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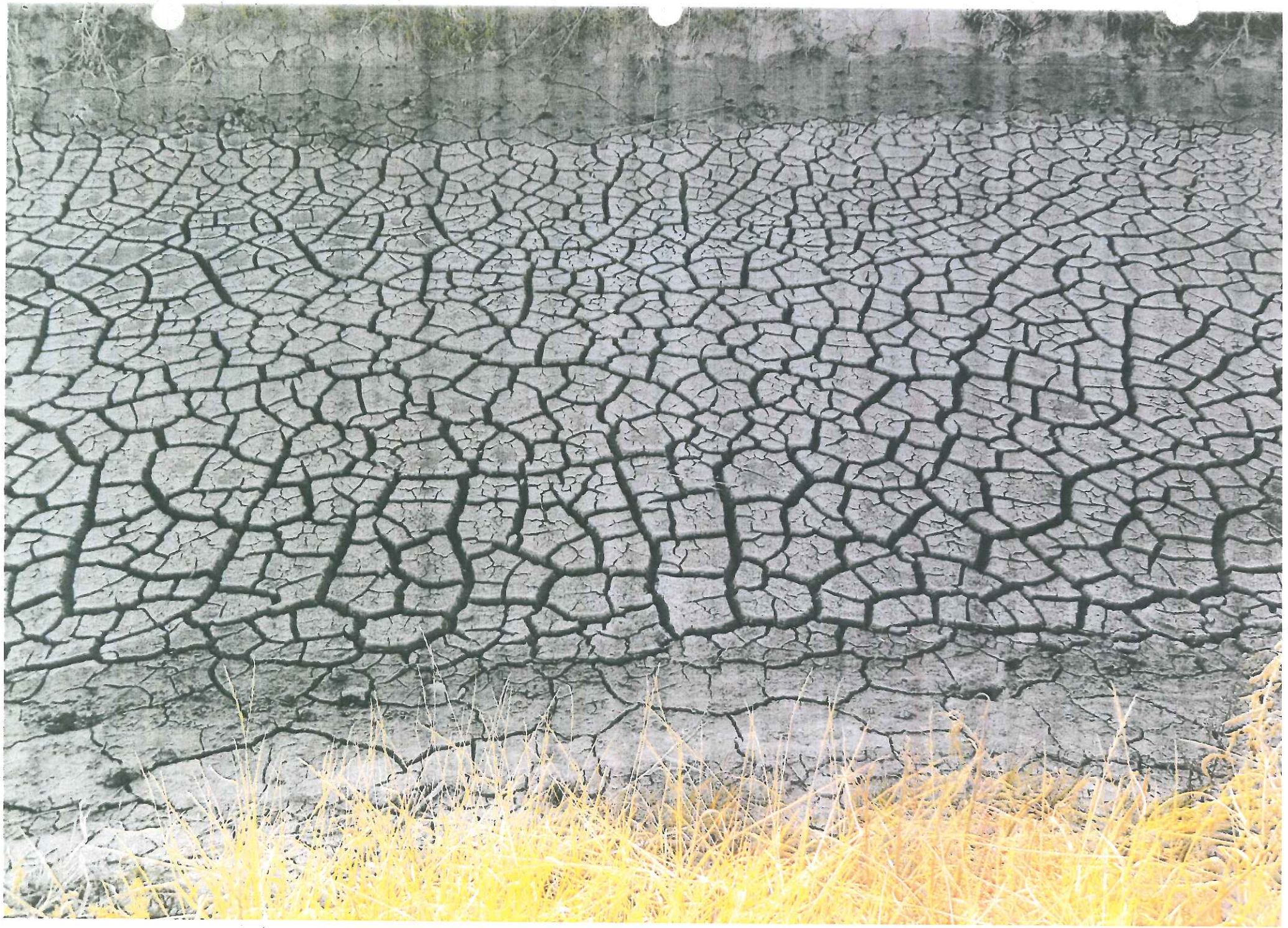

Managing Water in the West

Lining Ponds to Reduce Salt and Selenium Loading to the Gunnison River

U.S. Department of the Interior
Bureau of Reclamation
September 2004

Introduction

A collaborative effort to measure constructed-pond seepage rates was carried out by the U.S. Bureau of Reclamation (BOR) Technical Service Center and the Natural Resources Conservation Service (NRCS) in Montrose, CO. This work was aimed at quantifying the volumetric seepage rate for ponds located over Mancos shale to determine the ground water contribution. The objective of reducing pond seepage is to reduce the leaching of salts and the trace element selenium which is naturally occurring in Mancos shale derived soils.

A total of ten ponds were selected for seepage measurements, and a combination of double-ring permeameter tests and staff gage drawdown tests were performed. The double-ring permeameter tests were run on dry ponds and utilized a head tank to keep a constant depth of water on the site being tested. The drawdown tests were run on ponds that were full of water and the source of inflow shut off for the test. The nine ponds were surveyed so that area-capacity relationships could be established. Two ponds that had a high seepage rate were reevaluated after undergoing a combination of compaction and bentonite treatments.

Seepage from these ponds revealed several types of water loss from poor dike construction to point source water loss out of animal burrows. The seepage measurements in this study revealed many lessons, such as preferential ground water flow and large water loss when filling ponds that have dried out and are full of deep cracks.

Pond Lessons

The following observations were made while performing the seepage investigations on these ten ponds.

- Preferential flow through cracks may be a dominant source of seepage in many of the ponds. This observation was based on the different results between the double ring permeameter tests and full-pond drawdown tests. For example, a higher seepage rate was measured in a drawdown test where a vortex formed on the surface of one pond where the water was leaking into animal burrow. A low seepage rate was measured on this same pond with a double ring permeameter test. This water never did surface below the pond and was apparently flowing into fractured Mancos shale.

- Ponds that are allowed to dry for long periods of time, especially in the heavy adobe soils, form deep cracks which take time to seal during refilling. These cracks can result in very large fluxes of ground water movement during the first few days of refilling.

- Ponds that are excavated close to or into fractured Mancos shale have higher leakage rates.

- Leakage through poor dike construction is very common and could be a significant source of water loss. The NRCS is often requested to provide technical assistance to landowners who have constructed ponds on their own and have problems.

