Introduction: Welcome to this event that is associated with the Book in Common. The Book in Common this year is Unquenchable by Robert Glennon. Robert Glennon will be here a week from today in Laxson Auditorium at 7:30 to give a public lecture on water crisis facing the United States. And we have here today a group of people with enormous expertise in that topic, in our local area in Butte County and surrounding areas, to address the issue of Best Practices in Agricultural Water Use. The Book in Common, Unquenchable, makes a fairly convincing case that America does face a water crisis. Ground zero of the water crisis in the United States is California and agriculture as the largest user of developed water in the state is front and center in terms of solutions to the water crisis in California and nationally and beyond. So it's very timely that we have this distinguished panel here to address the agricultural water use. Joining us today, we have Kelly Miller who is the Butte County Resource Conservation District Person, Christina Buck from the Butte County Water and Resource Department, Joe Connell, UC Extension, Dan Taverner of the Natural Resources Conservation Service, and Scott Turnquist also of the Natural Resource Conservation Service. So, we thank them very much for their time and coming to campus to show their expertise and look forward to what they have to say and a lively discussion afterwards. So, thank you all for coming.

Kelly Miller: Well thank you very much. My name is Kelly Miller and I'm the district manager for the Butte County Resource Conservation District. And I just wanted to say how honored and pleased I am here to be with you today to discuss Best Practices in Agricultural Water Use.
I'd like to just first review the agenda a little bit and let you know what each of our experts here are going to discuss. Christina Buck is a Water Resource Scientist as Bill mentioned with the Butte County Water and Resource Conservation Department. And she'll be giving us an overview of water use in Butte County and a current groundwater monitoring efforts as well as current subsidence monitoring in Butte County. And following Christina, we'll hear from Mr. Joe Connell, Former Adviser and County Director for the University of California Cooperative Extension. He'll be giving us a little bit more information about what really drives water use here in Butte County and how water applications are applied to be able to meet that demand. Afterwards, we'll hear from Dan Taverner. He's the district conservationist from the NRCS. And he'll be offering us information on the programs that the NRCS offers to local landowners for conservation practices on their own properties. And finally, to wrap it up, we'll have a talk from Mr. Scott Turnquist, Agricultural Engineer from the NRCS who will provide us with some highlights on local stories about detailed practices that people here in Butte County have put into practice. After that, we'll open it up for questions and answers. So if you wouldn't mind holding your questions and answers until that time, we'll be able to address them as much as we can with the time given, so. So I like to start also real quick by introducing the Butte County Resource Conservation District for those of you who may not know much about it. But we are formed in 2002. We're a subdivision of the State of California formed under Title 9 of the Public Resources Code. And what we really do is we work to protect, enhance, and support Butte County Natural Resources and Agriculture by working with the citizens on the ground and local landowners as well as public agencies and non-governmental organizations to be able to implement those practices on the ground.
And that's done through education such as a venue that we here see today and on the ground programs. We work throughout the unincorporated areas of Butte County and we really act as a liaison between private landowners and some of these programs from our agencies that are permsized to help them. We really rely on partnerships to be able to get this work done and that's one of the most important pieces of moving these practices forward. I can't speak highly enough of how valuable partnerships are in working towards issues such as water use conservation in Ag and other natural resource issues. So with this limited time, I'd like to just demonstrate one particular partnership to give an idea of how that works on the ground. And right here, this is a great example of a partnership where we've got a group of experts that's providing information to the public and the community about these issues, and how we're moving forward in Butte County to address them. Now, another approach that we could take on that as well would be in the format of, say, a half or full day among the workshop where in addition to the experts and the information, we also bring in maybe some of the folks that would give us specifics on yield association--oh sorry, yield associated with employing some of these specific practices or maybe we would get some of our local vendors in that area that could give farmers and landowners specific cost estimates of what it would take to implement some of these practices. So by using our partnerships with our agencies and our local organizations, and our partnerships with our local landowners, since we have such a good tie with the community, we're able to get all the folks at the table and move these programs forward. And with that, I'd like to just go ahead and turn it over to Christina who will be talking about some of the work done here in Butte County. So thank you very much for your time.
