contribution in a highland area such as the planned future projects. He reduced the drainage planned by Dr. Mesghinna in some fields resulting in a revised plan averaging 43 feet of drains per acre rather than the 66-foot average of the Stetson plan. This compared favorably with the 45 feet per acre planned for the Riverton Reclamation Project, which is on lower lands more susceptible to drainage problems, and uses flood irrigation -- which is also more susceptible to drainage problems than the sprinkler irrigation planned here. (Tr. V. 95, pp. 8625-26.) The result of Dr. Willardson's work was a weighted average of $298 per acre for drainage rather than the $394 used by Stetson Engineers (Tribes' Ex. 13, pp. 29-32; id., Table 14, p. 35; Tr. V. 95, pp. 8611-30.)

Wyoming's Response:

57. See Wyoming's Response to Tribes' Proposed Finding of Fact 56 for the questionable drainage study by the Tribes.

See Wyoming's Amended Proposed Finding of Fact 18-22 for the correct construction costs regarding drainage.

Tribes' Proposed Findings of Fact:

58. The Tribes' fourth area of disagreement was engineering and contingency costs. Stetson included an additional 25% of all but one farm costs. The Tribes used 20% of all costs. (Tribes' Ex. 13, pp. 32-33.)

Wyoming's Response:

58. Dr. Mesghinna's relatively low figure of 25% for engineering and contingencies was not supported by any rationale or justification. Mr. Sostrom used a figure of 35% for engineering and contingency and based this on ASCE Guide No. 45; consultation with a Mr. Goldman, an instructor at a construction management cost estimating seminar; discussions with Mr. Floyd Bishop; and finally, his many years of experience cost estimating large construction projects in Wyoming. Tr. 13251-13233, 13351-13355, 13447-13483 (Sostrom). Mr. Sostrom's 35% figure is probably more reflective of local construction conditions. However, even this figure may be low in light of the questionable accuracy of the climatic data and arable land base data upon which Dr. Mesghinna was forced to rely.

Mr. Bliesner used 10% for engineering and 10% for contingency, but he testified that the Bureau of Reclamation uses 15% for contingency (the same percentage used by both Dr. Mesghinna and Mr. Sostrom for contingency). This discredits his use of only 10% for contingency. Mr. Sostrom used just less than the average of 17-1/2% contingency suggested in the ASCE Manual No. 45. Tr. 8334, 8374, 8440, 8263 (Bliesner); Tr. 13353, 13448, 13599 (Sostrom). Mr. Sostrom's experience, which

includes involvement in many projects which he followed through from design to completion of construction in Wyoming, provides a far superior evaluation of engineering costs. Tr. 13599-13601, 13688 (Sostrom); Tr. 12191 (Bishop).

Tribes' Proposed Findings of Fact:

60. The total investments in dollars per acre for the five projects designed by Stetson engineers compared with the recosting and design by Keller Engineers is shown at Tribes' Ex. 13, p. 35 (Table 14).

	North Crowheart	South Crowheart	Arapahoe	Riverton East	Big Horn Flats	Weighted Average
			Stetson Costs			
Total Investment	$1,837	$2,033	$2,030	$2,006	$2,067	$1,991
			Revised Costs (Keller)			
Total Investment	$1,430	$1,622	$1,673	$1,510	$1,444	$1,470

Wyoming's Response:

60. See Wyoming's Response to Tribes' Proposed Finding of Fact 52.

Tribes' Proposed Findings of Fact:

61. Dr. Mesghinna on cross-examination agreed that in trying to avoid any possible problems later on he had "over-costed" the project (Tr. V. 52, pp. 4744-45).

Wyoming's Response:

61. Dr. Mesghinna, in fact, underestimated construction costs. See Wyoming's Response to Tribes' Proposed Finding of Fact 52.

Tribes' Proposed Findings of Fact:

62. As to drainage Dr. Mesghinna on cross-examination agreed that there is a good chance that some of the drainage he planned will not be needed -- that he had designed for maximum protection (Tr. V. 48, pp. 4355-56). He did not dispute the validity of Dr. Willardson's conclusions that 50% of the drains were not needed but stated that he had them in because his intention was to plan a drainage design that "is beyond any doubt" (Tr. V. 135, pp. 12396-98).

Wyoming's Response:

62. Drainage, in the final analysis, ordinarily requires more, rather than less, of the original design estimates. Tr. 12166 (Bishop). In addition, there are numerous deficiencies in Dr. Willardson's drainage analysis. See Wyoming's Response to Tribes' Proposed Finding of Fact 56.

Tribes' Proposed Findings of Fact:

63. On pumping plant costs, Dr. Mesghinna agreed that he had used Bureau of Reclamation estimating guides that called for more elaborate pumping stations than are actually needed for this project. (Tr. V. 48, pp. 4362-68.) When recalled as a witness by the State, after the testimony of Mr. Bliesner, Dr. Mesghinna agreed that "[a]s to the cost of pumping and pumping plants, I think we are very high. . . ." (Tr. V. 135, p. 12403.)

Wyoming's Response:

63. Dr. Mesghinna earlier testified that his pumping plant costs are slightly lower than Bureau of Reclamation values yet higher than very low estimates. Tr. 4364 (Mesghinna). He goes on to state that it is up to the design engineer to come up with proper costs. Tr. 12403 (Mesghinna).

Tribes' Proposed Findings of Fact:

64. As to pipes and on-farm equipment, on cross-examination (Tr. V. 49, pp. 4376-81) Dr. Meghinna agreed that his prices did not include quantity discounts or consider that the Indians might lay the pipes with their own equipment and labor which could be a considerable savings. He agreed that reductions in cost of as much as 10% might be reasonable for bulk purchases (id., p. 4377).

Wyoming's Response:

64. There is no evidence in the Record to show that the Tribes' possess the necessary equipment or skill to install the pipes. Nor is there evidence that if they did, the end result would be more economical.

Dr. Mesghinna did not deduct 10% from the prices he used in U.S. Exh. C-245, in fact, he inserted a 15% overall contingency. This is a measure of confidence in the estimated prices and quantities used.

From the evidence, a determination can be made that, in fact, the cost of items omitted by Dr. Mesghinna and Mr. Bliesner range from 3% to 13% of the total costs per acre for the seven projects. Thus, it is apparent that bulk purchase percentages (which are speculative and may not be obtainable by the contractor performing the work) should not be deducted from the estimated cost in a feasibility level study. Wyo. Exh. WRIR FSO-4B; Tribes Exh. 13.

Tribes' Proposed Finding of Fact:

65. The State's witness on costs was Mr. Henry Sostrum of Banner Associates. Mr. Sostrum's experience in cost estimation was as a highway engineer. His only experience with irrigation or agricultural engineering was in moving portions of existing ditches when highways were to be built across them. Over the United States and the Tribes' objections to his testifying as an expert on costs of irrigation projects, I admitted his testimony. In doing so I stated that in weighing the probative value of his testimony I would take into account his lack of expertise in irrigation and agricultural engineering. I find that while Mr. Sostrum is a qualified engineer, with experience in cost estimation in connection with highways, he is not an expert in irrigation engineering and his testimony as to costs of irrigation projects is entitled to less weight than that of Dr. Mesghinna or the witnesses from Keller Engineers, all of whom are well qualified in irrigation engineering.

Wyoming's Response:

65. Mr. Sostrom has had a great deal of previous experience with design, estimating costs and engineering during construction, which includes:

1. diversion structures;

2. earth work amounting to many millions of cubic yards;

3. canal check structures, turnouts, drops, siphons, and many thousands of cubic yards of concrete in other types of structures;

4. channel stabilization totaling miles in length;

5. canal and ditch lining;

6. water measuring devices in irrigation canals;

7. many miles of perforated underdrain pipe;

8. open channel drains;

9. land leveling of many thousands of acres;

10. planting grass seed, distributing of fertilizer and irrigation on many thousands of acres;

11. many miles of fence;

12. placement of hand-move sprinklersin the borrow pits and on roadway cuts.

