Lockheed Martin Corporation

Moderator: Courtney Chambers ERDC EE-E

November 30, 2010

12:30 am

Edited by Courtney

Operator: This is the Julie Marcy conference call, conference ID AJM 4369.

Courtney Chambers: All right well I think well we having some other people getting logged on, but I am going to go ahead and get going. I do want to thank you all for joining us today. My name is (Courtney Chambers) and I work at the (ERDC) environmental laboratory in technology transfer for ecosystem restoration. I would like to welcome you to our ecosystem restoration web meeting on use of two dimensional hydraulic models for ecosystem restoration planning on the upper Mississippi by (Jon Hendrickson). This series of web meetings on ecosystem restoration topics by ERDC and The Ecosystem Restoration Planning Center of Expertise is designed to address a variety of topics including training, lessons learned, research and development, and emerging issues. The web meetings are recorded and the files are posted on the environment gateway under the learning tab - you can see link on the screen here. As you know, we have then implementing the learning exchange notification system. The way that system works is that everyone receives an initial email notification about a webinar two weeks in advance from the CorpsLakes address. Then in this email, you have the ability to sign up for the webinar and add it to your outlook calendar. However only those who clicked to sign up for the webinar will be reminded the day before the webinar itself. So thank you all for adapting as we integrate this new system. I do believe we have been sending the day before notification to everyone on the list for now just to ensure that everybody is getting used to the system. So please continue to work with us because it will ultimately be a much more productive notification system. Just to let you know our next scheduled web meeting at this time isn't going to be until the 25th of January and it's going to be an update on Wetland Delineation. Just a few more quick notes before we begin today. We are going to allow for a question and answer the last 15 minutes of the presentation. If you hear a term that's not familiar to you during the presentation either make a note and ask it verbally if there is a pause in the presentation or you can send the question via the chat feature in the bottom right hand corner of your screen. If you are using a speakerphone, I would like to remind you to keep it on mute while you are listening and please do not put us on hold with background music. And then again if you have a question, be sure to un-mute before speaking so we can hear you. And lastly in order to have a more comprehensive list of attendees I do want to ask that if you are calling in as a group then you take a moment to write the names of your attendees down in the chat box and this might appear as ERDC EL followed by the names of your participants or simply the number of participants joining you in your meeting. Okay, and now without further delay I want to give you today's speaker on the use of two-dimensional hydraulic models in ecosystem restoration planning on the Upper Mississippi River, Mr. (Jon Hendrickson). He is a hydraulic engineer working in environmental restoration and water quality for the Army Corps of Engineers at the St. Paul District and he is also a regional technical specialist for MVD. All right (Jon), I'm going to start your presentation and you will be the presenter this time.

Jon Hendrickson: Okay, thanks Courtney and thanks to everybody else who has joined us today for this webinar. I'm going to spend a little bit of time talking about our use of really a tremendous tool, two-dimensional models on the Upper Mississippi River. Let's see. I just have to get my control speaker down here. Okay. So some of the topics I'm going to cover are Upper Mississippi River system basics, you know, what it's about and why we need 2D models, the difference between one dimensional and two-dimensional hydraulic models, model development and model uses, two-dimensional modeling and support of the ecosystem restoration planning and future directions and by the way there are a lot of different types of two-dimensional models if you open up a chemistry book, you will see a two-dimensional model of the structure of a molecule and so you really have to be specific about them but right away in this presentation, I'm going to drop the word hydraulic from a lot of this and just say 2D models and I think we will all know that we are talking about hydraulic, two-dimensional models, okay.

Some basics on the Upper Miss, first of all the location map on the left side of this image shows the navigable portion of the Upper Mississippi River. It extends from Cairo, Illinois up to Minneapolis, Minnesota. The reach of the river that I really have worked on most of my career and that I'm going to focus today on a reach extending from lock and dam ten up to Minneapolis. Lock and dams are labeled on that image on the left. And then with the middle image I have kind of windowed in a reach - and this is the land use map. The light blue color is open water or river channels and then there are different types of land cover shown there. Lock and dam eight is kind of highlighted in red towards the bottom of that middle image. Then lock and dam seven is shown little bit more towards the top of that image. What I'm trying to highlight here is this pattern that we see on the Upper Miss, at least the portion that I'm going to be talking about, where just upstream of the dam there is a lot of open water and you can see that with the light blue. Just downstream of the dams, if you look down from the lock and dam seven, you don't see as much open water. You will see channels and in fact if I have to close up - it would look more like a river and we see this pattern over and over again if you look just upstream of lock and dam seven again you get this big open water area and we call these back waters or back water lakes or off channel areas and it's a very complex and changing type of riverscape.

