

DAVID So I was asking earlier what your backgrounds are. I think I've got-- do I have a clicker here?

LAWRENCE: That guy just walked out.

I was asking earlier what your backgrounds are. So show of hands-- civil? Civil 3D, specifically? OK, like most of the class.

InfraWorks, who's actually really, really used it on a project? A couple.

Transportation-based project or what, InfraWorks people? Just wondering. Transportation?

Mark's everything, Mark's a good guy.

Exhibits, proposals, that kind of stuff? OK.

3ds Max, anybody? Mark, a couple others. OK.

We use it for a lot of different things. So I'm going to go ahead and start.

I'm a geek, that's my self-proclaimed title. I do a lot of different things. Thanks, John.

We do a lot of different things. We sit in an odd position within our company. We get to work on proposals, projects, transportation projects, utility projects, a lot of different things.

I'm one of those people who have been gobbled up by AECOM. So I started in Dames & Moore back in '96, and then I was URS, and now I'm AECOM.

So the graphic of that in the corner is really me, and my wife can attest to the dangers of that mentality. But it gets us to be able to do a lot of different things.

So I grew up with a civil engineer dad, and my grandpa was a civil engineer also. Do spacebar.

So this is the class summary, it was in the book, you read it. That's why you're here. I'm going to try and stick to it.

We're going to cover InfraWorks-- starting with InfraWorks, doing Model Builder, taking that into Civil 3D. Taking that then back into InfraWorks and doing some visualizations and talking a little bit about Max, bringing that into stylize your InfraWorks model, and showing some

examples of what we've done with it. So go ahead, Josh.

So these are the objectives, and I hope I get them all for you so that you can do that. If I don't get that, I apologize. We're going to try. It's only a 60-minute class so we'll do our best to get through these.

I want to help you understand conceptual design in InfraWorks-- exporting to Civil 3D and importing it into Civil 3D from InfraWorks, and then taking your refined model and exporting it back into InfraWorks and utilizing it within InfraWorks, and getting the elements that are exported from that. And then symbolizing it, making it look a little more real than what your CAD set has.

So we've all probably seen this curve. Anybody who's been at AU before has seen this curve. If you haven't seen the curve, it's a curve that's used a lot.

So we here a lot about BIM and all different things. I'm going to take BIM out of that line and just say more information early. I mean-- because there was a whole discussion we had in several classes today and yesterday, talking about what BIM means to civil. To me, what it means right now in this class is more information early, more ability to look at that information quickly, and being able to share that information with other people.

There's a lot more to that, there's a gigantic world of BIM, but we have an hour. So I'm going to try and condense.

But the whole point of it is the earlier you can get at that information, and the more you can get at that information, and the more people that can get at that information, the less it impacts your project as far as time, budget, and schedule. Well, I guess schedule and budget are basically the same thing.

I need a remote clicker.

So does anyone really want a product that does everything? Is there anybody in this room that wants that? Good, because I'd just say go.

Audodesk has a lot of software, so we're going to talk about a couple of them. The reason you don't want one piece of software-- hit it again, John-- cost, overhead on your machine, the training level to do everything in one software would be a mince-- one more.

So we're going to talk about three specific pieces of software-- InfraWorks, Civil 3D, 3ds Studio Max-- and I'm going to talk about specific versions, too. So if you don't have or never have worked with 360, it may look a little different.

Working in Civil 3D 2016 service pack 1, so some of the tools may not exist in 2014, 2013, 2012. So if they don't exist in your software, it's probably because they don't exist in that version.

So 3d Studio Max, I'm going to cover some of that. But we have a lot less Max people. If you want to learn Max, raise your hand. OK, there's some Max people, sweet.

OK, I'm not going to cover that in a lot of detail because Max is daunting. It's a great program, and it can do just about everything we need, but it is really daunting to try and teach to people who are drafters.

I said that tongue-in-cheek, it's not true, designers. I grew up drafting and that has a pencil and paper. Designing is much different. I caught myself, though.

So is this your workflow? Hit it one more time, John. It should be going automatically. Hit it again, and there's supposed to be a your.

OK, do you start with InfraWorks? And that's spelled wrong, sorry about that. Go to Civil 3D, do all your design there-- and it's supposed to be just auto-going. Make your plan sheets, submit that, submit your CAD files, and then magically the client has no red lines and you never have to change anything.

Yeah, me neither. It's not what we do.

We start assuming everything is going to change at some point. You have to, that's kind of the whole point of this and why we started making a workflow, to revolve things around a lot of times. Because it's going to change. Go ahead, John.

Yeah, it doesn't work in the real world.

All right, so this is a little more like our workflow. I tried to make it smooth, but it's not. I don't know that-- Mark, I'm going to pick on you because I know what Mark does. Do you have a smooth, linear workflow?

No.

OK. I actually was trying to start making the graphic more like a wagon wheel, and that didn't really work, either. And so I just started drawing the lines, and it got really, really crowded and really convoluted.

But the big thing about this graphic-- and I'm not saying this is the optimal workflow in any way, shape, or form-- but know-- and this is key-- that you're going to go between these programs. Start with the end in mind, that this isn't just a Civil project-- Civil 3D-- this isn't just an InfraWorks project, this isn't just a Max project, it's not just a Revit project. I've got to be able to move there back and forth a lot. So how do we do that?

Projections matter. Who every time you start a project, you put projections in your CAD files? OK, a couple. Every hand in this room should have been up. That's my little soapbox there.

When we talk about BIM, we talk about all these things. BIM includes x, y, z in projection. If your building or your drawing or whatever is 0, 0, and nobody can find out that it's not at 0, 0 on the equator and the prime meridian, that's not good. When we're doing calculations with CO2 emissions, we're doing calculations with traffic flow, we're doing calculations with solar energy, we need to know where it is. And moving stuff between these programs, they need to know where that is, too.

So I've got a couple of those windows. Have you all seen those windows? OK, so the far right one is Max, Civil View, if you haven't seen it. The other two mostly you should know. I'll go into those a little bit more. So why does it matter? We talked about that a little bit. So let's keep going.

So we're going to create a conceptual workflow. Has everybody used Model Builder? OK, we've got some. Anybody not that wants to see it? OK, I'll cover it then. I don't want to cover it if you don't want to. So we're going to talk about these basic things of setting up a conceptual model in InfraWorks.