Christina Buck: Thanks Kelly. So, again, Christina Buck from Butte County. I'm going to just talk about the monitoring that we do as a county. Groundwater is an important resource for the county. And so, Butte County has an ordinance in place, a groundwater protection ordinance that outlines this monitoring that should occur that involves these three main areas: groundwater levels, water quality for evidence of saline intrusion and land subsidence. So this will be the focus of my brief talk here. And then, I just want to side note that there's lots of other water-related data available. The State of California Department of Water Resources collects streamflow data, there's precipitation data. So I'm not going to touch on those things that really can give us a good idea of our water resources. So this will be the focus. But that--certainly, that information is out there and available and if you are looking for it, feel free to come and talk to me afterwards.
So I just want orient ourselves a little bit. Here we are in Butte County, Chico is right up here, this. And so, I want to point out that about a third of the county is valley portion, about a third of it is foot land, range land, and the other third is mountain timberland. So our talk today is mostly going to focus on this Sacramento Valley area of our county. And water use is--primarily, this agriculturally-dominated and uses both surface water which is diversions from rivers and streams as well as groundwater. So the blue areas are areas that are dependent on groundwater, drill wells and pump from the ground to irrigate. And the yellow is surface water dependent. And those roughly match up to some degree quite match up with orchards generally in the north and then the southern part down by Gridley and then mostly rise in some wetland areas in this area that our surface water dominated. So I just want to point that out.
So for groundwater level monitoring, this is our grid. Again, Chico is right up here. And we have wells throughout, over 100 wells that are measured four times per year, in the fall, in the spring, twice in the summer, and then the fall for groundwater levels. So why those times? Spring, you have mostly recharge precipitation here, in the winter months, and so those are bringing the water levels up. And so spring level gives us the high water levels. And then irrigation begins through the summer and so your peak water demand is in July and August. So we capture that by measuring water levels at that time. And then at the end of the irrigation season getting a tap on where we at, at that point so we measure them as well. The red dots here are wells that went in since 1997. So this network is growing and continuing to grow. We put in the few wells last, last year. So it continues to add to the base to the information that we have geographically, as well as different aquifer systems in the area.
So some of them are domestic well, those are wells that serve household water use homes, some of them are Ag wells, quite a few of them are Ag wells. And then the more recent wells that are being put in are called multi-completion wells and these are wells that are drilled specifically for the purpose of measuring water levels. And multi-completion well has one hole that's drilled and then maybe three or four different PVC pipes that go down to different depths. And so, you can measure water levels from different depths of the aquifer.
So what does this data look like? This is all available online. So this is called a hydrograph, you have time across the bottom and then water level. And so, you can see that water levels go up and down. This is one of our longer records, so from the early 1940s or late 1940s. And water levels go up and down as we have drier and wet periods in California. Here, you can see where we’ve had drier years. 2011 is when this ends and that was a nice wet year so water levels came up. And then within a year, these spring levels, like I mentioned before, tend to be higher and the fall levels tend to be your lower levels. So we can take this data, take this and use it to learn a lot about the basin and the groundwater situation.
So I want to point this out, this is the CASGEM system. This is online website that is accessible. Or you can maybe see better kind of distribution of our wells within the county. So this data is available online.
