SALT RIVER PROJECT COMMENTS
SAN PEDRO RIVER PRELIMINARY HSR

November 14, 1990

TABLE OF CONTENTS

I. THRESHOLD PROBLEMS AND ISSUES 2
A. Reporting for Uses Served by Wells 3
1. Uses Supplied by Wells in Zones 2 and 3 5
a. Missing Claim and Previous Filing Information 6
b. Failure to Include Statement of Claimant Information . . . 8
c. Quantification for Uses from Wells in Zones 2 and 3 9
2. Inconsistent Reporting of Zone 1 Wells 11
3. Multiple Reporting of Domestic Wells 12
4. Comprehensive Index is Not Inclusive 12
5. Recommendation for Reporting of Wells 13
B. Application of 50-90 test 14
1. 90 days of continuous streamflow and less than 20 feet depth to groundwater 16
2. Time of Depletion 17
3. Boundary Effects 20
4. Recommendation 20
C. Impacts on Groundwater Under Federal Reservations 21
D. Municipal, Industrial and Mining Potential Water Rights (PWRs) 23
E. Irrigation Water Quantities 25
1. Averaging Procedures 27
2. Five Year Base Period 29
3. Consumptive Use Estimation Techniques 30
4. Growing Season 31
5. Effective Precipitation 32
6. Humidity Factor 32
7. Total Irrigation Requirement 33
8. Efficiency Definitions 33
9. Maximum Annual Quantity 34
a. Acreage 34
b. Cropping Pattern/Deficit Irrigation 34
c. Recommended Approach 37
10. Maximum Demand Rate 37
F. Use of Historic Data 38
1. Notices of Appropriation 38
2. Water Commission Maps 38
3. "Old" Rights and "Claimed" Rights 38
4. Applications to Appropriate 40
a. Use of Protested Applications to Appropriate 40
b. Reporting of "Claim Dates" 40
5. Aerial Photography 41
6. Summary 41

TABLE OF CONTENTS continued

G. Concerns Related to Previous Filings 42
1. Need for an Index 42
2. Volume 1 Reporting of Previous Filings 43
H. Changes of Use 44
1. Changes in Type of Use - Assignment of Date of First Use . . . 44
2. Changes in Type of Use - Assignment of Quantity 44
I. Transbasin Diversions 45
J. Statements of Claimant Problems 46
1. Incomplete Claims 46
2. Unreported Claims 46
3. State Land Department Blanket Claims 47
4. Statements of Claimant for Other Watersheds 47
K. Non-Indian Federal Law Claims 47
L. Treatment of Decreed Rights 49
1. Overall Approach 49
2. Assignment of Priority 50
3. Omission of Decrees 51

II. SPECIFIC COMMENTS 52

ATTACHMENTS

ATTACHMENT 1 - LIST OF PREVIOUS FILINGS NOT ASSOCIATED WITH A WFR HAVING APPROPRIABLE USE

ATTACHMENT 2 - SPECIFIC RECOMMENDATIONS FOR HSR REPORTING

ATTACHMENT 3 - ANALYSIS OF STREAM DEPLETIONS FROM PUMPING WELLS: NUMERICAL VS. ANALYTICAL METHODS

ATTACHMENT 4 - EXAMPLES OF M&I USE PWRs

ATTACHMENT 5 - IRRIGATION EFFICIENCY TERMS AND CONCEPTS FOR WATER RIGHTS ADJUDICATION IN ARIZONA

ATTACHMENT 6 - USE OF HISTORIC DATA

ATTACHMENT 7 - INDEX OF PREVIOUS FILINGS

ATTACHMENT 8 - ANALYSIS OF SELECTED WFRS

ATTACHMENT 9 - LIST OF UNREPORTED CLAIMS

SALT RIVER PROJECT COMMENTS
SAN PEDRO RIVER PRELIMINARY HSR

November 14, 1990

The Salt River Project (SRP) submits the following comments on the San Pedro River preliminary Hydrographic Survey Report (HSR). Although not a landowner within the San Pedro River watershed, SRP has substantial interest in this preliminary HSR and subsequent proceedings given their precedential impacts. This preliminary HSR is the first "official" report published by the Department in the Gila River general adjudication. Following receipt of comments and any changes in the preliminary HSR, the Department will publish a final HSR which will trigger the formal objection process. The intent of SRP's comments on several problem areas is to suggest changes that are needed before final publication. These changes will enhance understanding the HSR, minimize objections and reduce the need to introduce evidence at subsequent hearings thereby expediting the resolution of claims in this and other watersheds. As the Court stated in the Entitlement Order, "the [adjudication] process is advanced the furthest by having the Department provide the greatest amount of information available in the clearest of format." (Order of March 17, 1989, p. 6,)

In general, SRP concurs with the Department's approach for all procedures that are not specifically addressed below in Section I (Threshold Problems and Issues) and Section II (Specific Comments and Questions). However, we reserve the right to comment or object to items if further review raises additional problems or concerns. In addition, some procedures that are acceptable in the San Pedro River watershed may not be appropriate for other HSRs where circumstances differ.

I. THRESHOLD PROBLEMS AND ISSUES

This section of our comments identifies a number of important factual issues left unresolved by the HSR as well as inappropriate procedures used by the Department in the preliminary San Pedro River HSR. These issues and procedures affect significant numbers of claimants.

A number of our comments result from major changes to the HSR format as compared to the Silver Creek and draft San Pedro HSRs. SRP encourages the Department to utilize the opportunity for "technical meetings" as provided in Pre-trial Order No. 1 before radically changing its reporting or evaluation approaches in the future. Such meetings could be quite useful in order to exchange ideas and explore options. The formal comment and objection process leaves much to be desired for both the parties and, we imagine, the Department.

SRP does not agree with the Department's interpretation and application of the Court's September 9, 1988 order on the relationship of groundwater and surface water ("GW/SW Order"). Our concerns relating to the methodology and reporting utilized by the Department are addressed in the first portion of the comments below (Sections A-C). While SRP and other parties disagree about the legal characterization of pumped water, for the purposes of these comments we will use the Department's general classification of wells into three categories: wells that pump appropriable water (Zone 1); wells subject to federal claims (Zone 2); and other wells (Zone 3).

Although not as pervasive as the problems stemming from the Department's application of the GW/SW Order, SRP also has concerns with issues related to M&I uses, irrigation water duties, use of historic data, changes of use, reporting of claims and other specific

topics affecting numerous claims. SRP's comments on these points are contained in Sections D-M.

A. Reporting for Uses Served by Wells

The Department has climbed out onto a long thin limb with its reporting for many water uses from wells. It has adopted starkly different reports for the various categories of wells. In addition, we have concerns regarding inconsistent reporting of stockwater and domestic wells.

In our comments on the Silver Creek HSR, we posed the following question which we find to be relevant here as well:

> "If the Department plans to proceed to a final report before this [groundwater/surface water] issue is resolved, it is likely that a second round of preliminary and final reports as well as objections and hearings would be necessary for a number of claims once the groundwater issues are decided. What are the Department's intentions with respect to this issue?"

The Department stated in response:

> "The Department intends to proceed with producing watershed HSRs, and will make the appropriate modifications as directed by the Court/Master when a final decision is made on this issue by the Arizona Supreme Court. the Department does not believe it can further delay its investigations or HSRs."

The Salt River Project recognizes that the HSR process cannot come to a standstill pending the resolution of this and other issues on appeal. However, if the Arizona Supreme Court alters the Court's ruling, the limb upon which the Department sits may be sawn off. The "appropriate modifications" required of the Department may require a complete reissuance of the HSR for Zone 2 (and perhaps Zone 3) wells in order to

provide sufficient information on which to base objections and evaluate the Department's determinations.

It is also worth noting here that the Court has sought to clarify its September 9, 1988 order with respect to the 50%, 90-day test:

> "The intention was to give instructions to the Department of Water Resources to utilize that test in the HSR so as to set a base line. It was never intended to state Arizona law required such a 50%, 90-day test as indicating surface water. (August 17, 1990 Minute Entry, page 5)

This clarification implies that the so-called "brightline" has become gray in the Court's mind regardless of what the Arizona Supreme Court might do. Likewise, the Court anticipated that additional evidence might be needed to define what constitutes "significant diminishment" of federal rights, i.e. "Zone 2":

> "Because each sub-watershed is to an extent different and the downstream location of federal and Indian reserved surface water rights is different as compared to where upstream ground water pumpers are located, it may be necessary to hold factual and evidentiary hearings to establish the parameters of what constitutes a significant diminishment of the water rights within such time frame as would affect the United States ability to carry out the primary purpose of the reservation or federally reserved lands." (GW/SW Order at 22, 23.)

In other words even if the Arizona Supreme Court upholds the GW/SW Order, the Court may ultimately take exception with the Department's interpretation of "Zones." Again, the limb would be sawed off and the HSR might have to be reissued for wells in Zones 2 and 3.

Finally, the stratification of wells into three reporting approaches has led to problems in reporting small wells and has made it difficult to determine the disposition of a particular claim or water use. Stockwatering uses are treated inconsistently while domestic uses are

often reported in more than one volume. In some cases entire claims and previous filings are not reported at all, while in others, only limited information is included. The comprehensive indices only apply to potential water rights (PWR) supplied by Zone 1 wells or those supplied from a combination of Zone 1 and 2 wells. A separate index has been created in Volume 7 for WFRs with wells subject to federal claims and there is no index for uses supplied by Zone 3 wells.

As more fully described in the subsection below entitled "Recommendations," SRP recommends that the Department use a consistent reporting format for all uses of water until the major legal issues are finally decided. In order to comply with the Court's GW/SW Order with respect to reporting wells, after several corrections are made to the procedure for identifying subflow, the Department can simply note its assessment of water source within each Watershed File Report (WFR). If separate reports for certain well categories are desired or necessary, these can be in the form of indices or tables for PWRs with Zone 2 or 3 wells. Otherwise, each category of wells would be grouped together when added to existing Indices 6 and 7.

1. Uses Supplied by Wells in Zones 2 and 3

The San Pedro River preliminary HSR uses a very different approach as compared to the Silver Creek preliminary HSR to report uses served by wells at some distance from streams. In the Silver Creek HSR, the Department uniformly reported all available information for all water uses regardless of water source. In contrast, for the San Pedro watershed, the Department has significantly reduced the amount of information that it reports for water uses from wells outside of the 50/90 line.

Proper characterization of potential water rights requires the use of all available information. Indeed, the Department recognizes the importance of claim and previous filing information:

> "These filings and rights provide data such as the location of a water use, the location of the source of water for a water use (i.e., point of diversion), a claimed or established date of first beneficial use, the volume of water used, etc. This data may be used by the Court to establish a water right, and to assign an entitlement and date of first use to that right. Therefore, it is important that all of these filings and decrees are shown in the HSR and matched to PWRs when applicable." (p. 503, emphasis supplied.)[1]

In some cases the Department has failed to report the existence of claims or previous filings, while in others, it has chosen to simply summarize selected information for uses supplied by Zone 2 wells and not report a variety of information such as claimed water quantities, data from previous filings (unless used for apparent date), and most remarks. The only apparent exception to this reporting procedure is for wells serving uses that straddle Zones 1 and 2. Information for Zone 3 wells is even more abbreviated with only six characteristics being reported.

a. Missing Claim and Previous Filing Information

There are a number of claims which have been evaluated by the Department yet are not reported in the HSR.[2] In most cases, these claims appear to be associated with watershed file reports containing only catalogued wells (Zone 3) and are not reported because the Department did not match the claim to a use. (See for example, watershed file 111-20-CB-10 where claims 39-3372, 39-3374 and 39-3375 are not reported.)

---

[1]All citations are to Volume 1 of the San Pedro River HSR, except where otherwise noted.

[2]Further discussion on the need to report all claims is contained in Section I.J. of these comments.

Complete information on previous filings is not reported for uses in Zone 2 (Volume 7). It is apparently the position of the Department that previous filings for uses subject only to federal claims are of basically no importance. If a previous filing is not associated with a WFR containing a use in Zone 1, it is not reported anywhere in the HSR[3]. On the other hand, the Department still uses previous filings as the data source for establishing dates of first use for some Zone 2 reports (see 111-20-062; 111-21-CBC-001; 112-17-DBA-180). For example, the Bella Vista Water Company has 6 Water Rights Registration Act filings. All of these are unreported by the Department, with the exception of 36-29089, which is used as the basis for establishing an apparent first use date.

This lack of information is especially problematic where a user is located near Zone 1. The user may have filed for a surface water right; however, the Department has not reported the filing because the location of the diversion is in Zone 2. If it is subsequently determined that the well is pumping appropriable surface water, then reference to the filing would be necessary in order to determine the priority and entitlement associated with the use. The situation is further complicated by the fact that, historically, some acreage located in Zone 2 was actually served by surface water.[4] It is likely that reduced surface flows over the years have forced many users to convert to well water. These users may wish to assert their surface water rights. However, if pertinent surface water filings are not reported, these users will have to object to the HSR in order to introduce

[3]For example, in the Cloud WFR (Attachment 8) both Applications to Appropriate and the Water Rights Registration Act filing have been omitted.

[4]See, for example, certain users in the St. David Irrigation District as discussed in Attachment 8 (Merrill and Ross).

that information[5]. Attachment 1 contains a list of previous filings which were evaluated by the Department but not reported in Volume 7.

b. Failure to Include Statement of Claimant Information

Pertinent Statement of Claimant information is missing for uses reported in Zones 2 and 3 (Volumes 7 and 8). If a claim is not located in a watershed file report for a use involving appropriable water (Volumes 3-6), then the claim information is not reported in the HSR unless used as a basis for the date of apparent first use or quantity for a catalogued well.

This occurs frequently for municipal providers. For example, the Bella Vista Water Company (111-20-062: Volume 7, p. 14) contains 13 claims filed on 18 wells used for municipal purposes. The Department reports these claims as they apply to the wells but does not report any claimed information such as use, filing status, quantity, use location, diversion location, priority date, etc. The Department reports the apparent annual volume as 2,907 acre-feet per annum (AFA). Claimants who feel they are impacted by this use may desire more information regarding the filings by this water company and would be forced to search out the hard copies at the Department in order to obtain this information.

Another example of this absence of information can be found in WFR 113-04-DCD-003 (Volume 7, p. 360). The Department reports claim 39-2582 as applying to IR001 through IR006 but does not report any claimed information such as use, filing status, quantity, use location, diversion location, date of first use, etc. The total amount of water

[5]There are at least 4 Applications to Appropriate, 39 Water Rights Registration Act filings and 1 Stockpond Registration Act filing that were evaluated but not reported by DWR in Volume 7. For example, see Attachment 8 (Cloud WFR).

used by this landowner as determined by the Department is 330 AF for 47 acres of land. The diversion for this acreage is located only a short distance from the "brightline." As discussed above, the Court has made it clear that the brightline is only meant to be a guide for the Department and not a determination of groundwater/surface water interconnection. With this in mind, other users, especially those with later dates of first use may wish to assess specific attributes of these claims. The new HSR format does not accommodate this assessment.

Other examples of this situation occur for most municipal and industrial users. Claim information is generally not reported for M&I uses that obtain all water from wells located in Zone 2.[6]

c. Quantification for Uses from Wells in Zones 2 and 3

The Department's reporting of quantities for water uses involving wells subject to federal claims is also confusing. If a use has both an appropriable diversion and a diversion from a well subject to federal claims, the total volume quantification is typically listed in Volumes 3-6 and again in Volume 7.[7] The confusion occurs when one looks at the information contained in Volume 7 and overlooks what is in Volumes 3-6. For example, Huachuca City Water Company (111-20-50) is listed both in Volume 7 (p. 10) and Volume 3 (p. 2-137). Wells 1, 4 and 5 are reported in Volume 7 with a volume of use of

---

[6]See, for example, the discussion of the Sierra Vista municipal system in Attachment 4.

[7]However, there are exceptions where the quantities are reported separately. For example, Magma Copper Company (113-8-022) is listed in Volume 7 (p. 361) and also in Volume 5 (p. 2-112). Mine de-watering wells W13 and W14 are reported in Volume 7 with a quantification of 6,974 AFA. Volume 5 reports all of the wells with a volume of use of 17,102 AFA. Only by reference to Volume 1 (p. 355) can it be determined that Magma's total use is the sum of the two reports, 24,076 AFA.

274 AFA. Aside from a remark at the bottom of the page stating that "The apparent annual volume reported for MU001 is partially supplied by surface water," there is the appearance that the quantity reported is solely from these three wells. This is not the case. The reported volume is the total amount of water used by the town, including any water appropriable under state surface water law. All of the diversions and total volume are also reported in Volume 3 with a remark to indicate W1, W2 and W5 are wells subject to federal claims. It is confusing to duplicate some of this information in Volume 7. SRP acknowledges the Department's duty under the Court's order to report on wells subject to federal claims but the order may be better served by simply creating a table for these diversions and including this table in each volume and/or in the Comprehensive Index (See Section I.A.5, below).

Similar problems arise in connection with the reporting of catalogued wells. The quantity reported for catalogued wells in Volume 8 is simply the claimed amount. This is bound to cause confusion among some claimants. The Department notes "that there are currently no water uses other than domestic uses" (including irrigation of up to two acres) in Zone 3 (p. 110). However, Volume 8 shows claimed quantities of as much as 13,000 AFA (Volume 8, p. 37; 1862 date of apparent first use). There are a significant number of quantities that exceed the maximum amount of 10 to 15 AFA implied by the Department's findings of only small irrigation and domestic uses. In anticipation that later Court decisions may determine these uses to be in Zones 1 or 2, some claimants may feel compelled to object to all large claims in Volume 8. If the reports for these uses contained the same information as Zone 1 uses, the Department's assessment of relatively small use would be in the HSR and thus probably reduce the number of objections (perhaps the only objection would come from the individual claimants themselves).

2. Inconsistent Reporting of Zone 1 Wells

It appears that the Department interprets the Court's GW/SW Order to mean that all wells in Zone 1 pump subflow.[8] Included in this category would be small wells serving domestic and stockwatering uses. As such, all uses from these wells should receive a PWR, have a diversion code associated with them and a designation of "SUBFLOW" in the "WATER SOURCE" column under the "USES" section of each WFR. However, the Department does not report domestic PWRs and stockwatering wells using subflow in the same manner as each other or as compared to other uses. Domestic uses served by these wells are reported in the manner described above except that the volume and apparent date of first use are not identified.[9] Stockwatering uses, on the other hand, do not have PWRs nor do they have diversion codes.[10] The reporting of domestic andstock wells in Zone 1 should be consistent with the reporting of wells for other uses.

---

[8]SRP concurs in this interpretation of the order.

[9]See, for example, WFR 112-17-DB-67, page 56 of Volume 4.

[10]They are simply designated as "STOCKWELLS" under "USES FOUND BY DWR" in the "DWR ANALYSIS OF FILINGS AND DECREES" section of a WFR. It appears that stockwater wells that fall within Zone 1 do not have PWRs and are simply designated as "STOCKWELLS." Others clearly outside Zone 1 are designated as "CATALOGUED WELLS." See, for example, the different designation of the wells used for stockwatering purposes in WFRs 111-20-32, Volume 3, page 30; and 111-18-2, Volume 3, page 219. Those in the first WFR are located along the San Pedro River while those in the latter are clearly outside Zone 1.

Of special note, the Department's investigation of wells serving stockwatering uses is very limited. Only stockwatering uses with appropriate filings and/or supplied by surface water are given PWRs. Stockwatering wells located in Zone 1 are not given PWRs although they are given a unique designation (stockwell) if they supply livestock only. The Salt River Project suggests that the Department assign PWRs to stockwells. The Court has ruled that "rights [to surface water and claims where the water being used is sub-surface flow] are to be catalogued, prioritized and entitlements assigned thereto by indicating the nature, extent and relative priority thereto, all as required by ARS 45-256." (Groundwater/Surface Water Order at page 25.) Assigning PWRs to stockwells will ensure that all uses of water subject to the adjudication are before the claimants and the Court in the proper manner.

3. Multiple Reporting of Domestic Wells

Another problem area concerns the reporting of many Zone 1 wells serving domestic uses in both Volumes 3-6 and in Volume 8 (Catalogued Wells).[11] The GW/SW Order suggested that Zone 2 wells which serve domestic and stockwatering purposes, irrigation uses for less than 2 acres and all wells in Zone 3 should be catalogued. On the other hand, the Order states that Zone 1 wells should be assigned a PWR (see Section I.A.2 above). Reporting Zone 1 wells in Volume 8 could lead to problems concerning which parties and what wells are subject to this adjudication.

4. Comprehensive Index is Not Inclusive

The stratification of wells into three reporting approaches and the overlaps among the three reports make it difficult to find the disposition of a particular claim or water use. The Comprehensive Index (Volume 2) only applies to Zone 1 potential water rights and those uses that straddle Zones 1 and 2. A separate index in Volume 7 has been created for Wells Subject to Federal Claims (Zone 2 wells). There is no index for Catalogued Wells (Zone 3 wells) in Volume 8.[12]

---

[11]See, for example, page 140 of Volume 8 wherein one of the wells serving the domestic use in WFR 112-17-DB-67 is listed (55-0505970).

[12]To illustrate, the Sierra Vista Municipal Water Supply (111-20-056) can only be found by looking in the supplemental index located in the front of Volume 7. This is apparently because the diversions associated with this watershed file report are <u>only</u> subject to federal claims. The City of Tombstone (111-21-032), on the other hand, can be located in both the Comprehensive Index and the supplemental index in Volume 7 because diversions of surface water and diversions from wells subject to federal claims are associated with Tombstone's municipal use.

The information for Catalogued Wells is even more difficult to find. The only indexing for this volume is by legal description. The information listed under "DATA SOURCE" cannot be located in any index unless it is also located in a watershed file report with an

(continued...)

For a number of reasons, SRP recommends that all water uses be reported in a consistent format. Uniform reporting also facilitates the development of comprehensive indices. SRP's recommendation is for the Comprehensive Index to be just that - - comprehensive.

5. Recommendation for Reporting of Wells

Absent the final resolution of numerous legal issues, SRP believes that the Department has but little choice to revise its reporting approach for the final HSR. A uniform watershed file report for all uses in all Zones and a single comprehensive index will help eliminate confusion and insure that a full record is before the claimants and the Court. The Department's opinion on the source of water can simply be noted in the "Remarks" section for Diversions in each Watershed File Report.[13]

SRP further suggests that Volumes 7 and 8 be eliminated. If separate reports for certain well categories are desired or necessary, these can be in the form of indices or tables for PWRs with Zone 2 or 3 wells. Otherwise, each category of wells would be grouped together when added to existing Indices 6 and 7.

