

GEER 07 31 2008

Ronnie: Banyan One at 1:00 p.m. Uh, I see Ralph looking up at the bright lights. Yes, unfortunately, this is bright. We ... we are being webcast today. I'm gonna stand down here and serve as the liaison between the panelists and the audience. We have a very simple question to address today. I think we can probably do this in probably five minutes. And that question really is if we take the lip of Lake Okeechobee and the tip of Florida Bay and draw a straight line between those two elevations, we assume that Florida will ... water flows principally downhill if not towards money. I'm not sure which one goes ... has the strongest exercise of the direction of flow of water, but if we make the assumption that water flows downhill, then the basic premise of the conversation today is water flows downhill. Everything underneath sits where it is, so I'm gonna have Rock start off the conversation today. We will then bounce around. Each of them have been given their assigned order of talk ... of ... of presentation. Since this was an idea that was generated by Rock several months ago, we've had a number of conversations, I'm allowing him about ten minutes to give the intro and everybody else to give three to five minutes of their top, uh, ideas and then to have a conversation. We're gonna hear the conversation as they do this. It should be on now.

Rock: Good morning.

Ronnie: Say ...

Rock: Such a, uh, intimidating group of guys to have a morning cup of coffee with. It's too early for this. Yes (chuckles). I, uh, for the last several years, uh, various, uh, key players have been raising this question of we need to think again about the restoration hydrology for Everglades restoration and, uh, at the last conference two years ago, uh, I was honored to be able to give some ... plenty remarks and I ... I ... I'm ... I shared my observation that ... that the Everglades restoration really needed to be more thought of as the flow part of that rather than the depths that we've been doing and we ... we started that conversation of flow as the most important part of Everglades ... uh, not the only part, but an important part. So I ... since that time, I've, uh, I've seen myself ... in fact, I've been installed as a deacon in the Church of Flow. I'm not the high priest, but, uh, but I am definitely ... my ... my thinking on this is definitely coming out of the Church of Flow and so, uh, uh, if, uh, if you're with me on that, then you'll ... you'll like what I'm saying. If not, then you might be a little bit uncomfortable. Uh, for the last eight years or so, I've been troubled by the disconnect between the Florida Bay guys which generate analyses out of Florida Bay that says here's how much freshwater we need in order to restore conditions in Florida Bay and it is a big number. And then I looked at the freshwater analysis, NSM or other

kinds of analysis, and it wasn't even close. I mean, we had a major disconnect between the two macro-forms of analyses, one born of a rainfall-driven kind of analysis of natural flows coming from the north, the other from of a salinity for the ecological, uh, analysis coming up from the south. The two didn't meet. The second, uh, over and over again you would find that as you tried to take the Natural Systems Model, the NSM, which in its current use is defined by depths ... you know, when you talk about NSM, you're talking about water depths in a particular place and you apply that sort of a ... that virtual, uh, estimated depth, it really is a problem because the topography is altered and so as you try to take an ... uh, a historic presumed depth and apply it to an altered topography, you end up with regions competing against each other and the subsided regions always get too deep. The un-subsided regions are too shallow, and you have this ... this disconnect between regions that you can't solve except with a lot of detailed engineering, difficult engineering. Finally, uh, those of us ... there was a group of us that were trying to work on a, uh, uh, the operating plans for the Modified Water Delivery Project and we discovered that whenever we would ... and ... and part of the problems in the current system is that the southern part of Conservation Area 3A gets too deep and we kept trying to take water out of Southern 3A and move it over into 3B. Now, for the ... I was criticized yesterday for using terms that ... uh, I apologize for talking about sort of the ... the, you know, Everglades speak here, but ... but the point is as we moved the half a million acre-feet of water out of Southern 3A, moved it eastward into Conservation Area 3B, we ran the models ... 3A just filled up again. And what we discovered was that the water management schemes for the Everglades looks at the conversation areas as reservoirs and so when the water control plans see water going down, the ... the model see capacity and it sends more water. And so what ... what we basically have in our models, in our water control plan, is a series of reservoirs and the water management of those ... it ... it works as a balancing storage amongst a series of reservoirs, and that's just the system we have. It's a system that we've had since we've started. Putting it another way, no matter how hard you try, the ... the way we ... the way the system works, you can't ever make the progress we would hope. I had three solutions or three ideas I guess that, uh, that it seems to me what we need to do. The first is about two months ago, I saw Robert and I saw some flow results from Robert Fennema's new NSM model that were much wetter, uh, than the earlier NSM runs that I had seen. And so all of a sudden I started to see an NSM, uh, analysis that came closer to some of the ... the regression work that, uh, Dr. Marshall was doing coming up out of Florida Bay and at least I had two forms of analysis that were closer together, uh, that were ... it was less of an inconsistency between the freshwater inflows versus the ... the salinity flows coming back. When I went to Dr. Marshall's session yesterday, he hasn't run the adjustments for sea level rise yet, and we haven't refined all that and so I'm not trying to say that those numbers are