And these are ones that you have to know to really do much in InfraWorks. So I'm going to go through Model Builder really quick here. And so I'm actually going to jump to the program. And so this is kind of daring here. So I don't know, have other people had instructors that did live demos, or is it mostly screen captures? Live demo is always a questionable thing here.

So in InfraWorks, this is what InfraWorks 360 looks like. If yours looks different, it's probably an older version. Up on the top, there's a button called Model Builder. So Model Builder, what it

does is it gets you preliminary data really quickly. Let's see how quick it goes. If it doesn't go quick, we'll-- so what we can do, my project, I'm going to cover some of this, is in Gilbert, Arizona.

So I just go to Gilbert, Arizona. I zoom into my area. I'm working on this road right here, Ironwood Road, in this area here. There's not a lot there. But we can get at that area. So you could do a couple different things. You can pick an area. You can do a polygon. So you can get that.

If you go too big of an area, which I do a lot on some of these projects-- see how it goes too big? You can only do a certain amount. So you can do polygons. Click your area. And I'm going to pan over here. I'm used to three monitors and not just one.

So that's your polygon. You can actually import a shape file, too. So a lot of the projects start with GIS data. I can import a shape file. And if you don't have a shape file, you don't have a GIS application, Civil 3D does make shape files. I know that's kind of a taboo thing. They want to talk about the SDFs. But you can export a shape file from Civil 3D and get you that polygon. But your projection matters.

So I selected the area earlier and told it to-- I named it Ironwood Road. I gave it my directory. So we have a lot of directories within our client list. And so we actually put it into the different projects. So you could select different things that you want-- elevation, imagery, buildings, roads. It's going to go out. It's going to get Bing imagery for you at a specific scale. You can adjust that after.

It's going to get line work that's TIGER and OpenRoads, building data from OpenRoads, and the elevation data from USGS. So it's going to grab that automatically for you and insert it into a model. It's going to look exactly like what's out there, right?

[LAUGHTER]

OK, yeah, those of you who have used Model Builder laughed. So I'm going to go to the Ironwood Road here. So this is my Model Builder version that I downloaded earlier. I'm going to zoom into it and just look at it. And you'll see that it's identical to exactly what's in the real world. It's reality capture right from InfraWorks, right? No, it's not. But it's a good start.

So this is really kind of a barren area. But you can get more data. In a lot of the rural parts of

Arizona, we get zero buildings, just so you know. So in certain areas that are built up, you get more data. But this is what it comes out with. There's no buildings. There's not a lot. The roads are pretty generic. And they're stylized in a way that isn't really real.

So what good is this for us? OK, anybody got an answer to that? What good is this? It's not. OK, I heard you.

AUDIENCE: It's a place to start.

DAVID It's a place to start, OK. Who else? I agree with both of those to some extent-- a place to start
LAWRENCE: much more. What else? Why do we care? What good is this? You've got real road coordinates in the projection.

AUDIENCE: [INAUDIBLE]

DAVID What was the last one?

LAWRENCE:

AUDIENCE: Context.

DAVID Context, gets you context. OK, so we've got a basic intersection here. And so you probably all
LAWRENCE: have downloaded this. And you thought the imagery needed to be better. So I don't know if you've all seen this. So if you go to Data Sources-- and did I go too fast? I'm assuming maybe for some of you I did, some of you I didn't. You double click on Imagery here.

And I'm not going to do this right now. Because those of you who have done it, you know it's not a good idea to do that while you're waiting for it. So right before lunch time, go in and select your imagery level here. So you can go to Raster, and you can change this right here. By default, it goes to 17, which is this resolution, 1.9 meters per pixel.

So you can bump that up. And you can bump it up to 19, which is a lot higher resolution. But like I said, if you want to get a project done that day, don't do that while you're waiting for it, so just a little tip.

So you also may have noticed it's got the geolocation. Does anybody actually work in that, USG, WGS84, sudo mkdir? I do, but I'm an historic GIS guy. So anybody? No, OK.

So what good is that for us? We can project on the fly in InfraWorks. And if you don't think that's worthwhile, let me switch really quick to-- actually no, I'll show that later. We had a

project recently where we pulled in Model Builder, pulled in some base stuff, and then we started bringing in all the client's data. Context-- who said context?

We started pulling all the data in in the supposed projection. And we started finding errors, a lot errors, that a stack for a generator was 3 feet off. Well, in some context, well, it's just a picture, right? No, that 3 feet is a huge deal for an air permit.

So pulling all of it together helped us to understand that there was a quality issue from one of our subcontractors very early that we said, you need to fix this. We also had an issue where there was a road going right over a pipe that we had got the data from another subcontractor. We addressed that very early. And we were able to save a lot of money. So context is huge.

So going then, how do we make these look a little bit better, or a lot better? Those are the two different levels. So we've got the style palette. Anybody played in the style palette and got frustrated? OK, we've got the, played in the style palette, hands went up. And then I said, got frustrated, and then all these other hands went up.

OK, those of you who played in the style palette and got frustrated, have you played with Component Roads yet? OK, I've got a hand. Do you like it?

AUDIENCE: I got frustrated.

DAVID Got frustrated, too. OK, what was your frustration point?

LAWRENCE:

AUDIENCE: [INAUDIBLE]

DAVID I can go with that. So in the style palette, you've got a lot of different things-- 3D model. You've

LAWRENCE: got tons of different things. And we use that a lot, actually. So for roadway-- I think I made an Ironwood Road. Yeah, so I made an Ironwood Road style.

And it's pretty basic. It's not anything spectacular. But what they're going to do to that road is widen it to three lanes each way, add a shoulder and a barrier in the middle-- so nothing spectacular, nothing huge. But I only have an hour. So I'm going to go back to that crutch there.

So how to do we add decorations? Anybody know how to add the barrier in the middle? Mark does. He's shaking his head. I'm going to go really quickly through it, so if you want to add

something to it. You look at your style. You add a decoration. You pick where you want it to go. And this is a poor example. Because I didn't label everything.

But if I go to Bikeway, and I want to add, let's say, a street lamp on the side-- actually, I'm going to do a barrier. So let's do a barrier. So I added a barrier on the side here. So that obviously doesn't look right. So we have to adjust the spacing. And I think it's 10. Nope, it's nine. So it connects it.