---

[12](...continued)
appropriable use. For example, claim number 39-4052 (Volume 8, p.2) cannot be found in any index. In this case, there isn't even a legal description to go by. How would a claimant locate this statement of claimant? Claim 39-8237 (Volume 8, p.5) is also a catalogued well, but in this case the statement of claimant is listed in the Comprehensive Index because it is located in a watershed file report (115-02-006) that contains appropriable uses. The watershed file report then refers the reader to the catalogued well listing (Volume 8) but there is neither an index for this volume or any other easy way to locate the well.

[13]This is the approach currently used for uses that straddle Zones 1 and 2. See, for example, WFR No. 111-20-DDA-023; Vol. 3, p. 2-1.

Finally, SRP suggests that the Department consider an alternative to the standard WFR in cases where only stockwell or domestic uses are reported or when WFRs contain claims but no potential water rights (PWRs). The Department could reduce the complexity of the HSR, the potential number of objections, printing costs and claimant review time if the reporting of stockwell and domestic use WFRs, and WFRs without PWRs, were simplified. Examples of SRP's specific recommendations on reporting are set forth in Attachment 2.

B. Application of 50-90 test

In the September 9, 1988 Groundwater/Surface Water Order ("GW/SW Order"), the Court addressed the issue of distinguishing appropriable subflow from non-appropriable subsurface water in the following manner:

> "Still, where to factually draw the line on the ground remains a significant problem. The point most counsel accept, though some go further, is the suggestion of hydrologist Leonard Halpenny, that at least those wells which withdraw water from the 'Younger Alluvium' of the tributary streams' basin should be presumed to be pumping sub-flow. The Court will accept that and will instruct D.W.R. in its reports to investigate such and treat such wells as pumping appropriable stream flow provided that the investigation shows:
>
> 1. As to wells located in or close to that Younger Alluvium, the volume of stream depletion would reach 50% or more of the total volume pumped during one growing season for agricultural wells or during a typical cycle of pumpage for industrial, municipal, mining, or other uses, assuming in all instances and for all types of use that the period of withdrawal is equivalent to 90 days of continuous pumping for purposes of technical calculation.
>
> 2. A well is designated on state records as an in lieu well.
>
> 3. A well is designated by state certification as pumping surface flow, such as the wells for Pima Farms."

Order, p. 11.

The primary directive of the Court's GW/SW Order with respect to appropriable water is "those wells which withdraw water from the 'Younger Alluvium' . . . should be presumed to be pumping subflow." The Court goes on to provide for investigation to insure against anomalous situations.[14] Instead, the Department has focused on the 90-day continuous pumping assumption to the exclusion of the Court's primary directive. Thus, the Department's approach thwarts the GW/SW Order by adding restrictions, performing overly simplistic calculations and interpreting the order as narrowly as possible. As a result, numerous wells and water uses are excluded from the Zone 1 designation even though they are located close to the stream in the Younger Alluvium. This occurs along significant portions of the mainstream San Pedro River as well as most reaches of tributary creeks and streams (compare Fig. 2-4, p. 55; Fig 4-13, p. 215 and Plates 1-5).

Chapter 4 of the HSR contains many sketches implying that all subsurface water contained in the Younger Alluvium is intimately affected by and intimately affects surface streamflow (Figs. 4-2, P. 174; 4-4A, p. 178; 4-6B, p. 185; and 4-15, p. 219). Owing to delayed seasonal effects, a well in the Younger Alluvium that is outside the Department's "brightline" can still significantly affect streamflow, a fact recognized by the Department in Chapter 4. The cone of depression resulting from pumping such a well will eventually refill mainly from reduced streamflow.

SRP recommends that the Department reconsider its interpretation of the Court's GW/SW Order. In place of its current delineation of Zone 1, which includes slivers of Basin Fill and excludes substantial areas of Younger Alluvium, a more appropriate application of the "50/90 rule" would essentially designate all Younger Alluvium that

[14]Anomalies might include in situations where the Younger Alluvium is a number of miles wide or where slowly permeable material exists close to a stream.

contains water as Zone 1.[15] While this is the result for the San Pedro River basin, the 50/90 test may create different zones in portions of other watersheds.

1. 90 days of continuous streamflow and less than 20 feet depth to groundwater

The Department has misconstrued the Court's directive to use "90 days of continuous pumping for purposes of technical calculation" to require 90 days of continuous streamflow (p. 217). There is nothing in the Court's GW/SW Order, Arizona case law or the surface water code[16] that defines streamflow according to the period of continuous flow. All streamflow, whether ephemeral, intermittent or perennial, should be protected from depletion by pumping.

The Department's approach in interpreting the continuous pumpage formula to require 90 days of continuous streamflow is questionable on logical grounds as well. If the Court had required a 50 percent depletion in two years, would that mean that the river has to flow continuously for two years? What about 1 percent in 100 years, or 50 percent in 180 days?

Furthermore, if a pumper operates his pump long enough, it is possible that the pumping itself can induce recharge such that the river no longer flows for 90 days continuously. This has historically occurred along some stream channels in Arizona. It is possible for

---

[15]SRP's legal position continues to be that many larger wells outside of the Younger Alluvium derive a portion of their supply from appropriable water and are thus subject to the Gila River Adjudication as a matter of state law.

[16]See A.R.S. §§ 45-101 and 45-141(A). These statutes define "surface water" (A.R.S. § 45-101) and "appropriable water" (A.R.S. § 45-141A) to include intermittent streamflow, without exception or qualification. Moreover, under these statutes,"flood" water is subject to appropriation, although floods seldom last 90 days or occur every year.

wells to pump large amounts of water and sever the connection to the river and thus become Zone 2 wells.

In a similar fashion, the Department excludes stream reaches by creating a restrictive condition that appropriable subflow can only exist in areas with relatively shallow groundwater levels, i.e., within 20 feet of the surface (pp 217, 218). As a result of historic and current withdrawals there may not be "shallow groundwater levels." Therefore, this restrictive condition disregards seasonal groundwater variations and the effect of historic pumping on groundwater levels.

The Department has inappropriately constrained the definition of appropriable subflow by creating the restrictive conditions of 90 days continuous flow and groundwater depths of less than 20 feet. These constraints have the effect of removing some wells from Zone 1 designation even though they pump appropriable subflow from Younger Alluvium. The Court's GW/SW Order of September 9, 1988 does not contemplate those restrictive conditions. In addition, the Department has not used these criteria in considering Applications to Appropriate along Aravaipa Creek. In that situation, the Department has concluded that the wells will affect appropriable water even though they are nearly 12 miles upstream from Zone 1.[17]

2. Time of Depletion

As in the case of the 90 days continuous flow/less than 20 feet to groundwater restrictions discussed above, the Department's designation of Zone 1 based upon a 90-day period of stream depletion is unduly narrow. The Department has simply examined the stream depletion during 90 days and ignored the rest of the year. The GW/SW Order permits

[17]See Attachment 8 (Cloud WFR)

the Department to conduct its investigations based on the assumption of "90 days of continuous pumping." This assumption, however, is "for purposes of technical calculation" only. The overlying purpose of the Court's order is to identify all uses of underground water for which "the volume of stream depletion would reach 50% or more of the total volume pumped during one growing season for agricultural wells or during a typical cycle of pumpage for industrial, municipal, mining, or other uses . . ." In order to be consistent with this directive, the period of stream depletion that is investigated by the Department should be one year, not 90 days. A year-long evaluation of stream depletion is consistent with the fact that the growing season for most crops approaches 12 months, the typical cycle of M&I pumping is annual, and entitlements are measured as an annual volume.

The Jenkins' method employed by the Department to establish the "brightline" contains a second set of graphical/analytical techniques to look at the effects of stream depletion after pumping has ceased.[18] In example 4-1 (p. 222), the Department has used the first method to calculate the distance from a stream at which a well will deplete the stream by 50% of the volume withdrawn during 90 days of pumping. For this example, the Department used an aquifer having T = 9,632 ft^2/day and s = 0.169. The result is a "brightline" distance, "a", of 1,298 feet.

[18]In fact, the abstract of Jenkins' paper notes that: "The residual effects of pumping, that is, effects after pumping stops, on streamflow may often be greater than the effects during the pumping period. Adequate advance planning that includes consideration of residual effects thus is essential to effective management of a stream-aquifer system." A substantial portion of Jenkins' methodology is devoted to these "residual effects." Jenkins, C.T., 1970, "Computation of Rate and Volume of Stream Depletion by Wells," Techniques of Water Resources Investigations of the USGS, Chapter D1, Book 4.

Jenkins' second method can be used to estimate the percentage of the volume pumped that has been depleted from the river during the remainder of the year after pumping has ceased. Jenkins provides a graph of $(t_p + t_i)/sdf$ versus v/Qt times t_p/sdf, where:

t_p = time pumped = 90 days
t_i = time since pumping ceased = 275 days
sdf = original stream depletion factor
(29.58 for 50/90)
v/Qt = volume depleted from river divided by volume pumped from well

For the previous example of 50% depletion during 90 days pumping, the sdf was 29.58 and the brightline distance from the river was 1,298 feet (p. 220). After the pump has been off for 275 days, the depletion from the river increases to approximately 85% of the volume pumped.

Jenkins' second method can be used to estimate the stream depletion factor for which 50% of the volume pumped during 90 days is depleted from the river within one year. Using the graph discussed above, we find that the corresponding sdf is approximately 260. The corresponding brightline distance is 3,850 feet using the aquifer characteristics for the Department's example (T = 9,632 ft^2/day, S = 0.169) and an sdf of 260. This is nearly three times as far from the river as the distance for a 50% depletion during the 90 days of pumping (1,298 feet).

When considering the depletion to a stream over the entire year from 90 days of continuous pumping, the resulting Zone 1 area will be all of the Younger Alluvium in the San Pedro that contains water. Although using both of Jenkins' techniques will more accurately reflect the intent of the GW/SW Order, the greater calculated distance from the stream will have to be tempered by consideration of boundary effects. These effects are discussed in more detail in the next section.

3. Boundary Effects

The Department has not considered the effect of boundaries in its application of the 50-90 test (p. 226). Although the Jenkins method proves a useful tool for estimating the distance to the "brightline" in many instances, it is less useful in cases where there is a hard rock outcrop within the "brightline" boundary. This same effect can occur at the interface between the Younger Alluvium and Basin Fill as a result of significant differences between hydraulic conductivities.

The result of considering boundary effects is that the distance to the brightline will typically be modified from the idealized "infinite aquifer" conditions assumed by the Jenkins' methodologies. As discussed in the technical paper contained in Attachment 3, modeling techniques other than Jenkins' methodology are more accurate and reliable in the real world setting like the San Pedro basin and other areas in Arizona. However, none of the "easy" techniques will readily allow computation of a brightline distance from a stream channel across the boundary into the Basin Fill or Regional Aquifer. Pending resolution of appeals to the GW/SW Order, the preferred approach for the Department is to simply designate saturated Younger Alluvium as Zone 1 in the San Pedro basin.

4. Recommendation

In summary, SRP disagrees with the Department's interpretation of the GW/SW Order. As applied in the San Pedro River Basin, that application frequently locates the "brightline" within the outer edges of the Younger Alluvium. The Department should fully utilize the Jenkins' approach by completing the computations to estimate the depletion from the river within one year for 50 percent of the volume pumped during 90 days of continuous pumping. Boundary effects should be considered when interpreting the results. Finally, the Department should not impose additional restrictions such as 90 days continuous flow or less than 20 foot depth to groundwater, especially when historic

pumping has changed the groundwater/surface water regime. Application of these considerations in the San Pedro will result in a Zone 1 area which includes all of the saturated Younger Alluvium.

Designating all of the Younger Alluvium as Zone 1 for the San Pedro watershed will eliminate many future problems. For example, the Department notes that the principal channel may shift in the future, which would require recomputation of the position of the "brightline" (Appendix E, p. E-3, last sentence of paragraph 3). Including Younger Alluvium also eliminates the implication that part of the subsurface water in the Younger Alluvium is no longer surface water but, instead, is groundwater. If two wells were close to the brightline but only a few feet apart on opposite sides of the line, one would produce groundwater and be exempt from administration as subflow and the other would produce appropriable surface water. This situation is clearly shown in a sketch (Fig. 4-19, page 227). This illustration is an example of detailed maps of specific farmlands which are situated in the Younger Alluvium and through which the brightline passes. Many such maps are contained in Volume 9 and the wells that straddle the line are described in numerous WFRs in Volumes 3 through 6 of the HSR. Referring to Parcel 4 of Figure 4-19, if the owner of the parcel chooses to use this loophole to classify all of his irrigation supply to be Zone 2 groundwater, he would cease to use Well No. WO1.

C. Impacts on Groundwater Under Federal Reservations

The Department has inappropriately expanded the scope of the information that it is required to provide on the impact of surrounding pumping on a federal reservation's groundwater resources. The Department was not directed to evaluate the impact of historic or future pumping. Likewise, there is no authority to estimate the economic impacts of past and future off-reservation pumping. The Department was only directed to identify groundwater users that affect groundwater under federal reservations.

The Court's September 9, 1988 order on groundwater and surface water contains the following pertinent statements at page 24, lines 24-28; and page 25, lines 1-12 and 21-26:

> "Having ruled on the legal issues before it from the motion and the eight questions before the Court, the Court will now move to the area of its instruction to the Department of Water Resources for its Hydrographic Survey Reports.
>
> First, these reports should include all claims of surface rights and claims where the water being used is sub-surface flow under the criteria previously described. These rights are to be catalogued, prioritized and entitlements assigned thereto by indicating the nature, extent and relative priority thereto, all as required by A.R.S. § 45-256. All other groundwater sources, not involving federal claims, shall be catalogued and their data determined as previously indicated.
>
> When dealing with a claim made under federal law, <u>the same procedure should be followed for those claims where the federal claim is for a diversion and use which is in physical use at this time</u>. Where the claim is for a federal reserved right and there is no present physical use D.W.R. shall also:
>
> . . . d. In determining a prioritization of such claimed federal reserved rights, <u>it will be necessary to determine all stream users or diversions of</u> either surface water or <u>groundwater which significantly affect those sources reasonably available on, at or near the federal parcel</u> which would be available to fulfill the determined entitlement." (emphasis supplied)

Nowhere in the Court's order are drawdown calculations or an economic impact analysis requested of the Department. It is particularly inappropriate to speculate on the impact of future pumping since many of the variables may change; e.g., pumping amounts by off-reservation users or the reservation's own withdrawals. For example, Fort Huachuca was closed in the late 1940s and may be closed again in the future.

In the final HSR, the Department should simply identify which wells affect groundwater under federal reservations. SRP recommends that the designation be placed in the "Remarks" section for Diversions in each WFR.

D. Municipal, Industrial and Mining Potential Water Rights (PWRs)

The Department is reporting PWRs for municipal, industrial and mining (M&I) uses on the basis of a single apparent date of first use for the total quantity of "maximum historic use" (p. C-28). This method of reporting should not be used where water use has incrementally changed over time as evidenced by service area enlargements or consolidations. The Department should revise the watershed file reports for M&I uses to create multiple PWRs where different dates of first use exist. Each incremental increase in M&I use should be given a separate "entitlement" (water quantity) and "apparent date of first use" (apparent date of first use) unless the expansion is covered by a previous filing. Attachment 4 discusses numerous examples of M&I users with single PWRs and an example of how multiple PWRs should be created.

In response to a similar comment by SRP on the Silver Creek HSR, the Department responded:

> "The Department's interpretation of this directive[19] is to create PWRs for all uses where information is available to make these distinctions.
>
> The Department does not create new irrigation PWRs for the addition of new wells which supply an existing PWR. This is the same procedure utilized in creating PWRs for municipal uses or any other uses.

[19]The Little Colorado Adjudication Court's Pre-trial Order No. 3 directed that irrigation and non-irrigation uses be treated the same.

> If there are cases found where there are different sources of supply (i.e., surface water and groundwater) that serve discrete service areas and are not commingled, then separate municipal PWRs would be created.

The Department is apparently using the same approach for the San Pedro HSR.[20] Although the Department states above that discrete service areas with separate facilities can be given unique PWRs, this was not done in the San Pedro HSR. Expansion of service areas in contiguous blocks are treated as one PWR with a single date of first use of first use anywhere within the current service area. This is entirely inconsistent with the approach used for irrigation PWRs where each incremental expansion of the place of use is treated as a separate PWR with a later date of first use.

By inference from the Department's response to the Silver Creek comment, it appears that the Department's distinction between irrigation and M&I PWRs is based on availability of information - - more information is available for irrigation expansions than municipal expansions. The information for irrigation expansions is largely derived from the Department's extensive review of historic aerial photography. A comparable level of information for M&I expansions could be obtained from additional research on M&I history. The aerial photo approach used for irrigation could be applied to M&I use in some cases. For example, there are substantial acreages within the existing service areas of municipal providers in the vicinity of Sierra Vista from which it would be apparent from aerial photos that no roads, houses or any historic use existed in, say, 1970. Even more direct information is available on occasion from the providers themselves and the

[20]See Attachment 4.

Arizona Corporation Commission.[21] Finally, the Department has ignored the information it already has on municipal expansions.[22]

The Department should reconcile its differential treatment of irrigation and M&I PWRs. Either irrigation PWRs should be created based on an existing "service area" with a single date of first use, or M&I uses should be divided into multiple PWRs with different dates of first use.

E. Irrigation Water Quantities

The Department's procedures for quantifying irrigation quantities are moving in the right direction when compared to those previously proposed in HSRs and as part of the "Entitlements Report." Examples of improvements include the greater use of existing efficiencies and calculation of maximum demand rates for diversions. Apparently, these changes are in response to a growing recognition that surface water rights and the general adjudication process are fundamentally different than the administrative procedures of the Groundwater Management Act (GMA).[23] However, the Department needs to progress further in order to provide the relevant information required in the HSR and to correct for errors in its calculations of consumptive use.

---

[21]The Arizona Corporation Commission has additional information pertaining to private water companies including service area maps, annual use reports, rate cases (including annual water sales), Certificates of Convenience and Necessity, decisions, grants and service area extensions agreements.

[22]See Attachment 4.

[23]The quantification issue was discussed extensively in the process which led to the Court's March 17, 1989 Minute Entry on Entitlements. See, Water Rights Entitlement Report, DWR, September, 1988; and subsequent motions and comments by the parties in both the Gila River and Little Colorado River Adjudications.

The Department continues to treat irrigation uses differently from all other water uses. For example, the Department reports quantities for municipal and industrial use based on ". . . the highest historic water usage" (p. C-28),[24] and " . . . maximum controlled capacity" (p. C-25) is reported for impoundments. In contrast, irrigation quantification procedures are based on averages and in some cases, severely reduced "maximums." This problem is discussed in more detail below, especially in Section I.E.1. "Averaging Procedures" and Section I.E.9. "Maximum Annual Quantity."

In addition to the different treatment issue, the use of averages is particularly inappropriate for quantification of surface water irrigation. Surface water use patterns differ significantly from groundwater use patterns since the two sources of supply are fundamentally different. Surface water is more variable on a day-to-day and year-to-year basis than groundwater. Therefore a different approach is required. For the typical surface water user, there is seldom an average annual supply of water - - there is usually either more than normal or a drought exists. The surface water user gets an average supply by diverting more in some years and less in others. By contrast, the typical groundwater user is not confronted with supply variability from one year to the next.

A surface water right is simply a "hunting license" that entitles the holder to seek water for beneficial use subject to several constraints including date of first use and locations of diversion and use. Of course, day-to-day water availability is a further constraint and often means that less than the desired amount of water can be obtained. It appears to

[24]Although stating that the reported M&I use is typically the highest historic quantity, it appears that simply the 1989 volume is often being reported. See, for example, Magma Copper Company (p. 353 and Vol. 2, p. 112) and Apache Nitrogen Products (p. 341 and Vol. 7, p. 145). Magma's highest recent use occurred in 1988 and Apache's was in 1980.

SRP that the Department's approaches to irrigation quantification attempt to place yet another constraint on the "hunting license" - the right to no more than an average amount of water. This is analogous to the Arizona Game and Fish Department only issuing hunting licenses for average-sized deer. (If you found a larger than average animal, you couldn't shoot it.) To further the analogy, in the context of the Department's "maximum annual" approach, if you shot a small deer last year then you would not be able to shoot a larger one in any future year.

For these reasons, SRP makes the comments below and advocates maximum beneficial use as a water duty. Setting the water duty ceiling at the average means that a surface water user will typically get less than the average since periodic droughts will curtail diversions. In wet years, the user cannot take more than the water duty established by the average. In dry years, the user gets less. Over a period of years, the user cannot even divert the full "average" water duty.

1. Averaging Procedures

The Department utilizes several averaging procedures in developing irrigation water duties many of which are inappropriate for the reasons discussed above. Averaging techniques are appropriate for some purposes such as developing water budgets but "splitting the difference" is not appropriate for calculating a water duty. In fact, the Court noted that "[average efficient use] is not directly related to what is the property's water right[s] . . . " (Entitlement Order at 6). The adverse effect is compounded in many instances by using averages of averages. Examples of averaging include:

a. Average temperature and precipitation data is used to calculate Total Irrigation Requirement (pp. C-5 to C-10).[25]

b. "Average efficient quantity" is based on weighted average Total Irrigation Requirement divided by weighted average efficiency (pp. C-20 to C-21). Note that Total Irrigation Requirement itself is a result of calculations based on average climate data (a. above).

c. "Maximum annual quantity" is based on Total Irrigation Requirement for a specific crop which is based on average temperature and precipitation data (a. above).

