

Middle Pecos Groundwater Conservation District

Minutes of April 15, 2008

On this the 15th day of April, 2008, a Regular Session of the Middle Pecos Groundwater Conservation District, of Pecos County, Texas, met in the Courtroom of the Pecos County Courthouse, Fort Stockton, Texas located at 103 West Callaghan with the following members present, to-wit:

Glenn Honaker	President, Precinct 1
John Dorris	Vice President, Precinct 3
Noemi Navarrete	Secretary/Treasurer, Fort Stockton
Jack McIntyre	Precinct 1
M. R. Gonzalez	Precinct 2
Merrell Daggett	Precinct 2 (appointed at this meeting)
Lynn Holland	Precinct 3
Alvaro Mandujano, Jr.	Precinct 4
Bart Reid	Precinct 4
S. Evans Turpin	Iraan
Houston McKenzie	At Large

Others Present: Paul Weatherby/General Manager, Melissa Mills/Office Manager, Bob Varmette/Fort Stockton Pioneer, Brad Newton, Bill Johnson, Jed and Jean Ann Elrod, Zan Matthies, Doug May, Powell & Nancy Tarter, Victor Gene Robbins, Alyson McDonald, Sharon Roosevelt, Roberta Dunn, Lynn & Martha King, Lee Harris, Weldon Blackwelder, Rafael Castillo, Jr., Trel Herrea, Joe Schuster, Brent & Lisa Sigmund, Thomas Kincaid, Dan Percy, Patrick Bliznick, Cindy Demel, and Frank Carpenter. Attending on behalf of the MPGCD: Mike Gershon and Randy Williams. Attending on behalf of Clayton Williams: Michael Thornhill, Darrell Peckham, Erin & Jeff Williams, Dr. Jim Duke, and Paul Dionne.

Call to Order. The meeting was called to order at 1:03 pm by President Glenn Honaker.

I. Consider and/or act upon minutes of February 19, and March 18, 2008. Item considered after agenda item #IV.

II. Comments from Public and Media (limit 5 minutes per person). President Honaker recognized Mr. Jed Elrod with the Texas AgriLife Extension service, and also recognized Mr. Bob Varmette with the Fort Stockton Pioneer. There were no comments from the public at this time.

III. Consider and/or act upon Board of Director for Precinct 2. Houston McKenzie made a motion to appoint Merrell Daggett to the unoccupied position for Precinct 2, followed by a seconded by John Dorris, and the motion unanimously carried. Merrell Daggett took the Oath of Office at 1:07 pm. His term is through May 2010.

IV. Consider and/or act upon CWI Independent Groundwater Study.

Mr. Honaker recognized Mr. Jim Duke who began by stating the study began in February of 2007 and ran through March 1, 2008. There are meters that remain in the field as of today which are measuring water levels in the aquifer. The study concentrates on the Belding/Leon Valley area of the Edwards/Trinity aquifer. The study is comprised of water quality, the amounts of water pumped, and water levels. Dr. Duke then introduced Michael Thornhill who proceeded with the Power Point presentation that contains the data they have compiled.

See Attachment A

No Action was taken at this time.

Recess from 2:33 pm – 3:03 pm. Pres. Honaker called the meeting back to order at 3:03m.

Agenda Item I. Consider and/or act upon minutes of February 19, and March 18, 2008.

Upon review of both sets of minutes, John Dorris made a motion to approve both set of minutes which was seconded by Noemi Navarrete and the motion carried.

V. Consider and/or act upon Resolution – Verdes Solaris Project

The resolution seeks a willingness to negotiate a tax abatement that would be mutually beneficial. The proposed project will produce renewable energy to provide electricity for the state of Texas and expand the area's and county's support of renewable energy.

Paul Weatherby began discussion by stating that on January 14, 2008, that Pecos County adopted a resolution supporting the Verdes Solaris Project, and that our pending resolution mirrors their resolution.

Doug May, Pecos County Economic Development Corporation Director, presented to the board an overview of the Verdes Solaris Project. Verdes Solaris is a 100 mega watt solar project. The proposed site is on the north side of I-10 and about 15 miles due west of Fort Stockton on city property. This was formerly known as the Riley property. The resolution is non-binding. The project is expected to cost around 600 million. The resolution states that in good faith we will work with them. The engineers have been here and we have had financial groups in Fort Stockton from Europe, but the project is never a done deal until they break ground. Upon completion of his presentation of his knowledge of the project, and answering all questions put forth by our Directors.

Lynn Holland made a motion to approve the resolution, and was seconded by Alvaro Mandujano, Jr. The motion was unanimously approved, and the resolution was signed by all directors.