the right numbers. All I'm trying to say is that at least I started to see some form ... independent forms of analyses that weren't inconsistent with one another and that to me was an important step and it's important that we ... that we have that linkage. The second point is that I believe that our use of NSM depths as our key target, uh, just puts us in an impossible competition between the ... the ... the subsided areas which always get too wet, whether it's 3B or Northern 3A or wherever you have a subsided area, and as you ... as you make that water ... as you move water to try and balance that, our ... our restoration benefit score gets negative. And so rather than set our targets with depths like that, in my mind it ... it ... if you're in the Church of Flow, the better solution would be to set your restoration dominated by flow and realize that the subsided areas are gonna be deeper than they are now, that, uh, that what we're gonna have then is a system that'll change in the lower areas in 3B or Northern 3A are going to be different. I mean, our goal is not to preserve the ecology in Northern 3A right now, but it'll be something different, uh, and it'll be driven by the flows we need to match up through the system to provide the system-wide effects that, uh, that we're looking for. Finally, I know that there are places, uh, around the country where the water control plans aren't reservoir-driven but they're rather river-driven and so there are systems where you fill up a reservoir and then the reservoir is managed, the releases are managed to ... to meet, uh, flow parameters within the downstream river. And it occurred to me that, uh, the Everglades really is the river of grass, and there's nothing wrong with thinking about the water management scheme coming out of the EAA, at least in the Conservation Area 3, thinking about it as a river rather than thinking about it as a storage reservoir and to develop a water-control plan that is more patterned after the way you would ... you would do water management, uh, for a river than for the, uh, for the ... sort of a water supply reservoirs. Uh, I believe, if we don't do something like this, what ... we're really abusing our teams because, as Dennis Duke often points out, we find that you end up with a huge project that ought to give you the benefits that ... that make common sense. Yet, the benefits aren't there and if ... for the reasons I've tried to point out, we find ourselves bumping into each other. The final thing I'll say is, uh, I don't have a view as to what the ... what the vision is about what the end state needs to be. Lynn Scarlett mentioned the other day that there's a policy call here about what the end-state is. What I'm hearing from the hydrologists is if ... if Rock you say we want to have the Everglades 1850, you probably can't do that because of the ... of the impacts that are already there. Uh, if you want 1920 ... if ... if you're looking at the Everglades of 1920, we may have the space to do that and that may be an obtainable vision for that ... I'll leave that up for the scientists to sort of sort through what's possible but all I'm ... my point is whatever that vision is, uh, we need to settle on it and then with some of the things I've talked about I believe we can move forward. Thanks.

Ronnie: Thank you very much. Now, let's hold all the applause and et cetera until the end. I did fail to, uh, to go through one process and that was to introduce our panelists today. So, I'm going to do that while somebody is kind enough to pour Robert, uh, Fennema a cup of coffee because we should be drinking coffee if you want one. Okay. Uh, most of you already recognize Rock Salt. Rock is the Senior Executive for the Department of the Interior that has the main responsibility for Everglades restoration for The Department of the Interior. Robert ... and by the way, uh, uh, Rock Salt has been involved in the Everglades for approaching two decades now if not slightly past two decades. Robert Fennema ... Robert Fennema has been in the, uh, in South Florida for many years. I think he worked for a number of years for the Park Service and he's a, uh, superb hydro ... hydrologic modeler and, uh, will be giving a brief summary of some of his ideas and then John Ogden, this is the order in which I would like you folks to speak as well. We heard something the other day about John Ogden. I don't think any of us believed anything that was said. Of course, I'm joking (chuckles). Uh, John has ... John was around when the last mastodon was around and so he has enormous knowledge about the greater Everglades, uh, spending many years, both with the Everglades Audubon and back to Au ... uh, Water Management District and now back to Audubon again, but he truly is one of the great ... he is the grandfather of the greater Everglades. I accept that with John Ogden. Uh, Obeysekera is probably the most brilliant hydrologic modeler that I've ever encountered as well as probably one of the gentlest people that you will ever, uh, deal with. Paul Souza, wow, I have really been impressed with his positive, forward-thinking attitude towards integrating Fish and Wildlife and their responsibilities within Greater Everglades Restoration, a real positive, uh, to ... to the Greater Everglades system and Tom Van Lent. Uh, when Rock and I were talking about the panelists, he said I have ... I agree with him ... Rock said I have the highest of respect for ... for Tom Van Lent and his, uh, role with modeling, his understanding of modeling and the understanding of the Everglades. Tom has spent many years with the Everglades National Park, is now with The Everglades Foundation. So I think we have an absolutely superb panelists and I will move on with the next one, Robert.

Robert: Thank you. Uh, did, uh, uh, it's now time for the slide, uh, I wanted to show ...

Ronnie: Robert Fennema I think had a slide if you can put it up please.

Robert: There's one slide I'd like to talk about. It's, uh, it's a good slide to, uh, sort of, uh, get an idea of what the Everglades, uh, looked like at one time and, uh, what it is, uh, possible in a restoration, a full restoration scenario today and it sort of follows up on what Stephanie was saying about trying to, uh, do a natural system that, uh, molded and maintained the

Everglades I believe and also what Rock said about the outflows on the bottom and I've ... I had the opportunity to do a lot of fieldwork before I became, uh, a desk jockey and a modeler and, uh, uh, it is always a feedback loop. It's when you find some new evidence, uh, some new, uh, information that is out there to go back and, uh, recalibrate the models, uh, make sure ... you try to fit it everywhere and, uh, my ... uh, the latest version of NSM that is shown on the left side, uh, this is a, uh, underlying topography from 20 feet, uh, at the Lake Okeechobee and then 0 in Florida Bay. It's sort of even, flows down. You can see from the flow vectors, uh, in, uh, reddish color, uh, kind of there was a very broad expansive system. Uh, outflow south of Lake Okeechobee to that, uh, Pond Apple Forest into the sawgrass then, uh, a broad expanse truly what ... what is now the conservation area. It pooled very heavily around Fort Lauderdale, Miami, uh, it came south along that coastal ridge and that is where it went over to Rocky Glades and into Florida Bay, uh, and then out west to the Shark Slough. Well, something fundamentally changed between that, uh, uh, sort of model scenario of around 1900 to what it looks like today and one of the fundamental changes, of course, has been the topography. On the right on that slide what I did is I took the natural system model and I basically maintained it in the same type of hydrology as what you see on the left but I changed the topography. I put today's topography in there and, uh, as you can see, when you're now talking about, uh, restoration, it is something totally different from what it was. So on the right is a scenario that what would happen if we took out all the canals, we had no structures, we allowed Fort Lauderdale to be flooded, etc, etc, and so, uh, you can see from the flow pattern that it won't go through Water Conservation Area 1. It won't go through Water Conservation Area 2, but they are still in the center line. There is still a fundamental flow way. It's sort ... it concentrates now in Shark Slough, but as you can see, it's ... it would still flow full through 3B and we probably, in this type of scenario, we won't get as much flow through the Taylor Slough area in ... in Florida Bay. So I just, uh, thought I ... I'd point that out and have people considering about what they ... you know, what we actually mean about restoring the Everglades in sort of a natural system scenario. It's not gonna be what it was. It's gonna be something different and because of these changes in topography and as Rock also pointed out a little while ago, some areas are going to be deeper. Some areas aren't going to be like it used to be. So, there will be tradeoffs. There will be choices that we have to make. It's not a win/win situation and with that, I'll turn it over to John.