These and other items of work have been included in the more than 30 highway construction projects with which Mr. Sostrom has been involved. The capital costs average hundreds of thousands of dollars ranging up to $3,000,000 in total investment. Tr. 12150-12155, 13260, 13571-13572, 13600-13601, 13622, 13688 (Sostrom).

Tribes' Proposed Finding of Fact:

66. The costs testified to by Mr. Sostrum are summarized and compared to Stetson and Keller costs in State's Ex. FSO-4. At trial it became apparent that Banner Associates had on a number of instances initially determined costs to be substantially lower than those determined by Stetson. (See Tr. V. 147, p. 13567). Whenever this occurred Stetson's costs were used as Banner costs in the exhibit. For instance, in depositions, Mr. Sostrum had testified to pipe costs for North Crowheart 29% lower than Stetson's, but State's Ex. FSO-4 used the Meaghinna costs. (Tr. V. 146, p. 13498.) The higher total costs reported in State's Ex. FSO-4 are largely due to a 35% charge for engineering and contingencies -- not any item-by-item costs. (See Tr. V. 145, pp. 13351-52.)

Wyoming's Response:

66. Mr. Sostrom testified that he received from Dr. Mesghinna only 12% of the pipeline data. This represents only 2-1/2% of the proposed irrigation project area. Thus, for the remaining 97-1/2% of the project, the costs per acre used by Dr. Mesghinna were adopted. Tr. 13312-13318, 13498-13499 (Sostrom).

Tribes' Proposed Finding of Fact:

67. Similarly, in the comparison of costs for the two projects added by the Tribes, Big Horn Flats Extension and Stagner Ridge, costs were substantially raised by the contingency and engineering figures which far exceeded those used by either of the firms more experienced in irrigation engineering. The final costs reached by Banner Associates for each project, stated in dollars per acre, were as follows:

North Crowheart	South Crowheart	Arapahoe	Riverton East	Big Horn Flats	Big Horn Flats Ad.	Stagn Ridge
$2,333	$2,509	$2,683	$2,307	$2,000	$2,613	$1,76

These figures may be of some use as an establishment of the maximum per acre cost agreed to by the State. I find, because of the matters stated in Findings 65 through 67 supra, that they are of little probative value.

Wyoming's Response:

67. The figures illustrated are from Wyo. Exh. WRIR FSO-4. These are incomplete since they do not include the costs the United States and Tribes forgot, or intentionally failed, to include which are in Wyo. Exh. WRIR FSO-4B. The total costs are summarized in Wyoming's Amended Proposed Findings of Fact 18-22 and 19-13. The figures developed by Wyoming are more realistic than those developed by the Tribes as discussed in Wyoming's Response to the Tribes' Proposed Findings of Fact 39 through 66.

Tribes' Proposed Finding of Fact:

68. While I am aware that cost overruns are more common than underruns, the cost figures used in testimony here are all by agreement in 1979 dollars, thus inflation is not to be considered in figuring costs and the risk of overruns caused by inflation is not appropriate to consider -- because yields and prices also rise with time. I find in light of the admissions of Dr. Mesghinna that he overpriced his cost estimates to avoid any criticism. In light of the experience of Keller Engineers with construction of irrigation projects; in light of the detailed testimony of Mr. Bliesner concerning pumping plant costs, volume purchasing, pipe maximization; and in light of the testimony of Dr. Willardson on drainage and a comparison of his planned drains per acre with those in the Riverton Reclamation District, I find that the most reasonable cost estimates in 1979 dollars are those supplied by Keller Engineers. I accordingly find the proper estimates for per acre costs in 1979 dollars for the seven projects to be as follows:

North Crowheart	South Crowheart	Arapahoe	Riverton East	Big Horn Flats	Big Horn Flats Ad.	Stagne Ridge-
$1,430	$1,622	$1,673	$1,510	$1,444	$1,785	$1,542

Wyoming's Response:

68. See generally Wyoming's Response to Tribes' Proposed Findings of Fact 39 though 66; see specifically Wyoming's Response to Tribes' Proposed Finding of Fact 52.

Tribes' Proposed Finding of Fact:

3. Future Lands -- Economics

69. In my conclusions of law I state that there are two relevant tests for practicably irrigable acreage. One is whether the lands in question and the proposed irrigation projects are similar to other lands and projects actually in operation in the West which have sustained long-term irrigation. It would be grossly unfair to say to the Indians that they will not be permitted to irrigate lands of the same sort that are currently in irrigation in the area. A second test is whether the projects are shown to be feasible under a benefit/cost analysis. I have made findings relevant to each test. If the land is practicably irrigable under either test it should be included in the reserved rights of the Tribes. To hold otherwise discriminates against the Tribes.

Wyoming's Response:

69. This Finding is nothing more than a plea to the Special Master to reject the stipulation of all parties that practicably irrigable acreage is bounded by reasonable costs. See Wyoming's Proposed Finding of Fact 15-1. The Tribes suggest that the projects should be subjected to a benefit-cost analysis, but even if they are economically infeasible, the Tribes should be given water anyway if they are in some sense similar to other lands in projects which were authorized in the past.

If the projects are economically infeasible, it is clearly because project costs are unreasonable relative to benefits and thus practicable irrigability does not exist.

As Special Master Tuttle observed in his recent report on Arizona v. California:

> My reading of the transcript [of the prior proceedings] reveals that the evidence of "practicable irrigability" was determined by then current standards. I am similarly convinced that my determination of practicable irrigability should be based on present standards. Reference to past standards would introduce an additional complication into an already complex issue. Given that these issues are to be litigated presently, the most sensible method of determining feasibility is by using present standards.

Special Master Report at 98 (Feb. 22, 1982), Arizona v. California (Oct. 1981 Term, No. 8, Orig.) (footnotes omitted).

The Court should further note that there is no basis in the Record for determining irrigability using past standards. It is not even clear that it would have been possible to get water on lands such as those found in Big Horn Flats or North Crowheart twenty to forty years ago. Tr. 9014 (Cummings). Finally, as pointed out in Wyoming's proposed Finding of Fact 15-12, the reserved right claimed by the Tribes has a priority date senior to every other appropriator in the Wind River and Big Horn Basins, and further, these rights cannot be lost because of nonuse. To grant a water right of this type because lands appear at a glance to be "of the same sort" as others that are currently irrigated would be a gross miscarriage of the Court's responsibilities in this adjudication.

Tribes' Proposed Finding of Fact:

70. In determining whether the lands of the seven planned projects are similar to lands that have sustained long-term irrigation in the West, I have considered the testimony of Dr. Mesghinna that the lands in his five projects are similar to those successfully irrigated in the Federal Indian Project on the Reservation (Tr. V. 48, pp. 4351-53).

Wyoming's Response:

70. See Wyoming's Response to Tribes' Proposed Finding of Fact 69.

Tribes' Proposed Finding of Fact:

71. I have also considered testimony comparing the Midvale project, a largely non-Indian project on the Reservation, to the proposed projects. In some respects the lands included in the future projects are superior to lands sustaining long-term irrigation in Midvale. For instance, all Class 4 and 6 lands have been eliminated from the future projects while the testimony of Midvale officials showed that Class 4 and 6 lands are being irrigated at Midvale (Tr. V. 152, pp. 13729-30). Dr. Willardson testified that the drainage problems are less in most of the future projects than in Midvale (Tr. V. 95, pp. 9625-26). The future projects are also planned for sprinkler irrigation which permits better control of water, while Midvale is a gravity system.