So to mention groundwater quality, again, the have objective of this particular monitoring program is to evaluate the basin for evidence of saline intrusion. That is, we have fresh water, aquifer. And then deep below, there's a marine formation that has saline water, that saltier water. So the idea is that if the basin were to be over pumped, you could draw that saltier water into your fresh water supply. So to provide some baseline information, we have this network of 13 wells. They're a combination of irrigation wells as well as a few domestic wells that we measure pH, temperature, and electrical conductivity each year during your peak pumping periods, so July or August. And we have about 11 years of the data now. This is our 11th year that we measured this last summer. An electrical conductivity gives you a measure of how conductive is the solution or how well does the water conduct electricity. The saltier the water is, the better it will conduct electricity. So that's what the monitoring unit will tell you. And so to date, all these wells have fallen under the standard for agricultural water use which is 700 microsiemens. And all of them are below that or have been well below that in the 11 years of monitoring. So it's really just providing a trend like what are the baseline values for these parameters so that if changes were to occur, we could investigate that further.
And then just want to wrap up with subsidence. Subsidence is the gradual settling or sometimes sudden sinking of the ground surface. And this is often related to over extraction or pumping too much groundwater. So it's important because it can damage infrastructure like roads, canals, bridges, you know, if you have shifting ground. So we have five extensometers which are devices that measure very, very small changes in the ground surface elevation. And the first one went in 1999 and then others have been added, so now we have this five. And they record continuously. So to date, there has been no permanent subsidence in Butte County. And we're not as prone to it at some places. Clay layers tend to be the cause when you have over extraction of groundwater. It's your clay layers that compact and cause the sinking of the ground. And we, in Butte County, in our aquifer here don't have thick expansive clay layers that would make us more prone to this. So we keep an eye on it nonetheless 'cause it's important but we're not quite as susceptible to it as some other places. So with that, I just want to wrap up. We produce a report that touches on kind of the state of the basin each February, our department called the Groundwater Assess Report and that's available online as well as all these data is also available online. So thank you very much.
Joe Connell: My charge today is to give you a quick overview of what drives plant water use and how do we try to match water applications to that demand in agriculture. So I’m going to give you kind of a real quick irrigation and plantesiology 101 as we kind of flash through this.
And the thing that's most important is photosynthesis. That's the key driver in water use in plant agriculture. And essentially, photosynthesis if you boil it down to its simplest elements, it's the combination of carbon dioxide plus water driven by energy from the sun to produce sugars and to give off of oxygen. That's basically what's happening in photosynthesis.
If we take a closer look at photosynthesis and we kind of zoom in to the plant of--through the root system here and up to the leaf and if we look at the leaf closely, what's happening in photosynthesis is that for that process to take place, the plant has to utilize carbon dioxide from the atmosphere. And to do that, it has ports on the bottom side of the leaves called stomates that allow that carbon dioxide to infiltrate into the leaf for that sugar building photosynthesis process to take place. Incidentally, as that is happening, you've got this ports that are open and water vapor can leave through those ports. So that's how the plant ends up "Using water", water moves through the plant and then is lost through these ports while this gas exchange is taking place.
We call that transpiration. That's the loss of water vapor from stomata in the leaves and the rate depends on environmental factors and the available soil moisture that's in the soil. Water moves through the plant in the xylem and it moves along what we call a force gradient from high in the soil to low in the atmosphere.
If we look at the diagram of that, it looks something like this. This is the water potential gradient of soil to atmosphere and you notice that the atmosphere here has a very negative water potential, minus 50 to minus 60 bars. One bar is 14.5 pounds per square inch. So that's a very negative number. Inside the plant itself, the tree water potential is maybe minus 2 to minus 35 bars of suction. And the soil water potential is about minus a third to minus 2 bars of suction. So you can see that there's this big water potential gradient going from soil to atmosphere and that's what draws water into the plant, through the plant and then out through the stomates.
Now, we call a plant water use or water use in total evapotranspiration. And evapotranspiration consists of the evaporation from the soil, water that just evaporates from the soil surface. And then transpiration which is water evaporation from the leaves through the stomates, like we just talked about. As evapotranspiration increases as the day length, temperatures, and wind increase, and it also increases as humidity decreases. So those are the drivers of what’s moving evapotranspiration. The total evapotranspiration in an agricultural crop or an orchard is affected by the leaf area of that crop and the percentage of ground cover. If we have over 50 percent ground cover, we essentially have about a 100 percent evapotranspiration.