Now on the right image I have windowed to pool eight. So lock and dam eight is at the lower part of that image and flows from the top to the bottom and again it illustrates this pattern more closely. A lot of open water in that lower pool and, you know that lower pool where you can see most of the open water, that's about ten or 12 miles long and two and half miles wide to give you an idea of scale and the other thing you see here, even in the upper part of this image on the right, there is not just one channel, there are multiple channels, there is a main channel, there are secondary channels. Some of these secondary channels flow into back water areas and it's a real complex flow environment. So why do we need a hydraulic model? Hydraulics is the underlying foundation for processes affecting water quality, geomorphology, Habitat and Biota, in other words all of the things that make up an ecosystem and on the Upper Miss and in many systems I think, many of the long-term changes that have occurred on the river have altered hydraulic parameters. If you look at this series of photos, the one on the left is a section of pool eight. They are all the same reach of pool eight. The one on the left is 1954, excuse me, 1939, the one in the middle is 1954 and the one on the right is 1991 and so you just see a tremendous change in land that has occurred due to erosion of islands basically and everything has become more connected. So these long-term changes that occurred on the river have altered hydraulic parameters and many of the management actions that river managers are looking at to change and reverse processes also are going to alter those hydraulic parameters. Okay and then this is just an oblique area of a reach of river and pool - main channel in the lower right of this image - secondary channel. The secondary channel kind of takes a left and heads into this backwater area before it gets to the backwater lake, there is a delta that it flows through or that is forming at the end of the secondary channel and splits into many channels in this delta. So again it's just a very complex flow pattern and so we need a good model to be able to simulate these different types of flows. Two-dimensional hydraulic models on the Upper Mississippi