Wyoming's Response:

71. See Wyoming's Response to Tribes' proposed Finding of Fact 69. The Court should also note that the alleged "similarities" between Midvale and the proposed future projects are for the most part documented in the Record as potential problems facing the future projects. See Wyoming's proposed Findings of Fact 15-6 and 19-7.

Tribes' Proposed Finding of Fact:

72. Dr. Keller, who has evaluated irrigation projects throughout the world, testified as to all seven future projects (Tr. V. 97, pp. 8788-8802) that:

a. all the technologies are very common and can be seen operating in the immediate vicinity;

b. the crop mixes are conservative and are being grown in the area now;

c. the elevations of the projects are well under those of other successful projects in the Rocky Mountain area including the Navajo project;

d. the growing season is not unusual;

e. the water is of good quality and is accessible;

f. the land is irrigable using ordinary practices -- "Its not out of the ordinary. Its in common practice"; and

g. the investments per acre are well within ranges of current projects -- "they would be considered in the very comfortable side, . . ."

Wyoming's Response:

72. See Wyoming's Response to Tribes' Proposed Findings of Fact 69 and 77. See also Wyoming's Proposed Finding of Fact 15-12.

Tribes' Proposed Finding of Fact:

73. In determining whether the lands in the seven future projects can sustain long-term irrigation at a reasonable cost -- as a test separate from benefit/cost ratios per se, in addition to the matters listed above, I have considered the study of costs of irrigation projects presented by Dr. Ronald G. Cummings. Dr. Cummings testifed as an economist for the Tribes. He is a professor of economics and director of the Program in Natural Resources Economics at the University of New Mexico. Dr. Cummings holds a Ph.D. in economics from the University of Kansas. He has consulted on water resources both in this country and abroad. He headed the Resources for the Future natural resources program in Mexico where he worked with the Mexican Water Resources Ministry on evaluating irrigation projects. He has served as a distinguished visiting professor at the University of Wyoming. Dr. Cummings has also participated in a major historical study of Bureau of Reclamation policies in approving water projects (Tr. V. 98, pp. 8841-46; Tribes' Ex. 24, App. D).

Wyoming's Response:

73. See Wyoming's Response to Tribes' Proposed Finding of Fact 69.

Tribes' Proposed Finding of Fact:

74. I find that Dr. Cummings is an expert in natural resource economics, and both for this litigation and as a part of his prior academic work has made extensive studies of the projected costs of water projects actually built.

Wyoming's Response:

74. Dr. Cummings was not endorsed by the Tribes as a natural resource economist and, naturally, the Tribes cite no evidence to support this Finding. He was endorsed as an agricultural economist and water resource economist. Tr. 8846 (Cummings).

Dr. Cummings, however, disavowed himself of his credentials as an agricultural economist by stating:

> I am not what is typically referred to as an agricultural economist, so we are keeping everything clean. In general terms, I am familiar with sprinkler irrigation. I do not know when we began using them, you know.

Tr. 9009 (Cummings) (emphasis added).

Tribes' Proposed Finding of Fact:

75. Dr. Cummings' study (Tribes' Ex. 24) shows the projected cost per acre attributable to agriculture of 13 projects actually built in Wyoming and neighboring states in 1979 dollars to be a range between $675 per acre to $3,971 per acre with an average of $1,875 per acre. (Tribes' Ex. 24, Table A.6, p. A.23.) While Dr. Cummings recognized the problems in comparing projects (id., pp. A.26-A.28), these figures add to the evidence that the projects planned at Wind River are well within the middle range of costs for projects actually built.

Wyoming's Response:

75. As pointed out in Wyoming's Proposed Finding of Fact 15-12, and Wyoming's Response to Tribes' Proposed Finding of Fact 69, the reasonableness of irrigation system costs can be determined only by a comparison of projected returns. Dr. Cummings gave no testimony concerning the crops that were planned for the other irrigation systems described in Tribes' Exh. 24. Thus the Court has no basis for making comparisons. The system costs which might be reasonable for growing almonds and pistachios, as proposed during the recent Arizona v. California hearing, might be quite unreasonable for growing alfalfa. Special Masters' Report (Feb. 22, 1982), Arizona v. California (Oct. 1981, No. 8 Orig.)

Furthermore, it is apparent that many of the thirteen projects Dr. Cummings testified about involved water storage, and that projects involving storage have different arrays of costs and benefits than projects, such as those proposed here, which do not. Dr. Cummings acknowledged this fact in somewhat ambiguous terms, as follows:

> Mr. Merrill, when you say that a project with the storage which by definition -- well, generally, by definition is multipurpose, will have a different array of benefits and costs, which is another way of saying multipurpose -- you know, many purposes -- it is not clear that that's germain to what you are getting at here.

Tr. 9030 (Cummings). Thus, the Tribes' contention that Dr. Cummings' figures "add to the evidence that the Projects planned at Wind River are well within the middle range of costs for projects actually built" has little meaning without evidence that the benefits from those projects also fall within a reasonable range. The latter determination is best pursued through benefit-cost analysis.

Tribes' Proposed Finding of Fact:

76. The State made no comparable study of other existing projects. Both Mr. Sostrum (Tr. V. 147, p. 13594) and Dr. Jacobs (Tr. V. 160, p. 15042) denied that they had made any study of comparable projects. Mr. Bishop, while testifying that he considered costs of $1,800 to $2,000 an acre "excessive" (Tr. V. 133, p. 12168), did not claim to have made a study of comparable costs of larger irrigation projects.

Wyoming's Response:

76. Wyoming made no "study" for precisely the reasons argued in Wyoming's Response to Tribes' Proposed Findings of Fact 68 and 75. To do so would have been misleading and in direct conflict with the stipulation of the parties that practicably irrigable acreage is constrained by the concept of reasonable costs.

Tribes' Proposed Finding of Fact:

77. I find that the lands contained in the seven proposed future projects are similar to other lands and projects actually in operation in the West which have sustained long-term irrigation and that the 63,730 acres designated for those projects are, accordingly, practicably irrigable acres.

Wyoming's Response:

77. This Finding is irrelevant to the determination of practicable irrigability precisely for the reasons given in Wyoming's Response to the Tribes' Proposed Findings of Fact 68 and 75. In addition, the Tribes cite no support in the Record for this Finding.

Tribes' Proposed Finding of Fact:

79. Mr. David Dornbusch, president of David M. Dornbusch and Company of San Francisco, testified for the United States. Mr. Dornbusch is both a graduate engineer and an economist. He is experienced in feasibility studies for irrigated agriculture and other agricultural industries, having been a consultant to the World Bank before forming his own consulting firm. He has performed large-scale agricultural feasibility studies both in this country and abroad (Tr. V. 54, pp. 4891-908).

Wyoming's Response:

79. The State of Wyoming points out in its Proposed Finding of Fact 18-23 that Mr. Dornbusch was tendered as an expert in economics and economic feasibility analysis only over the objections of the State. Tr. 4908-4932. In fact, the Record shows that Mr. Dornbusch's undergraduate degree is in civil engineering and his Master's degree in business administration. Tr. 4893 (Dornbusch). Although Mr. Dornbusch has extensive experience as a consultant, see U.S. Exh. WRIR C-266 (pp. 1-7), the majority of projects he has worked on were not related to irrigated agriculture, and he had never testified as an expert witness prior to this case.

Although Mr. Dornbusch may have become self-trained in some phases of economics through his consulting experience, he is clearly not an agricultural economist or farm management specialist and the Court should not rely upon his opinions concerning cropping patterns, potential yields, or on-farm production costs pertinent to the operation of irrigated agricultural projects in the State of Wyoming.