DISTRICT COURT, WATER DIVISION NO. 2, COLORADO 207 Judicial Building 329 West 10 Street, Rm. 207 Pueblo, CO 81003 **IN THE MATTER OF THE PROPOSED COMPACT RULES GOVERNING IMPROVEMENTS TO SURFACE WATER IRRIGATION SYSTEMS IN THE ARKANSAS RIVER BASIN IN COLORADO** In Baca, Bent, Chaffee, Cheyenne, Costilla, Crowley, Custer, Douglas, El Paso, Elbert, Fremont, Huerfano, Kiowa, Lake, Las Animas, Lincoln, Otero, Park, Prowers, Pueblo, Saguache & Teller Counties	▲ COURT USE ONLY ▲
Attorneys for the State Engineer: JOHN W. SUTHERS, Attorney General EVE W. MCDONALD, Reg. No. 26304 L. JAMES EKLUND, Reg. No. 35149 1525 Sherman Street, 7th Floor Denver, CO 80203 Telephone: (303) 866-5072 Email: eve.mcdonald@state.co.us	Case No. 2009CW110 Water Division 2
STIPULATION BETWEEN STATE ENGINEER, SMITH MUTUAL DITCH COMPANY, AND CLOVER MEADOW LATERAL COMPANY	

The State Engineer, by and through the Attorney General's office, and Opposers Dale Mauch for the Clover Meadow Lateral Company and Don McBee for the Smith Mutual Ditch Company (hereinafter "Opposers Mauch and McBee"), both pro se, hereby stipulate and agree as follows:

1. Subject to the conditions set forth in paragraphs 2-3 below, Opposers Mauch and McBee consent to the entry of a decree in this case in the form of **Exhibit A**, the draft proposed decree dated August 18, 2010, and to any modified form of that proposed decree that is no less protective of Opposers Mauch and McBee's rights and interests than Exhibit A. In addition, subject to the conditions set forth in paragraphs 2-3 below, Opposers Mauch and McBee consent to **Exhibit B**, the State Engineer's July 9, 2010 draft of the Irrigation Improvement Rules and their attachments ("Rules"), and to any modified form of the Rules and their attachments that is no less protective of Opposers Mauch and McBee's rights and interests than Exhibit B. The State Engineer will continue to provide copies of future drafts of the Rules, of the attachments to the Rules, and of the proposed decree, to Opposers Mauch and McBee at the same time and in the same manner that they are circulated to other Opposers.

2. Opposers Mauch and McBee shall remain a party in this case to ensure compliance with this Stipulation; to monitor and participate as necessary (consistent with paragraph 1 of this Stipulation) to advocate for and protect their interests, including the pond seepage study agreement in paragraph 3 below; and to participate in any proceedings under the Court's retained jurisdiction. In addition, Opposers Mauch and McBee may, in their sole discretion and consistent with this Stipulation and exhibits hereto, choose to participate in support of the State Engineer's position on one or more issues in this proceeding.

3. Agreement Regarding Usage of Pending Pond Seepage Study:

Whereas, the current Irrigation System Analysis Model ("ISAM") contains conservative assumptions based on limited data regarding the amount of water delivered to head stabilization ponds that serve sprinkler systems [hereafter, "ponds"] that seeps from such ponds and returns to the river as deep percolation; and

Whereas, Opposers Mauch and McBee consider these conservative assumptions to be too low, and feel that a higher rate would be more accurate and would greatly reduce the amount of water owed to the river under the Irrigation Improvement Rules for their sprinkler system improvements; and

Whereas, there are numerous and variable factors that can affect the amount of water that will seep from ponds, including pond size, depth of water in the pond, time when water is present in the pond, silt loading of water supply, soil type, soil compaction, type and frequency of maintenance activities, pond lining and evaporation rates; and

Whereas, there is little available data on pond seepage in the Fort Lyon Canal and nearby ditch service areas of the Arkansas River Basin mainstem on which to refine seepage estimates; and

Whereas, the State and Division Engineers will be required by Rule 9.B.i.b. of the proposed Rules to re-evaluate the pond seepage assumption and to incorporate in the ISAM new or updated data and/or engineering information that becomes available. In any computer modeling for enforcement of the Arkansas River Compact, the State Engineer uses engineering assumptions that are based on reliable data and that he can reasonably expect will meet any applicable burden of proof in litigation. The State Engineer has advised Opposers Mauch and McBee that an unbiased scientific pond study of at least two years' duration involving reliably measured inflows and outflows and using current scientific procedures to estimate evaporation and precipitation impacts to the pond water balance should provide sufficient and reliable engineering and/or scientific information to update or revise the ISAM; and

Whereas, in reliance on the State and Division Engineers' representations as set forth herein, Opposers Mauch and McBee have expended considerable time and money organizing and obtaining funding for their pending pond seepage study to establish an accurate and reliable pond seepage loss rate for improvements under the Fort Lyon Canal system and nearby ditch service areas of the Arkansas River Basin mainstem. The study is funded by

grants from National Resources Conservation Service (NRCS) and the Lower Arkansas Valley Water Conservancy District (Lower Ark District), and by private funding from more than 15 private partners, and has received letters of support from Lower Arkansas Water Management Association (LAWMA), the Commissioner of the Colorado Department of Agriculture, and the State Engineer. More than 50 meters will be purchased, installed, certified, and monitored on over 20 sprinkler ponds under the Fort Lyon Canal system and nearby ditch service areas of the Arkansas River Basin mainstem. The study will last for two years and span two complete irrigation seasons (March 15-Nov 15) and will monitor no fewer than 20 ponds that are representative in terms of size, depth and soil type of ponds within the Fort Lyon Canal and nearby ditch service areas of the Arkansas River Basin mainstem that are all operated within the parameters of the State Engineer's policy on head stabilization ponds as described in the State Engineer's Reservoir Administration Guidelines; and

Whereas, Opposers Mauch and McBee are willing to stipulate to entry of the Irrigation Improvement Rules with the assurance that the State and Division Engineers will accept the results of this pending study when it is finished and adjust the pond-seepage assumption accordingly; and

Whereas, the State Engineer wishes to reserve the right to judge the adequacy of the study after it is concluded, and to ensure that no party can take advantage of the result of the study by altering the condition of a pond to reduce its seepage rate below the study rate;

Now therefore, both the State Engineer's and Opposers Mauch and McBee's objectives and interests being reasonable and valid, a mutually-beneficial agreement has been reached as follows:

A. The State Engineer shall accept the pond study result if it includes the following criteria and elements:

1. Demonstrates that the 20 ponds selected are representative of all the other ponds that serve sprinkler systems under the Fort Lyon Canal and nearby ditch service areas of the Arkansas River Basin mainstem. In other words, the study report explains how these ponds were selected to show that they are a fair subset of all ponds covered by the study results.