VI. Consider and/or act upon Drilling/Production Permits for 2-D's Oilfield Services

A general overview of the situation was given by Paul Weatherby: Well #1 has previously been approved with no problems. Well #2 was drilled out of compliance of our spacing rules.

They were advised of the spacing rule when they asked for approval from Paul Weatherby. Once they witted the water they drilled 65' from the property line which was discovered just prior to well completion, and they were notified of the violation. Manager Weatherby allowed them to case the well – but not equip the well. They dropped the casing in and capped the well with a PVC cap pending board review. 2-D's then applied for a variance which was denied at the meeting on February 19, 2008, due to fact that the neighboring landowners had not replied to his letters that he was required to send. Once the variance was denied, he was allowed 20 days to ask for a rehearing which he did not request a rehearing. Today we have a consideration to order Mr. Spencer of 2-D's Oilfield Services to plug or cap the well.

Mr. Spencer met this morning with Mike Gershon, the attorney for MPGCD, and Paul Weatherby. Mr. Spencer is asking us to let him permanently cap the well, due to the fact that he is currently trying to buy the neighboring properties which would bring him into compliance if he is successful. Meanwhile, he will not use the well.

Manager Weatherby recommended that MPGCD order him to cap the well. He has already installed a 4"/6" cap on the well. Our rules and state rules require the cap must support 400 pounds of pressure and prevent the entrance of pollutants and contaminates into the well. He has complied with that, and may drill another well if he can not buy the neighboring property.

A motion was made by M. R. Gonzalez to order 2-D's Oilfield Services to cap Well #2. The motion was seconded by Lynn Holland, and the motion carried unanimously.

VII. Consider and/or act upon the Account Payable, Treasurer's Report and Line Item Transfers.

The reports were reviewed, and all questions were answered. Lynn Holland made a motion to approve the account payable, treasurer's report and line item transfers which was seconded by Alvaro Mandujano, Jr. Passed unanimously.

VIII. Consider and/or act upon Resolution of Comanche Springs Cienega.

The project involves the development of trails, platforms, signs and kiosks along the Cienega, headsprings, and canals and will provide programs to promote historical public awareness, training, safety and volunteer service opportunities within the communities. After a brief discussion, Bart Reid made a motion to approve the resolution, seconded by John Dorris, and the motion carried.

IX. Consider and/or act upon Order of Cancellation of MPGCD Election

A motion was made by Houston McKenzie to Order Cancellation of the MPGCD Election to be held May 10th 2008. Cancellation is due to all candidates were unopposed. Those candidates filing for re-election were M. R. Gonzalez/Precinct 2, John Dorris/Precinct 3, Alvaro Mandujano, Jr./Precinct 4, and Houston McKenzie/At Large. The city of Fort Stockton did not have any one filing to fill the expired term. The motion was seconded by Merrell Daggett, and the motion carried unanimously.

X. Consider and/or act upon MPGCD Mileage Reimbursement Rate.

The Pecos County Commissioners' court has set the 2008 mileage rate @ 50.5¢ per business miles driven. A motion was made by M. R. Gonzalez and seconded by Evans Turpin to increase the mileage reimbursement rate for MPGCD to 50.5¢ per mile. The motion passed.

XI. Consider and/or act upon Progress Reports, Well Registrations, Production Permits, Drilling Permits, Data Loggers, Water Analysis, and Audit.

Well Registrations: The number of well registrations stand at 2,683. This number is the same as last month. There are 15 registrations coming in from SandRidge and several miscellaneous. Mr. Weatherby suggested that we send out a courtesy letter to land owners that have not registered their wells before taking legal action.

Production and Drilling Permits: Fort Stockton High School is going through the process of having a new well drilled; this well will be for irrigation for the playing fields and is located behind the WRTTC. The permit hearing is expected to come up at our next meeting.

Data Loggers: There are 4 data loggers remaining to install to monitor the static water levels. We may need additional data loggers after visiting with Randy Williams.

The water analysis program is going good and the preferable testing method is the petroleum hydrocarbon testing. A well owner called and is having trouble with sulfur smells in the water. Calls made by the well owner to the Texas Railroad Commission have gone unanswered, and he called me. MPGCD will be going out to test the water soon and also test area wells to try to get answers.

XII. Consider and/or act upon Groundwater District(s) Correspondence.

Regarding a question that was asked of Mr. Weatherby previously about whether or not to consider the part-time position as an employee or contract labor, the answer is an employee. Mike Gershon concurs with this decision.

The following meetings are coming up if any Board members would like to attend with Mr. Weatherby: 1) April 28 Region F meeting in Big Spring, 2) April 29 & 30 TAGD (Texas Alliance of Groundwater Districts) meeting in San Angelo.