John: Thank you, Robert, uh, I'm already beginning to hear a theme emerging from the comments, uh, and I think that's one that I will somewhat reinforce but, uh, because my ... it's my understanding of the hydrological patterns that we're trying to achieve, uh, in the Everglades is very much based on a melding of ... of information from a large body of science that's

accumulated over the years on the dynamics and patterns, the biological dynamics and patterns of many species and communities, the melding of that information, uh, with, uh, what we learn from a ... a number of hydrological models including vari ... various forms of the natural system model. Be ... I want to recognize Dr. Bill Roberts ... I mean Bill Loftus (sic) ... I should ... that was ... uh, that was an interesting slip ... who is retiring, uh, in a month or so. I want everybody here sometime today to walk up to Bill and shake his hand, thank him, wish him well. Uh, Bill has made a tremendous contribution to that body of knowledge about the Everglades system with his work and I've learned a lot from Bill. I've learned to use the word "fishes." Uh, I've learned that, uh, fish have some ... more value than being bird prey. Uh, we used to call it "prey" and ... and that would just infuriate Bill and re ... but at any rate, please give Bill a squeeze today in rec ... in recognition of his contribution, his substantial contribution to that large body of knowledge about the system that we are now using to, uh, understand the hydrological and ecological patterns we're trying to achieve. (All applaud). Uh, one other, uh, short comment about natural system model, uh, I ... I ... I saw ... be ... because I'm not and building on something Robert just said, because the system itself is so tremendously changed, uh, spatially, temporally, topography, everything about the system, chemically, is so tremendously changed, uh, I certainly view what we're trying to do as ... as a set of experiments in that we have a set of hy ... hypotheses based on what we've learned from this body of science and ... and from the model runs about how the system is going to respond. And I think much of what ... and that basically we're going out into the system and ... and testing and building on these hypotheses and so, uh, and I ... and my own view is that we've learned from natural system models is ... is ... that we've learned everything from them. They're not really the Holy Grail. They made an important contribution to the development of these hypotheses but I personally view that the NSM, the various forms of NSM, has told us all that they're gonna ever tell us about the system and that, uh, we mo ... we move on now with the set of hypotheses based on these different inputs and ... and get to work out there in the system and start evaluating these hypotheses. Uh, one of the ... I often hear people when they're commenting on the success in the system, they often express success in hydrological terms, that if we can only get a million-acre feet across the Tamiami Trail, if we can only this, that or the other, and then other people, uh, more like myself often express success more in biological terms, if we can only get the super colonies back, if we can only get the sea grass communities in Northern Florida Bay back and, of course, uh, the right answer is that we ought to be expressing them in both terms. We ought to be se ... uh, and again, in that hy ... hy ... that ... that concept of hypotheses is there's certain hydrological patterns are gonna produce certain biological and ecological responses and it's the combination of ... basically of these, uh, hy ... hydrological and biological features of the system linked together, uh, is

the way we ought to be expressing success, uh, basic ... building on those ... using those hypotheses to frame these statements of success. Uh, I, uh, one ... I guess one final comment is that, uh, I'm very much focused on the southern part of the system, the southern estuaries as ... as the key of the ultimate success. Uh, one can argue that, uh, and when we think of ... think about the historical Everglades, that much of the abundance and diversity and production in the system occurred in the southern estuaries, the southern mainland estuary downstream from Shark Slough, downstream from Taylor Slough and on up the southwest Gulf coast and that, uh, 20, 30 or 40 years from now, unless we hit our targets there, our salinity targets and our flow targets and so on, we may not think we've been successful at restoring the Everglades. And so when I think about places in ... like lakes embedded in the southern estuaries like Westlake that might have, uh, historically had salinity ranges of 0 to 5 or 10 parts that now have, uh, 25 to 60 parts and ... and the ... that they're ... they are key indicators of the success, that if we can get those salinities down in these lakes that are embedded, uh, in the southern Everglades, it's almost like, uh, somehow we've been successful. One ... one other quickie I just thought of, uh, I agree with Rock. In fact, uh, I had several conversations with Lynn Scarlett before she talked here about what we're ... ultimately what we're trying to achieve here and we had this conversation that Rock just started that ... or built on that, uh, we know very little about what the Everglades system was like pre-drainage. We know an awful lot I think about the system in the 1920s, pre-C&SF project and that there's, uh, a lot of our targets are not really ba ... based on some ... some pre-drainage condition, but they're based on sort of wa ... the way we understood the system in the 1920s, 30s, and 40s and I'm ... personally much more comfortable using that period of time as a framework for ... for where we're trying to get the Everglades in ... into the future. Thank you.