And then we actually need to flip it. So I'm going to flip the rotation here. And then it's still not right. Because it's sitting on the middle of the road. So we can do our track offset and adjust that so that it sits where we want it to. And then we go down here and hit Tiling. Mark, why do we have Tiling?

AUDIENCE: Tilting.

DAVID Or Tilting, sorry.

LAWRENCE:

AUDIENCE: [INAUDIBLE]

DAVID Have you guys done that, where you add a decoration in, and it's like, da, da, da, da, and it's
LAWRENCE: really stair steppy? That checkbox is your friend. It's the steps. So if you get rid of the steps, you hit the check box, it'll fix it.

Oh, I didn't drag it to it, sorry. And then you just can apply it. We back at the office have a lot of those styles.

AUDIENCE: How many of these styles have [INAUDIBLE]?

DAVID So in the out of the box, I only have one style I made in this model. So out of the box, it's got
LAWRENCE: these standard street styles here. So it's got that. So you can see how many. And then you've got the bridge deck. There's some standard bridge deck pieces. And then there's the interstate pieces that have some standard styles.

There need to be more. But how many more should they make? That's a question. Yeah.

AUDIENCE: [INAUDIBLE]

DAVID Oh, we have a lot.

LAWRENCE:

AUDIENCE: Does it come out of the box?

DAVID Not out of the box. They've got some. They're pieces. We make a lot in 3D Studio Max. We do

LAWRENCE: a mix of Inventor, 3D Studio Max, and then Civil 3D and CAD to 3D Max. The reason we go through Max is textures and optimization. Because a CAD file coming in has a lot of polygons. If you take that model that's got a ton of polygons and run it every 200 feet down a road, it's going to kill your model. And it's never going to run.

If you take that same model, pull it into 3D Studio, it has several optimizing commands, modifiers, where you can reduce that polygon count substantially. And then you run that along the road. And it's a lot more optimized. So we make a lot. We have a lot of ADOT standards that we do. Because we work in Arizona. But there's a lot you can buy online if you want.

Be careful. The Trimble online 3D Warehouse is really iffy on what you get. Sometimes it's an OK start. But I would never just pull it straight in, usually. Because they're either not optimized, or their textures are horrible. So it's a balance. Any other questions?

AUDIENCE: If you want to create a new one, you've got to start from scratch [INAUDIBLE]?

DAVID You can dupe one. So there's several commands right in this palette menu. Sorry I'm going a little slower than I want to. But it's your guys' class. So if we go here, and I want to dupe this road, I can either copy it to a new style palette-- so if I want to do a new catalog, I can actually make a new catalog right here. Or I can take that same button here and duplicate it to one within here, and then just rename it.

So then I can build off that. So if there's a style that you like, you just build right off of it from there. Other questions? Because I'm going to kind of jump away from the style palette for a second here. Component roads-- component roads are very similar.

So there's three types of roads in InfraWorks. There's just the generic road, which this is right now. And then there's a design road, which adds your vertical profile. And then there is a component road.

So if I draw-- and this is a big deal. The reason I specifically mention that is because if I take a road-- so if I draw a road, and I take this style here, I'm just going to draw a new intersection. You'll notice it's not that impressive of an intersection. It doesn't have any intelligence to it. It

doesn't really know much. But it makes it look OK.

If I then take this road, and I convert it to a design road, and I convert this one to a design road, it actually wacks out your profile first. So that can be annoying. But then let me convert this to a design road also. And you will see, as soon as I pull this back down-- so with the design road, I can actually add PVIs and edit them. And I've heard more than rumors that they're going to make it faster to be able to edit with the PVIs.

So look at the Sandbox. If any of you are really interested in InfraWorks, look at the Sandbox. That's all I'll say about that. So you can see there's a little more intelligence into this intersection now. There's right turns, left turn, center turn. It actually knows what's going on with that intersection.

And at this point, I can actually-- my road is horrible, by the way. So don't quote me that that's a design. Because it's not. I can actually do traffic analysis on this at this point. So how useful is that early, to be able to do your traffic analysis before you've actually spent all your time doing your Civil design?

So to do a quick traffic analysis, I just go into my Analysis panel. And I can do all these different analyses. I can actually do my flood analysis. I can do all sorts of different things right in here. So I could do my profile view, my traffic analysis, my sight line distance, right in here really quickly.

And I know my design right there is ugly. So I'm going to go to a component. You've got a question, or no? OK I thought I saw a hand up. So I'm going to convert to a component road. The big difference between a component road and the other road-- I'm just going to say Convert-- is each piece of the component road as individual.

So I can click on that. And the other big thing for me is that right there. If you've worked in the style palettes, they don't really have slope. They're flat, which we all know roads aren't flat. So I can actually add slope. I can add individual pieces.

I can take the road right here and add a component. So if I want to add a barrier into the middle, I can split my component from here to here and edit it on the fly and say, OK, I want it to be right there. I can do a lot more control with the component roads.

So with that-- and ooh, that's a horrible design. That's what you get when you do stuff on the

fly at AU. So what do we do with this then? We can export. We can do a couple different things. And I'm not necessarily saying that one is better than the other. They have different benefits.

So how do you get this into Civil 3D? You can just save your file and get out of it and import a SQLite file, which is one option. You can export to an IMX also. There's a couple benefits to the IMX versus just the SQLite depending on your workflow.

So if you want a snapshot in time, the IMX works great. Because the SQLite is a live document. It's going to change. So if you need a snapshot of the design at that time, the IMX works really good for that. If you want a clipped version really easily, I can select an area right here and say, I want this area to export to Civil. And I only want to look at that. I can double click it and have it.

I can re-project. And here's one thing that-- if you look at that, there's a goofy name called Ground on the end of it. I think it's Ground. It should be spelled right. I didn't type it. I'm a horrible speller. So if you see spelling errors, let me know.

So I can export to a different projection really quickly. So if somebody is working in UTM's, metric, lat/long, I can project this data to anything I want into it real quickly and export it. But InfraWorks, if you ever work in custom projections, the projections are held within Civil 3D or Map 3D.

So if you ever work in custom projections, make sure that that custom projection is registered within Civil 3D of the same year of InfraWorks. Because we've had that issue before. The same year-- it's got to be in that same year, or it's not going to work. So then we can export. I'm going to switch over to Civil 3D really quick here.