Tribes' Proposed Finding of Fact:

80. Mr. Dornbusch did an extensive feasibility study of the five projects designed by Dr. Mesghinna and testified that they are economically feasible (Tr. Vs. 54-55; U.S. Ex. C-268). He provided the following benefit/cost figures (U.S. Ex. C-268, Table 5, p. 13):

North Crowheart	1.47
South Crowheart	1.29
Big Horn Flats	1.07
Riverton East	1.25
Arapahoe	1.53

These ratios were computed using a 4% discount rate, using benefits restricted to direct income from sales of crops, and with 80% of farm labor costed at zero opportunity cost because of chronic unemployment on the Reservation. The crop mixes were representative of crops currently grown in the area, with no exotic crops or even high value crops such as sugar beets, formerly grown on the Reservation, added. Crop mixes were adjusted and yields reduced for elevations over 5,900 feet based on interviews with farmers and other knowledgeable people in the area such as agricultural extension agents. The yields and prices were based on similar interviews and reports. No secondary benefits were used. I find his method and results to be conservative.

Wyoming's Response:

80. Mr. Dornbusch did indeed provide the Court with the benefit-cost ratios given on page 13, Table V of U.S. Exh. C-268. Mr. Dornbusch also provided the Court with the following benefit-cost ratios at a 5% discount rate:

North Crowheart	1.27
South Crowheart	1.13
Big Horn Flats	.96
Riverton East	1.10
Arapaho	1.31

Wyo. Exh. ED-12 (Table 12).

Mr. Dornbusch also provided the Court with the results of his benefit-cost analyses at a 6% discount rate. They showed the following benefit-cost ratios:

North Crowheart	1.10
South Crowheart	.99
Big Horn Flats	.87
Riverton East	.98
Arapaho	1.14

Wyo. Exh. ED-13 (Table V).

Mr. Dornbusch also provided the Court with the results of his benefit-cost analysis at 7-1/8%. Those ratios are:

North Crowheart	.95
South Crowheart	.87
Big Horn Flats	.77

Riverton East	.86
Arapahoe	.98

Wyo. Exh. ED-14 (Table V).

Mr. Dornbusch also testified that he began his feasibility analysis at a 7-1/8% discount rate, Tr. 6071; and furthermore testified that it is standard procedure to stick with the discount rate you start with at the beginning of your analysis. Tr. 6073 (Dornbusch).

Mr. Dornbusch did cost 80% of his farm labor at zero, a procedure which violates not only Water Resource Council guidelines, Wyo. Exh. ED-6 (p. 72969), but also contradicts Mr. Dornbusch's own testimony that farmers in the North Crowheart area had stopped growing corn because "they were having difficulty in finding laborers to harvest the corn and had discontinued it." Tr. 4949 (Dornbusch).

The "interviews" upon which Mr. Dornbusch based his yields, crop mixes and elevation break points hardly form a credible base for his conclusions for the following reasons:

1. Mr. Dornbusch could not recall how many farmers he interviewed, or what their average crop yields were. Tr. 5855-5866 (Dornbusch).

2. Mr. Dornbusch could not recall how many interviews were conducted in person versus over the telephone. Tr. 5833 (Dornbusch).

3. Mr. Dornbusch could not tell the Court the cropping patterns of the people he interviewed. Tr. 5833 (Dornbusch).

4. The only recorded evidence of the results of these interviews presented to the court is Wyo. Exh. ED-16, which is primarily a set of indecipherable hand scribblings which hardly constitute the basis for forming conclusions as weighty as those suggested by the Tribes.

Tribes' Proposed Finding of Fact:

81. Dr. Cummings, testifying for the Tribes, accepted the Dornbusch data on costs and direct benefits. He testified, however, that the exclusion of a multiplier for secondary benefits unfairly judged Indian projects more severely than Bureau of Reclamation projects actually built had been judged (Tribes' Ex. 24, pp. 4-7, A.10-A.22; Tr. V. 98, pp. 8853-64). He testified that secondary benefits are the extra business created for suppliers and persons in the vicinity by reason of the new irrigation project and the money pumped in by it and should be included in the benefit/cost ratio (Tr. V. 98, p. 8854).

Wyoming's Response:

81. Dr. Cummings did indeed accept the Dornbusch data on costs and direct benefits. In fact, he stated that "I was not asked nor did I have -- given the time, nor did I take the time to analyze Dornbusch's work." Tr. 8969 (Cummings).

The Court should note that Mr. Dornbusch's work was based upon a published study by Mr. Doug Agee, who testified on behalf of the State of Wyoming. Tr. 4942, 4952, 4974. The Court should further note that the primary adjustments made by Mr. Dornbusch to Mr. Agee's study were to greatly increase Mr. Agee's hours of use for various pieces of equipment and "normalize" his 1977 prices to 1979 prices. Tr. 4979-4984.

Unfortunately, when Mr. Dornbusch increased his hours of usage of Mr. Agee's equipment to account for an assumed "cooperative" farm arrangement, he did not correspondingly accelerate the depreciation of that equipment. Tr. 14783-14785. Furthermore, Mr. Dornbusch's "normalization" of Mr. Agee's prices was in violation of Water Resource Council guidelines and resulted in prices that were substantially lower than 1979 price levels. Tr. 5808 (Dornbusch); Tr. 14781, 14782 (Jacobs). Thus, since Dr. Cummings did not bother to check Mr. Dornbusch's analysis, his own analysis suffers the same errors inherent in Mr. Dornbusch's work.

Dr. Cummings' inclusion of secondary benefits in Mr. Dornbusch's analysis is clearly inappropriate for several reasons:

1. As Dr. Brookshire testified, "one should probably not include secondary elements, but if one does, one must consider secondary benefits and secondary costs. You must balance the ledger. To do otherwise, it would be like putting all the deposits in your check book and never writing in any of the checks. You are obviously going to get a distorted view of what is happening financially to yourself." Tr. 14532 (Brookshire).

2. There is no reason to believe secondary benefits (if any) would accrue to members of the Tribes, as opposed to non-Indians living in the area surrounding the Reservation. Tr. 8943 (Cummings).

3. If secondary benefits do exist and do accrue to non-tribal members, they constitute a positive "impact" that would be inappropriate to consider without also considering negative impacts. Tr. 14532 (Brookshire).

4. Special Master Tuttle in the recent Arizona v. California report clearly indicated that contemporary standards should be used in determining practicable irrigability. Special Master Report at 98 (Feb. 22, 1982), Arizona v. California (Oct. 1981 Term, No. 8, Orig.). Furthermore, it is quite clear from Dr. Cummings' testimony that contemporary standards do not call for the inclusion of secondary costs or benefits. Tr. 8866; Tribes' Exh. 24 (pp. 3-8).

Dr. Cummings' argument is also internally inconsistent. He argues that "on its face, you penalize the Indian for not -- for not exercising their reserved right prior to 1973." Tr. 8566 (Cummings). Under cross-examination, however, Dr. Cummings was unclear as to whether it would be technically feasible to irrigate the proposed future projects had the Indians exercised their water right at an earlier date. Tr. 9014 (Cummings). Furthermore, Dr. Cummings admitted that had the Indians exercised their water right prior to 1939, the principle for evaluating feasibility would have been strict financial ability to repay costs. Tr. 8850-8851 (Cummings).

Tribes' Proposed Finding of Fact:

82. Dr. Cummings' study of 20 Bureau of Reclamation projects in the area showed that if secondary benefits are removed from past studies of water projects, the benefit/cost ratios of the portions of the project attributable to agriculture ranged from .36 to 1.46 (Tribes' Ex. 24, Table A.1, p. A.12). Thus either secondary benefits should be allowed or considerably less than a 1.0 benefit/cost ratio should be sufficient to find these projects feasible.