We recognize that the magnitude of the adjudication effort means that each claim and each variable cannot be analyzed in detail. This means that some generalizations are required. However, the excessive use of averages has the effect of understating the appropriate water duty ceiling that should be established as a part of the adjudication. Again, as quoted above, the Court does not find average efficient use to be directly

---

[25]For example, the two most prominent references on consumptive use estimation counsel against using average precipitation. SCS TR-21 states on page 28:

> "In view of this wide variation in net irrigation requirements from year to year, it is obvious that the development of a dependable water supply <u>cannot be based on average requirements</u>, since this would provide an adequate supply approximately half the time. It is common practice, therefore, to estimate effective rainfall and irrigation water requirement on a probability basis, the percent change of occurrence used being an economic consideration. For example, it might be economical to provide a water supply that is adequate in nine out of ten years for a high-value vegetable crop or tobacco. For a low-value hay crop or pasture, it may not be economical to provide an adequate supply in more than six out of ten years." (emphasis supplied)

FAO Paper 24 states on page 72:

> "Rainfall for each period will vary from year to year and therefore, rather than using mean rainfall data (saying roughly one years is drier, the next is wetter), a dependable level of rainfall should be selected (saying the depth of rainfall that can be expected 3 out of 4 years or 4 out of 5 years)."

relevant to the determination of the water right. To this end, and to insure consistent treatment among water uses, PWRs should only reflect maximum beneficial use estimates as discussed under Section I.E.9 below. The Court's directive to the Department to report average efficient use for perspective can be accomplished by simply reporting this value (or values) in Volume 1.

2. Five Year Base Period

The Department states that it uses the last five years as the basis for computing acreages for both "Average Efficient" and "Maximum Annual" water quantities (pp. 129, 136, 137, C-17). There is no requirement for the unilateral application of the five year limitation on irrigated acreage. Although the Entitlement Order generally approves of the Department's procedure to report maximum annual use for irrigation based on the most recent five year period, it does not restrict the Department from using information from a longer historic period. In fact, the Order provides that "the Department should advise of the maximum annual use for each of the years that it has in its investigation data base" (p. 6).

The Department's investigation period should, and often does, span more than five years, as shown by the following examples:

1) Municipal and industrial use is based on highest historic use (p. C-28); the example shown is a 10 year period.

2) Climatic data for crop consumptive use appears to be from 1951 to 1989 (p. C-5 and References, p. 539, et seq).

3) Aerial photography dating from 1936 was used (p. 498).

The Department needs to report historic irrigated acreage whether or not the acres were irrigated during the most recent five year period. In order to accurately reflect historic

water use, the Department should broaden its perspective on irrigation water rights beyond 5 years.

3. Consumptive Use Estimation Techniques

The Department has adopted the SCS Modified Blaney-Criddle equation for use in the San Pedro HSR and is using a SCS computer program called CONUSE to calculate crop consumption use requirements (p. C-5). SRP suggests that the SCS Blaney-Criddle approach should be replaced either with the original Blaney-Criddle approach or the FAO Blaney-Criddle procedures. If the SCS approach is maintained, then some changes are needed in the use of the CONUSE program.

SRP recommends replacing the SCS Blaney-Criddle equation for the following reasons. First, it does not include factors for wind, relative humidity or sunshine hours. These indicators allow better adaption to local conditions. Second, the SCS equation does not utilize the concept of Reference ET. Hence, it is not amenable to published and updated crop coefficient research information. Finally, the Department is using the FAO Blaney-Criddle approach in the Little Colorado Adjudication as well as in the Tucson and Prescott AMAs. The FAO approach includes indicators of wind, relative humidity and sunshine hours as well as Reference ET. SRP's preferred approach is to use published data[26] for the Salt River Valley and adjoining areas in central Arizona at elevations below 1,500 feet. For elevations of 1,500 to 3,000 feet, we recommend using the original Blaney-Criddle equation with the crop coefficients in the publication noted above and local weather data. For elevations above 3,000 feet, the FAO Blaney-Criddle equation is recommended. Since the elevation of most of the irrigated land in the San

[26]Erie, L.J., O.F. French, D.A. Bucks, and K. Harris, 1982. Consumptive Use of Water by Major Crops in the Southwestern United States, Conservation Research Report Number 29, Agricultural Research Service, USDA, Washington, D.C. 20250.

Pedro ranges from 2,000 to 4,000 feet, this recommendation places the watershed into two zones. SRP would not object if the Department elects to use the FAO Blaney-Criddle equation for elevations above 1,500 feet in order to simplify calculations.

If the Department continues to employ the SCS Blaney-Criddle method, several modifications should be made to the CONUSE program. These changes would make CONUSE consistent with SCS Technical Release 21 (TR-21) on which the program is based. First, the program should use the crop coefficients in TR-21, unless the reason for a change is documented. For some crops, the calendar-based coefficient must be converted to percentage of growing season to facilitate computer calculations. Second, as discussed below, the humid area adjustment should not be employed. Third, growing season effective precipitation should be reduced to that which is expected to be equalled or exceeded a designated fraction of the time.[27] Several other specific problems with CONUSE are described in Section II under the comments on page C-5.

If the Department uses the recommended FAO Blaney-Criddle method, then the FAO portion of the SCS CONUSE5 program is not valid for performing the calculations. The program erroneously uses the same crop coefficients for both the SCS and the FAO Blaney-Criddle equations. This problem has been brought to the attention of the SCS.

4. Growing Season

Full 12-month growing seasons for alfalfa, fruit trees, grapes, orchards, pasture, pecans, sudangrass, and turf are unrealistically long (pp. C-5, C-6). Growing seasons based on

[27]For example, 8 of 10 years (see Table 7, TR-21; also see discussion under "Averaging Procedures" above).

the recommended procedures in the SCS TR-21 manual for alfalfa and data in Phoenix for Bermudagrass are listed below as examples.

CROP	LOCATION	
	BENSON	WINKELMAN
Alfalfa	Feb 22 - Nov 10	Feb 10 - Nov 28
Pasture (Burmudagrass)	May 8 - Nov 10	Apr 29 - Nov 28

Wherever possible, growing seasons should be based on local practices or recommendations for planting and harvest.

5. Effective Precipitation

The Department may have underestimated effective precipitation by not including pre-season effective moisture. The text on pages C-9 and C-10 only mentions effective precipitation during the growing season. Our calculations indicate that pre-season effective precipitation amounts to a couple of inches for the commonly grown crops unless winter irrigation occurs as in the case of several large diverters.

6. Humidity Factor

The Department has reduced evapotranspiration (ET) estimates by 5% to reflect local conditions (p. C-5). The basis for use of 95% of ET should be further explained and supported.[28] Because of the "clothesline" configuration of the irrigated area in relation to the extremely arid surrounding environment, it is doubtful there is any moderating effect due to the San Pedro River.

[28]Apparently, the SCS CONUSE program includes a "humid area adjustment factor" because the SCS Blaney-Criddle equation reportedly over-predicts ET for humid areas.

7. Total Irrigation Requirement

As noted in D.3. through D.6. above, the Department has calculated Total Irrigation Requirement (TIR) with a method that should be changed, inaccurate growing season for some crops, apparent omission of non-growing season effective precipitation, and inclusion of an humidity factor. SRP has calculated TIR for alfalfa using the FAO Blaney-Criddle method for a realistic growing season, including non-growing season effective precipitation, and without a humidity adjustment. The values for alfalfa at Winkelman from Tables C-2, C-3 and C-4 are compared with our results in the following table.

CROP	BASIS	WINKELMAN (acre-feet/acre)		
		CU	EP	TIR
Alfalfa	DWR	4.65	0.46	4.19
	SRP	5.42	0.63	4.79

Tables C-2, C-3 and C-4 and calculations which depend on TIR values should be revised by the Department.

8. Efficiency Definitions

The Department's definition and use of irrigation efficiency terms is improving but still needs refinement. We have identified several specific problems that are described below in Section II (see comments pertaining to Volume 1, pp. C-12 to C-24).

Over the past several years we have investigated various alternatives for quantifying irrigation efficiencies. We found numerous publications that each contain very different

terms or definitions. As a result, we have developed a set of efficiency terms and concepts which is included as Attachment 5.

We urge the Department to adopt and promulgate a comprehensive set of efficiency terms and definitions that will be used for the adjudications.

9. Maximum Annual Quantity

The Department estimates a maximum annual volume of irrigation water use which differs from "average efficient" procedures due to acreage differences, specific cropping patterns or "deficit irrigation" (pp. 137, C-17, C-18). The maximum annual procedure has several problems as discussed below. The bottom line is that "maximum" is often a euphemism for a procedure that does not calculate maximum potential water use. The Department should modify its procedure so that it consistently estimates the maximum entitlement for each potential irrigation water right.

a. Acreage

"Total irrigated" acres are multiplied by "average efficient" water duty to calculate average efficient volumes (pp. 136-137). "Maximum annual" acres are less than or equal to "total irrigated" acres and are multiplied by the "maximum annual" water duty to calculate total volumes (pp. C-17, C-18). The Department should use "total irrigated" acreage in conjunction with "maximum annual" water duties to calculate the upper limit of annual volumes. This will insure that water users can irrigate all of their land if their water right is in priority and they desire to do so.

b. Cropping Pattern/Deficit Irrigation

SRP agrees with the procedure of using alfalfa or other high consumptive use crops to calculate maximum annual water duties where the Department has found full service

irrigation in its recent investigation. However, SRP does not agree with the procedure employed when lower consumptive use crops or "deficit irrigation" have been found by the Department in its survey.[29] As discussed at the outset of this section, the water duty should be a ceiling that reflects the full range of historic conditions. Just because farmers choose to fallow some of their land for a few years or grow small grains does not mean that their maximum annual water duty should be set at that reduced level. Likewise, deficit irrigation is frequently the result of short-term phenomena such as economic conditions, pumps or ditches in need of repair, drought, or neighbors "stealing" water.

The effect of basing maximum annual water duties on crop type or degree of irrigation is significant. Examination of San Pedro WFRs revealed 79 instances where the maximum annual water duty ("maximum") was less than the average efficient duty ("average"). As shown in the table below, "maximum" was determined to be less than "average" for 6,576 acres (about 33% of the irrigated area in the San Pedro watershed). This amount does not include discontinued use IRs and land that is served only by Zone 2 wells ("apparent annual volume used" based on "average efficient" duty is the only water quantity listed in Volume 7).

[29]Although the Department acknowledges that additional information is needed and will be incorporated into the final HSR, a few years of crop or irrigation practice data should not be used to establish the water duty ceiling.

SUB-WATERSHED	NUMBER OF WFRs WITH MAXIMUM LESS THAN AVERAGE	ACREAGE WITH MAXIMUM LESS THAN AVERAGE
Sierra Vista	11	1,416
Benson	26	1,591
Redington	16	1,820
Winkelman	19	1,458
Aravaipa	7	291
TOTAL	79	6,576

In all WFRs tabulated above, "average" was reported as 6.1 af per acre, while "maximum" ranged from 2.6 to 6.0 af per acre. Differences in "maximum" between WFRs did not appear solely related to crop type, although it was indicated in many files that deficit irrigation was practiced. As a measure of significance, the table below shows the cumulative amount of irrigated acreage at various ratios of "maximum" to "average." For example, nearly 5,000 acres have water duties where "maximum" is equal to or less than 80 percent of "average."

MAXIMUM/AVERAGE x 100%	ACCUMULATED ACREAGE
50%	1,958
60%	4,343
70%	4,955
80%	4,978
90%	5,735
98%	6,576

c. Recommended Approach

The Salt River Project suggests that, in the absence of clear historic evidence to the contrary (more than a couple of surveys in recent years), maximum annual quantity should be calculated based on the full "Total Irrigation Requirement" for alfalfa or other high consumptive use crop with:

a. correct consumptive use calculations,
b. no 5% humidity reduction,
c. inclusion of pre-season effective precipitation, and
d. proper growing seasons.

Alfalfa or other high consumptive use crop are used in this case since there is a high probability that these crops were grown historically on each tract and thereby define maximum historic beneficial use. Where there is clear historic evidence that alfalfa or similar consumptive use crop have never been grown on the land or full irrigation has never occurred, then the Department should make appropriate adjustments to the water duty. This may be the case for some pasture lands.

10. Maximum Demand Rate

SRP concurs with the Department's approach of reporting several irrigation diversion rates (pp. C-22 to 24). However, SRP believes that a maximum diversion rate is needed for each surface water diversion, not just large systems. Unless the diversion rate is decreed, the rate should be estimated since measurement is not practical for each and every small diversion. In addition, some changes are needed in the calculation of maximum demand rate. It would suffice to report a uniform maximum demand rate for small diversions in Volume 1 rather than adding a section to each watershed file report.

As discussed in the previous section ("Maximum Annual Quantity") unless there is clear evidence to the contrary, irrigation entitlements should be based on the full irrigation of

alfalfa or other high water use crop. In addition, the following changes are suggested by SRP in calculating the maximum demand rate. The technique described in SCS TR-21 (Table 5, footnote) for peak period consumptive use should be used (this basically increases the daily consumptive use by 10% to 15% to adjust from mean monthly values). An efficiency factor could be used in place of estimated daily conveyance losses in acre-feet.

F. Use of Historic Data

Greater use of historic data will allow both the Department and other claimants to more accurately evaluate PWRs.

1. Notices of Appropriation

We are pleased to note that the Department is planning to include applicable Notices of Appropriation in the final San Pedro River HSR (p. 499). Attachment 6 discusses the use of notices and other historic information in the evaluation of PWRs.

2. Water Commission Maps

Maps developed by the Arizona Water Commission in the early 1920s provide another useful source of historic information. A discussion of the use of these maps is also contained in Attachment 6.

3. "Old" Rights and "Claimed" Rights

The Department mentions these rights in its discussion of the surface water code (p. 16). Both Old and Claimed Rights are pre-1919 water rights which were filed with the State Land Department prior to the Water Rights Registration Act. The procedure for filing an Old Right required that a landowner file a certified copy of a Notice of Appropriation

along with any pertinent affidavits and maps.[30] Claimed rights differ only in that they do not contain proof of a notice having been filed with the county recorders office.

These filings contain a wealth of factual information such as date of first use, quantity appropriated, and location. While some of the legal descriptions can be quite obscure (e.g., "one mile below So-and-So's Ranch"), the information should be reported wherever it is specific enough to be useful, i.e., where it can be matched to a claim or PWR. The validity of that information may then be resolved during the appropriate phase of the Adjudication.

Old and Claimed Rights appear to be treated inconsistently in the HSR. In some cases, they have been used (at least in part) in the evaluation of PWRs. In other WFRs, they are omitted entirely. Examples of these situations are discussed in Attachments 6 and 8.

The Department's exclusion of data (e.g., historic maps, notices, old rights, and claimed rights) raises questions about the validity of the data presented in the HSR. It does not appear that all pertinent information that is available to the Department has been presented. They are charged with presenting all relevant material. According to ARS § 45-256A.2, the Department shall "Locate, procure and make available all public and other records relevant to determination of any factual or legal issues." The Department's exclusion of data from the report presents a clear problem regarding factual material which may apply to a claim. Claimants and the Court will find it difficult to rely on the Department to accurately present water use, quantity, dates, etc. if the Department fails to include all relevant data.

[30]See R12-5-502.C.

4. Applications to Appropriate

a. Use of Protested Applications to Appropriate

Applications to Appropriate (whether protested or not) typically contain relevant information which needs to be fully evaluated and reported in the HSR. The Department includes this information in the WFR if the application is not protested. There are a number of protested Applications to Appropriate in the San Pedro watershed. These applications are mentioned in the WFRs but not tied to PWRs. The applications include dates, maps and other information which can assist in the evaluation of PWRs.

At some point, these protested filings will need to be resolved. The adjudication proceeding is a good forum in which to address the applications and the protests. Matching the protested filing to a PWR can facilitate that process. The relevance of Applications to Appropriate is discussed in Attachment 8 (Sale WFR and Cloud WFR). In both WFRs, the applications contain important information for evaluation of PWRs. Because the Sale applications are protested, no information other than their existence is contained in the WFR. The Cloud applications are not protested but they are omitted entirely from the WFR because the wells are not in Zone 1.

b. Reporting of "Claim Dates"

The Department assigns a "claim date" to an Application to Appropriate which refers to the year that it was filed with the Department. Many Applications to Appropriate are "protective" filings for already existing uses.[31] Applications in this category often contain claimed dates of initial use from the 1800's on. In situations such as this, it may

[31]In the examples described in Attachment 8 (Sale and Cloud WFRs), they were filed in case the water that the wells were pumping was later determined to be appropriable.

be more appropriate to put these earlier dates in the column under "Claim Date" and to mention the filing date under Explanations.

5. Aerial Photography

Although the Department is using the dates claimed in previous filings more frequently,[32] there is still an over-reliance on aerial photography to establish dates of first use. As demonstrated in Attachment 6, particularly in the case of the 1936 aerials, it can be difficult to detect irrigable acreage, especially if the area irrigated was small or near the riverbed. Even though aerial photography can be indispensable in some cases, it should be used judiciously. Wherever applicable, filings such as Old or Claimed Rights, Notices of Appropriation and other historic records should be used to identify dates of apparent first use.

Attachment 8 contains a discussion of assignment of dates of first use for the Merrill and Ross WFRs which previously received surface water from Saint David Irrigation District (SDID). Portions of these two parcels were assigned a 1936 date based on the first available photo. However, neighboring PWRs received an 1881 date based on information of first use for the District. The Merrill and Ross PWRs that were irrigated in 1936 should be assigned a date of first use on the same basis as other lands historically served by the SDID.

6. Summary

A great deal of historical information is available to assist in the evaluation of potential water rights. Some of the information requires research to find. However, a large

[32]The Department states that apparent first use date for surface water uses will be based on "earliest previous filing/decree not refutable by historic aerial photograph" (Vol. 1, p. 508).

amount of data is attached to many Water Right Registration Act (WRRA) or Statement of Claimant filings in the Department's files. These attachments include Old and Claimed Rights, Notices of Appropriation, affidavits, maps and the like. The Department has been slow or sporadic in including this information in its analysis and reporting. It is very important that a systematic and comprehensive process be developed at the Department to incorporate and report this data.

It is important to document the historical background of a claim since Arizona surface water law is based so completely on historic beneficial use. If a claimant has in good faith compiled with Territorial and State laws to protect and verify the water right, then compliance with that process should be made visible. An individual who filed a Notice of Appropriation, an Old Right, a WRRA and a Statement of Claimant is in a very good position to argue that the right (if it has been used beneficially) has been fully perfected under Territorial and State law. Water use does not begin with a 1936 aerial photograph. In many cases, there is more accurate evidence available in the written record and these sources of information should be considered and reported.

G. Concerns Related to Previous Filings

1. Need for an Index

In addition to the indices provided in Volume 2, it would be helpful to include an index to previous filings. The index should include the previous filing number, the watershed file report number, any use location and/or claimed location information and the appropriate volume-table-page numbers. It might also be beneficial to include the status of the previous filing where applicable.

The Salt River Project has encountered numerous situations in which a previous filing index would be useful. For example, if a previous filing number is obtained through

research on a PWR or is known from prior disputes, then there is no easy way to find where it is addressed in the HSR, especially if multiple WFRs are covered by the previous filing. Also, some claimants or the Court will be interested in how many PWRs are covered by a certain category of previous filing and how those filings are addressed in the adjudication process.

Although the Department responded to our identical comment on the Silver Creek HSR by noting that it "lacks the resources to undertake the additional programming necessary to create such an index," SRP found the programming to be relatively easy. Using the data base provided on tape by the Department, SRP has developed such an index (volume-table-page numbers were not included since these were not on the data tape) and included it as Attachment 7 with the original of these comments. Parties wishing to use this index should contact the Department.

2. Volume 1 Reporting of Previous Filings

There is a large discrepancy between the number of previous filings and decrees reported in Volume 1 and the number reported in watershed file reports. The summary of the total number of filings on file with the Department (pp. 15-19) and a comparison of the Department's data tape should reveal similar figures. The table below shows the results of this comparison:

PREFIX	DATABASE	VOLUME 1	DISCREPANCY
C	0	13	13
O	4	12	8
3R	147	150	3
33	171	238	67
36	1,654	3,030	1,376
38	1,721	2,337	616
4A	162	162	0
TOTAL	3,863	5,948	2,085

The Department should address the reasons for any omissions and whether these filings will be evaluated in the final HSR. One reason may be the 2-year extension for filing on pre-1919 uses (Water Right Registration Act; "36s"). The Stockpond Registration Act ("38s") filings may be late filings by the State Land Department coinciding with their recently filed adjudication claims. In any case, these filings need to be evaluated by the Department.

H. Changes of Use

The Department's treatment of changes of use raises concerns regarding dates of first use and quantification. Where changes in type of use have occurred, the assignment of dates of first use and estimated volumes of use have overlooked the previous history of use.

1. Changes in Type of Use - Assignment of Date of First Use

In the case of the Paul L. Sale Fish Farm (pp. 475-477 and Volume 6, p. 78), the Department has assigned dates of first use of 1988 and 1989 to reservoirs constructed for fish rearing purposes on previously irrigated land. Potential water rights for a number of these small reservoirs should reflect the initial date of water use on that land (as early as 1878). Attachment 8 describes SRP's analysis of the Sale WFR and sets forth an alternative set of PWR dates for the fish ponds.

2. Changes in Type of Use - Assignment of Quantity

In addition to changing dates of first use, the Department should also consider carefully what quantity to assign to lands for which a change in type of use has occurred. In most cases, the quantity assigned to that land should be based on historic water use. Exceptions would occur where the new use is greater than the prior use. In that case, a

new PWR with a later date and separate quantity is appropriate. Attachment 8 contains a discussion of quantification for the Sale change of use.

I. Transbasin Diversions

It is unclear how uses involving transbasin diversions will be handled in the adjudication. This situation is treated in two ways in the San Pedro HSR. The Arizona Water Company transfers water from the Upper Santa Cruz watershed to the town of Oracle. The Unusual Circumstances Report for Oracle (Volume 1, page 478) states that a watershed file report will be created in the Upper Santa Cruz HSR (where the diversion occurs). Asarco's Ray Mine transports water from the San Pedro watershed to the Upper Gila watershed. The PWR associated with this use will be evaluated in the Upper Gila HSR (where the use occurs). Is the PWR to be addressed in the watershed where the use exists or where the diversion exists? The Court has previously determined that a claim should be filed in the watershed where the use exists and not where the diversion occurs. Although this creates some precedence on this issue,[33] SRP believes that the Department should address PWRs in the HSR watershed from which the water is supplied. This approach is preferable so that users located in the vicinity of the diversion to have the ability to file objections in that watershed. This approach also is consistent with the Court's Order on the Fifth Set of Issues in which the Court concluded that prioritization of rights should be completed on a watershed-by-watershed basis so that enforcement could begin (See, August 1, 1989 Order at 6-8, 17, 30).

The following Watershed File Reports in the San Pedro HSR contain transbasin diversions:

[33]The Court's previous ruling simply eliminated the need for claims to be filed in both watersheds.