Now, we schedule our irrigations in agricultural crops and ideally in landscapes as well based on what we would call reference ET or ETo. And reference evapotranspiration is evapotranspiration from a standard grass surface with a constant canopy cover. It's calculated from measurements of solar radiation, air temperature, humidity, and wind speed.
Now if you look at the reference ET, ETo, you see here from this three different areas, the San Joaquin Valley represented by Fresno, the Sacramento Valley represented by Orland and then the coastal areas. Over the course of the season, ETo changes, it peaks out here in June, July, and August. And it’s about the same, we lost the bottom part of my chart here I see when it got reformatted, but it’s about the same in both Fresno and Orland. It’s about 48 inches total for the season. Whereas over in the coastal valleys, it’s about 40 inches. So the San Joaquin Valley and the Sacramento Valley have very similar reference ET, a little bit less on the coast.
If you look at it in a graphic form, this is what it looks like over the course of the season. And you can see that this peak here is really in the month of July and the second highest ETo is in June followed by August and then once we get into September, it's dropping off quickly. And that comes back to that first slide. If you remember, I mentioned that it was driven by photosynthesis. That's because the longest days of the year are in June. So that's why even though it might not be as hot in June as it sometimes is in September, the day length is much longer, so that drives water use.
And then these kind of numbers are available to local growers through published numbers in the paper, for example, in the enterprise record and they’re also available through other locations on the web such as the Department of Water Resources website. And the closest station on that website is station number 12, Durham.
Now, if we go into irrigation schedule, and I'll going to talk to you a little bit about how we manage water, we schedule irrigations to try to determine how much water to apply to a crop. And to do that, we need the ET crop, the canopy size and percent cover, you know, what the climate is like, the temperature and the day length and the number of days between irrigations. And then we have to determine how long to irrigate. How much, you know, how much water to apply and how long to run a system to put it on. So to determine how long, we need to know the ET crop, that first factor, we need the efficiency of the irrigation system and then we need the application rate of either drip irrigation or micro sprinklers if we're talking about low volume irrigation.
I'm going to run through a quick calculation here that looks kind of intimidating at first but it's really very simple. This is not rocket science, it's just irrigation science. And basically, to come up with a recommendation, what we would do is we take the 7.4 inches of water use in June, that reference ET, divided by 30 days, so that means we use about a quarter of inch a day. If we irrigated two days ago, that means that if we assume ET crop is the same quarter inch, then we have to replace about a half inch of water use after two days. And if we're going to do that, then we know that if we look at an acre inch, an acre inch is 27,154 gallons, that's an empirical number. If you divide that by two to get the half inch, then that's 13,577 gallons per acre half inch. If you took an almond tree, for example, that was planted on a 22 by 22 foot space, that's 484 square feet per tree. That is, if you divide that by the number of square feet per acre, that's 0.011 acres. Okay, if you take 13,000 gallons per half acre inch multiply it by the percentage of an acre, that means that almond tree has used 149 gallons in two days. Pretty simple calculation, nothing really complicated if you know the basics. So then if you have to determine how long to irrigate, then if you assume a double line drip irrigation system with eight one gallon emitters per tree which would be standard for double line drip, and if we take 149 gallons of use and we divide it by eight gallons an hour, that's 80 meters at one gallon an hour. That means that we have to irrigate for 18-1/2 hours. And we have to run 18-1/2 hours of drip irrigation every other day. Not too terribly complicated. So that's the basic way we approach that.
We will check on our calculations with a variety of things. We can use what we call a water budget method of irrigation scheduling where if we were flood irrigating or sprinkler irrigating, we know what the soil contains and the available soil water, we know how much we want to allow to be depleted so that we avoid plant water stress, we know what the ET is, we simply accumulate that, figure out how much has been used to that point and then we know when we have to irrigate and how much water we have to apply. So the water budget method allows us to do that.