A rider for \$21 was added to our auto insurance policy in the event that Bill Johnson may be driving the MPGCD vehicle.

XIII. Consider and/or act upon Agenda for next meeting. Discuss raising the current per diem rate to the State Level, the high school well, and board reorganization.

At this time, the Board recognized Noemi Navarrete and she was honored with a plaque of appreciation. This is her last meeting.

Evans Turpin made a motion to adjourn, seconded by Lynn Holland. The motion carried, and the meeting adjourned at 4:15 pm.

Secretary/Treasurer

Glenn Honaker, President

Date Approved

Middle Pecos Groundwater Conservation District
ATTACHMENT A

Agenda Item IV.

Dr. Jim Duke began the presentation of the study. The study began in February of 2007 and goes through March 1, 2008. The study concentrates on the Belding/Leon Valley and Edwards/Trinity aquifer area. Meters remain in the field as of today measuring water levels in the aquifer. The study includes water quality, amounts of water that were pumped and water levels.

Dr. Duke introduced Michael Thornhill and turned the presentation over to him. Mr. Thornhill explained that he and Darrell Peckham have put the presentation of facts together. Thornhill began the power point presentation. This project is centered around the Williams farm area and then extended out to include the Leon-Belding area. The study will show that Leon/Belding area interacts with close proximity areas, primarily showing the Leon areas and the south of Belding area and east of Fort Stockton and due south. The purpose of the study was to obtain information regarding the aquifer and well conditions. Information was compiled gathering as much useful data as possible and put into usable formats that can be used for the present and future.

The primary purpose was to assess the long term groundwater conditions in the locale-Leon and Belding general area and the Edwards-Trinity aquifer under various pumping scenarios. The objectives were to present the regional and local hydrogeologic settings, including present geology, hydrologic units, hydraulic parameters, permeability, storage, transitivity, discharge and recharge concepts, and to look at specific well conditions, the particular wells at various water levels, how productive is the well and why. Specific capacity of a well is the most useful thing a district can require a system to put on a well registration sheet. They looked at well yields and trends in water levels and trends in water quality and assessed groundwater conditions, evaluated the effects of drought, and estimated long term conditions with projected pumping. Mr. Thornhill was able to compile the information from the MPGCD and other data sources into GIS formats and to make map cross sections and recommendations for the Leon/Belding area and district.

The study area is generally the Leon/Belding area. Also includes hydrogically interacting areas and aquifers. Thornhill refers to the study as "The Water Study". Well records were utilized to create the diagrams for key wells and old studies that show spring flows. They started out with background studies and compiled information from previous studies. They looked at geology and hydrology, looked at pumping and spring flow, water levels, water quality and isotope studies to see where the water originates, regional and local climate. They studied local and

regional rainfalls and soils, used aerial photos and satellite pictures to get an idea of the land use in the area during certain critical times and periods of times in order to see how many acres of land were irrigated. Pumping was hard to figure out, since there is so much of it, so the aerial photos were one way to go about it and to validate historic pumping records. The study includes records from Thornhill's office and state records to look at the fractures and cracks. In the Edwards/Trinity aquifer flow paths and production are somewhat controlled by these cracks and some of the rock formations have caverns in them and are fractured. There are faults that control the way the water can move. It enhances in some ways and blocks in others. More than 100 days were spent in the field logging, monitoring, testing and sampling. A few wells were monitored off the property. 9 wells were logged and videoed. Short term pumping test were done on 25 wells to see what the pumping rates are and what the specific capacities are. If you remember one thing, remember specific capacity which is the number of gallons per minute you can pump a well per withdrawal. It is a measure of the productivity of a well, and is extremely important to know.

Pumping records: Several wells were actually metered and gas records were monitored to try to verify how much water is pumped during long periods of pumping seasons. Then use that information and work backwards to see how accurate the previous records were for pumping. Pumping is the key. Farm records were used for comparison. There were 41 wells in which water levels were measured for 14 months. Currently water levels are being monitored every hour in 13 wells. 29 wells were sampled. Several of those wells were sampled seasonally during the winter when there was little pumping and then during the summer during heavy pumping to see what the variations were. The Texas Water Development Board has been monitoring several wells in the area and their data was referenced in this study. The data were compiled into a workable format. Diagrams, cross sections, charts and screens were created using the data. They wanted to nail down historical pumping and discharge from the aquifer. They took the information and compiled it into a groundwater flow model, now known as the groundwater availability models (GAM). First of all they looked at the Texas Water Development Board's (TWDB) version of the GAM's and then ran their own GAM because they didn't really like the one the TWDB had done, it was unsatisfactory. The model is based on a realistic representation of geologic structure. What we have is a very good geologic model that shows the shape and the orientation of the rocks out there and put that in the model. The model that they constructed is huge and covers the Edwards/Trinity aquifer. It's not very applicable to looking at all of Pecos County or even a small part of Pecos County. A model was created that fits within the regional structure, but models more on a detailed basis an area. We put into the model-not only where the pumping comes from, based on the MPGCD's records, but also based on well records where the most productive areas are and where the lesser productive areas are. We calibrated all the historic records from 1980 to the present. There are several important ground-water supply factors. They include the geologic