Arizona Water Co. - Bisbee	111-24-59
ASARCO-Hayden	114-1-5
ASARCO-Ray	114-4-35
Arizona Water Co. - Oracle	None

J. Statements of Claimant Problems

1. Incomplete Claims

The Department discusses a number of statements of claimant that were filed with the Department with incomplete information. It is not known to what extent the Department tried to locate these claims. If all avenues were exhausted (i.e., assessor roll books, telephone directories, return address information from original filing or uniform questionnaire, etc) and there is no way to assign a filing to a watershed file report, then it may be appropriate for either the Court or the Special Master to issue an administrative order directing the Department to eliminate these claims after an appropriate time period or notice.

2. Unreported Claims

There are 796 unreported statements of claimant in the San Pedro HSR. A.R.S. § 45-256.B. requires a claim-by-claim report. In addition, the Court has previously stated that "any claimed water use must be included in the HSR" (Order on Third Set of Issues, January 29, 1988, at 3 in Attachment to the Order). These are claims that were not evaluated in any way by the Department. The majority of these claims are by the State Land Department for specific uses not covered by their blanket claims in the San Pedro watershed. What is the Department doing with these claims? Are some of these late claims motions to intervene, new use filings, or claims for future uses? At a minimum, the Department should report these in a table in Volume 1 with an explanation as to the

nature of the claims. Through an administrative order, perhaps these claims may be eliminated from the adjudication. Attachment 9 contains a list of these claims.

3. State Land Department Blanket Claims (p. 481)

The Department has determined that the claims made by the SLD for rainfall retention are claiming a non-appropriable source (p. 506). Also, according to the Department, the blanket claims did not list specific locations. Therefore, they were not given a PWR in the San Pedro HSR. At a minimum, we propose that these claims be treated as incomplete (See I.1., above). If the legal descriptions are provided by the SLD, then the claims should remain in the adjudication to be resolved by the Court.

4. Statements of Claimant for Other Watersheds

We assume that the Department is proceeding in accord with the Order on the Fourth Set of Issues (attached to Minute Entry of July 29, 1988) and will place and evaluate these claims in the appropriate watershed HSR. Where the claim is for water that is not subject to the Gila River Adjudication (Wilcox Playa and Whitewater Draw), then a procedure similar to that described above should be used to eliminate these claims from the adjudication.

K. Non-Indian Federal Law Claims

The Department uses a different process to evaluate non-Indian Federal Reserved Rights (FRR) claims than for claims or uses under state law. This distinction results from the Department's opinion that "the legal basis of an FRR is markedly different from the basis of a water right under state law." (p. 525) The Department should use the same process for FRRs as for water rights under state law since under U.S. v. New Mexico (438 U.S. 696): "Where water is only valuable for a secondary use of the reservation . . . Congress intended . . . that the United States would acquire water in the same manner as

any other public or private appropriator." (at 702) The Court has not yet determined the primary and secondary purposes for each reservation.[34] State law investigation criteria and reporting must be applied for water uses under secondary purposes. In order to have a complete record in front of the parties and the Court, and to eliminate the need for additional reports and notice, the Department should provide the same information for FRRs as it does for state law claims (e.g., apparent date of first use for each PWR).

A related comment is that minor changes in evaluation and reporting of non-Indian federal claims by the Department would greatly assist the Court and parties. These changes are needed in order to add historical background and assign water uses to the initial reserve and each expansion of a federal reservation. For example, Fort Huachuca has undergone at least 3 expansions and has one pending (1883, 1940s, 1957). The Department notes that the "East Range" resulted from the 1940s expansion. Was the 1957 expansion an addition to the East Range? What are its boundaries? What are the water uses/claims located within the 1881, 1883, 1940s and 1957 parcels?

The Department has done a thorough job of collecting a large amount of information for Fort Huachuca. The questions posed above could be answered by a small amount of additional research on historical boundary changes and providing a description of the purpose of those changes. Minor changes in reporting (e.g., subdivision of Tables 5-51 to 5-56 and a map of the boundary changes) would provide the additional information that is needed to assign water uses to each potential date of first use associated with creation of that part of the reservation.

---

[34]It would appear that some secondary purposes may be the subject of claims and water use. For example, it is not clear that recreation (e.g., golf course) and wildlife are among the primary purposes of Fort Huachuca (p. 393).

L. Treatment of Decreed Rights

Although there are only a few small decrees in the San Pedro, SRP raises the following concerns regarding their treatment because of the unique status of decreed rights in the adjudication. A.R.S. 45-257.B.1. provides:

> " . . . when rights to the use of water or dates of appropriation have previously been determined in a judgement or decree of a Court, the Court shall accept the determination of such rights and dates of appropriation as found in the judgement or decree unless such rights have been abandoned."

SRP's concerns relate to the overall tracking of decreed rights, assignment of priority, omission of decrees and implications of forfeiture.

1. Overall Approach

It is not clear from the HSR what has happened to certain decreed rights. A discussion of historic disposition and current status of previously decreed rights might eliminate some concerns regarding the Department's treatment of those rights.

In the case of Clarkson v. Wilcox and Wolf v. Turner, only one-half of the decreed rights appear to be included. There is no discussion of the current status of water rights that resulted from Pyeatt v. Huachuca Mining. Finally, the discussion of Boquillas (pp. 24, 25, 432, 433) raises questions regarding the disposition of at least 120 acres of 1877 water rights described in the decree.[35] Is there no water use at all in the area? Have the rights been changed to another location or type of use?

[35]In fact, the Department notes: "It is conceivable that lands now served by well pumpage in this region [southern portions of the Saint David Irrigation District] may have been supplied surface water by the Curtis Ditch" (p. 433). This in fact appears to be the case.

SRP suggests that the Department use an approach which begins with identification and mapping of the decreed area and proceeds through time to the present. The initial identification may need to rely on information prior to decree such as notices of appropriation. Also, as discussed below under Omission of Decrees, the Department may need to research the records of the local courthouses in order to glean legal descriptions, etc. from the original filings and decisions of the Court.

2. Assignment of Priority

The Department has not consistently used decreed dates of first use as the apparent date for PWRs to which they apply. The decreed date should be used consistently as the data source for apparent first use.

The 1907 decree in Wolf v. Turner confirmed an 1892 date for irrigation within 160 acres of land. Most of that land is included in WFR 111-20-DDA-23 (Vol. 3, p. 1). The Department states that the decree applies to a parcel identified as IR90 but identifies a date of 1936 for that tract based on a photo. Curiously, IR91 is given an 1892 date based on Water Rights Registration Act (WRRA) filings even though the decree is not listed as applying to that tract.[36] In any case, IR90 should be given an 1892 date based on the decree.[37]

---

[36]The decree might not be identified as applicable to IR91 because of a typo in its legal description - - it is in the NWSW of Section 18, not Section 13. Or it may not apply if IR91 was developed in 1985 and was not the result of a change of location in use of the original right.

[37]This WFR is an example of some of the reporting and 50/90 line problems discussed at the outset of these comments. The only reason that there is any information on the decree is because unused Well 2 is within Zone 1. The current diversions for the irrigated parcels that straddle Zones 1 and 2 are all pumped out of Well 1, which lies just outside of the brightline.

On the other hand, an IR90 in WFR 111-23-DBB-26 (Vol. 3, p. 163) is given a date of 1901 based on the WRRA filing although the Clarkson v. Wilcox decree establishes a 1907 date. This PWR should be given a 1907 date as was done in the 1987 draft HSR.[38]

As a final example, the James v. Baumkirchner decision identified the two parties as "joint and equal appropriators" prior to 1919. However, in WFR 111-23-11 (Vol. 3, p. 119) the Department gives the use a date of 1890; while in WFR 111-23-22 (Vol. 3, p. 16, "Baumkirchner") the Department gives the use a date of 1880. Both dates are based on WRRA filings. In order to resolve this discrepancy with the decree, the Department may have to contact the parties involved.

3. Omission of Decrees

The following list of decisions is the result of appeals taken from lower Court decisions. These decisions involve water matters in the San Pedro River basin. Additional research is needed at the respective courthouses to get the underlying decisions and facts. Where relevant, the results of these judgements or decrees should be integrated into the final HSR.

1. Clifford v. Larrieu, 2 Ariz. 202, 11 P. 307 (1886).
2. Hill v. Lenormand, 2 Ariz. 354, 16 P. 266 (1888).
3. Dyke v. Caldwell, 2 Ariz. 394, 18 P. 276 (1888).
4. Miller v. Douglas, 7 Ariz. 41, 60 P.2d 722 (1900).

[38]In another change from the 1987 HSR, a nearby parcel (111-23-DBB-27) was given a decree date of 1907 although a remark said that the owner stated that irrigation began in 1973. The 1990 HSR does not mention the decree and assigns a 1978 date based on the claim.

II. SPECIFIC COMMENTS

The Salt River Project's comments and questions on individual items are enumerated below by HSR volume, page and line number.

VOL	PAGE	LINE	COMMENT
1	16	30	September 39, 1990 should read September 30, 1990.
1	104	5-7	The 186,910 af is a mixture of natural depletions (6,250 + 55,310) and cultural diversions (125,350). This is not useful since apples and oranges are being added together.
1	107	Table 3-1	Horizontal totals are incorrect; apparently a column is missing. The value for "Willow" ET in the Sierra Vista subwatershed should be 183.1.
1	109, 110	Table 3-2	Mathematically, there are 15 possible ways. It appears that there may be circumstances where the other four combinations of sources may exist (Z1 and Z3; SW, Z1 and Z3; Z1, Z2 and Z3; SW, Z1, Z2, Z3).
1	129	21	The Department should also note that "Average Efficient" is based on any area irrigated during 5-year period (See p. C-17, line 4; p. 136, line 4).
1	129	21-23	What concept or situation is represented by "Average Efficient?" Isn't "Average Efficient" a misnomer? In most cases, the area is not "average," nor is the system "efficient."
1	129	31	It appears that the calculated consumptive use requirement was used for hydrologic accounting (See also, p. C-1, lines 6-7 and p. 168, #7). Page C-19, lines 13-16 indicates that at least 3,620 acres were deficit-irrigated or that irrigation was not active. SRP suggests that 75% of the consumptive use requirement be used for depletion calculations rather than the calculated amount. This, or a similar adjustment, would reflect the year-to-year realities of irrigation practices that

VOL	PAGE	LINE	COMMENT
1	129 (continued)	31	include fallow land and deficit irrigation. This point should not be confused with SRP's position that the water duty should reflect "maximum beneficial use" which must be based on calculated consumptive use where diversion data is not available (see Section I.E.9).
1	138	3	This is not clear. The term "field crop surveys" implies the "Crop surveyed" category in Table 3-4, but the acreage reported is for "Average Efficient" (i.e., total acres).
1	147	Table 3-12	The totals for Total AF/A diverted (241.9), Net average flow delivered (CFS) (13.8), and Net AF/A (2.9) delivered are meaningless. Also, it is not clear how the "total" for the latter was calculated.
1	148	31	The 177 acres per cfs is distorted by the atypical Geldmacher data; deletion of those data results in 218 acres per cfs. As the Department implies on the next page, this simply means that the irrigators supplement surface diversions with pumped water. Given that some of the pumped water is appropriable, it is not clear that these calculations are very enlightening as to surface water diversion rates per acre.
1	177	2-3	It should be noted that significant upward leakage is rare. Layers that confine artesian systems are generally clay that is primarily amorphous. There are seldom fractures as long as it is saturated from beneath. Upward hydrostatic pressure causes extremely slow upward leakage through a clay confining layer but the rate is so slow that it is generally ignored.
1	179		The Department identifies evaporation for bare soil in and along the channel to be a significant component of the natural consumptive use - 5,780 af from the watershed. The Department's estimate for evaporation from the bare portion of the flood channel is about twelve times greater than the evaporation from the stream itself. This rate of evaporation is unrealistically high.

VOL	PAGE	LINE	COMMENT
1	193	second full para.	The Regional Aquifer underlying the Floodplain Aquifer in the San Pedro Valley has extremely low transmissivity. It is considered doubtful that the analogy with the Tucson Basin, where the underlying transmissivity is high, will ever reach the worst-case scenarios from one end of the San Pedro Valley to the other.
1	239, 240		The Department's water budget analysis considers surface water and groundwater inflows, tributary surface water and groundwater recharge as supplies. It should also discuss supplies "imported" through return flow from pumping of non-tributary groundwater.
1	284	4th para. 2nd sent.	The word "abandoned" is used to describe the current status of an instream pump that is not curretnly used by the City of Tombstone. Since the word "abandoned" carries with it a distinct legal connotation in this adjudication, it is suggested the term "discontinued" or phrase "no longer in use" be substituted for "abandoned."
1	292	29-31	This is not compatible with Table 5-7 or p. 296, lines 5-6, which state 394 acres are irrigated by surface water exclusively or surface water supplemented water from wells [wells in any zone].
1	296	5-6	This is not compatible with p. 292, lines 29-31 or Table 5-7 which specifies 187 + 199 + 5 = 391.
1	300	3-4	This is not clear; actually, the 150 acres also gets a large amount of pump water (pp. 303, 304).
1	300	10	" . . . next to . . . " Is the gage upstream or downstream of the diversion?
1	301	24-26	Does the 0.8 cfs average include periods of zero flow? (See Table 5-9). 566 acre-feet per year would require constant flow of 0.8 cfs.
1	302	17-22	In Tables 5-9, 5-10, 5-15, 5-16, 5-26 and 5-27, are the TIR columns actually TIR divided by field application efficiency, in other words, "water duty?"

VOL	PAGE	LINE	COMMENT
1	302 (continued)	17-22	Where is the TIR value for each of these users reported? In Tables 5-9, 5-15 and 5-26, should the 2nd column be "cumulative cfs - days?"
1	303	7	The Department should note that pump water is used to supplement surface water (See also p. 300, lines 3-4).
1	303	Table 5-9	How is the "TOTAL CFS/MONTH DIVERTED" derived from the measurements discussed on page 301?
1	305	6	Should this be 789 acres of pasture and small grain crops? (See p. 300, 1ine 5).
1	321		The section numbers on Figure 5-13 need to be corrected.
1	475		The Sale major user report refers to the "Young and Pringle Irrigation Ditch," which probably should be Young and Swingle ditch. P.O. Young, O.H. Swingle, and L.S. Swingle signed a Notice of Appropriation which states the ditch was completed February 1, 1878 (emphasis added)(see Exhibit 4, Attachment 8).
1	475	16-18	SR5 is identified as being built both in 1985 and 1989. Which is correct?
1	489		It should be clarified on lines 11 and 19 that claim 39-12167 was submitted by the "United States on behalf of" the Tribe. Likewise, lines 7 and 10 should be modified to read "claims made by and on behalf of the San Carlos Apache Tribe." The table of amounts claimed should be clarified in several instances: Irrigation On Trust Allotments 770 Municipal, Domestic and Related Uses[1] 5,935 Domestic Use on Trust Patent Allotments 20 [1]5,935 AFA are claimed for the entire Reservation, only a portion will come from water supplies of the San Pedro basin.

VOL	PAGE	LINE	COMMENT
1	489 (continued)		It would probably be a good idea to discuss the allotments at greater length in the final San Pedro HSR. This would serve to alert the surrounding land owners that significant reserved right claims are being made for these parcels located along the San Pedro River and Aravaipa Creek. Providing a map showing allotment locations would be beneficial as well.
1	502, 503		The Department's assignment of PWR numbers appears to be inconsistent in some cases. According to the Department, ". . . a PWR is a water use with an independent purpose. It is supplied in its entirety by the same source(s) of water, and has the same apparent date of first use for the entire period of use." In file 113-14-AD-001 (Dobson), the source of supply for both IR1 and IR2 is the same (subflow) and the apparent dates of first use are the same (1936); however, there is a "36" filing, which covers IR2 but not IR1 and different diversions serve each of these two IRs. In the same file (Dobson) IRs 8 and 9 are distinguished only by different diversions (same source, date and previous filings). On the other hand, in file 114-4-BAB-007 (Sale), IR1 is assigned to non-contiguous areas having the same previous filings, same source and same date of apparent first use, but different diversions. SRP recommends that the Department clarify its procedures for creating PWRs. PWRs should be created for unique combinations of first use date, source and previous filings. Separate PWRs are not necessary if only different wells serve the two parcels.
1	504, 505		The procedure for assignment of SOCs to an adjudication watershed file appears inconsistent where the land has been subdivided since the claim was filed. Examples 8-1 and 8-2 appear to have similar factual circumstances in that each contain subdivisions with no use found by the Department. Example 8-1 describes a situation where one landowner has

VOL	PAGE	LINE	COMMENT
1	504, 505 (continued)		filed a claim for a water use, then later has subdivided his property. The Department will only create files for the subdivision with the use and diversion. Subdivisions with no use found do not have WFRs. Example 8-2 describes an identical situation, except that there are no uses found at all. In this case, the Department has created files for all subdivisions. It seems that the Department should be consistent in its consideration of all claims, either: (1) Files should be created for all subdivisions covered by an SOC, regardless if any water use is found; those without a use should be labeled as such in the the Department analysis, or (2) No files should be created for subdivisions in which no use is found. Option 1 is probably preferred so that the fate of the claim is trackable.
1	507	last sent.	The absence of continued use of water as determined from aerial photography should not change the apparent date of first use of a water use whose date of first use is based on a decree. The apparent date of first use should be as stated in the decree.
1	516		The Department states that "Amendments to Statements of Claimant are evaluated and the information is included in the WFR and the statement of claimant record." In the Paul L. Sale WFR (114-4-BAB-7), it appears that DWR included amended quantities for six Statement of Claimant under "Applicable Filings and Decrees."[39] SRP suggests that the "Filing Status" for amended Statements of Claimant be completed. In this case, "Amended" should follow the appropriate Statements of Claimant under "Filing Status." Also, filing 33-80715 is protested, but has also been amended. Therefore, "Amended" should appear with "Protested" under the "Filing Status."
1	541	33-35	The revised and current edition of FAO Paper #24 by Doorenbos and Pruitt is dated 1977, not 1975.

[39]This was only determined after SRP viewed the entire Paul L. Sale file at DWR.

VOL	PAGE	LINE	COMMENT
1	A-3	Table A-1	It would be helpful to include subtotals in all columns for each of the upper and lower Basins.
1	A-1 to A-3		For the Floodplain Aquifer an average saturated thickness of 60 feet was used for all five sub-basins. This is a generality that might be too high or too low. Data are available from which to construct a depth to water map which would depict the upper surface of the saturated zone. Well data is likely to be available from which to estimate the total thickness of the Younger Alluvium, such as was done by Putnam and others for the Buena Vista Hearing in the upper Santa Cruz River in 1983. Perhaps additional work is not feasible at this stage of the proceedings, but if these suggestions were feasible, the average saturated thickness in each sub-basin could be estimated more reliably. A more serious problem is that the figures developed by the Department for coefficients of storage do not appear consistent. For the Floodplain Aquifer the coefficient of storage use to compute the volume of recoverable groundwater is 0.12 (12 percent, pp. A-1 and A-2). The figures, which were used to compute the position of the brightline in the northern part of the Sierra Vista sub-basin and in the other four sub-basins, are shown in Table E-1 on pages E-10 and E-11 of Appendix E and are higher than those used to estimate the volume of recoverable groundwater. The figures ranged from a high of 0.76 to a low of 0.226. For the 14 townships listed, the average was 0.162, about 33 percent higher than was used to compute recoverable groundwater. For the Regional Aquifer the average coefficient of storage applied to compute recoverable groundwater was 0.08 (8 percent). This figure appears to be low for the aquifer in the vicinity of the City of Sierra Vista and Fort Huachuca but is probably high for the balance of the Sierra Vista sub-basin and for the other four sub-basins. There are few wells in the Regional aquifer except near Sierra Vista; elsewhere in the basin production from wells is low because of much conglomerate and similar formational units. It would seem

VOL	PAGE	LINE	COMMENT
1	A-1 to A-3 (continued)		more appropriate to use a figure closer to 5 percent for the Regional Aquifer except in the vicinity of Sierra Vista. The computed volume of recoverable groundwater in the Regional Aquifer of the Aravaipa sub-basin is considered startlingly high (nearly 4,500,000 acre-feet when recomputed using a lower storage coefficient but nearly 6,250,000 acre-feet as shown in Table A-2, page A-3). This is nearly three times greater than the recomputed figure for the entire Winkelman sub-basin. Figure 4-13 on page 215 of the HSR shows that all of the Regional Aquifer that exists in the Aravaipa sub-basin lies upstream from the beginning of Aravaipa Canyon. Visits by Leonard Halpenny to this upstream area consisted of several field trips in the early 1940s and one in the summer of 1959. The impression gained was that the Older Alluvium (Basin Fill or Regional Aquifer) was relatively thin, has a saturated thickness far less than 400 feet, and was not a prolific aquifer (Halpenny, personal communication). It is suggested that the Department revise this figure substantially downward. In conclusion, the figures developed in Appendix A need to be consistent with those used or discussed in Chapter 4 of the HSR or vice versa.
1	A-3	Table A-2	There are substantial errors in some of the figures, based on the parameters set forth in the text. The figure for Regional Aquifer Storage in the Redington sub-basin should be 10,841,039 acre-feet; surprisingly the figure in the final column is correct. The figure for the Regional Aquifer in the Winkelman sub-basin should be 1,535,494 acre-feet; the figure in the final column is correct. The figure for both Aravaipa sub-basin aquifers is a typo; the corrected figure should be 6,459,829 acre-feet. The figure for total groundwater storage in the Regional Aquifer in the lower San Pedro Basin should be 16,822,502 acre-feet. These suggested corrections are based on the parameters used by the Department in making the computations.

VOL	PAGE	LINE	COMMENT
1	B-1, B-2		The Department's criteria for delineating the boundaries of the floodplain is unclear and seems to confuse the distinctions between the active channel and the lithologically-defined Younger Alluvium.
1	C-1 to C-31		Appendix C is silent on how quantities or rates of use for certificated rights are determined and reported. A discussion of certificated water rights in Appendix C would help clarify the Department's approach. Chapter 1, Section 1.3 (p. 15) mentions several hundred applications, permits and certificates. Some of the certificates are reported in the "Quantities of Use" section for various WFRs. For irrigation uses, the water duty shown on the certificate is reported along with "average efficient" and maximum annual" water duties in some instances (e.g. WFR 113-12-CAA-1; Vol. 5, p. 96). In other cases, a certificate is listed but the water quantity applied for is not further reported because the filing is "protested" (e.g., WFR 111-23-AAA-1; Vol. 3, p. 34). This is consistent with the Department's policy to list but not use these protested previous filings (p. 516). However, SRP believes that it may be valuable to list the quantity and date in the PWR summary since the application provides additional perspective on these attributes (see Section I.F.4 and Attachment 8).
1	C-1	2	Delete "used."
1	C-1	Sec. B.3.	Isn't "Average Efficient" a misnomer? In most cases, the area is not "average," nor is the system "efficient."
1	C-4	18-20	This doesn't agree with Tables 5-9 (p. 303), 5-15 (p. 314), or 5-26 (p. 330) which list Total Irrigation Requirement as crop use, divided by on-farm irrigation efficiency.
1	C-5	3-6	This is the definition of consumptive use whether the plant is just kept alive or achieves optimum growth. The consumptive use <u>requirement</u> should have some statement of associated yield level.