River system and the simulations of hydraulic parameters in the longitudinal and lateral directions provide information on water surface and velocity given a certainly flow rate, certain boundary conditions, geometry and surface roughness and the model outputs for existing conditions, historic conditions and alternatives provides information for PDT or project delivery team decision making. We have been using them for a couple of decades up here, and they have been getting better and better with time. In fact over the last five years we have used the adaptive hydraulics model and the acronym for that is ADH, which was developed through the system-wide water resources program, SWWRP and has become the 2D model of choice for PDTs on the Upper Miss. ADH includes a library of routines for sediment that are reusable in most hydrodynamic codes - includes grid adaption to improve model accuracy when it's needed and we can do a long term stimulation though there are some limits on that. There is a water quality library connection and ecological modeling capabilities and ADH represents an improvement over what we had, you know, five to 10 years ago. So that helps us because it's just a easier to use tool and it's given a better result. Okay, I want to talk about 1D versus 2D, because I know not everybody that listens to these Webinars is a hydraulic engineer, you might not be familiar with that. I'm showing the one dimensional model on the - on the left and 1d model essentially consistent with once your cross action those are shown in blue, that will layout, that we are interested in this happens to be - and we will code in the geometry, for each one of those cross sections, so the water depths across the cross section will provide a bunch of other information related to the vegetation patterns and things like. Then we will choose a flow rate to run through here quite often just one flow rate and we will give it a starting water surface and now 1d model will calculate hydraulic information, water surface and velocity at each one of those cross section and it's starts at the downstream end of the model or the lower right end of that image on the right - on the left hand side and it works its way from cross section to cross section upstream in most cases, all right. Now that's nice, it's a very good model, we have used it for years and years and sometimes it is the best, it is the best choice in many situations but, it gives the average information like it will give you the average water surface at a cross section or the average velocity in the main channel and when we need better than just averages that's where we go to a two dimensional model. I'm trying to illustrate the grid that we set up and that’s shown in the right image there and a two dimensional model simulates the change in parameters in two directions, in both directions in our case from downstream to upstream and from one side of the channel or river valley to the other side. I would like you to know a two dimensional model will give you information at each node in that grid or at each intersection between those different lines, it will give information on water surface elevation and velocity and a lot of other things. So I want you to look at this highlighted cross section at about river mile 746 that I have shown on both of them and I want to show you some results from the 1D model and then from the 2D model and they will illustrate the difference. This is just one example, but this is the water surface profile that was calculated by the one dimensional model and we were looking at some alternative for this. Lets just focus on this blue line representing routine regulation. This is the way the water surface normally looks for this discharge. You go to - 746 on X-axis go up to that blue line and you go over to the Y-axis you can get an elevation of about 662.5, okay. So that's the average water surface elevation at that cross section and that's all we know about water surface there. But with a 2d model and I'm shown you the water surface elevations on the left image and if you look in the main channel you also see that elevation of 662.5 that's not surprising, because this model was calibrated to water surface elevation at gages in the main channel. What's interesting is when you look in that backwater on the left side that large area is a green colored area in this image. The elevation, of the water surface elevation is 661. So, why is that important? Well if you look over on the right image here and this is the bathymetry and in this same backwaters it happens to be the weaver bottom backwater in pool five (unintelligible). If you look at the elevation in that area, kind of pick an average elevation of about 657. There is some variation there as illustrated by the colors but the reason that this is so important is that if you just went with the 1D model you would assume that the water depth is five and half feet here and at the 2D model for this discharge is showing a water depth of 4 feet, so that's a 40% error which might have some significant implications if you looking at things like light penetration through the water column and then submerged aquatic vegetation growth and if you look at design elevations for a project in this backwater so when you have differences like this, this is where we really need to go to a two dimensional model. (Unintelligible) differences is great by the way so I did pick a discharge that would really kind of illustrate this, important to know that stuff, this does occur. Okay, so I hope that gives you little bit of an idea of difference between one and 2D models and why we might want to go to a 2D model sometimes. Two dimensional models provide information beyond the monitoring site- we could say this of 1D models to, but I'm just trying to illustrate some of the power behind these models. We got data at each one of those black cross sections or monitoring sites, you know, that the - point two in this image, we have collect the data therefore different call rates and when we develop a model for this area we calibrate that model or make adjustments to it so it matches the flow measurements and once we have done that we feel like we have got a good flow distribution, the right flow distribution in this area then we just allow the model to give us information on velocity and water surface flow distribution elsewhere in places where we don't have monitoring data unless space you can monitor everything out there so - some what of the powers of a model and once you have this information you can easily bring this into a GIS type of database or layer and start comparing hydraulic parameters to other parameters, other spatial parameters that you may have, maybe start - correlation regarding habitat. 2D models provide information for the full range of conditions, but especially important is we can look at extreme events like floods or droughts the image and table on the slide illustrate a simulation of the 1% chance flood or 100 year flood in lower Pool 4 - and we were looking at the impacts of the islands. We didn’t have data for the 100 year flood, in fact the model was calibrated and verified using much lower flow events, but once we had it calibrated and verified we could then use it to look at these extreme events. So two dimensional models help team members communicate during planning and design. This two dimensional model was used to simulate hydraulics for existing historical and reference conditions and provided a common starting point around which the PDT can plan and design the project. I've just shown here that this leg on island N8, was extended at the request of fishery biologist to prevent flows from entering in the interior of the island. That extension was pretty expensive and that was a nice visual way for modelers to look at the effects of the project and make some important design decisions. So some important points to include, I have been talking about 2D models so far. But you know the rule, use the simplest model that helps the team answer the questions and if the 1D model does that, that's great, however 2D models are getting easier to create and they drive a lot of other models, like models that simulate sediment transport, fish movement, mussel habitat, and habitat in general that we have to evaluate for ecosystem restoration. 2D models also provide information and learning opportunities to the PDT and the research community, so 2D models are only one tool that help the team make decisions during project planning. I’m not here saying that this will give the answer - it’s just going to help the team get to the answer and you’ll also be looking at things like constructability, funding levels, regulatory issues etc. Calibrate and verify models to field data and on the upper left that usually means water surface elevation and flow distribution and it’s really important to do both of those when you are working in an environment where we have all these flow splits - secondary channels - back water flow, things like that. You want to get the flow distribution right. If you are simulating sediment transport you have to go out and collect sediment information and it gets more complicated if you are going to use the hydrodynamic models to look at other things like sediment.