Obeyskera: We need some slides. Yes, uh, I don't know if this is on. I guess this is on. We got, uh, Ronnie gave me four minutes. I'm gonna try to finish. Uh, I'm a modeler. I have to have visuals to talk from. Uh, I think, uh, again, uh, I'm gonna talk about the natural system model and its use in, uh, perhaps the role of ... I guess some time back, uh, myself and, uh, I guess Tom Van Lent were with Rock on a panel in front of CISRERP and this idea of flow came about and I've been thinking about it a little bit now so we do, uh, we've been working on the collection of all the information. It's kind of embarrassing to say that ... how long we have been working on it. Uh, the book, uh, with Chris McVoy and Winnie Said and Joel VanArman and myself and it's gonna be out very soon, uh, but this ... this information has been used to produce a ... yet another version of the natural system model and I couldn't let, uh, Robert, uh, overtake me in terms of producing a model that ... uh, no, and I, uh ... well, we do have a... uh, a natural system, regional simulation version that we're just

finishing. It's been peer-reviewed to some extent. We're finishing it up. The idea of this model is ... you know, we have that two by two grid that we had and we're getting into this, uh, I guess what we call unstructured grid or, a triangular element so that we can put a lot more detail. So we used that information I showed you earlier to calibrate this model. Now ... soft calibrate this model, because we are very uncomfortable because these tools as modelers, uh, you may know that we really need to have a good calibration. And this is where my comments on the use of the NSM come in and I will make some comments on the use of flows as well. Uh, I ... I think there ... there are two ways that the model has been used in the past for ... for CERP elevation. On the front end we used the ... the depths that Rock mentioned as targets to drive the operation of the current system and that's okay. Uh, then we need to kind of, uh, come up with operating policies so the flows to kind of see what kind of depth produced that you may need if that's the way you want to go. But on the back end I think we've been using, uh, it's to evaluate the performance of plans and I think we're putting a little too much faith into this model that has been soft calibrated in terms of point depths and frequencies and so forth. We've got a lot of information. I think the model is very useful to look at the effect of dynamic storage we had and I think that's the kind of high-level information we should use from this model to understand how we should, uh, pursue the restoration. Uh, with this model, we developed a ... a water budget for the Lake Okeechobee at the natural condition. It will be interesting to compare this with Robert's new model. So you got several NSM models, uh, and that's a good thing because I think we have, uh, many different versions to learn from. From this, and I had this idea, if you do want to have a passive system where flow is the primary criteria, uh, uh, before I get to that, uh, you know, model has water depths of different landscapes regimes like, uh, or ... or landscapes like ridge and slough and ... and we realize that from the basic information that we developed or we collected, uh, the model does reasonably well in reproducing the depth regime and this is the kind of comparison we want to make using box and whisker plots. Looking at the flow of the dy ... effect of dynamic storage, the red line here is the ... the current manage system and this green line is the natural system. You see that time shifting the hydrograph and I think that's the kind of thing ... if you do use flow, you need to kind of create that, uh, time shift, uh, you know, inter-annual, uh, or within the year shifting timing and that's the kind of storage you might need to kind of ... to do the time shifting. So, there are three things that we need to think about. Uh, the depths are obviously going to be larger if you use flow as a way to operate the system like Rock said because the topography has subsided. You would need the storage to provide this dynamic storage. In terms of multi-year, uh, of dynamic storage, you know, in the natural system ... you had like two or three, uh, member in the system. You probably need to use, uh, uh, something like Lake Okeechobee as a buffer to kind of provide that kind of thing. So you really do need the

storage to ... if the time shift is important. And the other thing we have to obviously look at is, uh, as our agencies need to, uh, look at the water supply for other uses as well. So there are three things that we need to think about, uh, that, uh, in looking and understanding the natural system and if you want to use the flow as a criteria, I just want to put one caveat. This is not the agency position. I put my scientist hat and ... hat and two days ago in the hallway we were talking with Rock and talked about using the flow as a way to have a passive operation in the system.

Paul: I've got to tell you, Rock. I am not yet prepared to join the Church of Flow. There is ...

Rock: No problem. (chuckles)

Paul: There is much about the doctrine of the Church of Flow that I'm attracted to, but there are some core questions and assumptions that I still think need to be answered before I could make that commitment. I think for me there are really three fundamental issues that we have to consider. The first is the easiest and that is where are we now. The second is really the goal of restoration and that is where do we want to be and the third, which I think is maybe even more important, that is how do we get there. Clearly, right now we have a compartmentalized system. That's why we're all here. We're trying to fix the damage that has been done by the water infrastructure of the mid 20th century. From a biological perspective, the record is clear. Just to give you a couple of examples. Cape Sable's seaside sparrow is extraordinarily in danger. We've got about 3,000 birds left in the world. We haven't seen a rebound of that population from a crash that occurred in the early 1990s. So we're basically kind of muddling through with a current condition that isn't very good. Everglades snail kites, we've seen the population go from 3,000 plus in 2000 to roughly 750 now, kind of a perfect storm of drought conditions, back-to-back two-year droughts during that period and also the habitat degradation that continues in an un-restored system. So clearly we need to move beyond where we are, but the key question that we still I don't think have answered fundamentally ... a couple of us have eluded to it today as where precisely do we want to be? There has been some wonderful new science from USGS that basically took core samples in marl prairies to the west of Shark River Slough and what they have found is peat formations in those core samples which suggests in the Everglades very much wetter than it is today, very much wetter I believe than 1920, 30, or 40. Is that the kind of outcome that we want? Do we want to have flows and depths that are going to produce no marl prairies? Do we want to turn the clock back to 1700, to 1800 and essentially lose some of the diversity of habitats that we have today? Personally, I would have questions about that, serious questions about that. For me, kinda like John, I am much more comfortable with a 20s, 30s, 40s kind of goal,