AUDIENCE: [INAUDIBLE]

DAVID
LAWRENCE: Not dynamically, no. What we do for that is so when I bring in the InfraWorks file in Civil 3D, it now has an insert. Within the Insert tab, there's an InfraWorks button. And so what you can do is you can actually set up your styles of how you want these to be handled, what layers you want them to go onto, and define that really quickly. And that saves out to an XML file.

Then what we'll do is I'll take that and save the input. So let me just grab-- oh, let me do one more thing really quick. So this is your import panel. And you can pick your IMX file. Actually,

let me go to a new file before I do that. And it's going to not carry all my styles. Because my style template is on my network back in Phoenix. And I forgot to copy it.

So have your style template set up. And you'll notice in my drawing here I don't have a projection set up. So it gives me this error. It says, you want your Civil 3D to have a projection. And I would agree with that completely. Big red X-- don't work in Civil 3D without a projection ever please, being the guy that has to deal with data that comes from that.

But what you can do, you can actually hit Set Coordinate System and say, use the coordinate system from InfraWorks. And it grabs it. If I set it automatically, it'll automatically-- if I already have it set in Civil, it will take that projection and pull it through. Now it will project for you, too. So they don't have to match.

AUDIENCE: So by selecting this coordinate system in here, does it assign it to your CAD file, or do you have to at some point save the CAD file? Does it just do it for the import, or does it--

DAVID
LAWRENCE: It assigns it to the CAD file. So you'll see if I run this-- and I had clipped this IMX. So I was careful not to do a huge file. So if we go into the drawing system utilities, and I say-- it's set here.

Now one thing to know, I have a custom projection system. If you want to send it to someone else who has a custom projection system, you need to send them a CAD file that has the custom projection system in it.

When they open that DWG, it will auto add that to that machine. And it is machine specific. So if your buddy down the hall hasn't ever opened a file with that custom projection system, he won't have it. So you've opened it. It's here.

If you save this file and give it to them, it will then be assigned to their machine. But they won't be able to open the IMX in that projection system without having that loaded on their machine first. So you have to have that protection system defined on the machine first. And I'm harping on that because it drives a lot of this stuff.

So this is what it looks like when it comes in. And this is because I have a really, really, really generic style template loaded. So if I pop open my tool space and look at my surfaces, I've got an AIW existing and an AIW existing transportation. So it takes the two surfaces and gives you the different surfaces so that you can use both of those.

So back to the question you asked of, is it linked? No. But I can then take this file and save it as a data shortcut. And then that is then linked to my files. So if I update that, it's going to update in my data shortcuts. And I have that ripple through all the rest.

Be careful with that. But you can do it. And so that's kind of how I do the workflow. I'll export to this, and I'll make sure I'll save it. And then if I update it, I have to go through the process and then update that file. And then it updates with my data shortcuts.

So no, but you can work around it. Does that answer the question you had of what you want? It should be connected. It's not yet. That's my own little preaching to the choir, probably. So then we get the alignments, center lines. And you've got a lot of center lines.

So if you need a lot of center line alignments that don't need to be completely, completely survey grade, I'm throwing that out there. Because this is coming from online data. But if you look, all the stuff that came from online is actually named. And I have, for any of the design roads, profiles. For roads that aren't design roads, I don't have the profiles.

So I believe-- oh, I exported this before I built the design road. That's not good. So you'll see it's got all these different roads. So if you need a lot of alignments really quickly, you can do that. You can get the context. You can get the alignments. You can get all the data very quickly, and the existing surface. And then you can draw your surface profiles, just like you would normally in Civil 3D. Questions to this point?

AUDIENCE: [INAUDIBLE]

DAVID
LAWRENCE: It's not too bad. You don't want to go to the point of full design, obviously. But that's where the beauty of data shortcuts comes into play. If I have a road named Ironwood Road, and it's my data shortcut, and I have my alignments in a separate file than my profiles and everything else, I can replace that data shortcut. It does cause problems if they're not exactly the same. You can get yourself in trouble real quick.

AUDIENCE: [INAUDIBLE]

DAVID
LAWRENCE: The image? As long as it's assigned within Civil, you can pull up the imagery. In Civil, there's the Geolocation tab. Once you've assigned your projection-- this is one of the reasons why I think everybody ought to assign projections. You can then edit your location and pull Bing

imagery directly from the web. And it will auto-project and do all that.

AUDIENCE: [INAUDIBLE]

DAVID Aha, Mark's like, ahh. Well one, you call your surveyor and say, don't ever do that again, or

LAWRENCE: define it. I know it happens every single day. And that's why projections matter. If you get something that's in a local coordinate system that isn't defined in relationship to a real coordinate system, it's almost worthless.

AUDIENCE: [INAUDIBLE]

DAVID Yes, yes. Huh?

LAWRENCE:

AUDIENCE: [INAUDIBLE]

DAVID You can translate your field book. There's lots of things in Civil you can do to line it up. In

LAWRENCE: InfraWorks-- I'm going to pop to a video here really quick. And I'm not going to show the whole video right now. So let me skip to about here. So in this project, we had, oy, I want to say 300 plus data sets linked in, 12 different projection systems, including lots of different local ones.

AUDIENCE: [INAUDIBLE]

DAVID State plane, lat/long, UTM, or just arbitrary x, y. How something that's on a round surface gets

LAWRENCE: put on a flat plane is all I mean when I say projections. It's how it's projected flat. But if we don't address that as designers, we're not really doing the service our clients really need. We actually need to talk about that.

So I had data. The tanks and the proposed plant were in some local coordinate system that one of the subcontractors gave to us that was based off a survey that was on a local coordinate system. We derived the standard offset with the x and y's and programmed that in so that every time we import that file, it sits at the exact same spot every single time.

Same thing with 3D Studio-- you can get an offset. And when you export from InfraWorks to-- and so the reason they do that, does everybody know about single point, double point precision? OK, a couple people said yes.

Single point, double point, I'm not going to go into all the math of it. But double point-- more

accurate, big numbers, correct, or am I backwards? OK, double point is huge numbers. You're out at the millions. And so what we, as guys who have done 3D Max for a long time, have dealt with is that if we have something out in the millions, we've got coordinates within coordinates within coordinates.

We've got the little pieces that we've got to have stuff hit dead on millimeter. But we're out a million and a half units from the origin. And it starts dropping a significant digit, basically. It just drops it.

So if that decimal is a meter, my powerline looks horrible. My roads don't line up. Nothing works. So a lot of the programs shift it closer to 0, 0. That's why surveyors do it. And they used to do it for 32-bit. And so it would handle that stuff a lot better.