VOL	PAGE	LINE	COMMENT
1	C-5	8-21	This is not clear. The Department is using the SCS Blaney-Criddle method but Equation C-2 and the discussion of reference crops relates to the FAO Blaney-Criddle calculations.
1	C-5	11	Neither the SCS nor the FAO Blaney-Criddle equations use precipitation for calculation of consumptive use.
1	C-5	12	The word "daily" should be changed to "monthly" so that the phrase reads ". . . mean monthly percentage of total annual daylight hours . . ."
1	C-5	19-20	In addition to the comments made in Section I.E.3, preliminary review of SCS CONUSE indicates questionable interpolation procedures for planting and harvest month temperatures, percent daylight hours, and precipitation. Partial month values are not adjusted to monthly basis for estimation of effective precipitation. Statements 3220 and 4490 appear to be incorrect. Specific comments on the CONUSE program code are:

PROGRAM STATEMENT NO.	NOTE
410-970	Source of crop coefficients is unknown.
3220	Should be D(M2) = INT((B2 + B(M2))/2
3470, 3490	Basis for temperature interpolation procedure is unclear. Results appear to be incorrect.
3510, 3530	Procedure is based on percent of daylight hours at mid-month, rather than mid-period.
3740	Peak daily use is calculated and could be used in Appendix C of HSR (see Section I.E.10).
4470, 4490	Basis for precipitation interpolation procedure is unclear. Results appear to be incorrect.
4490	Should Q2(M2) be Q1(M2)?
4560	For Q3(I) calculation, Q1(I) and U1(I) were not adjusted to monthly basis as prescribed in TR-21, p. 25.

VOL	PAGE	LINE	COMMENT
1	C-7	5	These Kc (should be kc) values, apparently from CONUSE need to be changed to reflect TR-21.
1	C-7	10	kt = (0.0173) T - 0.314
1	C-7	19	Tabulated kc value for October should be 0.58 to be consistent with line 5 (but see the comment for line 5, above).
1	C-8	Table C-2	What species of pasture grass is used for calculating CU?
1	C-9	32-33	There are no records of effective precipitation anywhere!
1	C-10	16	There is no mention of non-growing season effective precipitation, i.e., soil moisture at the beginning of the growing season (precluded on Pomerene and St. David Irrigation Districts by winter irrigation).
1	C-12	34-35	Conveyance efficiency ratio is inverted.
1	C-12	37	Irrigation efficiency is the ratio of the irrigation water used by the crop, to that delivered to the farm. In other words, the irrigation requirement may not have been made available to the crop.
1	C-13	2-3	Inclusion of conveyance efficiency in the calculation implies that the Water Duty (p. C-4, line 16) is measured at the point of diversion. Is this correct, or does Water Duty refer to the volume at the farm headgate? (See p. 130, line 19). SRP recommends that the Department employ a consistent point of measurement for Water Duty. Since the diversion point is the focus of administration, it is the preferred location to measure Water Duty.
1	C-21	Table C-7	Why were 39% and 54% selected for Gravity/Surface and Sprinkler Irrigation efficiency, respectively?
1	C-21	22	How does the weighted mean value of farm irrigation efficiency for "Maximum Annual" compare with the 47% for "Average Efficient?"

VOL	PAGE	LINE	COMMENT
1	C-24	Step 4	What is the basis of 51% field application efficiency for calculation of maximum demand rate?
1	C-27		Aren't the numbers on the sketch reversed?
1	C-30	3-4	Is the 0.17 AF per person converted to a household use?
1	D-1	28-29	Blaney-Criddle methods for riparian vegetation are found in Appendix B rather than Appendix C (see line 5).
1	E-10 & E-11	Table E-1	The Department devised coefficients of transmissivity and storage for those areas not covered by previous investigations, i.e., all of the San Pedro River valley except in the vicinity of Sierra Vista and Fort Huachuca. The Department's estimates are set forth by township in Table E-1, pages E-10 and E-11 of Appendix E. These coefficients relate to the Floodplain Aquifer <u>only</u>. On page 226, paragraph 1, it is explained that "it is possible" for the brightline boundary to extend beyond the younger alluvial boundary into the basin fill. Indeed, the brightline extends into the basin fill wherever the channel banks are close to the edge of the Younger Alluvium, i.e., the distance "a" is greater than the width of the Younger Alluvium from the stream channel. The assumption was made by the Department that in such cases the transmissivity and storage coefficients to be used for Basin Fill are the same as for Younger Alluvium. To the extent that the Department evaluates groundwater conditions in the Basin Fill outside of the Younger Alluvium, different coefficients should be developed wherever appropriate.
1	E-11	fn.4	There is a reference to Table E-2 that apparently is intended to describe T and S values for the Freethey Model Area. No Table E-2 exists but it would be helpful to have included in the final HSR.
1	F-2	13-14	Doesn't seem compatible with lines 1-2.

VOL	PAGE	LINE	COMMENT
1	F-3	#5	Substitute "Irrigation depletion within the San Pedro River watershed is the amount of water depleted from the hydrologic system, as a result of crop consumptive use minus effective precipitation." Delete discussion of irrigation 1 efficiency unless some of the irrigation losses are considered to be evaporation or consumptive use by weeds.
1	F-4	1-17	Why is efficiency discussed in relation to depletion? The use of Total Irrigation Requirement, perhaps adjusted downward to reflect an assessment of the degree to which crop requirements were actually met in any given year would provide the depletion estimate.
1	F-4	12-14	How can a PWR be multiplied times an acreage? Does this mean the water duty based on the efficiency of each PWR was multiplied by the acreage?
1	F-4	27	What is the weighted crop irrigation requirement (CIR)? (Not in List of Abbreviations, p. xviii). Is it the TIR, weighted for crop proportions, p. C-21, Table C-7?
6	2-78		WFR 114-4-BAB-7 In the 1990 Explanation, reference is made to discontinued uses IR90 through IR92. IR91 is listed in the "PWR Summary" section, yet IR90 and IR92 are not summarized and are not listed under "Quantities of Use." IR90 is described in WFR-1-CCD-10 which is land leased from the State Land Department by Sale. Finally, IR92 was not mapped. There are questions as to how the fish ponds were quantified. SR11 and SR12 are reported to have surface areas of 5.5 acres and 5.1 acres, respectively. SR17 is listed as 4.4 acres, but is visually larger than either SR11, SR12, or IR91. IR91 is listed as having a surface area of 5.2 acres. Obviously SR17 must encompass a surface area greater than IR91. When SRP measured each of those areas (by planimeter), SR11, SR12 and SR17 were approximately 7.9 acres, 9.1 acres, and 11.5 acres respectively.

VOL	PAGE	LINE	COMMENT
6	2-78 (continued)		In the "Quantities of Use" section, IR1 lists a decree under "Quantification Type," yet there is no further reference to this decree. What decree applies to this PWR? This needs to be clarified in the "Explanation" section.
7	19		The apparent annual volume reported for WFR 111-20-CDD-1 is 1,079.7 AFA for 17.7 acres. This appears to be a typo and should read 108.0 AFA (107.97).

ATTACHMENT 1

LIST OF PREVIOUS FILINGS NOT ASSOCIATED WITH A WFR HAVING APPROPRIABLE USE

ATTACHMENT 1

PREVIOUS FILINGS NOT ASSOCIATED WITH A WFR HAVING APPROPRIABLE USE

PREVIOUS FILING #	WFR'S		LOCATION
33-85239	115-06-CCB	-001	07 080S 210E
33-85240	115-06-CCB	-001	07 080S 210E
33-89137	111-20-	-056	20 210S 200E
33-39138	111-20-	-056	20 210S 200E
36-14511	112-17-DBA	-180	08 130S 210E
36-18826	114-04-	-035	
36-18827	114-04-	-035	
36-18828	114-04-	-035	
36-18829	114-04-	-035	
36-18830	114-04-	-035	
36-18831	114-04-	-035	
36-21891	111-19-CAD	-005	
36-26145	112-17-DCA	-016	28 180S 210E
36-26146	112-17-DCA	-016	28 180S 210E
36-26153	112-17-DCA	-016	28 180S 210E
36-27389	114-01-CCD	-004	25 050S 150E
36-27899	112-17-BAA	-180	27 160S 200E
	112-17-BAA	-185	27 160S 200E
	112-17-BAA	-205	27 160S 200E
36-29082	111-20-	-062	27 210S 210E*
36-29084	111-20-	-062	02 220S 200E
36-29086	111-20-	-062	02 220S 200E
36-29087	111-20-	-062	02 220S 200E
36-29088	111-20-	-062	02 220S 200E
36-29089	111-20-	-062	02 220S 200E
36-29090	111-23-	-064	
36-43226	111-21-	-031	01 200S 230E
36-43227	112-20-	-010	14 200S 190E
36-43228	111-20-	-051	18 200S 200E
36-46495	111-23-	-040	35 220S 200E*
	111-23-	-041	02 230S 200E
36-67716	111-19-	-044	35 210S 180E
36-68544	111-24-	-059	01 230S 240E
	111-24-	-075	23 0S24 0E *
36-68545	111-24-	-059	01 230S 240E
	111-24-	-075	23 0S24 0E *
36-70414	112-17-BAB	-004	33 160S 200E
36-75650	111-21-CBC	-001	09 210S 220E
36-75653	111-21-CBC	-001	09 210S 220E
36-80652	112-17-DCA	-007	28 180S 210E
36-80653	112-17-DCA	-007	28 180S 210E
36-80654	112-17-DCA	-007	28 180S 210E
36-81202	112-17-	-042	28 180S 210E
38-81203	112-17-	-042	28 180S 210E*

* DENOTES LOCATION FROM CLAIM

ATTACHMENT 2

SPECIFIC RECOMMENDATIONS FOR HSR REPORTING

ATTACHMENT 2

SPECIFIC RECOMMENDATIONS FOR HSR REPORTING

A. Uniform Reporting

The Salt River Project (SRP) recommends that the Department include all available information pertaining to a particular well in a standard reporting format until the major legal issues are decided. The standard format, as utilized in Volumes 3 through 6, would apply to all PWRs unless a modified format is adopted for small uses. This recommendation eliminates Volumes 7 and 8.

B. Listing of Wells Subject to Federal Claims and Catalogued Wells

As discussed above, in place of Volumes 7 and 8, all wells would be reported with other WFR information in Volumes 3-6. Thus, all wells can also be listed in the Comprehensive Indices (Volume 2). In effect, this change will create lists for each category of well within Indices 6 and 7 since these indexes are arranged by source of water. If desired, excerpts from these two indices could be included at the front of each subwatershed volume. This would place, in one volume, all of the relevant data pertaining to PWRs and their respective sources of water for uses which are located in a particular subwatershed. Of course, the inclusion of the wells in the other indices within Volume 2 will insure that they can be easily found even if only a name, location or claim number is known.

If it is desirable to have a separate list of wells subject to federal claims, then this can be accomplished simply by creating a table with this information. The table could be entitled "Wells Subject To Federal Claims" and be indexed by WFR number. The table could be included in each subwatershed volume as well as the comprehensive index. Likewise, to satisfy the Court's requirement for a separate list of catalogued wells a table could be included with pertinent information cross-referenced to WFR, where applicable.

Again the table could be included in each subwatershed volume as well as in the Comprehensive Index.

C. Simplified Reporting For Small Uses and No PWRs

SRP urges the Department to consider simplifying the reporting of WFRs in cases where only stockwell or domestic uses are reported or when WFRs contain claims but no PWRs. Except for stockwells or domestic uses without claims, these WFRs are currently reported in the standard format at least in Volumes 3-6. However, it may be more useful and cost effective for the Department to report them in an abbreviated table since, in many cases, very little information is available for these WFRs.

For WFRs containing only stockwell or domestic uses and claims but no PWRs, SRP recommends that the following information be reported and arranged by owner name:

1. Name (Owner or Claimed)
2. Watershed File Report Number/PWR
3. Location (Found or Claimed)
4. Claim Number
5. Apparent First Use Date (Date of Drilling or Claimed)
6. Use (Found or Claimed)
7. Quantity Claimed
8. Apparent Estimated Volume
9. Previous Filings
10. Water Source (Appropriable Subflow, Subject to Federal Claim, Catalogued Well)

Of course, some attributes will be blank or say "None" where there is no applicable information. Again, these WFRs should be included in the Comprehensive Indices for reference by location, claim, WFR number, etc.

ATTACHMENT 3

ANALYSIS OF STREAM DEPLETIONS FROM PUMPING WELLS: NUMERICAL VS. ANALYTICAL METHODS[1]

NOTE: Subsequent to the original publication of this paper, minor errors in Tables 1 and 2 and Figures 1 and 2 were discovered. These tables and figures have been corrected for this reprint. The conclusions and assertions of the paper are not affected.

---

[1]American Society of Civil Engineers, et al. Proceedings of CONSERV 90: The National Conference and Exposition Offering Water Supply Solutions For The 1990's (Phoenix, Arizona; August 12-16, 1990), pp. 589-593.

ANALYSIS OF STREAM DEPLETIONS FROM PUMPING WELLS:

NUMERICAL VS. ANALYTICAL METHODS

Keith Buckley

Leonard Rice Consulting Water Engineers, Inc.
Denver, Colorado

INTRODUCTION The quantity and timing of depletions to a river caused by the pumping of ground water is often of interest to hydrologists. In Arizona, it has been proposed that wells that withdraw 50 percent of their total volume from a surface stream after 90 days of pumping be considered surface water diversions. The methods to determine if a well meets these criteria are either analytical or numerical. Analytical methods utilize solutions to partial differential equations first developed to describe heat flow. Numerical methods utilize digital computer models.

The analytical methods of R.E. Glover (1974) and C.T. Jenkins (1970) have been widely used to define stream depletions by pumping wells. The Arizona Department of Water Resources (ADWR) used Jenkins' method to delineate areas in the San Pedro River Valley where the 50 percent, 90-day criteria are met. We have applied these two analytical methods to the Verde River Valley on the Fort McDowell Indian Reservation. We have also applied the Prickett-Lonnquist Aquifer Simulation Model (PLASM) to this area. Our purpose was to compare the data and labor requirements, accuracy, applicability, and versatility of the three methods.

CONCLUSIONS

- Under simple conditions ideal for the analytical methods, the PLASM aquifer model, the Glover method and Jenkins method will all yield virtually equivalent rate and volume stream depletion estimates.
- The Jenkins method is simple to use but is most limited in applicability and reliability.

CONTACT: KEITH BUCKLEY, LEONARD RICE CONSULTING WATER ENGINEERS, INC. 2401 FIFTEENTH STREET, #300, DENVER, CO (303) 455-9589.

- Glover's method is essentially the same as Jenkins' except that it considers the effects of a limited aquifer. This makes Glover more accurate in a floodplain alluvial aquifer.
- Straight-forward applications of Jenkins' or Glover's methods are inappropriate for calculating stream depletions from terraces beyond the immediate flood plain.
- The PLASM model is more data and labor intensive than the analytical methods, requiring at least 20 times more labor to implement. However, modeling is more versatile and can more closely approximate actual aquifer conditions. The model can also provide more information about the transient nature of a stream/aquifer system than simply the quantity and timing of river depletions.

ANALYTICAL METHODS Jenkins provided a useful and simple equation and set of curves to determine stream depletions. His method is based on the earlier works of Theis, Glover, Hantush and others, and is limited by the same set of assumptions. The most critical assumptions for applications to alluvial stream/aquifer systems are as follows:

1) Transmissivity does not change with time.
2) The aquifer is isotropic, homogeneous, and semi-infinite in areal extent.
3) The stream that forms a boundary is straight and fully penetrates the aquifer.
4) The pumping rate is steady during any period of pumping.

Jenkins equation is simply:

$$sdf = a^2S/T$$

where: sdf = stream depletion factor (days)
a = distance from the well to the river (feet)
S = storage coefficient of the aquifer
T = aquifer transmissivity (ft^2/day)

The sdf for a depletion of 50 percent in 90 days is easily read from the curves created by Jenkins, and in this case is equal to 29.58. Thus, the Jenkins' Method is uniquely suited to the direct calculation of "a", the ADWR "bright-line" distance from the river. Within this distance, wells will deplete the surface stream by 50 percent or more of their 90-day pumping volume.

The "Glover Method" is essentially "Jenkins' Method", but includes image well theory to approximate the effects of a zero flow boundary on the equations of drawdown and stream depletion. This method has all the limiting assumptions as Jenkins except that the aquifer does not need to be of semi-infinite extent. Glover's method can be applied manually but has been adapted for use on a personal computer. The program we used (developed by Ross Bethel, Inc.) calculates monthly stream depletions as a percent of pumping volumes in a limited alluvial valley. It requires the same aquifer information as Jenkins.

It also requires the distance from the well to the edge of the aquifer. This method is not set up to directly solve for the "bright-line" distance (a). It requires an iterative approach, testing various distance configurations to solve for the 50-percent, 90-day criteria. Although it is a bit more cumbersome than the Jenkins' method, Glover provides much more accurate answers in limited aquifers. The PLASM model is not constrained by any of the assumptions that limit Jenkins and Glover.

PLASM MODELING We used a PC-BASIC version of the PLASM model (Prickett, 1971) to simulate the stream/aquifer system of the Verde River Valley on the Fort McDowell Reservation. We made some modifications to the original program code to allow for changing river head levels and to calculate and print river-to-aquifer flow rates. The modeled valley has the following features:

1) The river flows south down the center of the valley model without meandering. Both the river and the alluvial aquifer slope south at a gradient of .0025. The model is flat east to west across the 13 grid columns that represent a distance of 13,600 feet. The 25 rows cover a down-valley distance of 34,000 feet.
2) The saturated thickness of the alluvium is 60 feet and it is deposited on impermeable material. There are only two types of alluvium in the valley: high permeability flood-plain alluvium near the river and low permeability older alluvium at the margins of the valley. The width of the river is 200 feet and has an annual average depth of 1.33 feet. The streambed is lined with a thin low permeability zone which has a vertical infiltration rate of 1 foot per day.

The river head was varied monthly to simulate the actual flow cycle of the Verde River. The Chezy-Manning formula with a trapezoidal cross-section was used to estimate average monthly heads in the river. The river was considered to be in dynamic equilibrium with the aquifer. Initial head in the aquifer was equal to the annual average river flow depth. The river flow depth was set each month to that month's height above or below the annual mean. For example, the level in March is .91 feet above the mean, while the level in October is .51 feet below the mean.

Changing river levels each month resulted in large amounts of water moving from the river into the aquifer during high river stages. The reverse occurred during low stage months. For any given aquifer configuration, a "steady state" run with no pumping was first made.

Each model run calculated heads in the aquifer and flow rates to or from the river every five days for 300 days. Some model runs were for 720 days. The model was then rerun under the same conditions except that well pumping of some configuration was added. The runs were then compared. Increases in the volumes of water leaving the river during high stage months and decreases in the volumes gained by the river during low stage months were attributed to pumping the well. As much as 200 times more water was moving between the river and aquifer

because of river stage changes than because of well pumping. The model was capable of accounting for the effects of such a relatively small perturbation of the stream/aquifer system. We found unexpectedly that the depletion pattern was virtually the same no matter when pumping occurred.

COMPARATIVE RESULTS The variation in results between the analytical methods and the PLASM model were most sensitive to aquifer extent. Case 1 considers a wide, high permeability flood plain aquifer that extends 5800' from the river and has a hydraulic conductivity (K) of 1870 gpd/ft. The aquifer is bounded by older alluvium with K of 74.8 gpd/ft. The storage coefficient in both zones is 0.20. The well was pumped from March 1 to the end of May (90 days) and was positioned 1800 feet from the river. Depletions to the river as a percent of the total volume pumped from the well are listed on Table 1.

	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Jenkins	21	32.5	39	55	62	67	70	72	74	76
Glover	7.1	23.3	43.2	58.3	66.0	71.6	76.0	79.7	82.8	85.5
PLASM	18.3	30.3	38.2	52.9	61.1	67.1	71.7	75.7	78.8	81.6

Table 1. Depletions as percent of volume pumped – Case 1.

There are differences between the three methods, but they all agree that a well 1800 feet from the river in such an aquifer would cause less than a 50 percent depletion during 90 days of pumping. Figure 1 is a graphic representation of these different methods for Case 1. The graph shows volumes pumped and depleted over time in acre-feet rather than in relative percentage. Volume pumped increases linearly until 90 days when the pumping ceases. The Glover plot crosses the 50 percent line in about 100 days, the PLASM plot in about 110 days, and the Jenkins plot in 140 days. The Glover and PLASM plots have a very close match while the Jenkins method diverges from them over time. Jenkins method underestimates the full effect on the river because it assumes an infinite unbounded aquifer. However, the three methods are essentially equivalent during the first 90 days.

Case 2 is the same as Case 1 except the floodplain aquifer has been reduced in extent to its actual width in the Fort McDowell area, (2200 feet from the river). (See Table 2).

	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Jenkins	21	32.5	39	55	62	67	70	72	74	76
Glover	10.2	37.1	68.7	91.8	98.7	100				
PLASM	25.7	44.5	56.2	77.1	86.1	90.2	92.1	93.1	93.7	94.1

Table 2. Depletions as a percent of volume pumped, Case 2.