character and geometry, the shape of geologic units, confining units, faults, and boundaries. Hydrologic and hydraulic characteristics, meaning again porosity not particularly in the caverns that we call secondary porosity where a cavern or fracture has been dissolved out.

Hydraulic Conductivity: You've heard of this in the oilfield as permeability. Transmissivity, which is the same thing as hydraulic conductivity except it includes the aquifer thickness. Sources and spacial distribution of recharge. I don't like recharge as a term, it would be more of an influx of the aquifer. Amount location and duration of discharge either by natural means via springs, seeps, underflow, leakage or evapotranspiration, or by pumping. Also, the quality of water is a useful parameter. And then, hydrologic effects. What happens if this water is pumped and the hydrologic effects are _____ by the year total? The Groundwater Conservation District Board decides as to how they want to regulate.

Geology. The geological control here is very pronounced. These pictures here show mostly the limestone of the Edwards aquifer that over live the Trinity Sands. I know y'all are familiar with this- the Edwards/Trinity consists of limestone of the Edwards formation and the under lying unit is the Trinity aquifer and locally is called the Trinity Sands. Here is the down hole video where you can see an area where the rock is pretty tight at the top of it – and then all of a sudden “BOOM” a cavern/cavern/fracture/cavern – so those areas of production and productivity of the aquifer as well as the well. All is underwater @ 267' deep. Now if I drill a well on my place – I want a cavern like this @ 267' deep. As you might expect, water can move through those caverns and fractures quickly. The Trinity Sand on the other hand – water can't move through it as quickly, and it's a little bit more broad. So it acts as a two-fold system – you have the quicker moving productivity of the Edwards and then you have the slower in-filling from the Trinity underneath which actually helps to keep the Edwards full. So it's kind of a two component flow system. There are 2 geological structural troughs. These 2 troughs converge and actually funnel water toward the Leon/Belding area. The one to the west/southwest is known as the Hovey Trough/Hovey Channell. It is a scoop like feature and channels the water.

It is Thornhill's guess that the low spots are tied to the high productive areas. Because when water levels decline – these low spots would still produce water. Higher areas – we call them flanks – don't produce as much. There are some wells historically out there that pump good during irrigation season, but died off during the summer. The water flows from the Glass Mountains on a steep grade. Williams Farms (Stockton Farms) has the southern most farm as the Mesa Farm and the northern is the Stockton Farm. You can look at certain areas and there is a lot more production than in other areas, and it's all because of the shape of the geology. And because of the aquifer size – when you go north and get into the

Alluvium aquifer, although there's some good production, it is not like this. The trough is a north to south trough.

Water levels. Water levels are probably the key to understanding the hydrological system. There are two wells (had records for one well and combined the two wells adjusting for elevation). Well 52-60-802 which is the Pecos well in the middle of the prison yard. The records started in the mid 50's and continue to the present. The amplitudes shown are the difference in water levels due to pumping cycles between winter and summer. It illustrates rapid draw down and rapid recovery. It also shows from the 1970's to now there is an overall recovery of water levels in the aquifer. As you can see, the current water levels are comparable to the levels in the 50's. 70' to 80'. For fluctuation on key wells in 50 – 60's 20' and 20' in 70's, in 80's no overall water loss. 50' – 60' in 2000/2005 and 40-50" more recently. The groundwater gradient -water flows down from the Glass Mountains, if the gradient is steeper and all other equal – then that flow is higher than if the gradient is flat. So during pumping periods we have more flow that's leaving the Leon/Belding area. When pumping is at the highest - the gradient flattens – so, some of the water that usually flows past is captured.

There is always – always water leaving the aquifer in the Leon-Belding area. The other thing about gradient: The grade may be steeper in some places and flat in some places and a lot of times the flat gradient, especially around the Leon/Belding area is a large flat area and illustrates a high transmissive zone complex. High transmissivity means highly productive wells.

The other thing is to understand about it is sometimes a gradient may point like water is going one way – but it's not really flowing that much, that way. The reason is because of faults and cracks. He believes caverns, faults and cracks are affecting our flow. There is a component of flow that goes toward the north east because of the fracture.