And so when we export to FPX, which comes into 3D Studio, you get this shift. So if I say, I'm going to export the entire model to this coordinate, it gives me this shift number here. By default, it's the bottom left corner of the model. I never accept the default shift. Because it has a decimal point.

And that's not a huge deal unless you're trying to link it with stuff that comes from Civil 3D into 3D Studio and back in. Civil View, which is the tool that brings Civil 3D into 3D Studio Max, does not accept decimal points. So if you're ever going to go that route, you have to start without using that shift.

So I always just shift to user defined. And what we do is when we set up our project, we actually define this very early. We define our project shift. There could be changes in it. But we actually document it in our project plan that this is the shift.

And typically it's called false northing and false easting. So in a normal GIS program, you'll have a false easting, false northing, and where they shifted about 5 to 10 million to get closer to 0. And so it'll shift over. And it's mainly just an x, y shift. There's more complicated projections that they do. But that's the most common.

And so in InfraWorks, it's called offset. In Civil View, I think it's called shift. In Civil View, it's got to be a negative. In InfraWorks, it's got to be a positive. InfraWorks will have decimal places. Civil View doesn't. So knowing all that starting, you pick the point. You don't use decimal places. And you set it. And you go with it forever and ever on the project as much as you can.

Because if you keep changing it, things get really convoluted. And so what we do when we get

data, we document it. We shift it. We put it in the right spot. And then we create what's called a POS file, usually. Yeah, it's a great name for a file. It's your positional file. So it's your position data set.

So when you export from InfraWorks, it will create this file right here, this POS file. It looks something like this. It tells you what you exported, where you exported it from, what the base level projection is, and where it shifted. So right up here is my shift, my coordinate shift there. And if you notice, I didn't take the decimal points. Because I know at some point I'm going to go into Max, or someone is.

Are there questions? I'm taking a lot of questions, and I'm not quite where I want to be. But that's OK. So in Civil, then, we can just create those data shortcuts, pull it in, and work almost like we normally do. This is pretty much how most of you work-- plan, profile, corridor assemblies. Anybody not work with corridors? Oh good. I asked that a couple years ago, and there were actually quite a few hands.

So corridor modeling is how we get back into everything. So once we've built this-- and I'm going to switch to a different model. Let me go into site grading. I did mention site grading in my write-up. So I'll go get to that really quick.

So this is a project that we did. And there's a clipped version of the project. We work on big stuff. We built this model that's a wind farm up near northern Arizona. And we had 283 pads, I believe. And you can see we loaded in some basic GIS data, the hydrology. We loaded in the jurisdictional delineations. And then we started loading in points.

Has anybody ever worked on wind farms? Half a person-- was there a half a hand there? It was like, eh, sort of. OK, so typically what happens, for us at least, when we work on these, we get data in GIS data. So we took that data, point files for the windmills. We took the points, and we just buffered them.

Because we knew we had a clear zone that had to be a flat plane about 50 feet. So in Civil View, we buffered that 50 feet and created a shape file and pulled it back in as a land area. And then in your style palette-- has anybody used the land areas yet? Shake your head-- OK, so nobody has.

So it's one of those preview items that you have to hit a checkbox on. So if you go to the main page, there's a checkbox on the right that lets you check things on and off. And I have them all

checked on. Because I like all the new stuff.

And so land areas-- so if we check the land areas, we can just draw coverage. But I typically draw it in something else and bring it back. Because I'm kind of klutzy drawing in InfraWorks. I don't know if the rest of you are, too. I'm not the greatest at drawing a perfect boundary.

AUDIENCE: Everybody is.

DAVID OK, good. OK, so it's not just me. I kind of want to hook up a Wacom to it and draw. But I haven't figured out how to do that yet. So once we get that, we can then just do basic grading. So I can edit this and either push or pull up. Or if it's at an elevation, if you have a 3D feature line, you can pull it in and actually pull it in as a 3D shape file. And that will be your polygon for a feature line grading.

So you see it just does the basic grading here. And so what I've done for all these pads is I created a style. And one of the big issues for this project in particular was the cut and fill. They didn't want to see all the cut and fill. And so what we were able to do really quickly is when you go to the style palette down here, once you've changed the land areas on, you see all these grading styles.

And so I made a cut fill. Because the rule they gave us was, cut slope was 4 to 1, and the fill slope was 3 to 1. And so just to be able to see it really quickly, I converted the cut area to be red and the fill area to be green and set the style.

I did set a limit here. You can turn that off. But I didn't want to see beyond 200 feet. I didn't want it to calculate that. So I turned it off. If it was going to be that big, we were going to have other issues before we got to the point where I had to really worry about the grading.

And so I just take that. And I can apply it to this. And it updates. And so you can see that's all fill. But if I take the side here, drop it down-- and you can do a type in. And so you can start to see I can do my basic pad design here. And if I enable a theme, I can actually look at the slopes of the whole surface with the theme and then adjust my cut and fill that way, too.

So I got my basic pad design. And when I export to Civil 3D, that's going to carry, too. And it's going to carry my feature lines around that. So that's a simple site designed. But it's really powerful. Because you can do something really quickly with 280 pads that would take a long time.

And so we were able to see-- especially these pads right here, those weren't going to work. Those were going to be a big issue. Because the Bureau of Land Management was going to say, that's way too visible. I'm not going to let you do that much cut.

And so we were able to look at that really quickly. And especially in this area, you've got enough terrain that you need to actually microsite and do the basic design. The other ones, a lot of those are pretty flat. It wasn't a big deal. We knew where our issues were really quickly. And I could export that and pull it in. And then I can connect my roads.

And then we were able to then-- and I don't have it. So the next thing that we did with this in particular is we were able to then optimize the road lines by doing corridor optimization. Has anybody done that? I know, Mark. I'm going to just ignore your hand for a little while, Mark. If you haven't met Mark, he's a really good guy.

So you can actually pick the specific points along the road and have it optimize it for you. So if I go into my road design tool kit, I can then go into my optimization tools. And I can either do my profile optimization or my corridor optimization.

And with this in particular, we had a bunch of windmills we had to hit. We had to go to those specific locations. And it doesn't like most of my points. But it'll still run. It thinks they're too close together.

But I can then take this. And I can go into it and tell it my speed. And then in my advanced settings, I can tell it my cost mapping and get the avoidance zones. I can actually draw avoidance areas.