We have checks that we use on things just to make sure we're on track. And we would monitor soil moisture with things like tensiometers or resistance blocks. And then we might irrigate at the allowable depletion. So if we were looking at soil monitoring, we would see this daily evapotranspiration effects where the water in the soil was dropping day by day by day. And when it gets down to what our allowable depletion might be, then we would irrigate. And when we irrigate, the soil moisture comes back up. And then it gets depleted again. And down here, we'd irrigate again and it would come back up and you do that all season long. If you don't irrigate here, it continues to go down and then you get to a point where you begin to have crop water stress. So we would use this soil monitoring methods to keep an eye on that, just to make sure that our other calculations were right.
And more recently, we can do measure plant stress directly by using what we call a pressure bomb. And within that plant, because of the plant's water potential, if the plant is more stressed, it has a lower water potential than if it's well irrigated. And what this device does is we'll take a leaf, put it in this chamber right here. If you do a diagram of that chamber, here's our leaf in a little bag stuck in the chamber with its petiole sticking out through a hole and then with this pressure tank, we increase the pressure in the chamber squeezing on that leaf until if you look at the cut surface here at the top of the petiole, this is what it looks like when it's cut and dry. If we squeeze it hard enough, it will start to bubble right in the middle here. And that's the water potential of that leaf and that stem. So if the plant is stressed, it takes a lot more squeezing to squeeze water out of it. If it's well irrigated, it doesn't take as much squeezing. So we can use this method to hit a gauge on how the plant is actually doing and not have to rely directly on the soil moisture monitoring. So this is probably our most accurate method of determining how well our tree crops, for example, might be doing with their water management. This gives us a number that we call midday stem water potential.
So that's kind of a quick overview of what we can do. There's a lot of additional information available as Christina mentioned earlier. There are websites on management strategies, on soil moisture monitoring, and on the use of the pressure bomb, pressure chamber if you were interested in more information. So with that, I'll stop right there. Thank you.
Dan Taverner: Hello, like it says, my name is Dan Taverner. I’m the District Conservationist for Butte County with the NRCS, the Natural Resource Conservation Service. Just a little bit of history. The NRCS first began as a soil conservation service during the Dust Bowl and it since has developed and grown into the Natural Resource Conservation Service. So we kind of grown just to incorporate more resources that soil.
So, the bulk of what I do is deliver the Farm Bill programs to eligible farm Ag procedures in Butte County. We have a couple of different types of programs. One is a conservation type program where we would pay or cost share on conservation practices or best management practices as part of—to get farmers to—and like an initiative to get farmers to do conservation. Another one is the easement programs and some of these are perpetual or imperpetuity. For perpetuity they—and the rates that we pay go up as the more we can affect their development or the limit the access on the farmer's property. And I guess this is probably not the most accurate way to say it but basically, what we're going to do is we're going to develop an easement with a farmer that has ground that in an urban and cultivable space or a space where it would deem to be likely to be developed or be in a space where the Ag commodity that's produced is on soils that are tend to be flooded or prone to different types of flooding, different other resource problems. And what we would do is go on title, we would take the farming parts of that away. The owner would still have rights to the property and complete access, but they would not be farming. Anyway, and with the conservation programs, EQIP is our main program that we deliver this last year. And in Butte County we delivered almost two million dollars worth of conservation practices to Butte County farmers. And that kind of include the other programs that are kind of incorporated with that. That's the Ag Water Enhancement Program, the Cooperative Conservation Initiative Program and the Bay Delta initiative. It's another national initiative that Butte County is included in. And another one is the Wildlife Habitat Incentive Program. The next program, the Conservation Security Program is a different type of program. It's almost based on a type of rent that the USDA would pay a farmer to continue to do certain conservation or best management practices. As they do more, we
would pay more.