2. Includes a diagram of the shape of each pond studied (surface area at maximum operational depth, physical features such as settling pond forebays, types of pumps and pipelines from pond to fields, type of delivery to pond and other pertinent information that can be displayed on a drawing, topographical map or aerial photo).

3. Documents that all the meters were verified for accuracy after they were installed.

4. Lists all maintenance activities conducted on/for each of the ponds during the study period. (This could be in an appendix to the Report.)

6. Addresses how much the results varied between ponds, and attempts to explain any variation, e.g., soil type, location, shape, or some other physical difference between the ponds.

7. Analyzes whether it is best to use a single annual seepage rate in ISAM, or whether it is better to use monthly rates if seepage varies throughout the season and whether to use different seepage rates for different ditch areas or soil types.

8. Requires study participants to operate the meters for two years after the study for the specific ponds that will need approval under the new Rules to verify that the conclusions about pond seepage from the study remain reasonably consistent with metered data.

B. The Division Engineer's Office will have the right to randomly verify measurement accuracy during the study period.

C. Under these conditions, the pond study results will be used as the basis for determining pond seepage that occurs in conjunction with irrigation improvements within the Fort Lyon Canal and nearby ditch service areas of the Arkansas River Basin mainstem in both the Historic and Operational modules of ISAM for sprinkler evaluations unless and until it is superseded by more reliable data. After reviewing the Study Report containing the elements described above, the Division Engineer's Office shall determine whether a single value or multiple values tied to physical criteria and/or monthly values are most appropriate to implement the results of the study in ISAM.

D. Terms and conditions of any Division Engineer approval of any improvement involving consideration of pond seepage shall state that the approval may be revoked or modified if the applicant or his agent alters or fails to maintain conditions corresponding to those for which the representative seepage rate was determined by the study.

E. The applicant or his agent may annually file a form like the example (**Exhibit C** to this stipulation, titled "Annual Notice of Maintenance") to document that the applicant has conducted normal maintenance in good faith on the pond consistent with the maintenance performed during the study and that the pond has not been lined. The pond seepage assumption shall be reduced by an amount to be determined by the study each year after approval to reflect the natural build up of silt if the applicant or his agent is unable to perform the annual maintenance for a particular year or multiple years. If the applicant's pond seepage rate has been reduced by such a silt-build-up-factor for more than a single year and the pond is then restored to the study period condition, as

demonstrated by the applicant by any method acceptable to applicant and the Division Engineer's Office, the seepage rate shall be adjusted back to the seepage rate adopted from the results of the study.

F. The pond seepage assumption shall not apply to lined ponds, which shall be assumed not to seep.

4. This Stipulation is entered by way of compromise and settlement of this litigation. The agreement of the undersigned parties to the entry of the draft proposed decree shall not be construed as concurrence by these parties beyond the decree stipulated hereto with any findings of fact or conclusions of law contained therein, or with the engineering methodologies utilized by either party in arriving at this Stipulation, and nothing contained in said draft proposed decree shall be binding upon these parties in any proceeding other than the current proceeding. It is specifically understood and agreed by the parties hereto, that the acquiescence of any party to a stipulated decree under the specific factual and legal circumstances of this contested matter and upon the numerous and interrelated compromises reached by the parties shall never give rise to any argument, claim, defense or theory of acquiescence, waiver, bar, merger, stare decisis, res judicata, estoppel, laches, or otherwise, nor to any administrative or judicial practice or precedent, by or against any of the parties hereto in any other matter, case or dispute, nor shall testimony concerning such acquiescence of any party to a stipulated decree herein be allowed in any other matter, case or dispute.

5. Opposers Mauch and McBee consent to the Engineers' motion to the Water Court for an order approving this Stipulation, which motion the Engineers will promptly file following the execution of this Stipulation.

6. Opposers Mauch and McBee and the Engineers agree that this Stipulation shall bind and benefit them and will be binding upon and benefit their heirs, assigns and successors in interest.

7. The parties shall bear their own costs and fees associated with this case.

8. The parties hereto represent and affirm the signatories to this Stipulation are legally authorized to bind the parties in this matter.

9. The parties agree that the agreements made in this Stipulation shall be enforceable by them either as an agreement or, upon approval, as an order of the Water Court.

Date: 9-10-10 By: Dale L Mauch

Dale Mauch, President
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Date: Sept 10, 2010 By: Don McBee