Boundary conditions are very important. If the wrong starting water surface elevation is given, the model will still give you an answer but it will just be wrong and you have to have a way to test whether that model is giving you reasonable results. Sensitivity testing should be done to determine the effects of mesh size and boundary conditions on your project area. And in long term simulations of parameters like sediment or nutrients they might be limited with these multi dimensional models due to the computational requirements. Now at the beginning I said you can do long term simulations, there are some limitations on that in some cases. Some data needs include the bathymetry/topography, structure elevations, and then water surface elevation rating curves at the boundaries and if you –notice there is an emphasis there in parentheses on vertical data you need to make sure that your vertical data are the same for all of this data. If you are dealing with the system like the upper - you need to be thinking about flow distribution data to make sure you will get that right.

Vegetation patterns on a geo-reference map is nice including the information on seasonal changes that may effect how some of the parameters that you will input to the model and later on it might affect, you know, when you start doing. If you do use hydraulic models 2D models to simulate vegetation growth, you obviously would like information on that. And then the desired range of hydraulic conditions for target species or habitant - think of the information you will get on all those blue book models kind of simple HEP models there is nothing wrong with HEP models by the way. But, you know, sometimes you are getting information on velocities for - especially for things like fish, and if you can establish what those desired conditions are, your two dimensional becomes a more powerful tool. If you are modeling sediment you need to get sediment information including bed sediment gradations suspended sediment quantities and gradations and then water quality parameters too if you are going to be simulating water quality.

So when you will start modeling? I would say as early in the study as you can so the model results can aid in the decision making because remember there is all these other factors that effect the final alternative selection and you want the model, if you are going to invest the money in a two dimensional model you want it to be a useful tool for that PDT. If you need to collect data to calibrate and verify your models you better start that even earlier. Quite often though parallel modeling and monitoring are going to be a reality and in some cases the model might help - inform you what you need to monitor. So this is an example - just a timeline for the Reno Bottoms area - two-dimensional model. That’s a project that is ongoing and we started collecting flow data back in early 2005 it looks like in spring of 2005 and you need to see we are collecting water surface data. We actually put a gauge in this area and there were some supplemental bathymetry collected and all of that information was used to develop the 2D model and the two dimensional model was developed to look at alternatives. Model development occurred from about December 2006 into May or June 2007 but notice, we are still collecting some flow data even after the two dimensional modeling was completed. So again you may have parallel tracks between these two things monitoring and modeling. Model time and cost, keep in mind I’m talking about a pretty big river system - pretty big river and many factors can influence us, but three to four months and $50,000 in house labor is a good starting point for upper Mississippi river hydraulic models.

But the projects are big too and model cost, really even at 50K, are only about 1% of a typical project cost for ecosystem restoration projects we are doing here. Model review usually is a district quality control function. It would be nice to find other people in other districts to help you out in this area but the number of available reviewers is just limited. Okay so lets talk about 2D model using planning steps. This is just a reach of Pool 9 and the 2D model that was developed, was based on existing bathymetric data it's calibrated the flow and water surface data. And it can be used to interpret habitat and conditions for Biota for this large area. The area shown there is about a 16 mile long by 2.5 mile wide area. That's a lot of spatial information on some important parameters that might effect decision makings. We have recently actually been using the 2D models to help us forecast future conditions. The two dimensional hydraulic model is shown on the lower left image and I think I showed you that image earlier. There is a main channel, there is a number of secondary channels and that hydraulic information was used to simulate sediment transport through the same reach of river. That's what is shown by the image that's dominated by the yellow in the lower right. And we have looked at seven years simulation of beddisplacement in Pool 5 and then the thing that was kind of interesting and exciting about this is when you look at the sediment deposition is shown by the green colors here, yellow just means that nothing was really happening, the green colors you look at the pattern inside box, it really pretty closely matches the pattern of sediment deposition that we see from aerial photos shown by the aerial photo on the upper image there. This delta is forming into this back water area and it's just been expanding with time and I'm not sure if we are getting the magnitude right here but at least the pattern is right. And we also were able to use this model then to look at the effects of large flood because some of the river managers out there were wondering, well what if a 100 year flood occurs? Is that just gonna sweep sediments aside and we won't have to worry about this delta expanding into this backwater? The answer is no, the delta is forming and it's going to continue to form - nothing is going to sweep it away. So something that helps us to make decisions.