Another thing – when the system is not pumping – there is a certain amount of water coming in and going out. When the well is turned on and starts pumping the area of contribution changes and gets bigger. Water levels are lowered out to the edges and the water gets – it may be just a little bit – but it's over a big area which allows water to percolate into this productive area. So more water actually comes into this system when it's being pumped, than when it's not being pumped. Past pumping is much greater than the current pumping, based on historical records, crop areas and water usage.

This picture in 1972, 19,800 acres approx. are being irrigated. In 1952, 5,500 acres in this area, in 2005 almost 12,000 acres being irrigated. So there's a peak in the 1970's compared to where the pumping is now. There is a lot of difference. Past pumping is much greater than current pumping. The state estimates for irrigation are flat. They are low. They are based on an irrigated acreage of a

factor of 2 ½ to 3 acre feet per acreage interval. Which we think is pretty low compared to what really goes on around here.

A county wide production from the 60's, in Pecos County, the highest reported was 335,000 acre feet per year. He estimates that to be a little bit low, but that's the highest reported. Now the state reports that in all the county is 75,000 acre feet per year. But what it does illustrate is a dramatic decrease in pumping capacity?. Our estimates – the high pumping from the Edwards/Trinity aquifer does not include the Alluvium, and was between 100,000 to 120,000 acre feet per year. And in 2005 we saw almost 60,000 acre feet per year. So 50 to 60% less.

Historic pumping during this time – you can see the light green line here is the historic and existing use permitted amount issued by the District for the Edwards/Trinity aquifer and the Leon/Belding area. So you can see that historically the pumping was much more than what the permitted amount is now.

Alvaro Mandujano, Jr./Director: How many acre feet to the acre are you figuring the 60,000 acre feet on? The answer was 5 ½. In 2006/2007 that's what we monitored on the farms. That's just less than what the historical and existing use allows.

Water quality. The quality area shows very little difference in the summer. The TDS is a little higher, which is a good indicator of the mineral content. Fluoride and sulfates are a little higher during the summer, and probably comes from that dual flow system. In that there is a little more water coming in – as the head comes down and water levels goes down from the upper aquifer – more is contributed by the lower aquifer – when water moves slower it takes longer to get more minerals in it. So there's probably more contribution from the Trinity aquifer during the summer months. The seasonal fluctuations are relatively small. Water quality studies – The water comes from a big area, and the water moves relatively fast. There are variable contributions from the Trinity and/or the Rustler.

There are studies that show the Rustler separated by quite a bit of confining layer. A simple leakage calculation shows that there can be a considerable amount of water flowing up to the Edwards/Trinity. And there are studies done by the state recently that show there's a lot of water from the Rustler flowing into the Edwards/Trinity.

Now, explanations of fluctuations and water quality. In flows and out flows. Certainly we know this – there is enough water being captured in this area to support all this or more pumping. Since 1955 the average pumping from the Edwards/Trinity in the Leon/Belding area is 77,000 acre feet.

Roberta Dunn/Visitor: **In the winter time the springs flow at Comanche Springs in Rooney Park. Why can't that water continually flow if there's that much excess? Michael: Because it's like a bathtub with the little hole that keeps it from over flowing, it over flows as long as the water level is above it. As soon as the water level drops below the opening – the over flow stops. Even though the aquifer is still full, it just doesn't reach the hole at the top of the system. At springs all over Texas , the opening is right at the top of the aquifer and there's a ton of water below it, but the springs will quit flowing.**

Houston McKenzie/Director: **Have you got calculations on – like if Clayton sells water to Midland – and instead of pumping ?, he pumps a little less all the time – water levels in that aquifer – wonder where it'll be and how do you know the springs wouldn't give out? I mean it is possible. Michael's response: We have not done those calculations. We have thought about it.**

The recharge occurs, there's not a No-Recharge, it just happens to rise up.

Brent Siegmund/Visitor: **Reports of Leon Springs, when they flowed, there were reports of two different kinds of water flowing from each of the different spring modes. Could this be some of the Rustler water and was actually pushing up some of the Trinity water in that spring area? And if so, how many free flowing Rustler wells are there in Belding right now that might be relieving that pressure that keeps those springs flowing? Michael's response: It's a good thought/concept, but I don't know the answer. But yes it certainly could be, it could be, it's not something that we've studied.**

I calculated a leakage calculation and it's very thumbnail because the permeability across the formation that separate the Edwards/Trinity from the Rustler, that is unknown, so reasonable guesses were made – and it could be a few 1,000 gallons a day per square mile on the low end – or it could be like a million gallons per day per square mile. Those are reasonable calculations, but we just don't know. There are also faultings and fractures affecting this. Most of the recharge comes from mountains to the south. With a large rain area and when it rains, it goes through the sandy areas and seeps in. But, it's a large contributing area. There's a lot of water that flows down that trough whether there's pumping or not.