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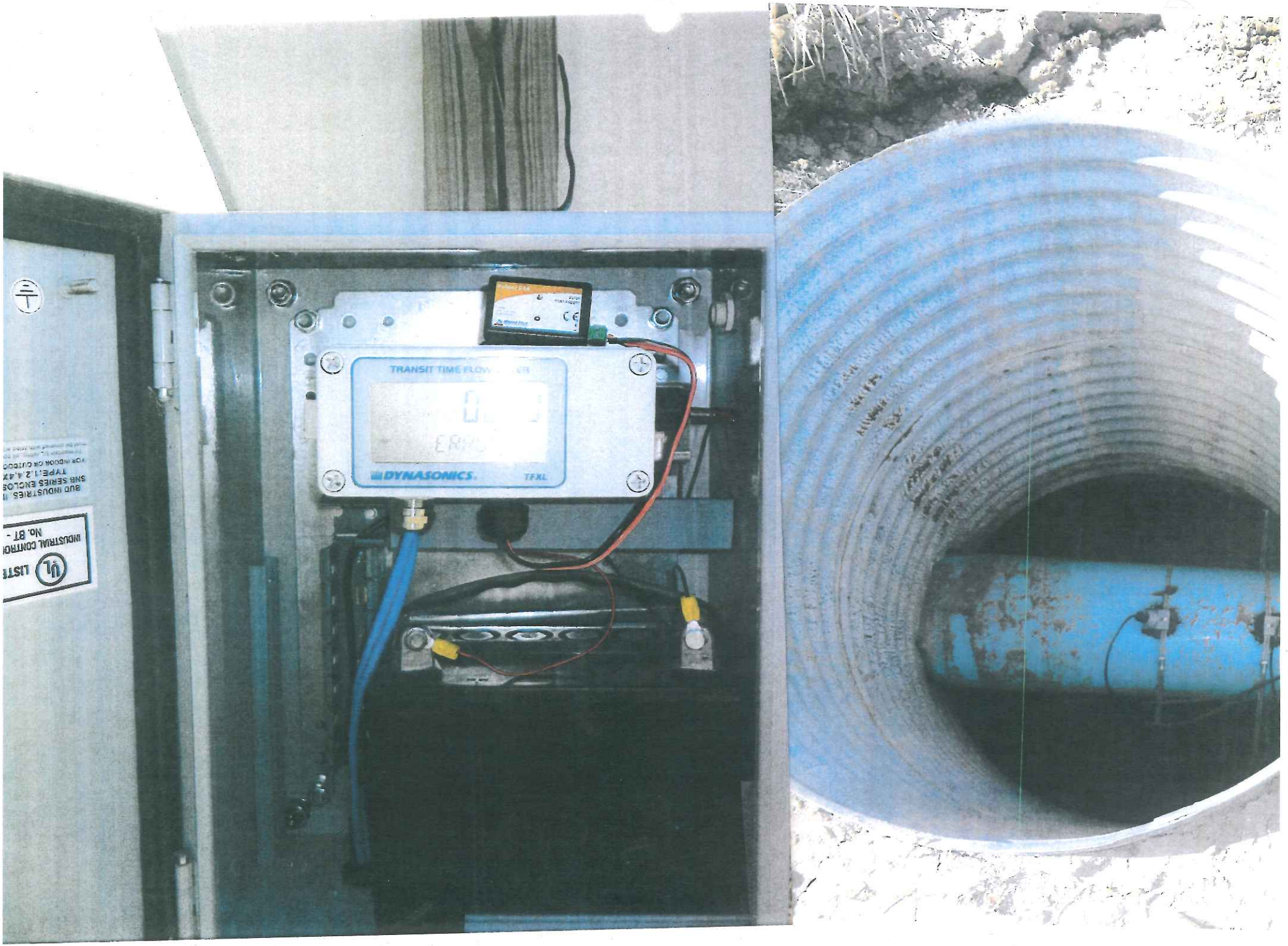
Eve W McDonald

Eve W. McDonald, # 26304*
Assistant Attorney General
Natural Resources and Environment Section
Attorneys for Colorado State and Division Engineers
*Counsel of Record

E-FILED PURSUANT TO C.R.C.P. 121. Duly signed original on file at the Office of the Attorney General.

POND STATUS:

- 26 PONDS IN STUDY
- 4 PONDS NO WATER DUE TO DROUGHT
- 1 POND TO COMPLETE


TRANSIT TIME FLOW
DYNASOMICS
TFXL


STAGE-DISCHARGE RECORDER

Science & Engineering
for Rural America

LOWER ARKANSAS POND STUDY
INTERIM REPORT

PREPARED FOR:

LOWER ARKANSAS VALLEY WATER CONSERVANCY DISTRICT

PREPARED BY:

GERALD W. KNUDSEN, P.E.
AGRITECH CONSULTING

In Association with:

Brian Lauritsen
Valley Ag Consulting

JULY 2013

INTRODUCTION

The common practice for using surface water for a sprinkler is to construct an irrigation head stabilization pond. The ponds usually consist of two cells, the first one serving as a settlement basin and the second as an equalization basin. The pond is located between the canal and the sprinkler. In the Arkansas Valley, the typical sprinkler is a center pivot.

Many of the pivots in the area have flow meters but there were limited flow measurement devices for measurement of the water into the ponds. The pond owners have noted that there were excessive seepage losses from the ponds. These losses not only impact the amount of water that get to the crop but also affects the return flow calculations for the Arkansas River Compact. The losses are expected to be significant because they are dry between runs and pond liners dry out and a saturated condition must be created in the subsoil at the beginning of each event. The same conditions exist when filling a canal for the first time during the irrigation season, i.e. great losses until the soil and water saturation points are balanced.

Typical Pond After Irrigation Run

A Stipulation between the State Engineer (DNR), Smith Mutual Ditch Company and Clover Meadow Lateral Company was agreed to in September 2010. The Stipulation created the "Pond Study" in order to provide reliable data for the State to "...re-evaluate the pond seepage assumptions and to incorporate in the ISAM new or updated data and/or engineering information that becomes available."

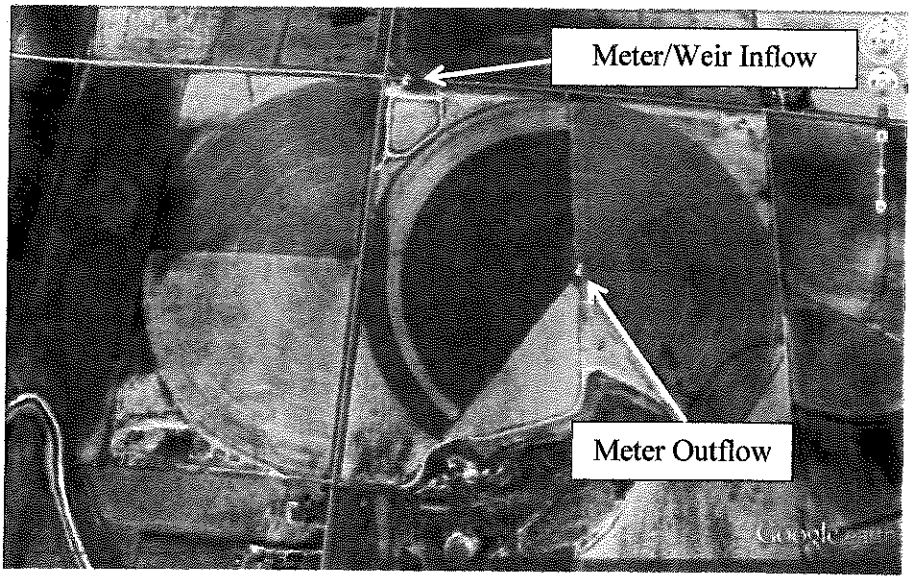
The work was to be "...an unbiased scientific pond study of at least two years' duration involving reliable measure inflow and outflows and using current scientific procedures to