but until we answer that question, I think that the means to get there is almost moot. Flow ... the Church of Flow might be the way to get there and if so, hoorah, let's go with the Church of Flow, but this really is a fundamental policy question that isn't formed by science. If, for example, we do agree that a much wetter system that would replace all marl prairies with other habitats is optimal in some values of restoration. I think we need to know what the ecological responses will be broadly speaking that would justify such a decision. And we also have to grapple with very difficult questions, if indeed that was the value judgment that we made about our end game. Would we be prepared to potentially have some species move to extinction as a function of that restoration effort, major questions for us to grapple with? Furthermore, as I was informed yesterday, this question of climate change is radically reshaping everything that we're considering right now. I think that it's clear we're going to need much more storage than we thought. So that's another factor that we have to build into the mix. We're almost not restoring the system back to the 20s, 30s or 40s. We are creating a functionally valuable system that has many of those old functions within the context of a rapidly changing environment within the context of sea level rise and everything else that we seek. So that is a core question that must be answered before I would be prepared to enter the Church of Flow. The final point I want to make is ... and I really think this is important. This is the issue of the transition. We are today in a very impaired state in the southern Everglades and we all want change. We are here because we want to restore the Everglades. This questions of do no harm is right spot on. The truth of the matter is we have to be willing to accept some risk in tree islands in 3B, in some endangered species habitat south of Tamiami Trail. We want that change. That is the ultimate vision for restoration but we have to be careful that we do it in a manner that does not have unintended consequences that we cannot recover from. So for me I think this transition of how we move from today to the goal of overarching restoration is really the key and this is a classic example in my view of adaptive management. I think we need to create projects that allow us to start with flows that will get benefits that are as aggressive as we possibly can get those benefits on a timetable that is short but at the same time not so overwhelming where we will swamp the system and have unintended consequences we can't rebound from. But we have to have the capacity to monitor and quickly increase those flows, probably more than we think we need, given the climate change impacts that are upon us, so that we can push as much water into the system as we can in an effort to achieve that long-term vision over some period of years and decades. Maybe!

Tom: Uh, when Ronnie first asked me to be on the panel, he, uh, he promised me coffee which he's delivered. That's good. And the ... kind of the opportunity to inflict my views on a broad audience which I ... I would never pass up an opportunity. But, uh, after being at this conference, uh, I

have to say I ... I've changed a little bit. I ... I ... I think I was talking with Stephanie Johnson at lunch one time and ... and she asked me, so have you learned anything and I said, yeah. What I really meant to say was I've been staggering from session to session trying to comprehend the implications of some of these talks. It's been ... it's been profound. I mean, it started out in the first session in the morning when, uh, uh, Paul McCormick gave a ... a session on why I should care about the mineral content of water, how cutting the canals has changed the mineral content of water and how this has affected, uh, this little picture of s ... uh, sawgrass, uh, growth rates affected by just mineralization of ... of water followed by effects on ... by ... grazer effects on periphyton and then it goes on and on and I left ... that was the ... that was the morning of the first day and I sort of left wondering is ... is anything exogenous to ... to the natural system hydrology and I think the answer's clearly probably not. I'm not sure we've really addressed the feedback, uh, to the extent that we can and ... and so when I listen to Robert's talk yesterday and came up and saw him afterwards, I ... I, you know, I sort of said, well, I think there are some things that we might have to work on which I probably said it, you're full of ... a little differently ... you're full of ... you're full of it, Robert. Uh, and so really I think fundamentally even this conference it's shifted my ideas about how much more we need to include the feedback loops, uh, into things that result in ... in questions as fundamental as what was the topography like. Uh, the ... uh, a friend of mine from college, uh, recommended that I read the book, uh, by Thomas Kuhn (sic) called the, uh, *The Structure of Scientific Revolution* and, uh, so I did. His ... his basic premise is that in any science process, uh, there is this tendency to ... for scientists to resist all change until they're forced to by the weight of evidence or being marginalized and not only is this a characteristic of all science but a characteristic of good science especially. And, uh, I'll just note that while he dropped out of grad school and made a fortune in the dot com boom and, uh, while I studied ground water mechanics and now I get to explain things to Ron. Uh, he has time to read books like this. Uh, but, uh, I think that ... clearly this session today has said that that process of science is alive and well and that for us to really understand the natural system, I think we're gonna have to incorporate some of these feedback loops in a much better way than we've ever done before. Uh, my second point was that I think we need to pay very, very careful attention to the questions. I'm not sure we've got the right questions, you know. Yesterday, we listened to Lynn Scarlett and she was very eloquent and quoted a number of truly, uh, truly great philosophers, Herodotus and John Ogden among them (all chuckle), uh, and, uh, I ... I ... I tend to ... for ... for my philosophical background, look more to like the Hitchhiker's Guide to the galaxy and Douglas Adams and, uh, he ... he has this little story in there where, after great effort, we know the answer to the meaning of life, the universe and everything is ... is 42. We just don't know the question and, uh, I ... how many roads must a man walk down. So maybe

we can make 'em up and I think we've done that a lot, uh, with the natural systems model. That has become our 42 and, uh, we've sort of twisted the questions a lot of times to sort of meet that ... we have that answer, 42. We have this natural systems model and, uh, so we come up with questions like how many people remember Xerox versus cookie-cutter questions, you know. You do, yeah. Uh, (chuckles) the answer's 42, uh, and I think conferences like this really help us hone the question of exactly what is the target and is that synonymous with natural systems hydrology? I think that's the question Paul asked. It's the question's everybody is asking, and I think the consensus has ... and this concept of a ... a paradigm shift or a scientific revolution. The answer is probably not. That doesn't mean we can't poke holes in ... in, uh, Robert's NSM or as soon as we get the new NSM, we'll start going ... poking holes in that but it's a ... uh, a very healthy process and I do think it's leading not only to good science but, uh, as I said, I was ... I was briefly sympathetic to ... to Rock after what it must be like to try to assimilate all this information and then try to make decisions but I ... that quickly fade ... that quickly passed and, uh, uh, you know, but, uh, I think that these questions are alive and well and conferences like this do a tremendous job in helping us focus our ... our ... our efforts on asking really good questions.