Wyoming's Response:

82. The Tribes' argument that secondary benefits should be allowed (or equivalently that a feasibility standard of less than unity be employed for direct benefits) is entirely inappropriate in determining practicably irrigable acreage for all of the reasons listed in Wyoming's Response to Tribes' Proposed Finding of Fact 81. The court should also take note of the following exchange between Mr. Radosevich and Dr. Cummings on cross-examination:

> Q. How much, in fact, impact of secondary benefits would actually accrue to the people on the reservation?
>
> A. Impacts . . . impacts to individuals directly on the reservation would be primarily included in your direct or N.E.D. benefits. Secondary benefits are primarily off the reservation.
>
> Q. So they'd be affecting other users, the Town of Riverton, the Town of Lander, outside in Wyoming?
>
> A. Outside of the project, yes.

Tr. 8918 (cross-Cummings) (emphasis added).

This testimony by Dr. Cummings makes it crystal clear that secondary benefits are nothing more than "impacts"; and it would be entirely inconsistent for the Court to include some "impacts" in its determination of practicably irrigable acreage and ignore others, such as the "impacts" upon current water users whose water rights might be affected by the Tribes' claims.

Tribes' Proposed Finding of Fact:

83. Dr. Cummings prepared benefit/cost ratios for the five Mesghinna projects using alternatively the costs testified to by Dr. Mesghinna and the lower costs testified to by Keller Engineers. He computed the benefits using a 1.053 multipler for secondary benefits obtained from the regional multiplier's guidelines of the Water Resources Council, which he stated was very conservative. He also recomputed the benefit/cost ratios without the multiplier but using mathematic procedures less conservative than Mr. Dornbusch's procedures followed by the Bureau of Reclamation. His ratios were as follows (Tribes' Ex. 24, Table B.6, p. B.6):

	With secondary benefits	Without secondary benefits
North Crowheart		
Stetson	2.52	1.72
Keller	3.29	2.29
South Crowheart		
Stetson	2.22	1.48
Keller	2.82	1.92
Arapahoe		
Stetson	2.57	1.77
Keller	3.18	2.21
Riverton East		
Stetson	2.21	1.46
Keller	2.97	2.01

Tribes' Proposed Finding of Fact:

Big Horn Flats		1.13
Stetson	1.70	1.64
Keller	2.40	
Big Horn Flats Extension	1.35	.90
Stagner Ridge	2.05	1.33

He testified that in his view all of the projects are practicably irrigable as determined by cost/benefit analysis and compare favorably with projects actually built in the area (Tribes' Ex. 24, pp. 9-10; Tr. V. 99, p. 8913).

Wyoming's Response:

83. Dr. Cummings' benefit cost ratios clearly overstate the potential benefits from the proposed future projects for the following reasons:

1. As discussed in Wyoming's Response to Tribes' Proposed Finding of Fact 81, Dr. Cummings accepted Mr. Dornbusch's analysis without any review whatsoever, and Mr. Dornbusch's analysis contains some serious errors which tend to overstate potential benefits to the proposed projects.

2. As described in Wyoming's Response to Tribes' Proposed Findings of Fact 81 and 82, it is clearly inapproprate to include secondary benefits in feasibility analysis for practicably irrigable acreage on the Wind River Indian Reservation.

3. Dr. Cummings used "mathematic procedures less conservative than Mr. Dornbusch's procedures" which involved subtracting on-farm irrigation system costs from project costs, and treating them as an on-farm cost. Tr. 8889-8890 (Cummings). This procedure is clearly inconsistent with the United States' contention that the projects would be operated "in some cooperative arrangement." Tr. 4980 (Dornbusch).

Tribes' Proposed Finding of Fact:

84. Dr. James Jacobs, of the University of Wyoming, performed an economic analysis of the seven projects for the State. Dr. Jacobs is a professor of agricultural economics at the University of Wyoming. His experience has primarily been with the economic effect of varying agricultural practices. He has some experience with crop budgets but has no prior experience with analysis of the benefits and costs of irrigation projects (Tr. V. 158, pp. 14669-70, 14683-84). I recognized him "as an expert in agricultural economics," while recognizing that "he has not had a great deal to do with benefit-cost ratios on irrigation reclamation projects" (id., p. 14684).

Wyoming's Response:

84. As pointed out in Wyoming's Proposed Finding of Fact 18-23, Dr. Jacobs is clearly well-qualified to testify concerning the economic feasibility of irrigation projects proposed for the Wind River Indian Reservation. Dr. Jacobs was raised on a farm, has an undergraduate degree in agricultural education, a master's degree in agricultural economics, and a doctorate in economics from Iowa State University where his thesis was on the impact of soil and phosphorous losses on farm income. Tr. 14663-14666 (Jacobs). Prior to joining the University of Wyoming faculty, Dr. Jacobs worked at Cornell University for three years on studies on the impact on farm income of reducing sediment and phosphate losses to surface water, and for one year in a research position for the U.S. Department of Agriculture.

Since joining the faculty of the University of Wyoming in 1975, Dr. Jacobs has had responsibilities in teaching, research and extension in the area of irrigation and water resources management. As a part of his teaching responsibilities, Dr. Jacobs teaches a senior level court entitled "Water Resource Economics," and a graduate level course in "Advanced Natural Resource Economics." The nature of these courses require that Dr. Jacobs have a

clear understanding of the assumptions and procedures of benefit-cost analysis and water resource planning and development. Wyo. Exh. EJ-1 (pp. 1-9).

Dr. Jacobs has published numerous journal articles as well as experimental station and extension bulletins pertinent to crop budgeting, irrigation and water management in Wyoming. Wyo. Exh. EJ-1 (pp. 2-5). In particular, Dr. Jacobs has published a report entitled Economic and Agronomic Effect of High Irrigation Levels on Alfalfa and Barley, which reports the results of a research study conducted on the Midvale Irrigation Project near Riverton, Wyoming. As a part of the study, Dr. Jacobs had to develop crop budgets for alfalfa and malting barley to determine the effects of alternative levels of irrigations on returns to the operator.

Dr. Jacobs has also presented numerous extension programs throughout the State of Wyoming related to water resource development and irrigated agriculture. Wyo. Exh. EJ-1 (pp. 9-7).

Tribes' Proposed Finding of Fact:

85. Dr. Jacobs limited benefits to direct income from agriculture as Mr. Dornbusch did. The lowest discount rate he used was 4%. His most favorable ratios varied from a low .10 for Big Horn Flats Extension to a high of .47 for Riverton East (State's Ex. EJ-4, Part I, Table II-7, p. 13; Part II, Table II-5, p. 6). He concluded that there are no practicably irrigable acres in any of the areas proposed for future projects.

Wyoming's Response:

85. This Finding misrepresents the results of Dr. Jacobs' analysis. Wyo. Exh. EJ-11 gives Dr. Jacobs' results for water delivery system costs developed by the State of Wyoming. Assuming a 4% discount rate, and costing on-farm labor at 20% of its full value, Dr. Jacobs' benefit-cost ratios range from a low of .25 for Big Horn Flats Extension to a high of .62 for the Arapahoe and Riverton East areas.

Wyo. Exh. EJ-12 presents Dr. Jacobs' results for the United States' water delivery system costs. Again assuming superior management and 20% labor costs, Dr. Jacobs' benefit-cost ratios range from a low of .47 for Big Horn Flats to a high of .86 for the Arapahoe Unit.

Wyo. Exh. EJ-13 gives Dr. Jacobs' results assuming the Tribes' water delivery system costs. Again assuming superior management and 20% costing of on-farm labor, Dr. Jacobs' benefit-cost ratios range from a low of .64 for the Big Horn Flats unit to a high of 1.04 for the Arapahoe Unit.

Tribes' Proposed Finding of Fact:

86. Dr. Jacobs' results are based on cost figures that I find to be unreasonably high and benefit figures that I find to be unreasonably low. In my view he engaged in an "overkill" that destroys the probative value of his conclusions.