Well capacity. Well characteristics, we've talked about the difference in Edwards limestone karst wells versus Trinity sandy wells – production areas – the Alluvium, although it can be very productive – you get a lot more draw down per gallon in the Alluvium.

Again, we talked about troughs and subterranean uplands. Certainly wells within troughs can be productive under all water levels. Yields are more consistent in troughs. They are typically less in areas without cracks and caverns.

The pumping rates on the farm range from about 1,000 – 3,000 gallons per minute. At least one well could actually pump more than 3,000 gpm with larger casing and a big enough pump. Some of them hit those caverns and they make some water. The specific capacity ranges from for every one foot you can get 30 gpm, and the draw down is 40' for a total of 1,200 gpm or for every one foot you can get 100 gpm with a draw down of 10', resulting in 1,000 gpm. The water level changes aren't that much, other than the springs aren't flowing. And large pumping along the flanks-irrigators that pump along the flanks- they're wells would decline to 300 or 400 gpm in the summer.

Modeling: We calibrated to historic conditions, and again to say the State did not do a good job of representing Pecos County on a local level, particularly in the Leon/Belding area.

The TWDB GAM is a very broad and gross model. So we've built a model representing more closely the local conditions. Certainly we don't claim this model is perfect, or that it has every little detail of the system – but we did the best we could to build a model that reflects the data we have. And again, there are good data records for the Leon/Belding area on water levels, geology, and pumping rates.

(Referring to the Power Point) The light blue is a hydrograph for a local well with records from 1981. The dark blue is the hydrograph for simulated pumping. We had a very good correlation between the measured and simulated water levels using the pumping as well as water levels that were entered historically. The model shows the flow from south to southwest, preferential flow to the Leon/Belding area. The pumping amounts we used were the historical and existing use permits. The permits you've granted, that's what we set as a limit on pumping. The model shows that more than that can be pumped and more than that has been pumped.

So, our key findings are these: we have good data in Leon/Belding area to work with, and we were able to apply our field work. Groundwater users should support long-term monitoring. So the more monitoring the better understanding of the aquifers. The information will allow the District to manage conditions more effectively in this part of the aquifer as well as others, if they monitor other areas, especially pumping water levels. These are the key factors: pumping – water levels – specific capacity of the wells – water quality.

One thing we did see in the District's data base – *he found a chart* – this shows the Leon/Belding area – this is the study area – and this shows from the district's data base – the distribution of historic and existing use pumping permits. The green wells are Edwards/Trinity – the brown/tan are the Alluvium/Pecos Valley – the Rustler's in there – and some unspecified. In this study area – the total of

96,371 acre feet per year is permitted, of that 63,923 is the Edwards/Trinity, and 21,482 is the Alluvium, and 5,971 is the Rustler. In this area and this is directly from the Districts data base – the Leon/Belding area – the total permitted pumping amount is 79,760 acre feet per year, of that 59,963 is the Edwards/Trinity, and 9,379 Alluvium/Pecos Valley, and 5,970 the Rustler. We think maybe some of this is not the Alluvium. There's a difference of about 9,000, and we think pumping from the Edward/Trinity is somewhere between 59,000 and 69,000. There's also some pumping that goes on that's not permitted. We think that's included in our historic numbers because it's based on crop irrigation usage.

Paul Weatherby/District Manager: When you say it's not permitted – you mean it's not put into our data base under the historic use program? Michael: That's right. They can pump their water – pumping is not illegal. Paul Weatherby: Well, there's 44,000 acre feet on Mr. Williams, permitted through the historic use. There are farms that didn't participate in any program other than the registering of wells, so that's an unknown too.

Michael Thornhill's other recommendation to the District is that as the state goes through this management process for groundwater – the groundwater management areas – establishing future desired condition – from there the state will take those and they'll say "Now OK we're gonna give you back what your managed available ground water is (MAG's)". Those processes as a board – our recommendation is to scrutinize and use caution in those processes. You need to really understand what you have before you in-trust that to state management. I know that y'all agree with that, but from what we see – particularly coming in and modeling this one area – and study the data in this one area and see what it does, compared to what the state says – it really opened our eyes.

Again, hydrogeology is the key, it controls the groundwater conditions – the pumping distributions and water quality in the Leon/Belding area. The unique hydrologic and geologic conditions converge in the Leon/Belding area, and it also dictates the production and water quality in other areas. Water is funneled to prolific production areas. And rainfall, local rainfall is not a big factor.