Ronnie: Okay. We're gonna sit back and listen for a few minutes while they have a conversation. They have mentioned a number of controversial topics. I want to hear 'em talk about it.

John: Tom, could you, uh, I'm really intrigued with your comment about incorporating feedback loops. Could you give an example of or elaborate on that a little bit?

Tom: One of the... just as an example, one thing that struck me was, uh, uh, certainly we know that peats are very highly ... uh, have very low ... poro... very low transmissivities and, uh, so the ... it tends to be a soft water system. This is just the ... the first talk from ... from ... and I was thinking well, that can't be true everywhere. Up on the pinelands there must have been contact with ... with, uh, calcium carbonates. There must have been a mix of, uh, different ranges of mineralization in the ... in the water and it must have a tremendous effect on peat accretion rates. So then I was listening to ... to Robert's talk and he basically had a map of what ... well, see if you subtract the bedrock depths, you have that ... that versus surface peats, I just asked myself the question. Does that ... does that make sense? The answer was I don't know. I gotta think about that. So that feedback loop of peat accretion versus location of ... of nearness to calcium carbonate outcroppings I think is a ... is a question I hadn't really thought about before.

Rock: Uh, I just want to say that it's not so important to me if Obey's NSM is the right one or Robert's NSM is the right one. In fact, let's do both of 'em, you know, and let's put 'em both up there and ... and have two kind of, uh, estimates. What was important to me is that our analysis that's driven by rainfall going through the system to generate some ... some conclusion has to match up with what our analysis is coming up from the bottom that you can't have two different competing visions of what we're trying to do that don't match 'cause that's just ... we just keep arguing with each other, one with the other, and it kinda goes to this point that both Paul and John mentioned that in some respects ... and ... and I think Robert mentioned this ... in some respects we're constrained with what we can do and ... and I think Tom said in order to get the full ... you know, if you ... if you wanted the water the ... from the 1880s, I mean you'd be flooding everything and so obviously that's ... that's not a very viable vision. So maybe you step back to the 20s and you say let's run the numbers with a 20s hydrology and ... and once we ... from my perspective, once it matches ... I mean, once we have sort of forms of hypotheses from different vectors that are ... that are getting us to the same place, then the science can work around on that and, uh, uh, we're ... at the end of the day we're gonna have something that fits together.

Obeyskera: And that's one of my ... I guess that's a follow-up. It seems like I get the sense as a modeler or a person who has been involved in some of the CERP evaluation we're trying to get away from the stage targets and trying to go more into a ... maybe a passive flow kinda situation where you don't have a target, but you let the climate drive in the dynamic storage and release the flows to the Everglades that the way it goes. And I like that ... actually last night did the volume of water, uh, in Lake Okeechobee as a function of flow that came out of the lake in the natural system condition and that's very good correlation there. And if you want to work on a passive flow system, that could be a way to apply the system depending on the volume you decide how much flow should go south. But understand that ... that you're gonna have deeper depths in some parts of the system and maybe there are ways to work around it like north of Alligator Alley, uh, you know, a system is messed up a little bit. You may not want to put deeper depths. You may want to leave, uh, part of the canal intact for some time and then later on back with that. Uh, but you have alleviated some of the (inaudible) but there is a way to passively operate involved with the system.

Rock: And I just want to say thanks to you and Paul both for saying that because I think once you get this big idea in your head of this is ... this is the way to do it. Now you go back to Paul's point and your point that the transition, the point that Paul made about the transition, you just can't go from where we are now to sort of the full operation because we have tree islands and

endangered species and other ... other parts of the system, it becomes a tran ... it becomes a transition question now, not an end-state question.

Paul: And that really is I think the fundamental question I have about this. I mean, I fully appreciate the point that we have subsidence. We just have some fundamental challenges about doing what we think we're going to do under an NSM style model because of the topography out there and in essence, my understanding of the Church of Flow is that we alleviate that subsidence issue by bringing the flows higher at the top and allowing them to make their way through those pockets of subsided habitat or areas throughout the system and that might be exactly what we have to do, but it also strikes me that there is a risk that we just have to think through that by having that higher level of water at the top, we're going to have higher levels of water at the bottom. And for me to get comfortable with it, I think we'd have to just answer those questions to have a sense for what the end ... the bottom of the system effects would be from taking this different tack which may be extraordinarily necessary given the subsidence that we see.

Ronnie: Okay, I'm gonna step in. Go ahead, Robert. Go ahead.

Robert: I just, uh, uh, the conversations about restoration are ... are ... are very interesting to me. It's, uh, uh, having also worked on a number of the, uh, projects adjacent to Everglades National Park and ... and, uh, seen the reality of the field data out there, uh, it's ... it's very important that, as we philosophize and try to find an end point of what we might call restoration that there are a lot of things that we can do immediately. For example, the high water conditions in the southern part of 3A, we know that, uh, it shouldn't be there. Uh, when I see areas in 3B in northeast Shark Slough that at a peak have six inches of water, uh, and are often dry and are formally deep-water sloughs, I know that the best thing we can do is put a little bit more water on that. And so, uh, there is ... there's a ... an end point that's called restoration, but they're in between ... I'm looking at something that I would like to call stabilization of the Everglades. Let's try to attack these problems that we know are harmful and let's move forward and a lot of that is going to have ... has to be done through things like experimental programs. Let's try and do this massive scale experiment in 3B and northeast Shark Slough, monitor the hell out of it, and then go back in the office, run some more models, and do it all over again. That feedback will ...