So this is kind of intimidating slide too. But with the Wetland Reserve Program, we have, like I was saying, we have the permanent easement for imperpetuity, the 30-year, and a restoration cost share agreement which you see is about 10 years and that's just doing wetland restoration, not doing anything that would go on the title of the property. And the Farm and Ranch Protection Program is more along urban areas or properties that would have the potential to be developed. As the idea behind that you--we would go on title and we would--the idea is just to make sure that that stays in agriculture and it really limits the developability of the property. It has a--I'm not as familiar with the easement programs. We do have a limited number in Butte County and--where they really comes in handy for potential farmers and the use of the program and where they get the most access, I guess, is--were along the Butte Sink and American Basin and these are the properties. Either they tended to flood too much and they were really limited what you could grow on them anyway or they had other kind of farm management issues where it would increase likelihood of us having a good success with the program.
With the conservation programs which I’m a little bit more familiar with, the Ag producers are given a cost share to install conservation measures. Usually, we go out and do outreach every year to try to bring farmers that are having resources to us. We pay different rates based on their eligibility level. Like it says, we have the three parent rates of 50, 75 and 90 percent for the limited resource farmer. A socially disadvantaged farmer would be mostly minority farmers and beginning farmers are considered farmers less than 10 years farming. And the bulk of the parent rate is 50 percent. So if you considered that and we did about 2 million dollars in Butte County that means really we got about 4 million dollars worth of conservation on the ground on Butte County which is a pretty number. The program areas like what I said on the previous slide where we had the CCPI and [inaudible], they’re defined by the geographical area or watershed like Butte County or Honcut Creek, or lower Feather River, some--those are the local areas that we’ve done. The EQIP Program now is delivered via a cluster of counties so we are in a cluster with Tehama, Glenn, Yuba, Sutter, and Yolo Counties as a cluster and we manage our programs similarly and we’re all the district conservationists that my counterparts had conspired to and negotiate to get the best coverage for programs for people in our county. The AWEP program came to our county as a partnership to the Rangeland Coalition and that is a type of non-government organization that had a partnership with the [inaudible] Association and the NRCS and they developed [inaudible] practices that would be designed to fit the area and address the resource concerned in that area.
The AWEP program came to Butte County and this is a good success for us and remember that's the Ag Water Enhancement Program, it came as a partnership—oh, I'm sorry, not the AWEP. The CCPI was came to the county as a partnership to the Yuba-Sutter RCD and the Butte County RCD and what happened is they put together an application for the program and it covers both counties and there's more of a resource-based along the Honcut and lower Feather River. The Bay Delta Initiative is a new national initiative that were covered. It goes from basically Redding to Bakersfield and all the counties in that area have a direct effect on the Bay Delta and waters that go through there. So its program priorities are wildlife, water quality, and water quantity. And this last year was our first year delivering that program where the Butte County had got money to do the program. And that was the Waterbird Enhancement Program and I was a good success here. We had 1.3 million dollars of that, 2 million went through this program.
And the Conservation Stewardship Program is really present in Butte County. We are one of the biggest counties in the state on that and really in the nation. And that is the program that delivers dollars to Ag producers for essentially what the conservation measures that they're taking now so we've deemed it necessary to ensure that they keep doing this and to protect our resources. It's a way to increase the different levels of conservation and ensure that they continue doing them. Anyway, that's what I have here, thank you.
Scott Turnquist: Hi, so I'm Scott Turnquist. I am also with the Natural Resources Conservation Service. Dan spoke of the program implementation side of NRCS and frankly not the most exciting side. I'm going to speak of the specific practices that we implement and encourage through NRCS.
So in NRCS, the best management practices are synonymous with the conservation practices. And so from here I will be referring it to them as conservation practices. NRCS over the decades has developed collection of practices. I think there's somewhere around 250 of them that we use to address resource concerns. Resources that we've--that we address specifically are soil, water, air, plants, animals, energy and then animals--humans, sorry, animals. Each practice has a standard and specification and we utilize those to do everything, from evaluate the resource concerned all the way to implementing it. And I have up here--we have the Electronic Field Office Tech Guide. It used to be just the Field Office Tech Guide which we had bunch of binders in the office that we'd go to draw from for our standards and specs. But now we have a website that actually the public can go to now and view all of our standards and specs for our practices. And I know that there are public entities out there that lean on this as well that utilize our standards and specs specifically for implementing conservation practices.