The Jenkins results for Case 2 are the same as Case 1 because T and S remain the same. Glover and PLASM both find that under this scenario the well would deplete the river more than 50 percent of the total volume pumped in 90 days. Figure 2 illustrates the Case 2 results. Jenkins plot remains unchanged

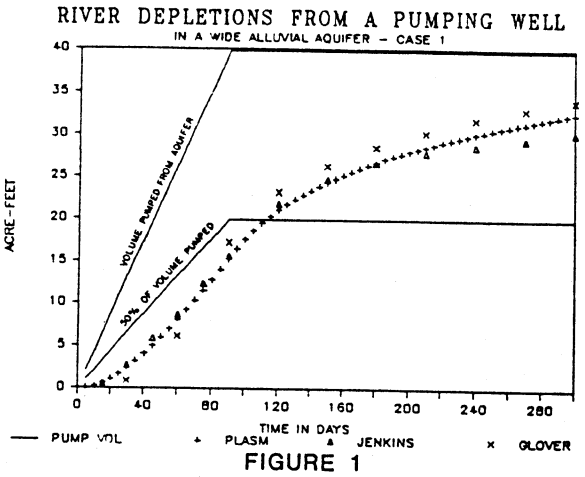

FIGURE 1

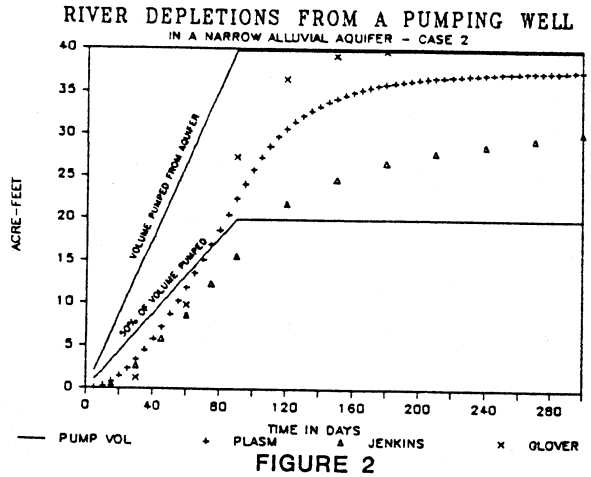

FIGURE 2

from Figure 1 and further underestimates the rate and quantity of stream depletions. Glover estimates that depletions occur more quickly than does the model. This is expected because Glover uses a zero-flow boundary at the edge of the aquifer whereas the model has a low (but not zero) flow boundary.

In both cases the "bright line" distance calculated by Jenkins method would be 1490 feet. Using Glover to estimate a "bright line" distance results in a similar answer as Jenkins for Case 1, 1490 feet in a semi-infinite aquifer. For Case 2, Glover estimates the "bright-line" distance at approximately 2050 feet in the narrow flood plain aquifer. The PLASM model will not directly yield a calculation of the "bright-line" distance for a particular scenario because the model uses fixed grid spacings that are selected at the beginning of the modeling process. However, from the previous analysis, we can assume that the model would find a "bright-line" distance somewhere between Glover and Jenkins estimates and that it would be closer to Glover's estimate.

SUMMARY In summary, we found that if the only objective of an analysis is to calculate the "bright line" distance, then a Glover approach is more accurate than Jenkins' method. Glover's method is also easier and faster than a PLASM model and may be more reasonable to use in areas where there is little hydrogeologic information. However, if the actual complexities of a stream/aquifer system under man-induced stress are to be understood, a model such as PLASM is the better tool.

Glover, R.E., 1974, Transient Ground Water Hydraulics, CSU.
Jenkins, C.T., 1990, Computation of Rate and Volume of Stream Depletion by Wells, Techniques of Water Resources Investigations of the USGS, Chapter D1, Book 4.
Prickett, T.A. & Lonnquist, C.G., 1971, Selected Digital Computer Techniques for Ground water Resource Evaluation, Illinois State Water Survey, Urbana, Bulletin 55, 1971.

ATTACHMENT 4
EXAMPLES OF M&I USE PWRs

ATTACHMENT 4

EXAMPLES OF M&I USE PWRs

1. General

All M&I uses in the San Pedro River watershed have been given a single PWR.[2] This approach is reasonable for small, recently developed water systems but not for older systems that have expanded or changed significantly over time.

The Department specifically notes that numerous expansions or consolidations have occurred. The Fuller and Sulger Systems of the Arizona Water Company (111-23-33) are two separate systems that have been assigned one apparent date (pp. 262-264). The Bella Vista Water Company (111-20-62) is assigned a date of 1955 although it is a consolidation of three systems, one of which reportedly dates from 1929 (p. 264; Vol. 7, p. 13). The Huachuca City system (111-20-50) is a consolidation of three companies which have been assigned a date, 1967, which postdates the acquisition of the three systems (p. 275; Vol. 7, p. 10). Mammoth (111-4-3) is also a consolidation of systems yet is given the single date of town incorporation, 1958, although the town has existed since the late 1800s (p. 47, p. 276; Vol. 7, p. 359). Benson (112-17-39) is given an 1899 date for a use of 715 acre-feet per year although the city has certainly grown from its founding in 1880 and incorporation in 1905 (p. 260; Vol. 7, p. 139). Using just the opposite approach, St. David (112-17-44) is assigned a date of 1969 based on a Certificate of Convenience and Necessity although it was the first Anglo settlement in the basin, established in 1877 (p. 46, p. 282; Vol. 7 p. 142). The Southland Utility Company (p. 282), City of Tombstone (p. 284) and Magma Copper Company (pp. 349-355) are additional examples of M&I use where there is information in the HSR that indicates

---

[2]ASARCO is the one possible exception since it has two WFRs assigned to it but the ultimate treatment by DWR is uncertain since the Department does not plan to create PWRs for the mining use until the Upper Gila HSR.

that multiple PWRs should be established for particular M&I users. Dates for these incremental PWRs for these uses would often pre-date or post-date the single year which is currently assigned.

2. **Specific Example - Sierra Vista Municipal Water Supply (111-20-56, pp. 266-267)**

The Sierra Vista municipal system presents an obvious situation for the creation of multiple PWRs.

The Sierra Vista municipal water supply system consists of 3 wells, each with a discrete service area and use. Each well was drilled at a different time, and use began at different times (1971, 1975 and 1984). Clearly, three PWRs are warranted in this situation. Most of the following discussion was developed from the 1987 draft HSR and statement of claimant data since the WFR for these uses is abbreviated because the wells are in Zone 2.

The municipal system consists of three wells. The "park" well (well #1) produces 1,000 gpm and has a 3,000 gallon pressure tank. It is used to irrigate 40 acres of grassland park from April through October. It is also used as a potable water source for drinking fountains and restrooms at the recreational facilities. (Note: The claim states that 30 acres are currently irrigated; future irrigation is projected to be 60 acres and water is also used for the municipal swimming pool.)

The "community center" well (well #2) produces 610 gpm and irrigates 19 acres of parks and serves buildings occupied by an average of 60 persons per day. (Note: The claim indicates that 25 acres of turf are currently irrigated, future irrigation is projected to be 94 acres, and 7,500 people per month may ultimately use the community center.)

The "airport" well (well #3) produces 50 gpm and has a 60,000 gallon storage tank and 1,500 gallon pressure tank. It is anticipated that the well will service the airfield terminal

and industrial park which will be developed. The Sierra Vista-Libbey Airfield is a facility operated through an agreement between Fort Huachuca and the City of Sierra Vista.

The Department assigned a 1972 date for all three diversions and uses. Since each well was drilled to provide a specific use in a specific area, three PWRs should be created. In summary, those PWRs should contain the following information:

PWR No.	Well No.	Date	Type of Use	Quantity[3] (AFA)
MU001	1	1971	IR,RC	58.3
MU002	2	1975	IR,MU	27.5
MU003	3	1984	MU	0.4

The Sierra Vista situation also reflects some of the problems associated with the Department's abbreviated reporting of uses from wells in Zone 2. Nine adjudication filings were made. Of these, five were made by the City of Sierra Vista and four by the State Land Department (SLD) claiming "Federal Reserved Water Rights." The SLD claims are discussed below. Two of the Sierra Vista claims are original filings (39-1488 and 1489), one for each well in use at that time. These claims were later amended (39-2557 and 2558) to further clarify water use and "future projections." A later filing (39-12469) was made for a new well (#3). These three later filings form the basis for the Sierra Vista Municipal Water Supply claims.

Two previous filings were made by the City of Sierra Vista to appropriate surface water for future uses (33-89137 and 33-89138). One application is for 4,000 af of water to be collected as runoff from the Huachuca Mountains between Ramsey Canyon and Soldiers Creek drainages. The water is to be "captured in reservoir and distributed via pipelines for non-potable municipal uses." The other application is for 56,900 af of runoff in the

[3]These are the quantities claimed. Further research or estimation of quantities is needed since these amounts total less than the 147.4 AFA reported for 1982.

urban area. Flood control systems are proposed to "capture all surface water for recharge of the groundwater aquifer." The current status of these applications is not clear.

Four filings, which parallel the claims made by the City of Sierra Vista, were submitted by the State Land Department. Each of these claims are based on the State's assertion of "Federal Reserved Water Rights" with an 1853 date of first use. These claims were filed because well nos. 1 and 2 are on state trust land. These lands ("school sections") were withdrawn from the public domain on December 30, 1853 (sections 6 and 36). The state asserts that the United States impliedly reserved water for these lands to fulfill the purposes of the trust. The amounts claimed parallel those made by Sierra Vista with an additional 26 af for "other uses." These other use claims are for rainfall retention to support natural vegetation.[4] The Department considers these latter claims to be "not appropriable."

---

[4]The SLD defines "other use" claims thusly:
"The State of Arizona claims that portion of the public water which falls upon trust lands, is uniformly distributed over the surface, and infiltrates into the soil. This water sustains and supports the forage and vegetation used by the livestock and wildlife and is necessary for the prevention of excessive runoff which would cause the land to be eroded if the cover were destroyed."

ATTACHMENT 5

IRRIGATION EFFICIENCY TERMS AND CONCEPTS FOR WATER RIGHTS ADJUDICATION IN ARIZONA

By

Allan D. Halderman, P.E.
Irrigation Engineer

and

Leonard J. Erie, P.E.
Irrigation Engineer

November 5, 1990

TABLE OF CONTENTS

I. ABSTRACT 1

II. PURPOSE 1

III. IRRIGATION TERMS 1
- A. Total Use, Vt. 1
- B. Crop Consumptive Use, Vcu 2
- C. Management Water, Vm 2
- D. Effective Rainfall, Vr 2
- E. Water Subbed from the Water Table, Vg 3
- G. Water Placed in the Root Zone, Vp 3
- H. Water Delivered to the Field, Vf 3
- I. Water Delivered to the Farm, Vd 3
- J. Water Diverted from Source, Vds 4

IV. EFFICIENCY TERMS 4
- A. Soil Storage Efficiency, Ess 4
- B. Field Application Efficiency, Ea 4
- C. Farm Conveyance Efficiency, Efc 4
- D. Farm Irrigation Efficiency, Ef 4
- E. Delivery System Conveyance Efficiency, Ec 5
- F. System Irrigation Efficiency, Eu 5
- G. Water Use Efficiency, WUE 5

V. IRRIGATION WATER REQUIREMENTS 5
- A. Consumptive Use Requirement, CUR 5
- B. Net Irrigation Requirement, NIR 6
- C. Gross Irrigation Requirement, GIR 6
- D. Diversion Requirement, DR 6

VI. SUMMARY 6

IRRIGATION EFFICIENCY TERMS AND CONCEPTS FOR WATER RIGHTS ADJUDICATION IN ARIZONA

I. ABSTRACT

Irrigation efficiency terms and concepts are defined and illustrated schematically.

These terms are not all standard in the irrigation engineering profession - - rather, they are selections and modifications from various references. With the exception of Water Use Efficiency, all efficiencies are expressed in terms of volume of water with a useful output, divided by the volume of water input.

II. PURPOSE

The purpose of this report is to present irrigation efficiency terms and concepts which will facilitate discussions of water rights adjudication in Arizona.

Unfortunately, the standard irrigation references do not provide either a consensus or a unified set of irrigation efficiency terms and concepts satisfactory for Arizona water rights adjudication deliberations.

III. IRRIGATION TERMS

Irrigation terms are described below and illustrated in the attached schematic diagram.

A. Total Use, Vt.

Vt is the Consumptive Use plus Management Water. (Thus, total use is comprised of irrigation water stored in the root zone, effective growing season and non-growing season

precipitation, water subbed from the water table, and the irrigation water which serves a useful purpose for the crop as it evaporates or seeps below the root zone.)

B. Crop Consumptive Use, Vcu

Vcu is the sum of the water transferred to the atmosphere by evaporation from the soil and plant surfaces and transpiration through the crop leaves, plus that incorporated into plant tissues. (Evapotranspiration is commonly considered the same as Consumptive Use although, technically, water incorporated into plant tissues is not evapotranspiration.)

If field weeds are not controlled, some water will be lost to non-crop consumptive use.

C. Management Water, Vm

Vm is the volume of irrigation water which serves a useful purpose as it evaporates from the soil surface or seeps below the root zone. (Examples are leaching of salts, water for frost protection in the winter or crop cooling in the summer, activation of fertilizers and herbicides, crop or weed seed germination, insect control, soil conditioning, and maintaining crop quality during harvest.)

D. Effective Rainfall, Vr

Vr is the precipitation which is used by the crop for Consumptive Use. (Evaporation from bare soil, runoff, and deep seepage below the root zone are not included.) Precipitation prior to the growing season is included if it is stored in the soil root zone for later use by the crop.

E. Water Subbed from the Water Table, Vg

Vg is the volume of water which moves by capillary action into the root zone from a shallow water table.

F. Water Stored in the Root Zone, Vss

Vss is the volume of irrigation water stored in the root zone. (It is equal to the volume placed in the root zone, Vp, minus losses to evaporation from bare soil and slow seepage below the root zone. This frequently occurs after pre-planting irrigation.)

G. Water Placed in the Root Zone, Vp

Vp is the volume of water placed in the root zone during irrigation. (Subsequent losses occur to evaporation from a bare soil and to slow seepage beyond the root zone. If these losses are negligible, Vp and Vss are approximately equal.)

H. Water Delivered to the Field, Vf

Vf is the volume of water delivered to the field. (Subsequent losses occur from evaporation, runoff, and non-recovered deep seepage which cannot be considered Management Water.)

I. Water Delivered to the Farm, Vd

Vd is the volume of water delivered to the farm. (Subsequent losses include seepage and non-recovered gate leakage and operating spill from on-farm conveyance and distribution facilities. If these losses are negligible, Vd and Vf are approximately equal.)

J. Water Diverted from Source, Vds

Vds is the volume of water diverted from the source. (Subsequent losses include seepage, leakage, and operating spill from off-farm conveyance facilities.)

IV. EFFICIENCY TERMS

A. Soil Storage Efficiency, Ess

Ess is the volume of water stored in the soil root zone, divided by the volume placed in the root zone during irrigation.

$$Ess = Vss/Vp$$

In some situations, Ess is assumed to be approximately equal to 100 percent.

B. Field Application Efficiency, Ea

Ea is the volume of water placed in the root zone during irrigation, divided by the volume delivered to the field.

$$Ea = Vp/Vf$$

C. Farm Conveyance Efficiency, Efc

Efc is the volume of water delivered to the field, divided by the volume delivered to the farm.

$$Efc = Vf/Vd$$

In some situations, Efc is assumed to be approximately equal to 100 percent.

D. Farm Irrigation Efficiency, Ef

Ef is the volume of irrigation water consumptively used by the crop, plus Management Water, divided by the volume delivered to the farm.

$$Ef = (Vcu + Vm - Vr - Vg)/Vd = (Vss + Vm)/Vd$$

E. Delivery System Conveyance Efficiency, Ec

Ec is the volume of water delivered to the farm, divided by the volume diverted from a source - - stream, reservoir, or well (plus storm inflow).

$$Ec = Vd/Vds$$

F. System Irrigation Efficiency, Eu

Eu is the volume of irrigation water consumptively used by the crop, plus Management Water, divided by the volume diverted from the source.

$$EU = (Vcu + Vm - Vr - Vg)/Vds = (Vss + Vm)/Vds$$

Also, $EU = (Ef)(Ec)$

G. Water Use Efficiency, WUE (Not illustrated in the schematic diagram).

WUE is the yield of a crop divided by the consumptive use. Yield may be stated as the weight of dry matter but is usually expressed in terms of the marketable product. The concept of water use efficiency, although not a direct consideration in the process of water movement from source to consumptive use, is nevertheless relevant to discussions of consumptive use requirements for specified yield levels.

V. IRRIGATION WATER REQUIREMENTS

A. Consumptive Use Requirement, CUR

CUR is Consumptive Use by a crop for a selected yield level. Unless otherwise specified, Consumptive Use Requirement implies the consumptive use for maximum yield.

B. Net Irrigation Requirement, NIR

NIR is the Consumptive Use Requirement plus Management Water, minus Effective Rainfall and Water subbed from the water table.

$$NIR = CUR + Vm - Vr - Vg$$

C. Gross Irrigation Requirement, GIR

GIR is equal to the Net Irrigation Requirement plus on-farm losses.

Also, $GIR = NIR/Ef$

If farm Irrigation Efficiency, Ef, is approximately equal to Field Application Efficiency, Ea, then

$$GIR = NIR/Ea$$

D. Diversion Requirement, DR

DR is the Gross Irrigation Requirement plus off-farm conveyance and operating spill loses.

Also, $DR = GIR/Ec$

VI. SUMMARY

A. Irrigation efficiency terms and concepts are defined and illustrated graphically for the purpose of facilitating discussions of water rights adjudication in Arizona.

B. The terms are not all standard in the irrigation engineering profession - - rather, they are selections and modifications from various references.

C. With the exception of Water Use Efficiency, all efficiencies are expressed in terms of volume of water with a useful output, divided by volume of water input.

D. The irrigation terms defined are descriptive of irrigation as practiced in Arizona - - from the diversion to use by the crop.

E. Four primary irrigation efficiencies (Ess, Ea, Efc, and Ec) and two combined efficiencies (Ef and Eu) are defined.

F. Irrigation water requirements are expressed in relation to the irrigation terms and efficiencies.

G. Water Use Efficiency is defined for the purpose of facilitating discussions of consumptive use requirements for specified yield levels.

SCHEMATIC ANALYSIS OF IRRIGATION EFFICIENCY

ATTACHMENT 6

USE OF HISTORIC DATA

ATTACHMENT 6
USE OF HISTORIC DATA

SRP has acquired maps from the National Archives that were prepared by the Arizona State Water Commission as part of the Gila River Determination. This effort began earlier this century and the maps identify lands either cultivated, previously cultivated, or never cultivated. The area was surveyed between 1920 and 1923. The inclusion of these maps in the Department's analyses for the Hydrographic Survey Report will assist the Department in identifying boundary designations, clarifying dates of apparent first use, as well as quantifying acreage. Many of the apparent first use dates identified in the HSR which are based on 1936 aerial photography should have a date based on the survey.

Due to the cost involved in producing these Water Commissioner maps, copies have been filed with the Department. The public may access these maps through the Department.

By utilizing various historic data sources, the Department will enhance their reporting of some watershed file reports. An examination of Clifford and Carolyn Dobson's watershed file report (WFR 113-14-AD-1) illustrates how these sources may be applied. In addition, this file contains specific issues on which SRP comments.

1. Use of the Early 1920s survey

These Water Commission maps will assist in the analysis of the 1936 photography. Irrigable acreage is difficult to discern on the 1936 aerial photos. The 1920s survey provides a template from which to interpret the 1936 aerials.[5] Exhibit 1 illustrates how

---

[5]For DWR's benefit, SRP has supplied transparencies of the 1921 survey map at the scale of the 1936 aerial and at the scale of the WFR. These transparencies illustrate the usefulness of the 1920 maps. Those who wish to view these transparencies may access them through DWR. It is obvious by the course of the river and cleared land that few

(continued...)

closely the 1921 survey of this area fits the 1936 photography.[6] Even after 15 years, the 1921 survey fits the 1936 photograph like a glove.

Once the accuracy and relevance of the 1921 survey is established, the 1936 photography may be more accurately interpreted. For example, a comparison of the 1921 survey and the 1936 photography indicates where the original land was irrigated and where additional land was put in during the intervening years.

Exhibit 2 compares the information from the 1921 map and 1936 photo to WFR 113-14-AD-1, which includes the area discussed above. It is evident that the parcel identified on the 1920s map (and on the 1936 aerial photography) does not align with the field that is designated as 113-14-AD-1-IR1 (Volume 5, p. 2-41; Volume 9, map 113-14-AD, p. 151).

According to the WFR, the apparent first use date for WFR 113-14-AD-1-IR1 is based on the 1936 photography. According to the 1921 map, the apparent first use should reflect at least the date of that survey. Any additions such as an IR2 may receive a 1936 date. Thus, this WFR should indicate a PWR for an IR1 with a pre-1921 date of apparent first use and an IR2 that might have a 1936 date of use. The Department would then proceed with its regular methodology for later changes. See the sections below, "Notices of Appropriation," and "Old Rights" for further discussion of the dates of first use for WFR 113-14-AD-1.

---

[5](...continued)
changes occurred between the survey and the photograph. Note the road that clearly bisects the southern tip of both the aerial photograph and the survey.

[6]To create Exhibit 1, surveyed areas from the 1921 maps were transferred onto the 1936 aerial photography and were color photocopied.

2. Incorporating Notices of Appropriation

By incorporating all available data sources, the Department's determination of first use will more accurately reflect what occurred historically through time. The Department indicates that they will incorporate Notices of Appropriation in future HSRs, which will assist those claimants who have pre-1919 rights. Exhibit 3 integrates the Notice of Appropriation that applies to WFR 113-14-AD-1. The information provided in the 1920s maps (see "Use of the Early 1920s Survey" section, above) provides a chronology of use which, when combined with appropriate notices, better defines dates of first use and acreage.

Clifford Dobson, and his predecessors in interest, have irrigated farmland along the San Pedro River since the earlier part of this century, perhaps the latter part of the nineteenth century. This is based on a Notice of Appropriation which was filed by Angel Arandulez, Ricardo Apodaca, and Manuel Apodaca (see Exhibit 4) on January 6, 1917, in which they claim an 1880 date based on continuous beneficial use. According to Exhibit 1, based solely on the 1921 survey, WFR 113-14-AD-1-IR1 (as re-mapped) would have a date of first use based on the survey rather than the 1936 aerial. The Notice of Appropriation indicates that at least the 1917 filing date might apply. However, the date of first use should be 1880 based on almost forty years of continuous, beneficial use according to the notice of appropriation with no evidence to the contrary. As shown in Exhibit 3, the date for IR1 should be changed to 1880. From the legal descriptions in the notice, the dates assigned to IRs 1, 2, 3, 5, 6, 12 and 17 should be reconsidered.