estimate evaporation and precipitation impacts to the pond water balance…" The Stipulation also state that "More than 50 meters will be purchased, installed, certified, and monitored on over 20 sprinkler ponds un the Fort Lyon Canal system and nearby ditch service area of the Arkansas River Basin mainstem."

ACTIVITIES TO DATE

Planning for the study began previous to the signing of the Stipulation. It was determined that a whole pond water balance procedure was the only viable method of determining seepage. The procedure requires the measurement of water into the pond, water out of the pond via the pivots, calculation of evaporation and recording precipitation. The difference between the inflow and outflow components is the resultant seepage loss. Funding for the study included a Conservation Innovation Grant from the USDA Natural Resources Conservation Service (NRCS), the Lower Arkansas Valley Water Conservancy District (Lower Ark District) and by private funding from more than 15 private partners. The Colorado Water Conservation Board also provide a grant in 2013.

AgriTech Consulting was selected to conduct the pond study. Gerald W. Knudsen, P.E., General Manager of AgriTech Consulting had extensive experience with seepage studies for hog farm and feedlot impoundments and has designed large ponds for evaporation of oil and gas produced water. Local support was initially provided by Richards Well Calibration of Eads, Colorado.



Typical Inflow/Outflow Installation

Installation and operation of the measuring devices was a challenge because the ponds are designed for gravity flow. Accurate measurement in pipes generally requires full flow and laminar conditions which did not exist at many of the facilities. Flows through existing Parshall Flume weirs also required accurate measuring and recording devices. The challenge was magnified by the canal operation, which was a series of two-day runs during the irrigation season. Therefore if a meter was not working properly, the information from that run was lost. The troubleshooting had to occur during the next run, which required manpower at the right time and also meant that the data was not complete for that run either. The drought in 2012 also made the work more difficult because there were very few runs to work with.

In 2013, Mr. Knudsen requested further local assistance. The Lower Arkansas Valley Water Conservation District (Lower Ark) approved the hiring of Valley Ag Consulting from Lamar, Colorado to select additional ponds, install flow measuring devices, record meter readings between each run, inspect equipment and provide troubleshooting services. Valley Ag Consulting provides crop consulting services in the Lower Arkansas Valley and has provided the required expertise and labor to appropriately assist with the study. This local effort has been the key to conducting the study in accordance with the expectations and requirements of the involved parties.

As of June 30, 2013, there are 26 ponds in the study and one more pond is scheduled for piping modification for the meters. Due to the drought, four of the ponds have not received water in 2013. The other 22 ponds have produced sufficient data in the six runs of the Fort Lyon canal and three runs of the Holbrook canal to determine seepage rates that can be relied on. Additional data this year and in 2014 will provide a higher level of confidence as the repeatability of the readings is demonstrated.

LIMITATIONS

As previously discussed, the work involved with operating over 75 electronic and mechanical devices has been challenging. As a result, there are some data gaps at different sites and a few sites are still being evaluated for accuracy. Valley Ag Consulting has recently received meter testing and verification certification from the DNR and will continue to verify and "fine tune" the measuring systems.

Evaporation from the ponds is calculated based on the evapotranspiration rates from the local CoAgMet weather stations. There are two conversion factors that are used to estimate the actual evaporation from the ponds. Those factors are being evaluated by the DNR and AgriTech Consulting and are not included in the results that are discussed in this Interim Report. The evaporation is not significant compared to the large amount of water that flows through the ponds on a normal two-day run. Precipitation during each run has been recorded but is not considered in this report. Evaporation and precipitation will be included in the data in the annual and final report.

RESULTS

The seepage rates for the 22 operating ponds through June 30, 2013 are listed in Table 1. A chart of the seepage is also shown. Note that these values do not include evaporation and precipitation and will therefore vary slightly in the forthcoming reports. The actual seepage volumes have been submitted to the DNR and are being incorporated into the current Irrigation System Analysis Model (ISAM). These participating producers will be receiving return flow credits according to the Compact procedures.

As noted in Table 1, the average seepage for the ponds has varied from 2.8 percent to 44 percent. A statistical analysis has not been conducted for this interim report but will be done when there is more data. For illustration purposes, the following table provides an indication of the seepage for ponds for each 10 percentage points distribution:

Average Seepage (%)	Number of Ponds
0 - 10	4
10 - 20	5
20 - 30	10
30 - 40	2
40 - 50	1

The volume of pond study participant irrigation water that was inflow to the ponds through June 30, 2013 was 1,340 acre feet. The amount of outflow through the pivots to the crops was 1,040 acre feet. The seepage loss was 300 acre feet for an average of 22 percent loss of total flow. The current default allocation through the compact procedures is 3 percent, which would have amounted to 40 acre feet. Therefore, the producers in the study have received credit for 260 more acre feet of water than they would have received credit for without the real data provided by the flow measurement devices.

TRENDS

The long-term objective of the DNR is to provide a manageable system of allocating seepage rates for each pond by determining a common factor between the pond conditions and seepage losses. As stated in the Stipulation "...there are numerous and variable factors that can affect the amount of water that will seep from ponds, including pond size, depth of water in the pond, time when water is present in the pond, silt loading of water supply, soil type, soil compaction, type and frequency of maintenance activities, pond lining and evaporation rate."