As for future pumpage – if you can see – the yellow- this is what the state reported from irrigation studies back in the 60's – that's 339,000 acre feet and then a big decrease and now they say it's around 70,000 – 75,000 acre feet for the future. That's their projections. Fluctuations in production maybe due to the aquifer – but doesn't affect the Leon/Belding area. The aquifer is recovering in the Leon/Belding area. Of course, economic considerations have caused most of the reductions in pumping. The future projections show no significant increase in irrigation pumping. So, we think, we know, that the District in the Leon/Belding area – the historic and existing use permit amounts can be pumped on a

sustainable basis. And actually more than that can be pumped on a sustainable basis, especially the Leon/Belding area. Some of the evidence in previous studies show that it's possible in the county. Based on recharge reported for the total county and what's used.

The water levels have recovered, historic pumping is much less than it used to be. Our model confirms this historic information very well, which clearly says more than this can be pumped. Drought is not a primary influence.

This is key here, pumping at the historic and existing rates allows for a safety factor in our view. Of possibly several tens of thousands of acre feet. While this study involves complex groundwater system conclusions – the answers are really straight forward.

The studies and ground work that's been done allows for verification and validation and allows for verification, validation, and working within historic known information. We didn't go out there and say "OK, what happens if we pump 3 times as much" – we stayed within the historic known.

The information available reduced the need to rely heavily on theoretical concepts and allowed for minimizing assumptions. In fact we put the model together based on the geology and the water levels that we know and it matched the historical information. So we believe the information is very good and we didn't come up with theoretical things – we worked within historically knowns.

Now this one we may or may not disagree on – the highest pumping and the Drought-of-Record will likely never happen again together. While the Pecos County pumping was 3 times more according to the state, 4 times what it is today – we also had the Drought-of-Record going on at the same time. Those two conditions converging again are highly unlikely. Unless economics of farming change drastically.

Again, from our stand point to work with what's happened in the past versus what's going on now, there's a whole lot of – even if it gets bad – there's a whole lot of room to play with in these studies. In geology we have a saying "The present is the key to the past." In this study, the past is the key to the future. What happened in the past is known and understandable and helps us with the future. So, that's all we have.

Paul Weatherby/MPGCD Manager: The irrigation records that they have/we have/or anybody can get from the late 50's to early 60's are fairly accurate. When you reach 1970 – 72 – 74 we have found major discrepancies in records at the Texas Water Development Board. The reason for that was as computers came into play, the government programs were all FSA, USDA, and others. The state people gathered this information from only those agencies. There maybe 6 or 8

large farm operations that did not participate in any program. So a lot of data was not as correct in the 70's and even last year we found discrepancies. The state agencies were pulling information entered by the various agencies. And as a groundwater district we are getting accurate data on what is really going on.

Michael Thornhill: We looked at historical pumping and verified it with aerial photos. It's hard to say the state's wrong, and it makes me nervous. As the data were gone through and calculated and estimated the pumping & history – the historic and existing permits during that time were right on. So we feel the information we have presented is accurate for that part of time.

M. R. Gonzalez/MPGCD Director: Asked about a comparison between Leon/Belding and Comanche Springs.

Michael: The springs started flowing again around 1987; we have not done a study on the direct correlation, although we are considering the possibility. The USGS in '87 or '92 report correlated water levels in one well to when the springs flow and do not flow. One of the things I don't know is how the conditions of the springs have changed in terms of where they spill or do not spill. So, I don't know the story. For example in 1899, there's a report that the springs flowed 65 million gallons per day, then in the 1940's they flowed 20 million less – why- I don't know. But we are looking at the water levels and we have not done a correlation. But certainly we know that what happens is that the springs stop flowing when the pumping begins.

The county has allowed us access to a well that's right by a spring out let. So even when they are not flowing, we are measuring the water levels. The springs have been measured twice, but we don't have a correlation between the pumping and spring flow. Thornhill will work up those relationships for the final report. The water level is right below the opening spill point during irrigation.

Alyson McDonald/Visitor: The groundwater flow model for your chart are following Darcy (porous media) equations to model groundwater flow and you know that does not ?? to all crack pressure flow or fracture flow or the ?? flow yet and how good do you feel this is?

Michael: I think it is very good. The reason is because of the calibration of the water levels. Overall the system as a whole is correctly portrayed, but if you point to a specific point in the aquifer – it may or may not be correct.

Alyson McDonald/Visitor: You don't think that's ?? . Sometimes in modeling, you get some results that appear to be real for the wrong reason.