Specific water conservation practices that we utilize in Butte County, I'll go through some of these. But the biggest one that we do is irrigation systems. And as Joe is speaking of going from a flood to a microsystem is probably the most common. And the typical scenario of this is to replace an inefficient system that uses a lot like a flood system on an orchard to something like a sprinkler or a micro set that would have significant savings in water.

Pipeline is another one that we utilize. And this is typically where there is either a ditch over coarse soils where there's a lot of soil--subsoil loss percolation and we put it in ground so there's no loss or where there would be an old leaky ditch or something or old leaky pipe, concrete pipe specifically where we replaced that. Line ditch is also utilized. We don't use that a whole lot in Butte County but it is utilized where they want to keep it in a ditch as opposed to going with pipe. And so, you can concrete line it or use some type of poly lining. Land leveling is another. Land leveling and land smoothing, we will help producers in the foothill areas of the county to whether they have hay crops or they are irrigated pasture. We'll often help them to go through and level their land and it yet improve--drastically improves their efficiencies on their irrigation. A lot of times they either have wild flood scenarios or they have an old system that is out of alignment and they end up with high dry spots and low wet spots and end up over irrigating a lot to compensate for the high dry spots. [Inaudible] return system is another one that we utilize and that is to collect water that is going off flood systems typically, going off the property and then reusing them, using that water to recharge system at the top.
Irrigation water management is huge. We require it for all of our irrigation systems that we cost share or contract with landowners. And with IWM you can realize pre-significant savings. In the North Valley, we have kind of a perception or there's old school practices where folks still schedule irrigate and they basically will turn on their pumps every two weeks and they'll run their pumps for 24 hours and they do it because that's what grandpa always did. And so, we're here to help. First of all, educate them on some of the practices that you can utilize to improve their efficiencies. Joe went over using the evapotranspiration method. It's a climate-based method there and then he also spoke of some of the soil-based. The picture here is of a guy using a probe and he's using a method. He's taking up an actual soil sample that's in the field and filling it and kind of making a guess on what the soil moisture is and you can actually be pretty accurate with that method to determine if you need irrigate really. Wetland Restoration Enhancement, we utilize that as well. It obviously helps attenuate flows and helps replenish groundwater. And there--a lot of our other practices that we have, again I said there's 250 or so, a lot of them address water conservation collaterally. So an example would be cover crop or conservation tillage where a cover crop is really primarily for soil health or agronomic but it also has collateral benefits to water conservation. It allows water percolate better so there's less runoff and there's more organic matter to hold the water longer so the water holding capacity goes up a little bit. And they're not a significant. Obviously, it's using directly new irrigation system or something of that effect. But a lot of them will also address it collaterally.
So as I said, irrigation system is the biggest practice or by numbers what we utilize the most. We also throw the most dollars at it. And I just wanted to show. This is a spreadsheet that the State of California NRCS has developed to calculate water savings. And we utilized this to rank our customers when they come in the door to I guess assign and--so we can throw our dollars at I guess get the best bank for our buck. And basically what we do is this spreadsheet--I'm not sure how well you can see it but you--the inputs are you got soil types, crop types, location. And the location actually identifies which ET zone you're in and then the practices that you would be going to and from and then also the irrigation water management that you'd be using, what level you'd be using. And with that, we can calculate and actual acre inch per acre per year value that we assign to the producer and that allows us to rank them. And so, if you have more water savings, you're going to fair up better and through our raking process and have more likely have to be getting funded. So again, it’s about getting the best bank for our buck. We have really limited dollars.