The most obvious variable would be the soil types. In order to evaluate those impacts, soil texture analyses were conducted on most of the ponds prior to the irrigation season. There were 22 out of the 26 ponds that had both soil texture data and seepage data. The results are shown on Table 2 and the related charts. Linear trend lines were generated on each chart. The average seepage was charted to compare the seepage rate trends with the clay, silt and sand trends.

Initially, one would assume that higher clay content would result in decreased seepage. As seen from the clay chart, the current data shows that this is not the case. The trend line is very flat and actually could be interpreted to show that an increase in clay content has resulted in higher seepage rates. At this point, the author cautions the reader to evaluate trend lines carefully when there is limited data because outlying values can skew the results. The information that is not provided is the shrink-swell potential of the soil. The pond that has shown the highest seepage rate of 44 percent has soil with apparently high shrink-swell potential. It also has the highest clay content of all of the ponds. During the time period when there is no water in the pond, there have been cracks up to one inch wide throughout the floor of the pond. When water is added, there would be great losses until the clay swells again and reduces or closes the fractures. Therefore, even if there is a high clay content in a pond, there may be other factors that are more critical. The shrink-swell potential is one parameter that will be studied in more depth.

There appears to be a trend that lower silt concentration results in higher seepage but silt is not a significant factor in seepage conditions. Sand would be a more significant factor because higher concentrations of sand would indicate greater seepage rate. That increasing trend is evident but the data has high fluctuations and the actual significance needs to be studied further.

Other factors listed earlier in this report will have an effect on seepage. The project team will evaluate these variables more intensely in 2014 when there is more data available and the staff can change their focus from meter installation and maintenance to data analysis.

FUTURE ACTIVITIES

Future activities include the continuance of the study through 2013. Unfortunately, the drought is continuing and there may not be many opportunities to obtain more data this year. The study will continue through the 2014 irrigation season. As previously stated, there will be an emphasis on data analysis and determining a pattern between seepage rates and physical or environmental conditions. The Stipulation also requires that the study participants operate the meters for two years after the study for the specific ponds that will need approval under the new Rule to verify that the conclusions about pond seepage from the study remain reasonably consistent with metered data. This further review may be significant since the data collected to date represents drought conditions when there is longer period of time between runs and more frequent use of the ponds may reduce the seepage rates.

TABLE 1
POND SEEPAGE RATES

Study Pond Number	Water Source	Average Seepage (%)
5	Ft Lyon	2.8
21	Ft Lyon	5.2
29	Ft Lyon	7.7
4	Ft Lyon	9.4
16	Ft Lyon	10.6
20	Ft Lyon	12.3
15	Ft Lyon	13.4
9	Ft Lyon	15.9
28	Holbrook	16.5
26	Ft Lyon	20.5
11	Holbrook	23.4
1	Ft Lyon	24.2
22	Ft Lyon	25.1
10	Ft Lyon	25.4
24	Ft Lyon	26.4
14	Ft Lyon	28.0
8	Ft Lyon	28.4
2	Ft Lyon	28.7
27	Holbrook	32.3
7	Ft Lyon	35.0
3	Ft Lyon	44.0

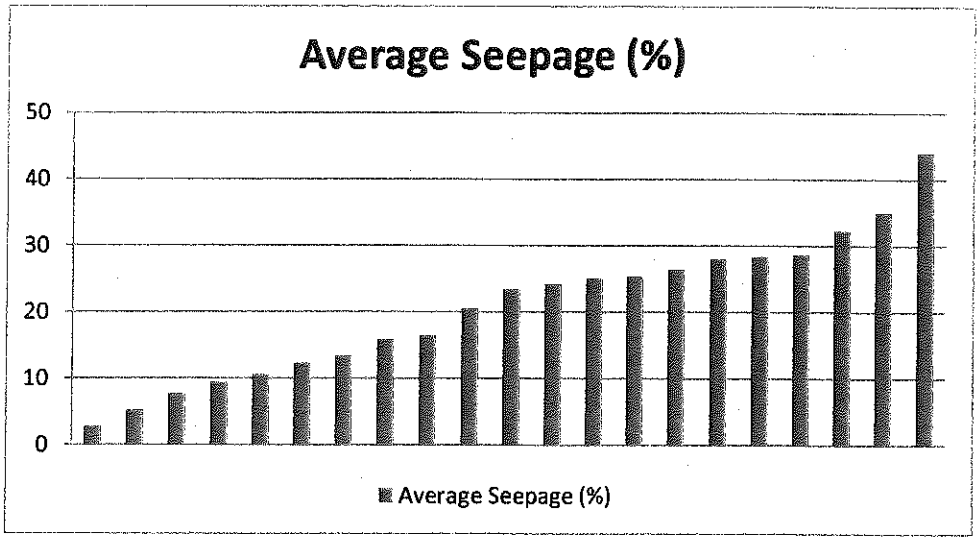
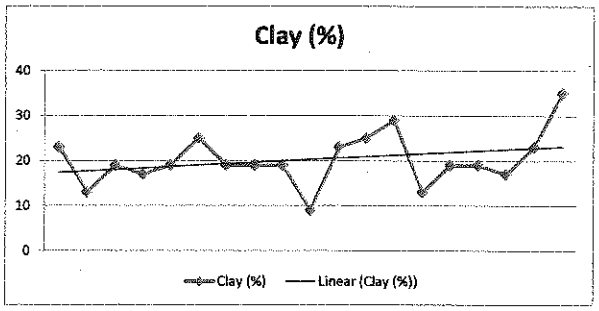
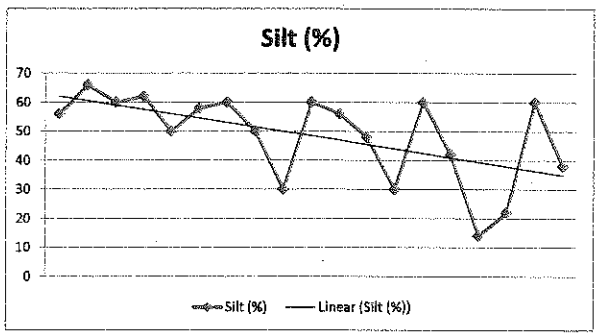
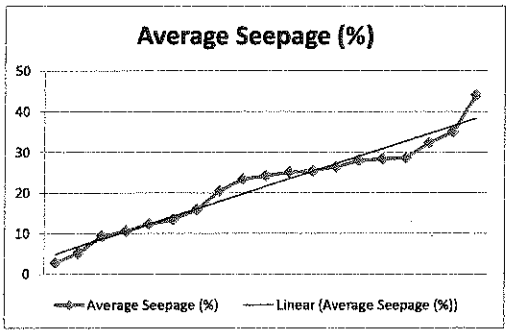