Or I can use coverages for that. So one thing that we pull in a lot is cultural data, so cultural surveys. We avoid all the cultural surveys. We can't build in those cultural sensitive areas. We can't build in jurisdictional delineated waters. We can't build in flood plains. We can't build in all these.

So we add the avoidance areas really quickly. And then it will help us to calculate the route. I can set the construction rules. And it gives me all these options. And I'm going through this pretty quick. Because we only have about 15 minutes left. And I went too slow. So we can set our maximum grade. And it will go through all that.

So back in Civil-- questions on that? Sorry, that can be a whole class in and of itself.

AUDIENCE: [INAUDIBLE]

DAVID Revit's an interesting one. And I would have to probably defer some of that on how it was done

LAWRENCE: with Dynamo to some of our guys in another office that aren't here. So the Revit is-- back to Revit is much harder. Revit into Max, into InfraWorks, is slick, mostly slick. But going back, it's Dynamo and FBX. So it's not really dynamic.

AUDIENCE: InfraWorks and 3ds Max use FBX?

DAVID Yep, we use FBX.

LAWRENCE:

AUDIENCE: [INAUDIBLE]

DAVID So if you look at the top of the bar, you've got all the little dots-- I don't know, polka dots,

LAWRENCE: whatever you want to call them. So base level InfraWorks is the red dot. The road design package is the orange dot-- or what color is that up there, tan. The purple is the bridge design module. The blue is the drainage design module.

So anything that's in the orange i is the standard. Everything else is a module. So it really depends on which piece. So the optimization, the roadway optimization, the profile optimization, is all in the road design package. Your watersheds, your drainage is all in the drainage package. But a lot of the basic stuff is in the normal one. Other questions?

OK, so just like you would in normal Civil 3D, we build a corridor. And I built the basic design profile just like-- and I know it's not the greatest profile in the world-- you would in Civil. I built an assembly. And it's just a simple assembly. Because we're going to do the lanes and the barrier in the middle. And then I've got my-- let me close this model actually really quick. Because InfraWorks does take a lot of your video card, if you haven't noticed.

AUDIENCE: [INAUDIBLE]

DAVID Yeah, if you want to hang out after, I'll show you those settings to play with to make your

LAWRENCE: InfraWorks run a little faster. Because if you adjust a couple things, it makes a big difference. So we build a basic corridor. And then you can save that file and bring it right back into InfraWorks.

Or you can also export that into a Civil View file for 3D Studio. And you might ask, why do I want to do that? Because Civil View's got a lot of great tools for animation and toys like that where you can take that, and then build that and bring it right back into InfraWorks. So you can do a lot of enhancing of your InfraWorks model in Max. So let me hop back into here. And I'm running out of time.

AUDIENCE: [INAUDIBLE]

DAVID Yes, you can. Yep.

LAWRENCE:

AUDIENCE: [INAUDIBLE]

DAVID Yeah, I don't know if you saw the windmills. They were spinning. OK, that's a really generic

LAWRENCE: windmill. The last windmill project I worked on, I built eight different windmills and then brought them in and used a rule to place them so they randomly had different rotational values and different speeds. And one of them actually didn't move. Because we all know on most wind farms, at least one of them isn't moving.

So yeah, you can pull it back in. But it takes some tricks. Willie Campbell and Dave Tyner of Autodesk are going to be putting out a webinar. They actually just did one on the InfraWorks forum.

[ALARM]

And that's almost time up. But yes, and let me hop into one that has that so you can see that. It might take a second to open. We've got a Bell Road.

Yeah, Bell Road has got the animation. And this one actually has been enhanced a lot with a lot of different things. When you import-- so if you open a Civil 3D file directly back into InfraWorks, it will bring your Civil surface that you're automatically dynamically making from your corridor. It'll also bring in corridor polygons and make coverages for you and shade them. So you can stylize based on that.

And in InfraWorks, in the Style Rules, I don't know if anyone has played with this in this-- not Style Palette, Style Rules, Style Rules. If you look in the coverages, there are some pre-built in tags. So if you bring in a polygon that has this tag, it will automatically symbolize it for that.

I don't like some of the texture. So I've replaced them. But you have standardized tags. So those tags will actually carry from your Civil corridor. And you can pull it in if you set up your corridor. Let me go to the movie file. Because that's going to take a while to reopen.

So here's a couple videos that we did with this [INAUDIBLE] of different things. This is the one I showed earlier. This is a lot of data that was enhanced. A lot of the buildings were actually started in with aerial pictometry and LiDAR in Reality Capture, then texturized, put into Max, and then put into InfraWorks as individual pieces. So each building is its own model that's brought in there. So we have a lot of models linked in here.

The power poles and lattice structures were built in Max and then placed with that. Because we didn't have to do full engineering on that. The landscape is all based on GPS points and the site. And you'll see as a little trick we did in post, if you do post video editing, you can do a lot more things with the storyboards than what is built in.

So we did construction phasing in post. All of this is rendered straight from InfraWorks. But we just used a tool in post to seam them together. So we did cross fades. So we were able to do different things like this and add voiceovers. I'm not going to bother you with the voiceover.

So you can see there's different things. Let me switch to another one and show you kind of the power of InfraWorks and the scale at which you can do things. And this is one of our projects we did where we actually modeled the whole Navajo Nation. We had 47,500 square miles of data that we pushed into an InfraWorks model.

So you can see it's the Northeastern corner of Arizona, part of New Mexico, Utah, and not any of Colorado but right on the border. So we did some fun stuff where we mapped flood plains and project areas. So we were able to get a lot of context really quickly and was able to provide information to the communities very, very quickly.

And one of the things that happened, in some of the areas that we did this mapping for the client, there was a fire. And so we were able to take our InfraWorks model, clip it down to the area we wanted, and then overlay KML data from incident command that was being derived daily, actually hourly, and overlay it on there and fly over the fire area.

And they used that at incident command to look at the model and understand the area. So even something like disasters and incident-- the awareness level of what's going on in 3D is really powerful. So you can see the scale at which we can work on. Go ahead.

AUDIENCE: [INAUDIBLE]

DAVID
LAWRENCE: Yeah, that actually was started before Model Builder existed. But yes, the reason that I harp on projections a lot is because we work with a lot of different groups. We work very closely with our GIS group on that project.