3. Old Rights

As discussed in Section 1.E., Old Rights contain important information which is relevant to dates of first use. Old Right 0-128 applies to WFR 113-14-AD-1 and is located within that file, yet in was not included in the report.[7] Right 0-128 was reported in the 1987

[7]An old right (0-128) was granted to Manuel Salcido. The date that SLD received the data is difficult to discern on the photocopy. Affidavits by Salcido, Lopez, and Gomez are dated March 1964. A certified copy of the notice of appropriation was included in the packet of affidavits.

HSR for this WFR with a remark stating that "The Old Right appears to match filing 36-18789 for the irrigation of IR1 with surface water in 1880" (1987 HSR, Volume 3, p. 40). Right 0-128 should also be reported in the 1990 HSR.

Additional background information of interest was found in the State Archives. In 1938, there was some controversy between Arandulez and the Apodacas regarding their water right. They appealed to the Water Commissioner, although he did not have jurisdiction in the matter. Apparently an "adjustment" was proposed, but the final result in this matter is not clear.[8]

Interestingly, the 1950 State Land Department letter states that water used before July 1919 "and used continuously without a five year period of abandonment, constitutes a valid right whether or not any notice of same has been recorded in this office (SLD)." Applications to appropriate water were sent to Mr. Polley and registration of old rights were discussed.

---

[8]Letter of March 25, 1950; from Engineer, Water Division, State Land Department to W.E. Polley, Attorney, Interstate Stream Commission, Box #84, State Archives.

EXHIBITS 1 AND 2

EXHIBIT 3

Notice of Water Appropriation
By Angel Arandulez, Ricardo Apodaca and Manuel Apodaca
Filed January 11, 1917
Cochise County

This notice claims three-fourths of the water for the Apodacas and one-quarter of the water for Arandulez.

Water Use:	Irrigation
Water Source:	San Pedro River
Place of Use:	NESE Sec. 20 S ½ SE and NE_W [sic] Sec. 21 SWSW Sec. 27 SESE, N½SE, NE¼, Sec. 28 SENE Sec. 33 NWNW Sec. 34 All in T 14 S, R 20 E
Claimed Quantity:	2,000 miners inches (50 cfs)
Appropriation Date:	1880 based on continuous beneficial use or January 6, 1917

Corresponding WFR
113-14-AD-001
Dobson, H. Clifford, Jr. & Carolyn R.
Volume 5, Table 2, Page 41

PWR NO:	IR1
Water Use:	Irrigation
Water Source:	W8, W9
Apparent Date of First Use:	1936 (should be changed to 1880 based on Notice of Appropriation)
Data Sources:	Aerial Photo (should be "0-128" or "Notice")

EXHIBIT 4

N O T I C E

Notice is hereby given that the Undersigned have appropriated from the waters of the San Pedro River 2000 miner inches of water to be used for the purposes of Irrigation on the Following described lands.

S. E. 1/4 of N. E. 1/4 Sec. 33, N. W. 1/4 of N. W. 1/4 Sec. 34, S.E. 1/4 of S.E.1/4 Sec. 28 and S. W. 1/4 of S. W. 1/4 Sec. 27, and The South 1/2 of the N. E. 1/4 and the N. 1/2 of the S. E. 1/4 of Sec. 28, and N. E. 1/4 of S.E.1/4 of Sec. 20 and S. 1/2 of the S.E.1/4 and the N. E. 1/4 of W. 1/4 of Sec. 21 and The N. 1/2 of the N. E. 1/4 the S. E. 1/4 of the N. E 1/4 and the N. W. 1/4 of the N. E. 1/4 of Sec. 28, Township 14, Range 20, East of the Gila and Salt River Meridian, Cochise County, Arizona.

Three Fourths of said water to belong to Ricardo Apodaca and Manuel Apodaca, and one fourth to Angel Arandulez.

We intend to and have already constructed a Dam and ditch to carry the water to said land said Ditch was built about the year 1880 by Grantor of present owners, and water has been continously used from that time to the present.

Angel Arandulez

Ricardo Apodaca

Manuel Apodaca

Subscribed and sworn to before me this 6th day of January, 1917.

J. N. Morrison

(Seal) My Commission expires March 3, 1920. Notary Public

Filed and recordedat request of J. N. Morrison Jan. 11, 1917, at 9 AM.

by Geo.M.Wales Ray B Krebs

Deputy County Recorder.

Rec Bk 26 P 319

NOTICE OF LOCATION

State (Cottonwood) WATER RIGHT.

KNOW ALL MEN BY THESE PRESENTS:

That I, H. L. Johnson a resident of Willcox, Cochise County, Arizona, have this day located for Mining and Stock Raising purposes 100 inches, miners' measure, of the water of this Spring (Cottonwood) under and in accordance with thelaws of the State of Arizona regulating thelocation and possession of water rights.

Also, the right of way for a ditch from the point where is posted thisnotice, to a place selected as a suitable site for a Reservoir.

The dimensions of said ditch at the head being as follows: 4feet wide at top 3 feet wide wide at bottom, 3 feet deep in depth, with a uniform grade of two inches to the rod.

This location may more generally described as being situated along the northern line of School Section 16, Township 15 S. Range 21 E. G & S.R.B. Meridian and about one mile northerly from the John Lyons Cabin.

I propose to construct a Reservoir at the source of this spring 10 feet in diameter and 10 feet deep to develop and conserve the water, then construct a ditch about 150 feet in an easterly direction to a point where I propose to put in an Iron tank forwatering stock and to maintain said improvements for the purpose of watering stock. in Cochise County County, State of Arizona.

Dated on the ground this 23rd day of January, A.D. 1917.

H. L. Johnson.

ATTACHMENT 7

INDEX OF PREVIOUS FILINGS

(Due to the length of this attachment, only the first page is included here as an example. The entire a copy has been included in the comments sent to the Department and is available in their offices.)

ATTACHMENT 7

PREVIOUS FILINGS CROSS INDEX

PREVIOUS FILING #	WFR'S		LOCATION	STATUS	VOL	TABLE - PAGE
0 -00063	113-04-DCD	-001	20 080S 170E			
0 -00071	115-05-DB	-002	27 070S 190E*			
0 -00110	114-04-BAB	-007	06 060S 160E			
			07 060S 160E			
0 -00171	115-05-DB	-001	26 070S 190E			
20-24425	111-20-DDA	-023	13 210S 210E			
20-29205	111-23-DB	-002	14 230S 210E			
	111-23-DB	-003	20 230S 210E			
	111-23-DBB	-026	18 230S 210E			
20-17863	111-23-	-011	30 230S 210E			
	111-23-	-022	30 230S 210E			
20-03061	115-05-	-034	12 060S 190E			
			23 060S 190E			
	115-05-AC	-003	25 060S 190E			
3R-00068	115-05-	-006	03 060S 180E	CERTIFICATE		
3R-00381	115-05-	-041	04 070S 180E	CERTIFICATE		
3R-00434	113-09-	-002	28 080S 180E*	CERTIFICATE		
3R-00488	114-03-	-012	28 070S 140E	CERTIFICATE		
3R-00489	115-05-	-006	11 060S 180E*	CERTIFICATE		
3R-00511	115-05-	-006	07 060S 190E*	CERTIFICATE		
3R-00552	114-03-	-012	28 070S 140E	CERTIFICATE		
3R-00610	115-10-	-006	11 100S 210E	CERTIFICATE		
			15 100S 210E			
3R-00802	113-05-	-001	07 080S 190E*	CERTIFICATE		
3R-00804	113-12-	-010	01 120S 190E*	CERTIFICATE		
3R-00914	111-20-	-002	24 190S 210E	CERTIFICATE		
3R-00915	111-20-	-044	24 200S 190E	CERTIFICATE		
3R-00918	111-21-	-002	17 190S 220E	CERTIFICATE		
3R-01142	111-19-DAC	-001	06 210S 190E	CERTIFICATE		
3R-01148	113-09-	-001	26 080S 180E	CERTIFICATE		
3R-01149	113-09-	-006	08 090S 180E	CERTIFICATE		
3R-01407	115-04-	-005	03 060S 170E	CERTIFICATE		
3R-01408	115-05-	-020	08 060S 180E	CERTIFICATE		
3R-01409	115-04-	-002	23 060S 170E	CERTIFICATE		
3R-01431	111-21-	-008	36 190S 230E	CERTIFICATE		
3R-01450	111-24-	-020	27 230S 230E*	CERTIFICATE		
3R-01451	111-24-	-020	24 230S 230E	CERTIFICATE		
3R-01452	112-18-	-029	05 190S 220E	CERTIFICATE		
3R-01569	112-18-	-014	27 170S 220E	CERTIFICATE		
3R-01570	112-18-	-014	01 180S 220E	CERTIFICATE		
3R-01571	112-18-	-014	03 180S 220E	CERTIFICATE		
3R-01572	112-18-	-014	24 180S 220E	CERTIFICATE		
3R-01573	112-18-	-014	27 180S 220E	CERTIFICATE		
3R-01574	111-23-	-031	23 230S 210E	CERTIFICATE		
3R-01575	111-23-	-031	26 230S 210E	CERTIFICATE		
3R-01576	112-14-	-027	21 150S 190E	CERTIFICATE		
3R-01577	112-14-	-028	30 150S 190E*	CERTIFICATE		
3R-01578	112-14-	-027	36 150S 190E	CERTIFICATE		
3R-01579	112-14-	-027	17 150S 200E	CERTIFICATE		
3R-01584	112-17-	-026	30 180S 200E	CERTIFICATE		

* DENOTES LOCATION FROM CLAIM

ATTACHMENT 8

ANALYSIS OF SELECTED WFRS

A. Sale
B. Ross and Merrill
C. Cloud

ATTACHMENT 8
ANALYSIS OF SELECTED WFRS

A. Analysis of Paul L. Sale Watershed File Report 114-4-BAB-7 (pp. 475-477; Vol. 5, p. 78)

1. Introduction

According to the HSR, Paul L. Sale's fish farm originally irrigated 201 acres. Due to a partial change from irrigation to fish rearing purposes, the Department reports that only 150 acres remain irrigated. At present, 17 fish ponds encompass approximately 40 surface acres.

The Department's treatment of this WFR raises numerous issues: treatment of changes of use; assignment of first use date; use of previous filings; characterization of use; changes between the 1987 and 1990 HSRs; and protested applications to appropriate. These issues and a few specific items are discussed below.

2. Assignment of Date Where a Change of Use Has Occurred

The Salt River Project disagrees with the Department's methodology for assigning dates to Potential Water Rights (PWRs) which have undergone change in the type of use over time. At least two types of changes of use have occurred on the Sale property, both before and since the publication of the draft San Pedro HSR in 1987. For example, in one case the change resulted in a feedlot becoming a fish pond;[1] while in other cases, irrigated acreage was converted to fish ponds.

The Department identifies 17 fish ponds in Paul L. Sale file. Many of these fish ponds are located on previously irrigated land; in fact, lands that had been irrigated since the

[1]It is not known whether the feedlot was previously irrigated. Aerial photos would have to be analyzed to determine whether one or two changes have occurred in this instance.

1800's. In order to provide a complete history for the land to which the PWR is appurtenant, the Department should report the date of apparent first use taking into account all prior water use and previous filings on the properties.[2] In this example, the ponds are on land which was previously irrigated, thus the ponds should be given the same date of priority as would be assigned to that land if it still was used for agricultural purposes. Water was beneficially used for irrigation and now it is beneficially used for fish rearing. The right to use the water has not been removed, simply changed. Table 1 outlines SRP's evaluation of dates of first use.

3. Use of Old Rights

The Department's files contain two Old Right filings for the Sale WFR. One of these filings was used, the other was not reported. Old Right 110 (0-110) is listed in the HSR but 0-124 also appears to apply to this file. In the 1987 HSR, 0-124 is listed as applying to this WFR and the hard copy Sale file at the Department also contains 0-124. Why was factual data deleted from the HSR? Not only was factual data eliminated, but the reason that it was eliminated is not explained (see further discussion under "Changes from 1987").

With respect to 0-110, the "Explanation" section states Old Right 110 "can be matched to portions of IR1, IR2, and IR6," yet the apparent dates of first use for those IRs are 1878, 1949, and 1983 respectively. Why is there a discrepancy between the matched filings and the apparent date of first use?

4. Characterization of use: SR v. ID designation

At a minimum, SR12 should be reclassified as a primary reservoir (PR) based on its size being greater than 15 af.

---

[2]In the Expalantion Section of the WFR, the Department should note the dates when changes of use have occurred.

TABLE 1

(1) POTENTIAL WATER RIGHT	(2) THE DEPARTMENT'S APPARENT DATE OF FIRST USE	(3) LOCATED ON PREVIOUSLY IRRIGATED LAND	(4) DATE BASED ON IR FIRST USE
SR1	1988	IR5	1971
SR2	1988	IR5	1971
SR3	1988	IR5	1971
SR4	1988	IR5	1971
SR5	1988	IR5	1971
SR6	1989	IR1	1878
SR7	1989	IR1	1878
SR8	1989	IR1	1878
SR9	1989	IR1	1878
SR10	1989	IR1	1878
SR11	1989	IR1	1878
SR12	1989	IR5	1971
SR13	1989	IR4, IR5	1968, 1971
SR14	1989	IR1, IR4, IR5	1878, 1968, 1971
SR15	1989	IR1	1878
SR16	1989	IR1, IR4	1878, 1968
SR17	1989	IR1, IR5	1878, 1971

Column Explanations
Columns 1 and 2 - from 1990 HSR.

Column 3 - The IRs listed are the Department's designation in the 1990 HSR for the irrigated land on which it appears that the fish ponds were constructed. SRs 1-5 have been built on land which the Department mapped as irrigated in the 1987 HSR. SRs 6-17 were assigned to the IR for which they appear to have been built. Evaluation of historic aerial photos will be required to accurately identify the IR on which the pond was constructed.

Column 4 - The Department's assigned date(s) for the IR(s) in Column 3 from the 1990 HSR.

More importantly, it is not clear why the 17 fish rearing ponds were assigned a Storage Reservoir (SR) designation rather than an Industrial (ID) designation. The Unusual Circumstances Report of Volume 1 (1990 HSR) provides a report on the "Commercial Fish Farm" of the Paul L. Sale Investment Company. The Department's definition for an ID states it is "water used by a commercial operation or business such as dairies, sand and gravel operations, and fish farming" (emphasis added) (1990 HSR, Vol. 1, p. 501). The SR category is for an impoundment equal to or less than 15 af with a primary purpose other than stock watering or wildlife watering. This category is most often used for reservoirs which re-regulate water for irrigation use. In order to eliminate any confusion, it may be useful to provide additional information within the SR definition which describes these primary purposes.

The purpose of the Sale ponds is to raise fish for commercial purposes; storage of water is not the primary purpose of the ponds. In fact, the 1987 HSR identified the fish ponds as industrial PWRs. Since the ID classification more appropriately captures the purpose of the Sale reservoirs they should be categorized accordingly.

5. Quantification

Where a change of use has occurred, the Department should report quantities of use based on the maximum amount of historic water use on the land. In this case, irrigation water duties apply for most of the SRs. However, that entitlement should be checked to insure that the new use does not exceed the historic amount. For these particular uses, the wells which serve the fish ponds also deliver water for irrigation. The amount of pumped water delivered to the ponds would be difficult to determine. Therefore, the comparison against irrigation duty will need to be derived from estimates of evaporation and seepage from the ponds. If the new use amount exceeds the historic use, then a new entitlement is appropriate for the amount of excess.

6. Changes from 1987 to 1990 HSR

Data from the 1987 HSR has been deleted and does not appear in the 1990 HSR. Also, unexplained changes have occurred between the two HSRs.

In Sale's major user report, the Department states that the ponds were built at various times over a four year period. It is not clear if the Department intended to use the dates of construction for evaluating the claims and dates associated with the ponds. Apparently the 1987 HSR used the date of construction for the apparent priority, yet the 1990 HSR uses different dates. Are these differences due to information from the claimant? If so, the Explanation section should reflect where the information came from. There is additional information in the file which may assist in the determination of the date of first use.

As discussed above, the 1987 HSR lists two Old Rights (0-110 and 0-124) associated with Sale's watershed file report. The 1990 edition only lists 0-110 and there is no mention in the Explanation section as to why 0-124 was eliminated.

Also as mentioned above, the classification of use for the fish ponds has been changed from industrial (commercial) to storage reservoir. Again, there is no mention of the reason for this change.

7. Protested Applications to Appropriate

Like other previous filings, Applications to Appropriate (whether protested or not) typically contain relevant information which needs to be fully evaluated and reported in the HSR. The Department includes this information in the WFR if the application is not protested (albeit with the wrong date on occasion as discussed below). There are seven protested Applications to Appropriate in the Sale WFR. These applications are mentioned but not tied to PWRs. The Sale applications were apparently "protective" filings as opposed to new applications to appropriate (see Section I.F.4). They were filed in case the water that the wells were pumping was later determined to be appropriable.

The applications include dates, maps and other information which can assist in the evaluation of PWRs.

As a special note, the Department assigns a "claim date" to an application which refers to the year that it was filed with the Department. In the case of Sale, the filings actually claim dates from the 1930s through the 1970s. It would be more useful to put these earlier dates in the column under "claim date" and note the Application filing date under Explanations. At some point, these protested filings will need to be resolved and the adjudication proceeding is a good forum in which to do so. Matching the protested filing to a PWR can facilitate that process.

B. Analysis of Ross and Merrill WFRs

The WFRs for Frank W. Merrill (112-17-DBA-123) and Robert A. Ross (112-17-DBA-84) are located within the St. David Irrigation District (SDID). These two WFRs are representative of situations involving issues regarding the problems of reporting for uses from wells, unexplained changes from the 1987 HSR, and the assignment of date of first use based on aerial photography.

1. Changes from 1987 HSR

Both of these tracts use groundwater for irrigation. One of Merrill's wells is located in Zone 1; all other wells for both parcels are in Zone 2. The changes in irrigated acreage and dates of first use since the 1987 HSR are listed:

		MERRILL		ROSS	
		1987	1990	1987	1990
Total irrigated acres		58.2	47.8	27.3	27.0
Date/Acres:	IR1	1895/17.4	1936/17.5	1896/18.9	1936/19.6
	IR2	1982/40.8	1979/30.3	1972/4.9	1972/4.9
	IR3	- -	- -	1976/0.8	1976/2.5
	IR4	- -	- -	1979/1.7	- -
	IR5	- -	- -	1983/1.0	tailwater pond
Date:	SR1	1977	1955	- -	- -
	SR2	- -	1986	- -	- -

There is no apparent reason for the above changes when one reviews both HSRs. Explanations should be placed in the 1990 HSR for these changes.

2. Problems in Reporting of Uses Served By Wells

As mentioned above, the Ross WFR is entirely served by wells located in Zone 2. As a result, this WFR contains limited information now that it is located in Volume 7. Some of these problems are listed below.

a) Ross has only an average efficient water duty reported which is less than his neighbor Merrill's maximum water duty for the same crop (Merrill has both reported since one of his wells is in Zone 1).

b) Only abbreviated "Explanations" or remarks are included in Volume 7. As a consequence, the 1987 HSR remark that the Ross WFR was formerly supplied with irrigation water by SDID is omitted.

c) Since information on previous filings is not included in Volume 7, the claimed date of 1896 and claimed quantity of 200 AFA is not reported.

3. Assignment of Date Using Photography

The Merrill WFR contains a PWR (IR1) where the use was once served by Saint David Irrigation District (SDID) surface water. In the 1987 HSR, IR1 was assigned an "apparent priority" of 1895 based on the claim. In the 1990 HSR, the Department assigns a date of 1936 based on a photo. According to the 1920s maps discussed in Attachment 6, this PWR was served by the Saint David Canal at that time. It still appears to receive some SDID water through SR1. As such, this PWR should receive an 1880 date based on the SDID Notice of Appropriation or 1881 date of apparent first use.

The Ross WFR (112-17-DBA-84) is another example of an assignment of date based upon a photo that should receive an earlier date of first use. The 1987 HSR states that all irrigation PWRs for this parcel were formerly served by SDID. Ross claimed and was assigned an 1896 date for IR1 in the 1987 HSR. In the 1990 HSR, this date now has been changed to 1936 based upon the earliest available photo. Again, an 1880 or 1881 date should be assigned at least to IR1 based on the SDID filings.

C. Cloud, et al. WFR (115-6-CCB-1)

This WFR represents a situation which raises issues with respect to the extent of Zone 1 and problems with reporting uses served by wells.

1. Reporting Problems

This WFR straddles Aravaipa Creek along its upper reaches (see Exhibit 5A, attached). The Department's designation of Zone 1 does not extend to this portion of Aravaipa Creek (Exhibit 5B, see discussion below). As a result, this WFR is placed in Volume 7 which contains only an abbreviated summary of the information which the Department has on file. Among the information that is omitted is the following:

a) Applications to Appropriate Nos. 33-85239 and 33-85240 claiming dates in the 1940s and 1963.

b) Water Rights Registration Act filing No. 36-68497.

c) Statement of Claimant information such as the claimed date of 1867 and claimed amount of 790 AFA.

Adopting SRP's recommendation that all uses from wells should be reported uniformly and completely will allow a full evaluation of this WFR by providing alternative dates, quantities and legal bases.

2. Groundwater/Surface Water Designation

The Department's delineation of Zone 1 ends approximately 12 miles downstream of the land in this WFR. Apparently, Zone 1 is terminated at that point based on the Department's criterion of 90 days continuous flow.

In response to the Applications to Appropriate, the Department conducted a hydrologic analysis of the area. Exhibit 6 in this attachment is a memo describing that analysis for Application No. 33-85240. A similar memo is in the files for the other application. The memo concludes "that pumping from the well in question will affect Aravaipa Creek." The memo also describes Aravaipa Creek flowing for "several months that spring," a depth to groundwater of about 13 feet, and well contruction in "recent alluvium." The Department is prepared to grant the application upon payment of the fee (See letter attached to Exhibit 6 dated June 30, 1990).

The background material for this WFR evidences the Department's overly narrow (and inconsistent) designation of the appropriable subflow zone. This information is not readily available to other claimants in the adjudication as a result of the abbreviated reports discussed above.