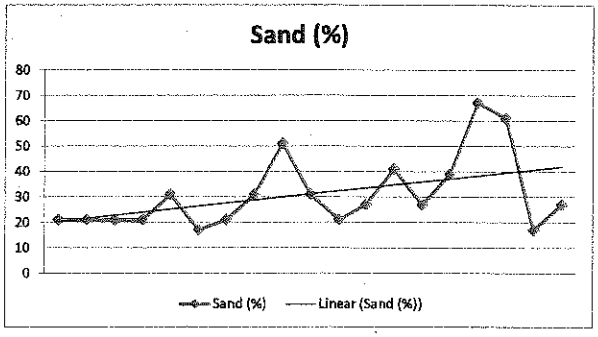
TABLE 2
SOIL TEXTURE AND SEEPAGE COMPARISON

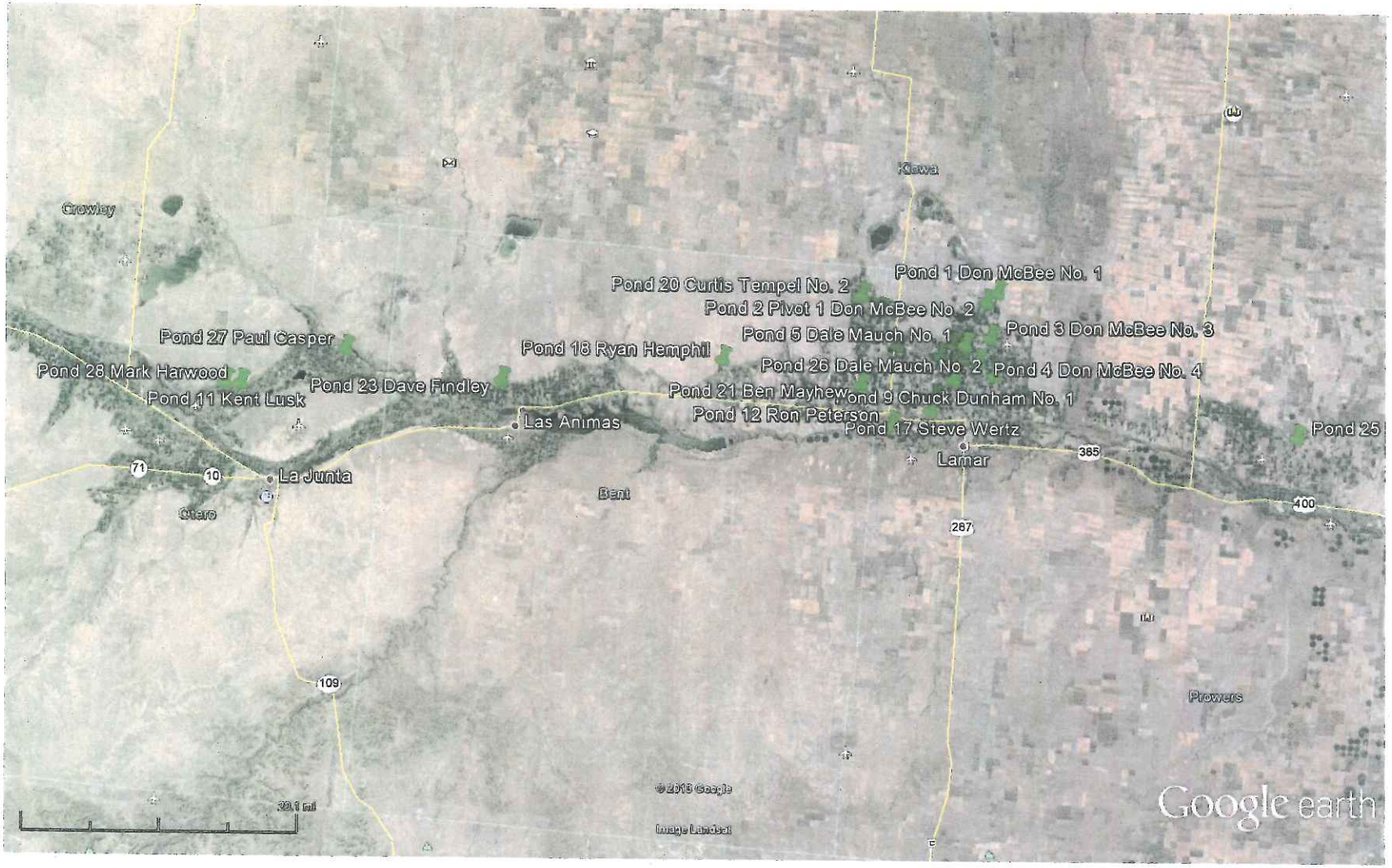
Study Pond Number	Water Source	Average Seepage (%)	Texture	Sand (%)	Silt (%)	Clay (%)
5	Ft Lyon	2.8	Silt Loam	21	56	23
21	Ft Lyon	5.2	Silt Loam	21	66	13
4	Ft Lyon	9.4	Silt Loam	21	60	19
16	Ft Lyon	10.6	Silt Loam	21	62	17
20	Ft Lyon	12.3	Loam	31	50	19
15	Ft Lyon	13.4	Silt Loam	17	58	25
9	Ft Lyon	15.9	Silt Loam	21	60	19
26	Ft Lyon	20.5	Loam	31	50	19
11	Holbrook	23.4	Loam	51	30	19
1	Ft Lyon	24.2	Silt Loam	31	60	9
22	Ft Lyon	25.1	Silt Loam	21	56	23
10	Ft Lyon	25.4	Loam	27	48	25
24	Ft Lyon	26.4	Clay Loam	41	30	29
14	Ft Lyon	28.0	Silt Loam	27	60	13
8	Ft Lyon	28.4	Loam	39	42	19
2	Ft Lyon	28.7	Sandy Loam	67	14	19
27	Holbrook	32.3	Sandy Loam	61	22	17
7	Ft Lyon	35.0	Silt Loam	17	60	23
3	Ft Lyon	44.0	Clay Loam	27	38	35