And a lot of the data that's overlaid on that fly-over is actually being pulled from an ArcGIS server. So it's not just dead data in the file. It's actually linked to data being served from GIS that people are actually editing on the fly constantly.

So we don't work in just an Autodesk-centric world. I mean, that's what we get all week. But we have to be able to work with all the other tools. I put a generic icon down on the bottom. But that GIS is a huge deal.

And I have to say 99% of my GIS is not in Map 3D. It's just not. But we have to be able to work with what's out there, and work with what our clients have. But yeah, it was imported. We have a lot of data that was imported.

And this is just a smaller scale project. I've got questions. Feel free to shoot them out. I'm just throwing some samples of stuff we round-tripped. This is one we did in less than-- I think it was three days. We were able to get the context, pull the data, spit it back to Civil, our Civil guys.

And one of the other offices pulled the InfraWorks model down, exported it to Civil, built his little truss bridge, uploaded it from Santa Ana. The guy in Denver built something else and was doing the calculations for the flood, the 100 year flood, while I was doing some other stuff in Phoenix. So we had four offices working together to spit that out in less than a week.

AUDIENCE: [INAUDIBLE]

DAVID
LAWRENCE: Style rules. Style rules are your big friend, and GIS data. So when you export-- and I'm not offended if you walk out because you have a class. And I'd be glad to stay if you have more questions. So style rules-- a lot of the data we pull in has attribute data. So a lot of the polygons will have heights. And that's an attribute data field that you can query from when you import the data.

The trees, a lot of our tree data-- we get saguaros a lot. Because saguaros are a protected

species, and you can't move them. So we specifically call out saguaros. And all the 3D models of saguaros are out there. But the other trees we have-- we have a decent library. We actually have a bunch of stuff that we build in 3D Studio Max and put in. But trees are hard. Because they're polygon heavy.

AUDIENCE: [INAUDIBLE]

DAVID
LAWRENCE: Yeah, there's actually a tool. You can pull in a polygon and just say, within this polygon area, put random trees. And if you put a tag of generic tree or whatever in that attribute field, you can run a rule and say, I want these 12 trees to be populated at these percentages in that polygon. And so it automatically generates it.

So we do that with people, cars, trees, different things like that. But that's generic style rules. We do have scripts we run. But you can do that generically with straight out of the box InfraWorks. OK, I could show you if you need me to after.

AUDIENCE: [INAUDIBLE]

DAVID
LAWRENCE: Oh, speed. Anything else? OK, rate the class. Give me feedback if it's positive, please. I didn't say that. No, give feedback no matter if it's positive or not, but especially positive feedback.

AUDIENCE: [INAUDIBLE]

DAVID
LAWRENCE: This is my third, I think. How did I do? I didn't get through all of my content. I know I didn't. So I know that.

AUDIENCE: Real life situation.

DAVID
LAWRENCE: And real life hit me the last month. So I'm not going to use that as a crutch. But yeah, I had a massive flu attack. And it kind of really-- so you've got a couple different options here. Visual effects-- so animations, turn that off. That's going to speed you up. It's going to make it so your skies don't move and your wind turbines don't spin. And everything else that's animation won't move.

You've also got the high visual quality. But if you switch that, it's going to look like crap. You could see really quick it's blah. But it will run faster. So if you want just a quick thing, and you're looking at line work, you can do that.

All the rest of them are in the application options here. 3D graphics-- so I don't usually run any higher than 3/4 ever, except when I render. So if you have that up here, you're going to get horrible performance. Where do you run, Mark?

AUDIENCE: I usually keep it right about where you're at. But it would be nice if you had a style rule where you could say, these are my five different quality styles.

DAVID It would be nice to do a Save of preferences.

LAWRENCE:

AUDIENCE: Yeah, you could say, when rendering, I want to do everything [INAUDIBLE].

DAVID Yeah, and that is per machine, too. So that setting is per machine. If you build a model, you

LAWRENCE: sync it up to the cloud, somebody syncs it down, that's not going to come with it. That's on your machine. So the other thing with that is focal views for some of the cameras. Some of the times, the time of day, you can tweak that if you don't do it right. And they don't share between the people. So those are some things to watch out for.

Shadows-- if you turn off shadows, that's quicker. I have ambient occlusion on high. Just because it looks better. That's going to give you the darkness in corners. And it just looks a lot better with the ambient occlusion on.

But it runs faster with it off. So if you don't care, you're just trying to draw a line, that's usually where I run. And I'll lower this a little bit. But I usually stay at least halfway, usually a little higher. Because if I want to see imagery, it's going to look horrible if I go too much lower.

Does that answer your question? Back faces, if stuff is there but it's not, it's looking at the opposite side. So it's like a two way mirror. Do you guys know what back face is? Does that make sense? OK, no, yes, no? OK, good. Other questions?

AUDIENCE: [INAUDIBLE]

DAVID You can always change it. You can always change your materials. But you can't get the
LAWRENCE: animated material, no. It's either animated or not. Is there a way to do it other than that, Mark, do you know?

AUDIENCE: I've always just done a color.

DAVID OK, I always just do a color, too. Oh, did somebody want to see the animations? I'll pull that
LAWRENCE: up. Yeah, I'll pull up a file with cars moving.

AUDIENCE: [INAUDIBLE]

DAVID I cheat and use a tool in 3D Max. There's scripts. There's tools. I make it as mesh and pull it
LAWRENCE: in. Because I don't like the way the lane markings are in InfraWorks. And that actually is a big
issue with a lot of my transportation designers. They want very specific lanes and markers.

So what we do is I take those lines and bring them into Civil View, and then use those to
create polygons using Civil View, or mesh. And then I'll bring that mesh back in as an FBX. So
do you have a-- I keep picking on him, because I know he knows this stuff. Any tricks other
than just scripts?

AUDIENCE: For lane lines?

DAVID Yeah, lane lines.

LAWRENCE:

AUDIENCE: Lane lines are kind of a pain in the ass for InfraWorks. Because the specific lane lines
[INAUDIBLE], which is fine. Because then you get a nice sharp object as opposed to a texture
[INAUDIBLE]. One of the tricks that I've used-- and it really only works when you build a road.

DAVID It's loading still.

LAWRENCE:

AUDIENCE: You can do one of the elements, the roadway, as the lane line. It's usually on the edge of a
curve of the center line. But the dash line doesn't work. So what I've done in the past is I've
done like what David said, is you go to 3ds Max or a similar application that generates its
[INAUDIBLE].