Michael: Every bit of information that we weighed, fits. So did the in-flows fit to recharge calculations – pumping fit – everything fit – so, is it exactly the flow

paths? **No. But is the overall model accurate? Yes. This system is not controlled by fracture as much as the Edwards (near San Antonio) aquifer. This is known.**

Dr. Jim Duke: She has eluded to the fact that there is no such model for a fractured system. Therefore, the model that was used is the only tool that could have been used, and therefore is the best tool that could have been used. Fundamentally this model, the Darcy's model, is a porous medium model. An example of a porous model is here, the one Mr. Elrod brought for display. When you get these cracks and crevices where water can flow through these caves, it is more like a pipeline, so we should probably have a mix of those. I am not comfortable with this model, but when we compare it with all the things we have compared it to – like simulated water level with the measured water levels – the simulated pumping volumes that had been measured and compared it to the recharge and worked every different facet test sensitivity and was comfortable with it, then this is the best estimate we are going to be able to give you today.

A process called continuation, imagine a flash flood, the farther the water travels away from the peak the more normal the water level will be. The same thing happens in groundwater systems – except the continuation is much higher, and it flattens out. That is why a flood 1,000 years ago will not affect current levels.

Houston McKenzie/Director: Couldn't you put a test in the troughs to monitor the wells water levels?

Dr. Jim Duke: We would love to have had some test wells south of the property.

Paul Weatherby/MPGCD Manager: I am working with Brewster County now to work out a cooperative agreement to get with the scientist suggestion and with the people that have lived there for 40 years to find an area that we need to monitor or develop more data from Brewster County that directly contributes to Pecos County. They do not have access to any wells to my knowledge in Brewster County.

Dr. Duke: We had no access to any thing practical south of the Pecos County line.

Paul Weatherby/MPGCD Manager: The cooperative with Brewster County would be for all of Pecos County, not just this project. We are currently working on that to upgrade our information.

Unknown person: The speed of the transmissibility of the water recharge is faster when the water level is lower, right? Dr. Duke: It depends on the gradient entirely, it is the slope of the water table.

Michael: In the pumping area the gradient is flat. So the water passing Leo/Belding slows down. The grade may be steeper up north and move faster.

Paul Weatherby/MPGCD Manager: **Most of this water supply y'all are talking about is what comes from the Glass Mountains and the Davis Mountains. We don't know what water, if any, that comes from south of Fort Stockton, from areas we call the Allison Ranch and the Longfellow Ranch. The highest point in Pecos County is on the Allison Ranch, and we don't know if any of the water supply comes from that area of the Glass Mountains, correct? We are looking at the water that, basically, when you drive down the Alpine Highway going to Alpine and you look left and then right, it's coming from where the big radio tower is on the hill, and splits and goes to Coyanosa, and then comes to Belding, Fort Stockton, Imperial and to the river. The upper part of it has weaker wells. The wells 5 miles from town on the old Hollomand farms, between here and the orchards, etc., are what we call weak wells. Drilled the same depth and equipped the same way, but they are weak wells. We have determined (even before they started their study) that once you get to the mesa area to the farm land on Railroad Avenue, the water becomes tremendously more available or strong. Then cross the highway and get to the Hovey Trough, and go down the Interstate to the next set of mountains and the water is weaker.**

Alvaro Mandujano, Jr./Director: **Where in the Glass Mountains does the water run back to the Rio Grande?**

Paul Weatherby/MPGCD Manager: **We think it is down the Marathon Highway past Gene Lyda's country where it drops off to those flats on the Longfellow. But, I can't answer that scientifically. Simply because the wells between that area and this area are so weak we don't think there is much groundwater flow.**

Merrell Daggett/Director: **In the channels, do you have stacked layers of flow channels that are isolated from one another?**

Dr. Jim Duke: **I know they have found some perched water tables in places which means that you have water under flowing as well as water up above.**

Merrell Daggett/Director: **So, it loses water onto the lower channels?**

Dr. Jim Duke: **Yes, it would be like weeping through the layers.**

Michael: **There is a windmill out to the west and the water level is slightly higher than all the rest of them, resulting from the perched zones that are tight limestone.**

Paul Weatherby/MPGCD Manager: **The windmill is on Hovey Road west, west of Mesa Farms. That's where the meandering channels are?**

Dr. Jim Duke: **I don't know of any data that determines that.**

M. R. Gonzalez/Director: **Are you through with your studies?**

Michael: **We are writing the report right now. We are still monitoring water levels and spring flows.**

Houston McKenzie/Director: **Will we get a copy of the report?**

Michael: **Yes**

Dr. Jim Duke: **On the reports you will also receive the supporting data, models, forecasts, etc.**

Glenn Honaker/Director: **We thank you for presenting the data to the MPGCD Board and to the public.**