I'll go into a success story here. And actually I have a sheet that I'd like to pass out. And we're--thank you. The Beldins [phonetic] are--they are a--they're rancher in South Butte County and they have little more than 300 acres of pasture, irrigated pasture and hay crops. And they came to us a few years ago and they had--and this is kind of a typical scenario. They had a lot of issues with their water. They had a lot of stuff running off. They had a lot of fields out of whack. They had old concrete line running through their property. We're talking hundreds of feet of it. And it was very evident going out there in the summertime that they were way over using the water. I mean, everything was wet. They had a lot of mud pits. And they had a lot of water running off. And their pumps were going constantly. And they had three pumps. They're pulling water out of the ground. And--so we worked with them to deal with a whole bunch of things. We help them level fields. You could see land leveling and smoothing, kind of tightening up some of their fields. We help them deal with a lot of their leaky concrete line. And we help them with a tailwater recovery system and then of course the irrigation water management at the end. And--so the estimate of savings that we came up with was around 210 acre feet per year and just I guess to get an idea for you folks, it's roughly about 160 feet or 16 foot storey of water covering the sides of a football field in a year. So it's pretty significant.
And then this is more of a typical scenario of a producer that we work with. This is an orchardist. They had prunes and walnuts, 74 acres of prunes, 100 acres of walnuts. And they flood irrigated previously and they had particularly coarse soils or sandy soils where they had a lot of percolation issues and they went from a flood system to a sprinkler and a micro. They put sprinkler on the walnuts and micro on their prunes. And we estimated that they saved about 410 acre feet per year which is about double what the Beldins saved annually. And that's a pretty significant thing.
So with that, we will go to questions.

**Question:** Do you go to farmers and wanting pay them from then or do you follow them and say maybe?

**Answer:** Our programs are voluntarily, strictly voluntary, but we do outreach. We try to do a fair amount of outreach, whether it'd be flyers, mailing to landowners. When we have particular programs like Dan spoke of that address certain areas, would be watershed or [inaudible] that we want to try to tackle, we would address those landowners. We would be able to identify who lives there and send them flyers, but all of our programs are voluntary. So landowners come in to us with concerns and we help them. And usually, it's something like they heard their neighbor got an irrigation system cost shared with us. And so, they come in because they say, "Hey, obviously, that's going to help up the bottom line." And by just getting them through the door, we're able to deal with typically way more than just what their original concern was, so.

**Question:** In one of those slides, how many how many landowners do you touch or maybe this is a question that [inaudible], can you give us some indication, percentages or numbers?

**Answer:** Probably pretty low percentages. Could you speak of that Dan at all? This last year was 54 percent. 54 different individual entities came and applied for programs and some of that is kind of confusing because some people have multiple entities and so you're essentially working with the same guy but addressing that through multiple entities.
**Question:** this is a question for Christina in terms of trends that you seem that you're monitoring wells around the area. You know, one might expected with increasing urbanization and more water use that the ratio of recharge to groundwater extraction would be diminishing. Are you seeing those kind of trends?

**Christina:** So far what we’re seeing, in general, over water levels compared to 1980 levels are similar or 5 feet, 5 to 10 feet lower. So generally, not huge downward trends. Again, like I mentioned with the example that one hydrograph, there are--we work--we've been in a dry period. The last 6 years have been dry years except for that one, wet, 2011. And so, we've certainly seen lowered levels as a result of that and kind of depending on what happens in these next years. So we get some groundwater response slower than surface water resources obviously. So you really need a few good what years to bring those water levels back up. But for instance, since the 1990's drought, water levels did generally return to pre-drought levels in Sacramento Valley. So we’re not in the situation of overdraft.

**Question:** So the trends you're seeing you think are will be in the variability of weather patterns as opposed to excessive extraction from [inaudible].

**Christina:** Generally speaking. There are areas of, like for instance the Chico area because of pumping in the Chico area, there are areas that are depressed. But overall, basin conditions I would say are not downward trending in general.