Wyoming's Response:

86. There is not one shred of evidence anywhere in the record that Dr. Jacobs engaged in any type of "overkill." To the contrary, the record clearly shows that Dr. Jacobs' analysis was conducted in a purely professional and credible manner. This fact is illustrated by the following table which compares Dr. Jacobs' on-farm costs and returns for the lowland areas with those of the United States:

Comparison of On-Farm Costs and Returns - Lowland Areas

Crop	Returns		Production Costs		Net Returns	
	U.S.*	Wyoming**	U.S.*	Wyoming**	U.S.*	Wyoming**
Malt Barley	$297.50	$243.37	$142.73	$172.16	$154.77	$138.60
Nurse Barley	264.98	276.30	146.54	186.61	118.45	89.69
Alfalfa	246.68	244.27	77.30	134.69	169.38	109.58
Corn Silage	318.00	--***	172.04	--	86.79	--
Beans***	--	406.40	--	280.16	--	126.24

* U.S. Exh. C-268 (p. 5).
** Wyo. Exh. EJ-4 (pp. 9,17).
*** Wyoming used beans rather than corn as a third cash-crop.

The first two columns of the Table show that Dr. Jacobs used comparably high, if not higher, returns for the proposed projects than did the United Stated. This fact clearly refutes the Tribes' contentions that he used "benefit figures that I find to be unreasonably low." Both Dr. Jacobs and Mr. Dornbusch's benefit measures are,

of course, lower than Dr. Cummings because they did not include the so-called "secondary benefits," which Dr. Cummings admits are nothing more than off-reservation impacts. Tr. 8918 (cross-Cummings).

The table shows that Dr. Jacobs' production costs are higher than Mr. Dornbusch's, which Dr. Cummings accepted without checking. Tr. 8170 (Cummings). As pointed out in Wyoming's Response to United States' Proposed Findings of Fact 316 and 317, this is primarily because Mr. Dornbusch assumed unreasonably low management charges, U.S. Exh. C-268 (p. 6), used a method of normalizing input prices that resulted in so-called 1979 prices that were lower than 1978 index prices, see Wyoming's Response to United States' Finding of Fact 317, and did not properly account for equipment replacement costs in his analysis. Tr. 14783, 14784 (Jacobs). Dr. Jacobs is clearly more qualified than either Mr. Dornbusch or Dr. Cummings to estimate on-farm production costs. See Wyoming's Proposed Finding of Fact 18-23. Furthermore, Dr. Cummings did not even review Mr. Dornbusch's production costs, Tr. 8970, and Mr. Dornbusch provided the Court with absolutely no published data or corroborating evidence to verify his production costs. See Wyoming's Response to Tribes' Proposed Finding of Fact 88.

Tribes' Proposed Finding of Fact:

87. Dr. Jacobs computed his machinery costs based on approximately 160 separate farms each of 320 acres and each with a full complement of farm machinery. He assumed no cooperative use of equipment and no "enterprize" farms. His reason for doing so was that 320-acre farms had been used in a study of farm costs by Mr. Doug Agee and were typical of farm sizes in the Riverton area (Tr. V. 149, pp. 14866). Dr. Jacobs did not consider that the 320-acre farms near Riverton are based on reclamation laws inapplicable to the Tribes and which, in any event, may be amended. These 320-acre farms are thus irrelevant to a determination of optimum farm size for the proposed projects and grossly raised the equipment costs used by Dr. Jacobs for those projects. Dr. Jacobs made no attempt to determine an optimal farm size or equipment complement although he admitted that if a private purchaser came to him he would do that in computing costs (Tr. V. 160, p. 15014). Nor did he take into account (1) the existence of successful Reservation family farms of over 2,000 acres (e.g., Tr. V. 151, p. 13514), (2) the existence of "communal or enterprize farms," or (3) the sharing equipment for the new projects. I find that Dr. Jacobs' use of 320-acre farms for computing costs was unreasonable and biased his results.

Wyoming's Response:

87. Dr. Jacobs did indeed assume a 320-acre farm size for his feasibility analysis of the proposed future projects. This assumption was entirely appropriate and reasonable in light of published data from the United States Department of Agriculture concerning economies of scale in field crop farming:

> Since medium-sized commercial farms with gross incomes from 41,000-76,000 dollars achieved most technical efficiencies, society benefits little in terms of lower real food costs from further increases in farm size. Actually, many commercial farms now exceed the size necessary to achieve all available cost efficiencies. With current crop production technology, further growth in medium size and larger farms will not likely improve overall food production efficiency.

U.S. Department of Agriculture, Economies of Size in U.S. Field Crop Farming at 4, para. 6 (July 1981) (Wyo. Exh. EA-8). Based upon Mr. Agee's testimony that a 320-acre farm in the Riverton area would gross between $70,000 and $90,000 annually, Tr. 15372, there is absolutely no basis for the Tribes' inference that "Dr. Jacobs' use of 320-acre farms for computing costs was unreasonable and biased his results." Dr. Jacobs never denied that fixed costs might be lower if a larger farm size had been assumed. He testified that there were factors, however, that would tend to offset fixed costs savings as farm size grows larger:

> If you look at just the fixed costs of that particular item, then there would be some reduction in those fixed costs. But again as you increase those hours of annual use, you are going to increase the repair costs. You are going to increase the rapidity with which the equipment has to be replaced.
>
> You also have the problems, as I mentioned earlier, in terms of timing of your operations to make sure they get done in a timely manner and as you go to these large units, you are also going to have management problems in making sure those operations are done on time.

Tr. 14882 (Jacobs).

What the Court is faced with is a situation where Mr. Dornbusch took published studies by Mr. Agee, and adjusted his production cost data under the assumption that huge economies could be realized through some sort of cooperative farm enterprise. Tr. 4979-4981 (Dornbusch). The fact is that Mr. Dornbusch is not an agricultural economist, see Wyoming's Proposed Finding of Fact 18-23, and there is not one shred of evidence in the Record, other than Mr. Dornbusch's unsubstantiated testimony, that his proposed economies of scale could be achieved. To the contrary, the Record clearly indicates that Mr. Dornbusch understated his production costs because he did not assume reasonable depreciation charges for his equipment, Tr. 14783, 14784; he used a method of normalizing input prices which is inappropriate, see Wyoming's Response to United States' Proposed Findings of Fact 304, 317, and he used management charges of an astonishingly low $1.32 per acre per year for alfalfa production. U.S. Exh. C-268 (p. 6).

Tribes' Proposed Finding of Fact:

88. Dr. Jacobs also used equipment costs almost twice those shown in accepted lists (e.g., National Farm Tractor and Instrument Blue Book, 1981), and apparently when choosing between costs found in Blue books, interviews with dealers and other publications often utilized the highest cost (Tr. V. 159, pp. 14883-98). In one instance his cost for 125-horsepower tractors was $37,433 each in 1979 dollars, while the Blue book showed a range around $23,000. When I brought this to his attention (Tr. V. 149, pp. 14885-86) he had no satisfactory explanation. I find these equipment costs to be unreasonable and to bias Dr. Jacobs' benefit/cost analysis.

Wyoming's Response:

88. Dr. Jacobs provided the Court with 16 exhibits, including five bound volumes encompassing hundreds of pages of documentation of the results of his analysis. It is interesting to note that after a thorough review of Dr. Jacobs' completely documented study, the only details the Tribes could find to quibble with are tractor prices, see Tribes' Proposed Finding of Fact 88, and the fact that Dr. Jacobs inadvertently included a small double charge for baling alfalfa, see Tribes' Proposed Finding of Fact 89.