EXHIBIT 5A

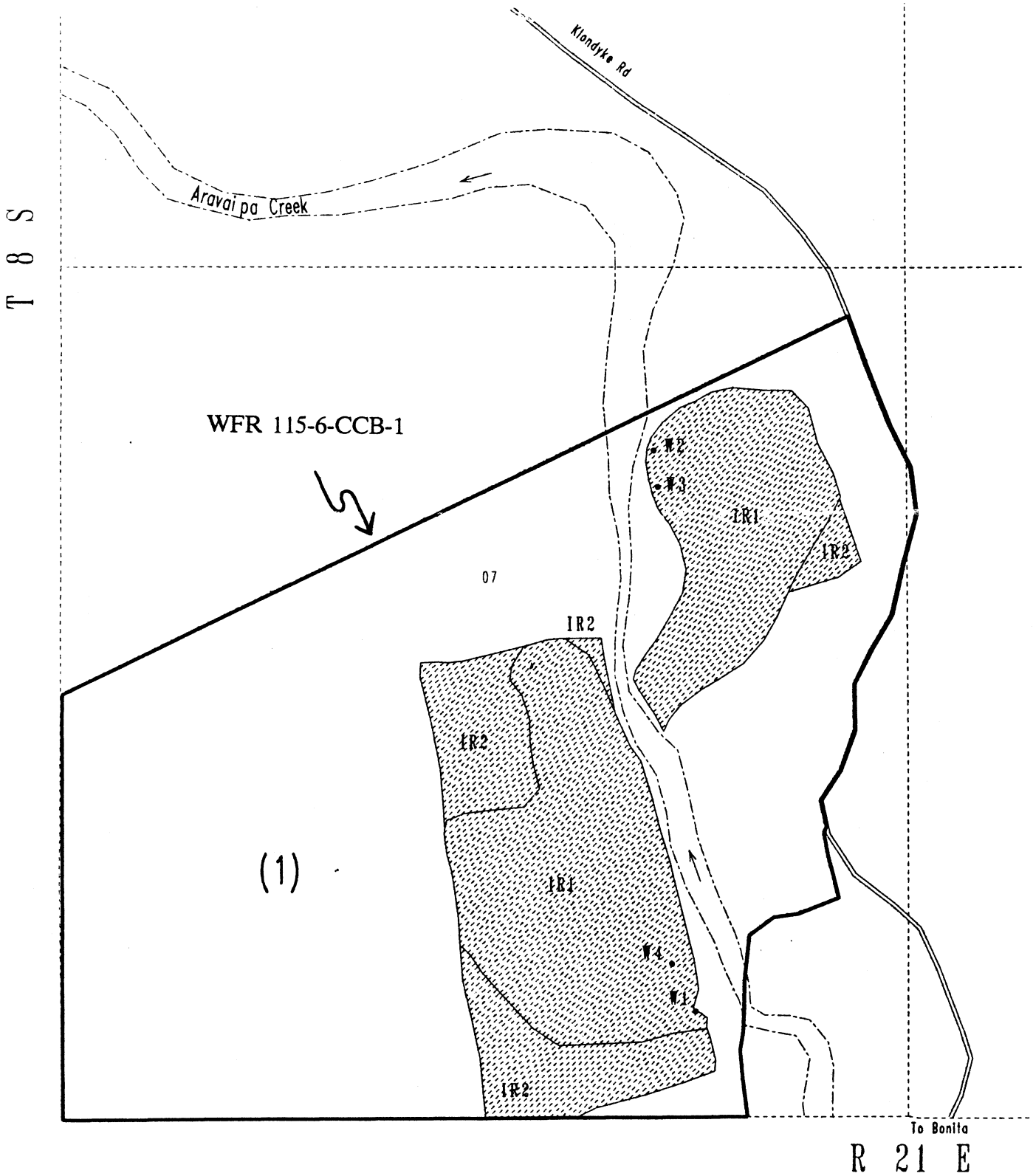
Klondyke Rd
Aravaipa Creek
T 8 S
WFR 115-6-CCB-1
07
IR2
IR1
IR2
IR2
IR2
IR1
IR2
(1)
To Bonita
R 21 E

EXHIBIT 5B

FROM PLATE 5

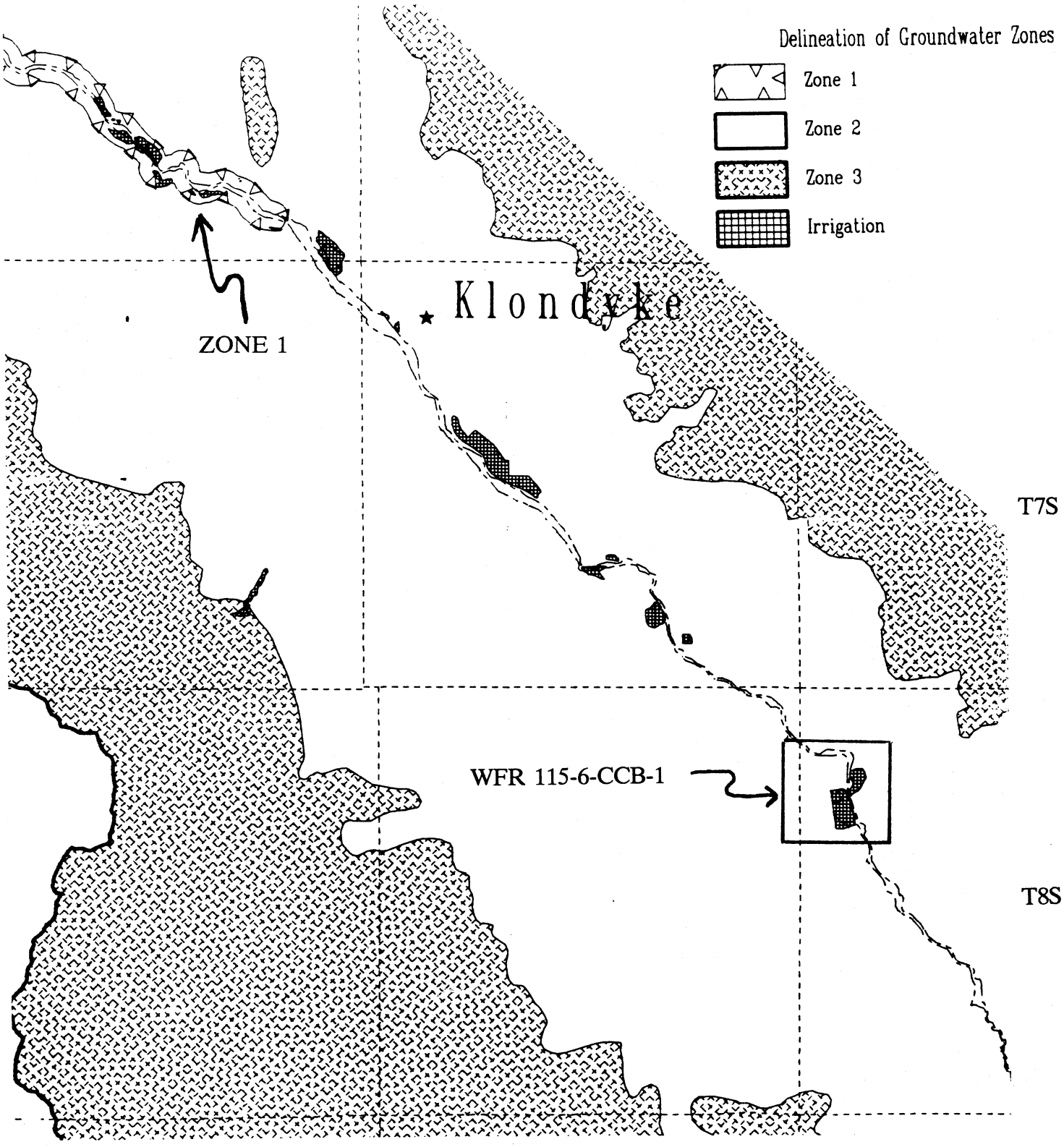

EXHIBIT 6

DEPARTMENT OF WATER RESOURCES
Hydrology

MEMORANDUM

TO: Dick Gessner

THROUGH: Frank Putman FP

FROM: Skip Hellerud SH

DATE: July 12, 1983

SUBJECT: Application To Appropriate Surface Water Number 33-85240

Application No.: 33-85240
Location: (D-8-21) 7DDC

CONCLUSION

Available data suggest that pumping from the well in question will affect Aravaipa Creek. This conclusion is based on the volume of water to be pumped and the close proximity of the well to the stream.

INTRODUCTION

Daniel T. and Virginia Cloud, and Robert V. and Sarah Stephens, 3411 North 5th Avenue, Suite 210, Phoenix, Arizona, filed Application to Appropriate Water Number 33-85240 on July 17, 1980, for a total of 460 acre-feet per year for use as irrigation water and for 182,000 gallons per year for stock water. This water is to be taken from an existing well located in (D-8-21) 7DDC and is equivalent to 286 gpm on a continuous basis.

LOCATION

The well for which the application has been made is located at (D-8-21) 7DDC in the Aravaipa Creek Watershed. The site of the proposed application is on the west terrace of Aravaipa Creek.

GEOLOGY

The water for irrigation is withdrawn from the applicant's well constructed in recent alluvium underlying the floodplain of Aravaipa Creek.

The recent alluvium may be described as mainly alluvial gravel, sand and silt in flood plain, terraces and fans. The hills adjacent to the inner valley, which also underlies the recent alluvium consist of the older alluvial conglomerate. The older alluvium may be described as a cemented conglomerate consisting of loosely to firmly consolidated cobbles, gravel, sand, silt, local clay, gypsum, marl, limestone and diatomites (1969, Modified from E.D. Wilson, R.T. Moore and J.R. Cooper).

HYDROLOGIC CONDITIONS

SURFACE WATER

The site of the proposed appropriation is at (D-8-21) 7DDC, in the floodplain of the Araviapa Creek, an intermittent stream at the site in question which is located about 9 miles southeast of Klondyke, Arizona. The riverbed flows to the northwest and has a slope of about 40 feet per mile. The Aravaipa Creek is a tributary of the San Pedro River and drains an area of about 550 square miles. The creek bed at the site may be described as a sandy wash about 40 feet wide with mesquite trees growing in the wash and on the adjacent banks. During a recent field trip on April 27, 1983, Frank Putman and I observed Aravaipa Creek to be dry at the site in question. Joe Tatum, the applicant's ranch foreman, reported that Aravaipa Creek had flowed for several months that spring at the site in question, but had been dry for one month at the time of our visit. During the recent field trip, Frank Putman and I observed Aravaipa Creek to be flowing at a point about 10 miles downstream from the applicant's well.

The perennial surface flow which begins about 10 miles downstream of the well in question is probably due to the narrowing of the valley, which forces subflow to the surface.

GROUNDWATER

The well being applied for is completed in a highly productive aquifer. The well has a 14" diameter casing and is equipped with a 40 horsepower turbine motor. (See attached photograph). This well is located on a low terrace which is about 8' feet higher in elevation than the adjacent Aravaipa Creek, which is incised at the site. The well is located about 70' feet west of the creek. Land surface elevation at this well is about 3,820 feet above mean sea level. Depth to water in this well while being pumped at a reported 700 gpm was 45 feet below land surface on April 27, 1983. A well located about 300 feet north of the well being applied for was not equipped with a pump. The depth to water was 21 feet below land surface. The depth tc water in this well was probably not greatly influenced by the pumping well (based on attached Thesis analysis using reported data). This indicates the static water level elevation in the applicant's well is about 13 feet below the streambed elevation.

SRP375

The applicant's well probably diverts surface water after sustained flow when stream recharge has saturated the alluvium between the water table and the streambed. The well, when the stream is not flowing, creates a cone of depression which is probably filled by recharge during times of surface water flow in the nearby creek or from subflow, thus depleing the streamflow downstream by the amount of added infiltration possible due to the creation of the cone of depression by the well.

REFERENCE: 1969, Geologic Map of Arizona by Eldred D. Wilson and Richard T. Moore, Arizona Bureau of Mines and John R. Cooper, U.S. Geological Survey.

SRP376

ARIZONA
DEPARTMENT
OF WATER
RESOURCES

Rose Mofford, Governor
N. W. Plummer
Director

15 South 15th Avenue
Phoenix, Arizona 85007

June 29, 1990

Daniel T. Cloud
1300 North 12th Street, Suite 404
Phoenix, Arizona 85006

RE: Application for Permit to Appropriate Public Waters No. 33-85239 and 33-85240

Dear Sir:

The Department of Water Resources is prepared to issue permits for the above referenced applications.

Before a permit may be issued the following information must be provided:

1. Provide the maximum, minimum and average amount of stock to water.

2. Provide the quarter, quarter's, section, township and range for the irrigation, domestic use and for stockwatering.

Upon receipt of the statutory permit fee and the requested information, the permit will be issued.

Each permit is $50.00. Please submit $100.00 payable to the Department of Water Resources.

Yours truly,

Joe B. Stuart
Manager, Surface Water Rights Systems
Operations Division

JBS:im

ATTACHMENT 9

LIST OF UNREPORTED CLAIMS

ATTACHMENT 9

39-00132	39-01933	39-02044	39-02752	39-03130	39-03447	39-03807	39-04160	39-04870	39-04872	39-05478
39-05807	39-05889	39-05902	39-06035	39-06584	39-07781	39-10905	39-11755	39-11845	39-11988	39-12615
39-12740	39-12748	39-12749	39-12750	39-12751	39-12752	39-12756	39-12757	39-12758	39-12759	39-12760
39-12761	39-12762	39-12763	39-12764	39-12765	39-12766	39-12767	39-12768	39-12769	39-12770	39-12771
39-12772	39-12773	39-12774	39-12775	39-12776	39-12777	39-12778	39-12779	39-12780	39-12781	39-12782
39-12783	39-12784	39-12785	39-12786	39-12787	39-12788	39-12789	39-12790	39-12791	39-12792	39-12793
39-12794	39-12795	39-12796	39-12797	39-12798	39-12799	39-12800	39-12801	39-12802	39-12803	39-12804
39-12805	39-12806	39-12807	39-12808	39-12809	39-12810	39-12811	39-12812	39-12813	39-12815	39-12816
39-12817	39-12818	39-12819	39-12820	39-12821	39-12822	39-12823	39-12824	39-12825	39-12826	39-12827
39-12828	39-12829	39-12830	39-12831	39-12832	39-12833	39-12834	39-12835	39-12836	39-12837	39-12838
39-12839	39-12840	39-12841	39-12842	39-12843	39-12844	39-12845	39-12846	39-12847	39-12848	39-12849
39-12850	39-12851	39-12852	39-12853	39-12897	39-12898	39-12899	39-12900	39-12901	39-12902	39-12903
39-12904	39-12905	39-12906	39-12907	39-12908	39-12909	39-12910	39-12911	39-12912	39-12913	39-12914
39-12915	39-12916	39-12917	39-12918	39-12919	39-12921	39-12922	39-12923	39-12924	39-12925	39-12926
39-12927	39-12955	39-12956	39-12957	39-12958	39-12959	39-12960	39-12961	39-12962	39-12963	39-12964
39-12965	39-12966	39-12967	39-12968	39-12969	39-12970	39-12971	39-12972	39-12973	39-12975	39-12976
39-12977	39-12978	39-12979	39-12980	39-12981	39-12982	39-13015	39-13016	39-13018	39-13019	39-13020
39-13021	39-13022	39-13023	39-13024	39-13025	39-13026	39-13027	39-13028	39-13029	39-13030	39-13031
39-13032	39-13033	39-13034	39-13035	39-13036	39-13037	39-13038	39-13040	39-13041	39-13042	39-13043
39-13044	39-13045	39-13046	39-13047	39-13048	39-13049	39-13050	39-13051	39-13052	39-13053	39-13054
39-13055	39-13056	39-13057	39-13058	39-13059	39-13060	39-13061	39-13062	39-13063	39-13064	39-13065
39-13066	39-13067	39-13068	39-13069	39-13070	39-13071	39-13072	39-13073	39-13074	39-13075	39-13076
39-13077	39-13078	39-13079	39-13080	39-13081	39-13082	39-13083	39-13085	39-13086	39-13087	39-13110
39-13111	39-13112	39-13113	39-13114	39-13115	39-13116	39-13117	39-13118	39-13119	39-13120	39-13121
39-13122	39-13123	39-13140	39-13141	39-13142	39-13143	39-13144	39-13145	39-13146	39-13147	39-13148
39-13149	39-13150	39-13151	39-13152	39-13153	39-13154	39-13155	39-13156	39-13157	39-13158	39-13159
39-13160	39-13161	39-13162	39-13163	39-13164	39-13165	39-13166	39-13167	39-13168	39-13169	39-13170
39-13171	39-13172	39-13173	39-13174	39-13175	39-13176	39-13177	39-13178	39-13179	39-13180	39-13181
39-13182	39-13183	39-13184	39-13185	39-13186	39-13187	39-13188	39-13189	39-13190	39-13191	39-13192
39-13193	39-13194	39-13195	39-13196	39-13197	39-13198	39-13199	39-13200	39-13201	39-13202	39-13203
39-13204	39-13205	39-13206	39-13207	39-13208	39-13209	39-13210	39-13211	39-13212	39-13213	39-13214
39-13215	39-13216	39-13217	39-13218	39-13219	39-13220	39-13221	39-13222	39-13223	39-13224	39-13225
39-13226	39-13227	39-13228	39-13229	39-13230	39-13231	39-13232	39-13233	39-13234	39-13235	39-13236
39-13237	39-13238	39-13239	39-13240	39-13241	39-13242	39-13243	39-13244	39-13245	39-13246	39-13247
39-13248	39-13249	39-13250	39-13251	39-13252	39-13253	39-13254	39-13255	39-13256	39-13257	39-13258
39-13259	39-13260	39-13261	39-13262	39-13263	39-13264	39-13265	39-13266	39-13267	39-13268	39-13269
39-13270	39-13271	39-13272	39-13273	39-13274	39-13275	39-13276	39-13277	39-13278	39-13279	39-13280
39-13281	39-13282	39-13283	39-13284	39-13285	39-13286	39-13287	39-13288	39-13289	39-13290	39-13291
39-13292	39-13293	39-13294	39-13295	39-13296	39-13297	39-13298	39-13299	39-13300	39-13301	39-13302
39-13303	39-13304	39-13305	39-13306	39-13307	39-13308	39-13309	39-13310	39-13311	39-13312	39-13313
39-13314	39-13315	39-13316	39-13317	39-13318	39-13319	39-13320	39-13321	39-13322	39-13323	39-13324
39-13325	39-13326	39-13327	39-13328	39-13329	39-13330	39-13331	39-13332	39-13333	39-13334	39-13335
39-13336	39-13337	39-13338	39-13339	39-13340	39-13341	39-13342	39-13343	39-13344	39-13345	39-13346
39-13347	39-13348	39-13349	39-13350	39-13351	39-13352	39-13353	39-13354	39-13355	39-13356	39-13357
39-13358	39-13359	39-13360	39-13361	39-13362	39-13363	39-13364	39-13365	39-13366	39-13367	39-13368
39-13369	39-13370	39-13371	39-13372	39-13373	39-13374	39-13375	39-13376	39-13377	39-13378	39-13379
39-13380	39-13381	39-13382	39-13383	39-13384	39-13385	39-13386	39-13387	39-13388	39-13389	39-13390
39-13391	39-13392	39-13393	39-13394	39-13395	39-13396	39-13397	39-13398	39-13399	39-13400	39-13401
39-13402	39-13403	39-13404	39-13405	39-13406	39-13407	39-13408	39-13409	39-13410	39-13411	39-13412
39-13413	39-13414	39-13415	39-13416	39-13417	39-13418	39-13419	39-13420	39-13421	39-13422	39-13423
39-13424	39-13425	39-13426	39-13427	39-13428	39-13429	39-13430	39-13431	39-13432	39-13433	39-13434
39-13435	39-13436	39-13437	39-13438	39-13439	39-13440	39-13441	39-13442	39-13443	39-13444	39-13445
39-13446	39-13447	39-13448	39-13449	39-13450	39-13451	39-13452	39-13453	39-13454	39-13455	39-13456
39-13457	39-13458	39-13459	39-13460	39-13461	39-13462	39-13463	39-13464	39-13465	39-13466	39-13467
39-13468	39-13469	39-13470	39-13471	39-13472	39-13473	39-13474	39-13475	39-13476	39-13477	39-13478
39-13479	39-13480	39-13481	39-13482	39-13483	39-13484	39-13485	39-13486	39-13487	39-13488	39-13489
39-13490	39-13491	39-13492	39-13493	39-13494	39-13495	39-13496	39-13497	39-13498	39-13513	39-13514

SRP379

-13515	39-13516	39-13517	39-13518	39-13519	39-13520	39-13521	39-13522	39-13523	39-13541	39-13542
-13543	39-13544	39-13545	39-13546	39-13547	39-13548	39-13549	39-13550	39-13551	39-13552	39-13553
-13554	39-13555	39-13556	39-13557	39-13558	39-13559	39-13560	39-13561	39-13608	39-13609	39-13610
-13612	39-13613	39-13614	39-13615	39-13616	39-13617	39-13618	39-13619	39-13620	39-13621	39-13622
-13623	39-13624	39-13625	39-13626	39-13627	39-13628	39-13629	39-13630	39-13631	39-13632	39-13633
-13634	39-13636	39-13637	39-13638	39-13639	39-13669	39-13670	39-13671	39-13674	39-13675	39-13678
-13679	39-13683	39-13684	39-13687	39-13688	39-13689	39-13690	39-13692	39-13693	39-13694	39-13699
-13711	39-13712	39-13713	39-13714	39-13715	39-13716	39-13717	39-13718	39-13719	39-13720	39-13726
-13727	39-13734	39-13735	39-13736	39-13737	39-13738	39-13739	39-13740	39-13742	39-13743	39-13744
-13745	39-13748	39-13749	39-13750	39-13751	39-13754	39-13755	39-13756	39-13757	39-13758	39-13759
-13760	39-13761	39-13762	39-13763	39-13764	39-13765	39-13766	39-13778	39-13779	39-13780	39-13781
-13782	39-13783	39-13784	39-13785	39-13786	39-13787	39-13788	39-13789	39-13790	39-13796	39-13797
-13798	39-13799	39-13808	39-13809	39-13813	39-13814	39-13815	39-13816	39-13817	39-13818	39-13823
-13824	39-13825	39-13826	39-13827	39-13830	39-13831	39-13832	39-13833	39-13834	39-13835	39-13844
-13845	39-13846	39-13847	39-13848	39-13851	39-13852	39-13854	39-13855	39-23723	39-23724	39-71947
-79037	39-79072	39-79074								

795 TOTAL FILINGS

SRP380