Ronnie: We're gonna move to engaging the audience now. Thank you very much. Since I'm the moderator, I have the opportunity to be the first to que ... person to ask the question. So I'm gonna ask a few questions to stimulate some thought. I think we have some realities of today. We have the topography of today is a reality. Whatever we do has to deal with that.

If you give nature what she needs, she will do a great job. I can't say the same for humans. We do not want to make our carbon footprint larger than the net gain we get from Everglades restoration. It would be erroneous to contribute to global warming in restoring the Everglades. We do have time, Paul. We will not turn to Babylon tomorrow and have the water flowing downstream immediately. There is time to make changes both from nature and adjusting and understanding better and allowing the system to adjust and believe me, as sea level rises or before then, I'm gonna pack my bags and leave Florida. The reason I'm saying that is that nature may be to our assistance in helping them pack their bags and going to the right location.

John: Was that a question?

Ronnie: (Inaudible)

Male: Uh, I'm gonna give you ... a, uh, hopefully something that's not gonna sound vulgar but, uh, in ... in ... in your ... your Church of Flow, are you willing to exterminate the rabbis of water quality? (Applause) Uh, it's a simple question. Uh, I'll put it in a ... I'll put it in another term ...

Tom: That sounds like a policy question to me. (Chuckles)

Male: Do ... do you un ... do you understand where we're coming from here?

Rock: Uh, the an ... the answer is ... I need to ... I need to know more about it, and I think ... I mean, Lynn Scarlett the other day sort of posed the policy tradeoff and she did not say, uh, what the answer was, but in answer to your question, yeah, I mean, rabbis, can join. I mean, uh, we, uh, we ... we can recruit rabbis into the church and ... and ... and ... and, uh, and ... even ... it's a really slippery slope. You know, once you say that the water doesn't have to be Everglades clean, now you're into the ... okay, now that we know you can be bought, you know, it's ... we're just dickering about the price and so you get down that slippery slope and ... and so the policy ... the policy pieces, how do you create a ... how do you create the ... the frame of reference that you would do that? Or putting it another way is, if you're gonna put, uh, higher than ... than no end balance water, higher than 10 parts per billion water, uh, what's the tradeoff? You know, and how ... how dirty? And ... and how ... how do you do that? If ... for me, if it came down to, uh, 10 and have very little flow or 20 parts per billion and solve my flow problems, I'd probably go more on the ... let's get it ... set the bar at 20 parts per billion and do the flow but I don't know ... I don't even know what I'm talking about here. I mean, I ... that's a ... that's a function of ... that's a function, you know, what the ...the designers of STA's and everything else ... how far can we go? What makes sense? All those kinds of things.

John: Uh, John Marshall. Uh, I really wanted to ask Paul, uh, whether he was an atheist or an agnostic because it doesn't look like he's a fundamentalist but I'm gonna ... I'll pass on that 'cause that wouldn't be a nice question. And I'm gonna go to Tom Van Lent and, uh, Kuhn's, uh, work was one of my favorites and, uh, when I was a, uh, civil servant, uh, testing airplanes and I thought there ... there could be a radical approach to what ... what was known as acquisition reform. Uh, it didn't have much success there but you mentioned that, uh, what ... uh, we don't really have a paradigm shift. I ... I think that we do have a paradigm shift and as climate change it's sea level rise and ... and we just haven't quite shifted into looking 50 to 100 years ahead and seeing what the effect is going to be because we tend to look more in the rear-view mirror than we do more than five years ahead. Do you not consider our ... our current concern with sea level rise the upcoming paradigm shift?

Tom: Uh, I think that there has been a paradigm shift already in the science community about global warming. I ... I don't ... I don't think that's, uh, that has happened. Uh, I also think that there's been a number of paradigm shifts even within Everglades restoration. Our thinking has evolved. Uh, the ... the question for ... for Everglades related to global warming, I ... I think is, uh, clearly a critical one. Uh, Ronnie's point about are we gonna use our carbon footprint to pump all this water around potentially going to be larger than our carbon sequestration rates in ... in the marsh and that's an excellent, excellent question and one that we as scientists really need to pay attention to and, uh, but I ... I think that that question's very much at the forefront and it's been at the forefront of this conference. It's been on the forefront of ... I mean you can't help but go to ... to some of the sessions and that question, uh, continually comes up. So the paradigm shift has already happened and I think what we're struggling with maybe is how do we implement that. Uh, so I ... I ... I guess I was saying that because I've seen so many paradigm shifts, some larger than others, that I think this is indicative of a very healthy scientific process in Everglades restoration.

Paul: Could I make a comment on that too, Ronnie? I really do believe there is a paradigm shift that's underway and I believe it is extraordinarily significant. Historically, our conservation practices have largely focused on protecting what exists today. All of the laws and the regulations that we have, The Endangered Species Act for example, you talk about a critical habitat boundary, what was the purpose of it? It was to delineate those areas on the ground where habitat exists for a listed species and protect them, keep them from changing into subdivisions. How do you resolve this kind of a regulatory and legal framework with a situation where we want change with a restoration program like Everglades, we want to change the system. We don't want static lines on maps. And when you then overlay the

forthcoming changes associated with climate change, it just further complicates the tools that we have right now to do the jobs that we care so deeply about. So even restoration, the term restoration, talks about returning something back to what it used to be. We I think really need to change the way we are considering everything associated with Everglades restoration to creating that functionality within the future's conditions which are gonna be different than today and certainly different than the past.