We have used 2D models to look at reference conditions and this is Reno Bottoms in upper pool nine I should say the modeled contours - water surface contours are shown on the left. But the questions we were trying to answer here was - why had our floodplain forest shifted over time. It actually had shifted to the parts of this backwater or this floodplain area that were about two feet higher than it was in the 1930s - prior to the lock and dam construction.

And what we did is we collected water surface data out there and we are able to draw the rating curve that is shown in green on that chart on the X axis water surface on the Y for existing conditions we just set some of those gauges out and collected that data but we have no way to determine what the water surface was prior to the locks and dams and that's where we used the two dimensional model and, you know, with great caution because, I mean, a lot of - that are from the 1930's, we set up this model and we have a some gauge data in the main channel and - model to match that and then use the model to give us water surfaces in the backwater areas and what we found was a shift of two feet and the text here is just from the report on this and this was the HGM analysis that was done by Mickey Heitmeyer in this area and there was a correlation between the forest change and the change in water surface. So once we know that we can look at management actions to may be shift this water surface to a condition that might be more desirable for flood plain forests. The model gave us information we couldn't have obtained any other way. Models can be used to define objectives and performance criteria. This is kind of work in progress here but and I guess we have seen the - a couple of times but what is looking at side channels and we are trying to establish criteria for what is a good sideor secondary channel. We are talking to the biologists on the team about, you know, which one of these provide good habitat for fish and for muscles, I could say for work in progress we are not their yet but it is in the model allows us to look at all of the special data and up along just to look at different discharges. Okay and then so just like all good Engineers had taken all the other planning steps and lumped into this one big giant step formulate, evaluate, select alternative plan but the 2D model can be used through out that process. It doesn't make a selection to you again. There is so many factors that affect, you know, what a PDT ultimately decides but it is one important tool that we can use in making a selection and we use them quite a bit to refine designs and evaluate constrains like floodplain constraints and again you can communicate, it helps people visualize estimates of habitat outputs. This is the pool 8 project and, you know, the model shown on the left and it's - it's a number of different things are labeled there including interior islands and a rock sill, there are two rock sills, there is a notch at the upper end of it and the images on the right side show photographs from different time periods and you see the 1961 historical conditions when I think habitat was pretty good in Stoddard Bay at that point. But in 1994 a lot of land mass, a lot of the vegetation was lost. that in this period and so we introduce that information we only have money to do a project here and we work with the partners, came up with the design and, you know, that 1961 images you really that have a lot to do where allowed on the island that just makes a lot of sense to build islands where they exist before and this is construct ability and there is a geo-technical reasons for doing that cost issues etc but the model was used to simulate in fact some of these islands and it was use to fine tune the heights of the rocks fills, the rock sills basically are just overflow structures. So when you do get like a two or three year flood event you will have flow through this area and you wanted that to occur and it was use to fine tune the position of interior islands and the size of the notch and probably the most important criteria we had for this project was on velocity criteria. The biologists we were work on this project gave us this criteria and we were able to simulate that and that really is how the notch came to have a certain size to it, just that we would obtain those low flow - low flow velocities. But, you know, another thing that we did and hope that -