Crowley
Kiowa
Pond 20 Curtis Tempel No. 2
Pond 1 Don McBee No. 1
Pond 2 Pivot 1 Don McBee No. 2
Pond 3 Don McBee No. 3
Pond 27 Paul Casper
Pond 5 Dale Mauch No. 1
Pond 18 Ryan Hemphill
Pond 28 Mark Harwood
Pond 26 Dale Mauch No. 2
Pond 4 Don McBee No. 4
Pond 23 Dave Findley
Pond 21 Ben Mayhew
Pond 9 Chuck Dunham No. 1
Pond 11 Kent Lusk
Pond 12 Ron Peterson
Las Animas
Pond 17 Steve Wertz
Pond 25
Lamar
385
71
10
La Junta
Otero
Bent
400
287
109
Prowers
32.1 mi
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Google earth

RE: story

From "Eve McDonald" <Eve.McDonald@state.co.us>
To '"donald034@centurytel.net"<donald034@centurytel.net>
Date Tue, 12 Mar 2013 21:59:53 +0000

Hi Don. I am sorry you are still troubled by the ISAM's assumption for pond seepage. It was based on data from a Colorado State University Irrigation Management Practices Study, not on any Gunnison study. There was not any lawyer involved in coming up with the number. The ISAM was peer reviewed by a large committee of engineers, and they all found the pond seepage assumption to be appropriate. Again, I'm sorry you are still dissatisfied with our Stipulation on this topic, and will keep my fingers crossed that your Pond Study shows a higher rate.
Regards,
Eve

-----Original Message-----
From: donald034@centurytel.net [mailto:donald034@centurytel.net]
Sent: Saturday, March 09, 2013 9:39 AM
To: Eve McDonald
Subject: story

Hello, I heard story last week about pond leakage in ISAM. I am sceptically, this is crazy enough to be true or this was made up to take blame off of Lynard-Rice. I am sure if it were true that you could not confirm it but you could state it as false. The State was going to use the Gunnison pond study and give us a 12% loss. Dennis Montgomery said we better cut that in half to be safe and go to 6%. And Steve Witte said that to really be safe we need to cut that in half and go to 3%. Is that true? Don McBee

Page 1 of 1

pond loss

From "Ryan Hemphill" <ryan.hemphill@centurytel.net>
To <donald034@centurytel.net>
Date Wed, 21 Aug 2013 15:59:33 -0400

Don,
During the the drafting of the Irrigation Improvement Rules in 2008 I was part of the technical committee that evaluated the ISAM model. While most of the assumptions used in the model (like canal seepage losses, on-farm losses, and SEV losses) were set by the HI Model (and therefore not debatable), two major variables were argued: sprinkler application efficiency and pond loss. At the time, CSU was still involved in the field collection of irrigation data related to these two factors but the final report on this project would not be released for several more years. If I remember correctly, the division engineer's office made suggestions for sprinkler efficiencies based upon published literature (you would have to ask Bill Tyner about this) and pond seepage losses based upon on-farm (ditch) losses. There were a few in the committee who didn't think pond losses needed addressed at all in the ISAM model. Even though CSU was able to estimate seepage losses on three ponds during its study (that were higher than the ISAM assumption), there was not enough statistical signifigance to apply this loss to all ponds in the valley. So in short, the division engineer's office decided to use a lower pond seepage loss number until a time when another study could prove that a different pond loss number was more appropriate. The story is similar for sprinkler efficiency. The 85% was used to essentially keep other water rights "safe" while still allowing for adjustments later on as better data became available. As far as I know, none of the data from CSU's report "Irrigation Practices, Water Consumption, and Return Flows in Colorado's Lower Arkansas River Valley" has ever been used in the ISAM model or the HI model. Hope this helps. Please email me at this address from now on.

Ryan

Ryan Hemphill
1104 S School St
Hasty, CO 81044

Question on Sprinkler Efficiency

From "Tyner - DNR, Bill" <bill.tyner@state.co.us>
To "Donny McBee"<donald034@centurytel.net>, "Don McBee"<quail42@centurytel.net>
Cc "Dick Wolfe - DNR" <dick.wolfe@state.co.us>, "Steve Witte" <Steve.Witte@state.co.us>, "Evelyn Mcdonald" <Eve.Mcdonald@state.co.us>
Date Wed, 19 Jun 2013 07:48:10 -0600

Don,

You wrote a message that Dick Wolfe received that stated:

> Hello, Yesterday we got 1/2 in. rain everywhere. Today we got 1/2 in. at north end, 2 1/2 in. at sw end, 3 1/2 in. at se end. The dumb thing is that we have water at the sw end. The sprinkler is on tracks and it looks like a sprinkler floating on a lake watering fish. The dumber thing is that we have to turn on everything else Tues. afternoon. The May Valley Drainage is flowing bank full on both east and west sides and I have an 85% efficiency rating on those sprinklers. A well person would have turned off yesterday and would not turn on for a week. You should be able to change the efficiency down in ISAM because that kills our efficiency. Don McBee

The ISAM uses a maximum efficiency of 85%, but that is just the cap, and it will reduce that to a lower "improved condition" efficiency rate if the water balance it computes for your field (which includes diversions and precipitation and several other factors) is high, like you've described. So, let's wait to see what the ISAM calculates for your efficiency on those fields under the improved condition for the month of June... I expect it will be below 85%. Note that the maximum flood efficiency under these conditions (65%) would likely also not be the calculated efficiency for the unimproved condition. You are welcome to let me know if you would like to see the result for your farm after the June numbers are input into ISAM.

Thanks

Bill Tyner, P.E.

Assistant Division Engineer

State of Colorado, Division of Water Resources

310 East Abriendo Avenue, Suite B

office: 719.542.3368x2110 | fax:719.544.0800

email: bill.tyner@state.co.us