Gwen: I'm ... I'm Gwen Burzycki. I've got a couple of ... couple of things, uh, first is just a small plug for the "other national park." Uh, I noticed in Robert Fennema's NSM 5.1, there weren't any vectors going through the transverse glades in the southern end and so as we're proceeding on discussion on restoration, don't forget Biscayne Bay was also an estuary, had much, much lower salinities than it does today and restoration should not, in all this discussion of flow, we should not be leaving that national park behind. That being said, I want to go back to the main Everglades and, uh, along with the Church of Flow and the rabbis of water quality, I don't think we should ignore the Imams of rise and fall of water. Uh, what ... is flow actually the defining characteristic? Because as I listen to discussions on how the Everglades work, a lot of what's happening biologically is definitely related to the rise and the fall of water and the marl prairies are intimately connected with that particular issue. Not only do they have the highest plant diversity in the system and a lot of the endangered plants the ... that we have in the system are in the marl prairies. This is also the place early on in the wet season. It's dry first and so the kickoff of the breeding season for everybody that has a concern for everybody that is related to the ... to the Everglades, they move into those marl prairies to feed first. And so how much of those do we need to sustain the system? Is there a proportion that's critical for that early jumpstart to the feeding system? Because I've ... I've heard people say that if the birds feed too late in the system, then the nestlings are still trying to put on weight when the water levels rise and it's dry season and the marl prairies are critical for that. So that ... that's a consideration too. You need to take into account how much land do we need to be drying down early in the system.

Ronnie: And we will have time for only two more questions.

Rock: Could I just say real fast I agree but I ... I'm saying that we need to think of that as a transition question to take up Paul's point of getting from where we are and transitioning to where we need to be and I'm saying it's these deeper flow-driven kinds of systems which frames our ... our strategic interest in Everglades restoration. That becomes more a tactical implementation as we ... as we move up. But I agree that those are the kinds of things that you have to deal with, uh, as we ... as we go from where we are to where we need to be.

Robert: I ... I just wanted to add a comment on ... on, uh, my model doesn't show, uh, a lot of flow to Biscayne Bay. That's quite true. It's also ... it's a model. It's a very crude approximation of what we understand the hydrology and the complex geology and surface water interactions are like. It's ... it's not perfect. It's not a 3D model and it's also a two by two grid. Two miles by two miles, it can't capture those, uh, small, uh, features. It barely captures the coastal ridge. So whenever we look at models we have to really keep in mind they're ... they're approximations and scale is very important.

John: I want to make a quick comment, uh, since, uh, Tom says maybe we're not asking the right questions and nobody's asked me the question that I want you to ask me so I can say this. So I'm gonna say it without the question. Uh, we were kidding with Stephanie before she made her remarks about The National Research Council. Give us a hint. Give us a hint, hint, hint of what the new report is gonna say and she's ... she was ... man, she was perfect. She wouldn't give us a damn anything (chuckles) but, uh, but if you were ... but when she summarized what the L6 report said, one of the major messages that Stephanie put up there on the screen was in '06 they thought we weren't moving fast enough. And so what do you think the '08 report's gonna say when (chuckles) ... Uh, I ...

Male: Slow down.

John: (Chuckles) So, uh, dealing a little bit on what, uh, Robert said earlier about, uh, pretty quickly needing to get out there and hit some of these bad spots that where we, uh, I ... I ... I think that's an important ... uh, it should be an increasingly important way of looking at what we need to do. We're beginning to hear the word triage even, that ... that restoration ought to be a two-step process. Get out there as quickly as possible and hit the ... the ... the bad spots. Uh, and then have this more long-term strategy that we're talking about here. Uh, one other comment on that is that, uh, we're talking about do no harm and so worrying about, uh, don't get me wrong here but I'm ... I'm still gonna say this. Uh, we're worrying about tree islands or Cape Sable sparrows or that sweet spot in the middle of 3A that's still perfect and never been altered and all the time the system itself is in ... we're doing tremendous harm to the system itself on the wide ... all across the board and so, uh, when I think about the fact that, uh, that nine years has now passed since the yellow book was put out and the ... all the damage that occurred in the system in the last nine years and how much more difficult the restoration is going to be to be able to achieve today than it was nine years ago. So you didn't ask me this question, but that's the answer.

Robert: And especially since some of these problems have been known for over 30 years.

Male: Uh, this question pertains to choosing, uh, a period of time you might want to restore to, 1920s or before and ... and Robert's, uh, discussion yesterday, of the 8 feet in some places, uh, subsidence of portions of the Everglades. My question is given the overwhelming evidence for changes in large-scale synoptic climatology in particular rainfall for the last century not only from Willard's marl prairies but coral records and the ... the broader picture in the Caribbean and the sub-tropics over the last couple of centuries, uh, on what basis can we attribute that subsidence to canal building and human activities as opposed to changes in climatology and the feedbacks on sediment transport like Laurel Larsen is doing for the USGS and Greg Noe in the biogeochemical processes and peat accretion and subsidence. Can we really attribute the 8 feet or several feet solely to human canal building?

Robert: Also, don't forget fire. Uh, the ... the problem is ... is ... is ... if you take the water off the peat, uh, it oxidizes and it's susceptible to fire and I think there's sufficient evidence over the last, you know, century or so that ... that that is what happened.

Ronnie: I said one more question but unfortunately we are well into our break time. So we're gonna stop now. Thank our panel very much for ... for both ... (All applaud).