hope that I can explain this image in a reasonable amount of times so that you understand it. It's just a basically a discharge rating curve. On X horizontal axis you have the total flow in the river and on the vertical axis you have the site discharge in all that we just back up once year and also if you notice on the image on the left, you see the Stoddard Bay transect. So we are measuring or stimulating the total flow at that transact, across that transact and that's what showing here for low flow conditions, the flood conditions. The upper curve is what existed that's the existing conditions and I say that there is a lot of flow to be going through a back water area and you got to remember that backwater area was flood plain at one time and wouldn't have any flow through it for anything –less than three year flood condition. And the dash line at the bottom is what we create out there. So basically we eliminated most of the flow for low flow condition and it's only when you get up on that X-axis to a discharge that amounts to a two year flood of that, you know, 75000, 80000 CFS that you actually start getting lot of flow through this Stoddard bay. I think when you look at this we really restored a more natural flowregime. –Capoli Slough is a project that we are working on right now in Pool nine and the project consists of a lot of different features on multi canal, see them on here but there is island, backwater dredging shorelines stabilization habitat structures in secondary channel and you are looking at a 10 to $15 million project. And the 2D model average flow velocity is that you can see that the 2d model here of Capoli Slough is just a small part on this large model but they were use to establish baseline conditions on project alternative conditions and even to establish some criteria for mini project goals. Spatial organization in this project was done by open water - was by cover type. So open water, submerged aquatic, rooted floating, and emergent aquatic vegetation. Okay. Modeled velocities were compared to the curves for smallmouth bass and bluegillsconsidering habitat like food, cover, and life stages like fry - and, you know, as just to get example of the hydraulic model we are providing information to the biologists who was doing this analysis and by the way – HEAT software was used to calculate the average annual habitat needs for this. I know we just had a talk about too long ago on the HEAT software. So it was nice. We are doing some interesting work for the Omaha district at the Lower Little Sioux Bend Shallow water habitat for Pallid Sturgeon can be constructed and we are considering doing that because –they are an endangered species but it's going cost a lot. And the questions is how long will the habitat last and how significant are the maintenance requirements do to sedimentation and - shallow water habitat criteria at the bottom Unsteady means that you are running the hydrograph instead of a constant discharge. May be daily changes in discharge through the model and that's what we are doing here. It's a big model 31000 elements, the models being used to optimize hydraulics and sediment transport in the navigation channel and off channel shallow water habitat, it's very sensitive to sediment boundary conditions and run time is 10 to 12 hours on the ERDC - super computer for a 300 day stimulation. So that's a pretty significant amount of simulation time that's required there but they are looking at unsteady conditions of sediment transport but they are also looking at spending a lot of money to create this habitat. So it's worth it to do this. There is lot of colors here no time to go through it but if each model is being use to optimize hydraulic and sediment transport and the navigation channel handed off channel areas. Okay, just real quick, SWWRP is the System-Wide Water Resources Program. I want to say something about them. They have provided us the ADH tool and they continue to provide us a number of different types of tools as I kind of outlined here and I think in the interest of time we will just keep going through this. Here is one tool we are looking at and this is kind of the - getting to the future uses of two-dimensional models but ADH CASM, CASM stands for the Comprehensive Aquatic Systems Model and it's been used to look at alternatives in pool five and calculates daily changes in biomass and water quality Basically in pool five at each node model - velocity is provided to the aquatic food web algorithms and ultimately what they want to do with this model is predict vallisneria growth which is the type of (merged project vegetation) growth. And so you can use that, you know, if you can get a model like this develop, you can use it in a number of different planning steps. And then there is ADH ELAM, ELAM stands for the Eulerian-Lagrangian Agent Method and that could be the subject of a webinar to describe what all that means but let's just say there are these models being used to look at fish passage alternatives on the UMRS developed in the pacific northwest for - projects and it forecasts the responses of highly mobile Aquatic Biota and really talk about fish here again the limits on this are really by your limits on what you know about how fish respond and these can be substantial at times and in the pacific northwest I think they know lot more about the Salmon than we do on sturgeon and paddlefish on the Upper Miss but we are trying to collect information on that. So ELAM offers a way to more closely couple ecosystem response at physical conditions. And again we are using that lock and dam 22. And then I don't know too much about HydroMussel but it is something that's being worked on. I know that fresh water mussels are big deal and basically this is flow based ecological modeling software that consists of a hydraulic model, habitat model and population model. The nice thing about these last three models that I have talked about is that really you are coupling the physics that you are getting from 2D models with the ecosystem response of some type rather than taking the physics from those models and then having a team interpret what they mean for ecosystem response. To summarize, 2D hydraulic models have been a tool of choice for a couple decades on UMRS due to the complex flow pattern and the ADH develop for this work is the latest 2D model that we have been using. Model cost are about 1% of project cost. 2D models provide (H&H) information at un-gauged locations across the river valley, which can be incorporated into a GIS database. They provide information for the entire flow regime and they provide information for extreme flow events, which we usually don't have data for. And then 2D hydraulic models have been used in ecosystem restoration planning on the upper miss to inventory existing conditions, provide information for alternative analysis, and more recently we have simulated future with out project geomorphic changes with them and we have simulated historic reference conditions. Then for future directions, I think we are just looking at again coupling the physical model or physical results you get with the 2D hydraulic model with ecosystem response and with that, I think that's all I have to present.