The Tribes' insinuation that Dr. Jacobs, "when choosing between costs found in Blue Books, interviews with dealers and other publications, often used the highest cost" is totally false and without any evidentiary support in the Record. To the contrary, Dr. Jacobs made it quite clear that he consistently used U.S.D.A. published prices for the Rocky Mountain region to determine his equipment costs, except in some cases where he had to rely on Mr. Agee's publication because U.S.D.A. prices were not available. Tr. 14894, 14896, 14897. He admitted that in some cases his tractor prices were higher than Bluebook prices, but stated that there was a logical explanation:

> If you look at these (indicating), these prices are based on the national level. I can show you the set of prices I used which come out of the federal budgets that they use for the Rocky Mountain region. You are welcome to examine those, and that's where my particular prices come. If you compare that price with the price of the machinery that Doug Agee used for that particular area, I think they will be very representative. We are talking about a national market in these kinds (indicating) versus a local market . . .

Tr. 14886, 14887 (Jacobs).

Contrasted with Dr. Jacobs' carefully documented study results, the Court should review the level of documentation supplied by Mr. Dornbusch. Mr. Dornbusch first presented the Court with the results of his feasibility analysis for the future projects in the form of a scantily documented exhibit, U.S. Exh. C-268, covering a scant 13 pages. At a later date, similar documentation was provided for Mr. Dornbusch's analyses at 5, 6 and 7-1/8%. Wyo. Exh. ED-12, D-13 and ED-1. Mr. Dornbusch did not supply the Court with any of his individual equipment prices for scrutiny by the Court or Wyoming. Mr. Dornbusch did not supply the Court or the State of Wyoming with a statement of what farm size he assumed in his calculations. The Court is faced with the task of evaluating Mr. Dornbusch's work on the basis of a series of barely decipherable hand-scribbled notes such as those depicted by Wyo. Exhs. ED-16, ED-18, ED-52, ED-54, ED-55, and ED-56. The Court should carefully consider

whether the documentation presented in these exhibits adequately supports the results of Mr. Dornbusch's work. It is certainly clear that in comparison to Dr. Jacobs' extensive documentation of his analysis, Mr. Dornbusch's work is hardly documented at all.

Tribes' Proposed Finding of Fact:

89. The testimony of Mr. Doug Agee, called by the State, further demonstrated the excessive costs in the Jacobs' study. He admitted that farms considerably larger than 320 acres are farmed in the area and that economies of scale would result (Tr. V. 164, pp. 15334-35, 15366-68). He also testified that the farm equipment could be used many more hours than assumed by Jacobs, though there are limits (id., pp. 15381-88). He also testified, when confronted with Jacobs' figures, that the cost of alfalfa cutting had been put in twice (id., pp. 15417-20).

Wyoming's Response:

89. This finding is a clear misrepresentation of Mr. Agee's position concerning economies of scale. Mr. Agee did testify that farms "become more efficient up to a limited size, and then that curve starts to back up." Tr. 15367. Mr. Agee later presented evidence that shows that farms of 320 acres have achieved almost all economies of scale. Wyo. Exh. EA-8.

Mr. Agee did admit that farms considerably larger than 320 acres are farmed in the area. His testimony to that effect is as follows:

> The largest irrigated unit that I am familiar with in the Worland-Lander area is run by the Sherman family down on Tie-Down Flat, maybe you know where that is. But it was about a 1500 acre irrigated farm, and I can tell you they have all kinds of problems keeping the work up and timely and together.

Tr. 15358 (emphasis added).

Mr. Agee did state that it appeared Dr. Jacobs had included the cost of labor in the baling operation twice in his alfalfa budget, not the cost of alfalfa cutting as suggested by the Tribes' Proposed Finding of Fact. Tr. 15417-20.

This Finding also gives the misleading impression that all three parties agreed upon price levels in their economic analyses. The Record clearly shows that Dr.

Cummings did not even attempt to verify Mr. Dornbusch's prices. Tr. 8969 (Cummings). Furthermore, United States' proposed Finding of Fact 300 points out that Dr. Jacobs used malt barley prices that were 20% higher than those used by Mr. Dornbusch. Tr. 14726-14727 (Jacobs).

The State of Wyoming's objection to Mr. Dornbusch's use of 100-bushel per acre barley yields is detailed in its Response to United States' proposed Finding of Fact 296. As a practical matter, however, Mr. Dornbusch's unreasonably high malt barley yields are of little consequence since he underestimated malt barley prices, resulting in long-term returns that are comparable to those projected by Dr. Jacobs. See Wyoming's Response to Tribes' proposed Finding of Fact 86.

The Tribes offer no evidence in support of Mr. Dornbusch's contention that full yields can be obtained the first year new lands are put into production. As discussed fully in Wyoming's proposed Finding of Fact 18-30, the Record clearly shows that a period of reduced yields is appropriate during the early years of production in new projects. Special Master Tuttle also used reduced yields over a 3-5 year period for all major crops considered in the most recent Arizona v. California hearing. Special Master Report at 306-15 (Feb. 22, 1982), Arizona v. California (Oct. 1981 Term, No. 8, Orig.).

Tribes' Proposed Finding of Fact:

92. Four economists testified regarding the appropriate discount rate to use in performing benefit/cost analysis. The Tribes' economist, Dr. Cummings, testified that discounting was inappropriate in a situation such as this where the needs of future generations are as important as those of the present generation, but if it was to be applied then the rate was between 2.5 and 4%. (Tribes' Ex. 24; Tr. V. 98, pp. 8871-77.) Mr. Dornbusch, for the United States, testified that the applicable rate was between 2 and 4%. (Tr. V. 55, p. 5049.) Dr. Stephen Goldfeld, also for the United States, testified the rate was between 1 and 4% and, if he were to choose one figure, he would use 2.5%. (Tr. V. 165, pp. 15517-18.) The State of Wyoming's economist, Mr. David Brookshire, testified that the appropriate rate was between 4 and 11%. (State's Ex. EE-3; Tr. V. 136, pp. 14525-27.)

Wyoming's Response:

92. This Finding is an over-simplification of the parties' positions regarding specific discount rates. First, Dr. Cummings clearly stated that there is no objective way of choosing a real discount rate. See Wyoming's Response to United States' Finding of Fact 311. Second, Mr. Dornbusch apparently changed his mind several times concerning the appropriate discount rate. He began his analysis using a discount rate of 7-1/8%. Tr. 6701 (Dornbusch). He later testified that the appropriate rate is 4%. Tr. 5042. After a recess in the hearing, he changed his mind again by stating:

> I should clarify that. In my professional opinion, the correct rate is in the range of 2% - 4%, and it's probably not over 4%.

Dr. Brookshire, testifying on behalf of Wyoming, said:

> I would argue that one cannot pick a single rate. One must pick a range of rates, again from the obvious observation that the American economy is very diverse, has many sectors, and each of these sectors will have different real rates of return.

Dr. Guldfeld testified to a range based upon alternative theories. Tr. 15491-15494 (Goldfeld); Tr. 15517-15525 (Goldfeld). Thus, Dr. Goldfeld's proposed range can only partially be compared to the other economists -- Mr. Dornbusch, Dr. Cummings and Dr. Brookshire. The appropriate subjects of comparison are

the proposed values under the opportunity cost of capital theory which all parties had agreed to in a virtual stipulation prior to Dr. Goldfeld's testimony. Tr. 5039-5042, 5078-5082 (Dornbusch); Tr. 8875 (Cummings); Tr. 14521-14522 (Brookshire).

Tribes' Proposed Finding of Fact:

93. All the economists agreed that the discount rate is based on the opportunity cost of capital net of inflation. They also agreed that the rate may reflect a "social time preference" or a weighing of the needs of the present generation over future generations. The lower the discount rate the more feasible a project becomes.