Courtney Chambers: Well thank you Jon. We can start now with any questions from our participants. If you would like to ask it out loud you can do so. Just remember to take your mute off or you can type your question in the chat box. Don't be shy.

Woman: I guess something that I'm wondering, you kind of mentioned, you know, that takes about three to four months in 50000, you know, get when these started. I don't know what a one-dimensional model cost - understand the comparison cost.

Jon Hendrickson: Oh yeah, that's really good - great question and I wish I really have some good statistics for you on that - that pool five model that I have shown you because they covered the same area but I think with a 1D model, you know, you might be looking at - I'm going to say 20000 that - that might be high. It depends on the information that you have and usually especially on the Upper Miss when we are developing a 1D model the cross sections are already there, in fact there is a number of cross sections that had been collected over - overtime and so to get a model up and running for, you know, just - let's say a single discharge, the 100 year flood that you want to look at, you know, 20 maybe 10 to 20 something like that and I hope that kind of answer the question. Now one of the things I should add to that is these 2D models on the Upper Miss - that really is - is nice for us and it's another reason why we use them so much as we have this program, it's called the environment management program and it's part of that program. We have a long-term resource monitoring effort going on and they have collected of the (symmetry) through that effort. So when we go to a pool, a lot of times we can just pull up this data and that's it's actually USACE program, the USGS collects the data for us. So have it all that in the symmetry of course saves a lot of cost for us too.

Courtney Chambers: Great, thanks Jon. Any other questions?

Jon Hendrickson: I see one in the chat box here from - district - the ADH models considered engineering or planning models, have they been certified, approved for broad usage on ecosystem restoration studies and do they still need case-by-case approval. I'm not an expert on certification but everything I have ever heard is that no they don't need to be certified. They are engineering models, the answer of your first question. They haven't been certified and I think they have been used broadly on ecosystem restoration studies and I guess on a case-by-case base I think it's going to be up to the modeler and whoever reviewing doing the quality control in that district or - or perhaps from another district to make sure that these models are - are providing good results and, you know, I mentioned calibration and verification, that's a big part of quality control. So good - good set of questions. Then - to our participant, is there a report for the pool five-sediment analysis? I would like to see how the seven years - took my computer a week and continuous runtime to run 30 days. Yeah, good - good point. I'm not sure if you are using a daily time step there for the 30 days. We really simplify the hydrograph into, you know, very big time steps to run this and we - we looked at, you know, when I say big, we are talking, you know, probably a month long time stuff. So we would have a constant low flow condition in august for a month and in the spring we might have like a two year flood or - or larger flood that - that would be run there.

That's how we simplify that. I don't know how long all of that took. It's - it's a big question now. And let's see - I will just keep reading these and if somebody wants to jump in with a question, please do so anytime. So (Steve) asked me just saying ADH is on the HH&C Community of Practice list of approved models actually listed as preferred and thanks for helping me out there Steve. And then from the - district are any limitations to use of 2D models for occasional streams because that may experience seasonal dry condition and I - I don't think there is a limitation there of course you are dealing with a lot of other issues with the stream in - in areas like that area to areas especially but I think they have - I'm trying to remember if the Los Angeles district use a 2D model for some of their work on the real - I guess I'm - I'm not sure about that but I - I think you could because quite often you are picking a design discharge or range of discharges that you want to look at even for the error streams. And let's see from Detroit district, can you discuss the flexibility of the grid set up, for example the notch and the example you have mentioned how much refinement did you perform. I - I really don't have the answer I - I will tell you this much, we developed these models and, you know, we are starting out with this initial mesh and after a week - of work by a - a good model, you might have a model up and running and then I - I swear they send another two weeks, three weeks trying to get the model to calibrate and verify and they are making sometimes adjustments to the mesh, sometimes adjustments to - to other parameters. Now at this notch - it's a very small notch it's probably, you know, 20 feet wide on the bottom then - and so it's very small and I - I think we will just used real small elements sizes in that notch and, you know, set up a track of soil cross action. And make sure we had enough elements - enough details to simulate these conditions there. So it's a good question sounds more like it's from a hydraulic engineer though.