Wyoming's Response:

93. Concepts of social time preference have absolutely nothing to do with a "real" discount rate, a fact recognized both by Mr. Dornbusch, Tr. 6220-6221, and Dr. Goldfeld, Tr. 15492-15494. The fact is that the United States, Wyoming and the Tribes all agreed that a "real" discount rate should be used in economic feasibility analyses prior to the rebuttal testimony of Dr. Goldfeld. Dr. Goldfeld's testimony that the social time preference argument should be considered is nothing more than an after-the-fact second-guessing of a virtual stipulation reached by all major parties to the adjudication. See United States' Proposed Finding of Fact 311. As Mr. Dornbusch testified:

> if you have some long-range social objectives in mind such an advancement for the future and what you are very concerned about is the preservation or a value that should be appreciated at some future time, what those theorists have done in order to do that is to hypothesize the discount rate you should use should be lower to increase the values in the future. I have chosen not to do this.

Tr. 6220-6221 (emphasis added).

Tribes' Proposed Finding of Fact:

94. I find that the most persuasive testimony on this was by Dr. Goldfeld. He is the head of the Department of Economics at Princeton University and has served both on the staff and as an appointed member of the President's Council of Economic Advisors. Real rates of interest and costs of capital are at the center of his area of specialization. His mastery of this area was evident in his testimony which, as a rebuttal witness, served to clarify many of the points made by the other economists.

Wyoming's Response:

94. Dr. Goldfeld's "clarification" was primarily the reintroduction of concepts that had been previously rejected by the United States, Tribes and Wyoming. See Wyoming's Response to Tribes' Proposed Findings of Fact 92 and 93.

Tribes' Proposed Finding of Fact:

95. I am also impressed with the evidence presented by Dr. Cummings and in the cross-examination of Dr. Brookshire that the discount rate used when the majority of water projects in the West were approved and at the time of the principal decision in Arizona v. California, which established the "practicably irrigable acreage" test, was 2.5% (see Tribe's Ex. 24, p. A.25; Tr. V. 157, pp. 14543-44). I am also impressed with the fact that, although Dr. Brookshire supported a range of discount rates from 4 to 11%, in much of his own prior work he had used discount rates under 4%. (See Tribes' Ex. DB-1 through DB-10; Tr. V. 157, pp. 14575-77.)

Wyoming's Response:

95. It is interesting that the Tribes cite the discount rate used in the original trial of Arizona v. California. Master Tuttle's recent Report in Arizona v. California makes it clear that practicably irrigable acreage should be evaluated using contemporary standards, and the discount rates used by the parties in that recent trial ranged from 7 to 7-1/8%. As pointed out in Wyoming's Proposed Finding of Fact 15-22, the projects should be evaluated at discount rates which reflect contemporary standards of comparability, and thus a 7 or 7-1/8% discount rate certainly should be included within the range of discount rates considered by the Court.

The Tribes' claim that Dr. Brookshire's work utilizes discount notes below 4% is a clear distortion of Dr. Brookshire's work and the Record. Dr. Brookshire made it quite clear under cross-examination that although in some cases he had previously used lower discount rates, he had been dealing with entirely different problems involving "disinvestment" of environmental resources, or risk and the value of life associated with nuclear waste, earthquakes and cancer issues. Often the "lower rates" claimed by the Tribes were mathematical illustrations of the process of discounting. Tribes' Exh. DB-4, DB-5, DB-6, DB-7, DB-8, DB-9. Additionally, the Tribes chose to

ignore that the range for the problems at hand (i.e., nuclear waste) in Dr. Brookshire's work was infinity to minus one. Tribes' Exh. DB-5, DB-6, DB-7, DB-8 and DB-9. The positions of all parties in the recent Arizona v. California hearing is a clear indication that higher discount rates (7 to 7-1/8%) are more appropriate for agricultural economic feasibility studies. Futher, Wyoming Exhibit EB-3 clearly shows 7 to 7-8/1% is a real rate found in the United States economy, thus falling into the conceptual notion of a "real rate" which all parties had agreed to.

Tribes' Proposed Finding of Fact:

96. I find that the appropriate discount rate to use in judging the feasibility of the water projects at issue here is 2-1/2%. I find, however, having considered all the economic testimony on benefit/cost ratio, that all of the projects, namely, North Crowheart, South Crowheart, Big Horn Flats, Big Horn Flats Extension, Riverton East, Arapahoe, and Stagner Ridge, are economically feasible. I further find that using a 2-1/2% discount rate the margin of feasibility would be correspondingly greater.

Wyoming's Response:

96. The Court should note that the United States and Tribes have systematically attempted to lower the discount rate range from an initial value of 7-1/8%, Tr. 6071 (Dornbusch), to 4%, Tr. 5042 (Dornbusch), to 2-1/2%, Tr. 15517-15518 (Goldfeld); Tribes' Post-Trial Brief at 28, see also Wyoming's Motion to Strike, filed contemporaneously herewith. The United States also has added additional theories such as the opportunity cost of consumption and the social time preference theory in attempts to further lower the range of discount rates. See Wyoming's Response to United States' Finding of Fact 313.

The social time preference theory -- originally rejected by Mr. Dornbusch, Tr. 6220-6221, and Dr. Brookshire, Wyo. Exh. EB-3 -- was first argued for by Dr. Goldfeld, the last witness in the trial. Dr. Cummings never mentioned the theory in his testimony.

The "opportunity cost of consumption" approach was also not mentioned by Mr. Dornbusch or Dr. Cummings. In what amounts to a virtual stipulation, the State of Wyoming agreed to focus on the opportunity cost of capital only to have the last witness in the trial -- Dr. Goldfeld -- argue yet for a new reason the discount rate range should be lowered further.

The Court should note that, when the "after the fact theories" -- social time preference and opportunity cost

of consumption -- are set aside, Dr. Goldfeld arrived at a 4% discount rate based upon adjustments to the Fraumeni and Jorgenson study. Dr. Goldfeld's estimate is based upon a weighted average real rate of return of 4-7/8% from the Fraumeni and Jorgenson study. United States' Supporting Brief at 400. Dr. Goldfeld's adjustment was based upon an assumption that the marginal rather than the average measure of the opportunity cost of capital should be utilized. However, Dr. Goldfeld stated in response to a question as to whether there was direct empirical data as to the magnitude of the marginal rate of return:

> There is no direct empirical evidence that would weep [sic] out and would say 'I am the marginal rate of return of capital.'

Tr. 15543 (Goldfeld).

Mr. Dornbusch did not argue for a marginal rate of return, nor did he ever use the word "marginal." Instead, he argued for an average rate by stating:

> Yes. On page 96, which is the last page, the last paragraph in the first column, and continuing over to the top of the middle column, they refer to 4 percent which they -- excuse me -- the author says, "Why 4 percent? Because Jorgenson and Auerback believe that is the best estimate of the <u>average</u> real return . . ."

Tr. 6234 (Dornbusch) (emphasis added).

Thus, Dr. Goldfeld again disagrees with Mr. Dornbusch, Dr. Cummings and Dr. Brookshire. By arguing for a "marginal" rate, the United States found another

conceptual argument -- in addition to the introduction of new theories -- by which the discount rate range would be lowered on the last day of trial.

As Dr. Cummings testified on behalf of the Tribes:

> There is [sic] no objective ways of choosing a real discount rate, we can get a range of economists in here and some will argue high and some will argue low.

Tr. 8877.

Tribes' Proposed Finding of Fact:

97. In sum, I find that the Tribes have proved that they have 63,730 acres of practicably irrigable land in the category designated as "future projects" and that they are entitled to a reserved water right to divert 234,531 acre-feet per year with a priority date of 1868 to irrigate that land, or to use for any other purpose, so long as the consumptive use is not thereby increased.

Wyoming's Response:

97. Based upon Wyoming's Response to Tribes' Proposed Findings of Fact 68-96, it is clear that the Tribes have not proved they have 63,730 acres of practicably irrigable acreage in the form of "future projects" on the Wind River Indian Reservation. It is interesting to note that through the phrasing of this Finding the Tribes implicitly admit their burden of proof in this matter.