Courtney Chambers: Great, thank you Jon. That was a good slew of questions we will leave a few more minutes if anyone else wants to speak up or type in a question feel free to do so.

Man: Does ADH any capacity to handle ice?

Jon Hendrickson: Yes, they have added ice to ADH or it's a work in progress so it might be something that - that they are working on. And so I - I think that's - that will be a tool, valuable tool in the - in the future if you are - and that type of climate just like we are here. And in fact, you know, when we have been than work for started then we are trying to predict the velocities for bluegills we didn't have a way to simulate ice work for 2D models. So we just used some, you know, kind of tricked the - the model into given us some answers by reducing the cross sectional area by, you know, just a - a certain amount and it was just really kind of an arithmetic solution that we came up with to look at ice conditions I think in the future that will change.

Courtney Chambers: All right, Steve actually had a response to that question it looks like, it says that current use - currently grow, current uses are grow ice fiction libraries (Erin) I think helped with the code.

Man: Yes, (Erin) be using from - actually he is on the same pole also - really a top-notch modeler.

Courtney Chambers: Great, thank you Steve, any other questions for Jon? All right well, thank you all very much for participating and then thank you Jon for providing that information and then answering those questions for us.

Woman: Courtney.

Courtney Chambers: Yes Ma'am.

Woman: Yeah, this is late, he had several questions about the cost. So may be he could just real quickly recap why it's - those cost, you know, couple thoughts on that.

Jon Hendrickson: Sure, sure. Well I think there is a number of reason why it might be worth the cost to someone to use a two dimensional model. You know, first of all there is, if you will look at models that simulate other ecosystem processes plant growth or fish movement or mussel colonization they rely to large extent on - on hydraulics. So if you want to do a good job with these other processes if you are in a complex system like the upper Miss or may be even in that - some situations you might want to use it - you know, the very simple channel. You can get a lot more information with the two dimensional model. I think we are all competing for money these days for ecosystem restoration work around the country and sometimes we have difficulty convincing people that we should get money or we that we should go ahead with that. A feasibility study from a 2D model may give us the - the strengths to, you know, a better I guess marketing ship to do that. And so from that standpoint 2D models are worth it and when you think about the corps of engineers planning to me when I will look at one of the weakest parts of the planning there is a prediction of future with all project conditions. Sometimes it's just a paragraph saying, things will get a worse or things will stay about the same or whatever but there is no back up for it and I think the reason for that is its pretty tough to predict that and like I showed with that one image I think that we are getting to a point where we can start, at least doing some sediment transport simulations with these models that will help us to do a better job with that future without condition. And then one final part of that is I was trying to remember some of the reasons why I do the 2D model. Another thing is we doesn't get more information on ecosystem response and, you know, Bioda response.

In last 10 years we probably gain some information on average velocities that are good for certain curators or may be that was 20 years ago with the blue book models that they have and more recently may - or sort of look at, the range and variation with time and I think as we keep working on ecosystem restoration we will get more and more information like that and spatial information. You know, what really makes a good channel cross-section for your species, I mean, interest. Is it just based on an average velocity or is it a range of velocities across that channel. And if it's a range of velocities then you probably want to look at a two dimensional model to simulate that. I hope thats the answer, you know, why we might want to - why you might want to go to a two dimensional model in some cases.

Courtney Chambers: They had a little bit more as information shared by (Thomas Kimbuchi) as well, "think that's a great set up, it's very flexible in ADH were assignments occurs internally, automatically were needed and as much as needed tips of islands are sharp ends in mesh - and just the side channels cause trouble for him."

Jon Hendrickson: Thanks Tom.

Courtney Chambers: Any last questions? All right, well I do want to again thank you all for participating today, I hope you can join us for our next meeting and it's going to be the 25th of January and that's going to be an update of Wetland Delineation by Jacob Benowitz). Thank you Jon again for your presentation today.

Jon Hendrickson: You are welcome.