DAVID That is slow.

LAWRENCE:

AUDIENCE: [INAUDIBLE]

DAVID Oh, I've got to get to the right--

LAWRENCE:

AUDIENCE: And it's just slightly abrupt on the surface. It takes a lot of extra time. [INAUDIBLE].

DAVID Yeah, we use a tool called RailClone on top of 3D Studio Max. It's kind of like a Dynamo

LAWRENCE: Studio, if you've been seeing that around. It's like a procedural flow chart type additive tool that then links onto the geometry.

And so we use a Civil View feature line that then is draped to the Civil surface. So as your Civil surface changes, it'll update. We can pull it into Civil View, update that, and then just spit the geometry back out. And so we have styles for all the standard road markings with RPMs and everything that we've built that then is linked onto the line. And so there are certain things that work a lot better in Max and certain things that work a lot better in other programs.

AUDIENCE: One of the things you can also do is-- we've done this in the past. You build a roadway style that has two options. You have decorations. But you also have [INAUDIBLE]. Another profile would be a cross-section option. And so what you could do is build lane lines if you build an object that's just a repeating amount.

So for instance, if you have a turn lane, the short dash goes to the long dash in parameters, you can build [INAUDIBLE]. So on your road, it actually follows [INAUDIBLE]. It's just a piece of geometry that's slightly floating above the surface. It takes a little extra prep time. But again, it's a hack.

DAVID We've tried textures, too. But the ends and the edges just never-- a dash texture never really

LAWRENCE: works at the edges of the lane line. Go ahead.

AUDIENCE: [INAUDIBLE]

DAVID Was yours lane lines?

LAWRENCE:

AUDIENCE: No.

DAVID OK, go.

LAWRENCE:

AUDIENCE: If you just make a barrier style, and that barrier is maybe an inch tall and sitting halfway--

DAVID Oh, where's my road?

LAWRENCE:

AUDIENCE: And then you can take the line as SDN [INAUDIBLE].

DAVID Oh, I have it on that one.

LAWRENCE:

AUDIENCE: [INAUDIBLE]

DAVID I have it on one of these proposals. But I don't remember which one. Because I wasn't

LAWRENCE: planning on showing it. But you can do the DAEs. Only DAEs carry animation in.

AUDIENCE: [INAUDIBLE]

DAVID It was not created in InfraWorks, the drainage. Does that answer the question? It was

LAWRENCE: imported as a polygon. That project in particular was very much a team effort with a lot of different applications doing a lot of different things. And that was started before they had the drainage analysis tools.

And so we didn't do any of that in the drainage part. But we're actually coming back now and then coming in and starting to do the drainage pieces and some animations using Project Boulder. If you've looked at the labs, there's a tool where they actually integrate it, RiverFLO-2D, into here. But we haven't finalized that on a project yet.

My cars aren't-- I have the wrong file with the animation cars. If you want, I can send you how to do it if you want to leave a card. I'll be glad to.

AUDIENCE: [INAUDIBLE]

DAVID No, 3D Studio. You can also do it as a CAD file and import it as a 3D DWG, and then

LAWRENCE: interactively place that. A lot with the text, we actually use GIS points, and then put the Max file on the point as a point of interest. So then if the point of interest moves, it carries it.

AUDIENCE: You mentioned that InfraWorks will break a corridor up into different coverage areas for you to change. I haven't seen that before. Do you have a quick example of that?

DAVID Yeah, I have one that import-- yeah, let me pull that up.

LAWRENCE:

AUDIENCE: [INAUDIBLE]

DAVID Yeah, here, I can show you that pretty quick, unless there's another teacher coming in.

LAWRENCE: There's not, is there? OK, is this the last class of the day? No, there's another one? OK. I think I did it on this one.

AUDIENCE: [INAUDIBLE]

DAVID Yeah, I didn't see one when I came. Yeah, I think it was there. So this is a really horrible

LAWRENCE: looking corridor model.

AUDIENCE: [INAUDIBLE]

DAVID OK, good. So I built the corridor. And I built a surface. And I saved the surface with the

LAWRENCE: interactive terrain clipping. And then if I just go to Import Civil 3D, then I can go into my projects. And I think--

AUDIENCE: [INAUDIBLE]

DAVID So then it added this. You'll see it brings in the different pieces. So you have corridor

LAWRENCE: coverages. And where that's going to be set is-- so you know how in the assemblies, you can set your type and your materials? So in your assemblies and subassemblies, and you set the codes for what type of material that is, that's going to carry over and go to these tags. So if you look at this coverage here, it's going to carry that tag of daylight.

And so that when you go into your style rules, and go to your coverages, anything that's got a tag of daylight is going to be created to that material. So then you can modify that material all you want and set up materials. Because I actually don't like the default road texture. So I always change it.

And then once you set those, then you can export them to a JSON file and have that saved. So that's your default texture. So like what he was talking about, setting up the assets, setting up the styles, that's a key thing to start with and set up that. And then you can make it a lot better as you go through different things.

AUDIENCE: [INAUDIBLE]

DAVID Yeah, and this is just a simple fly over where we put a bunch of GIS data in and LiDAR data so
LAWRENCE: we could actually see where we were going to have issues with vegetation and habitat and different things as we were working on this project. So you can do a lot of different things and visualize them really quickly.

AUDIENCE: [INAUDIBLE]

DAVID Yeah. Yeah, we actually used Mapper to take the-- we had the point cloud with no RGB
LAWRENCE: values. And then the new Mapper will actually add RGB values from an aerial. So the new LiDAR pluggin within Mapper will-- not an Autodesk product. I love that product. It'll take the RGB values of the aerial image and embed it. And then you can actually do classifications and analysis through Mapper.

And then what we did is we classified the ground and not ground, built our surface from the ground surfaces, pulled that in. And then everything that was not ground above ground we exported as an LAS file, then pulled that into ReCap, and then took the ReCap file and brought that in.

So everything above grade was point cloud. Everything at grade was solid. So we were able to do both.

AUDIENCE: Is that Global Mapper?

DAVID Huh?

LAWRENCE:

AUDIENCE: MAPPER, or Global Mapper.

DAVID Global Mapper.

LAWRENCE:

AUDIENCE: I was like, wow. [INAUDIBLE].

DAVID No, the new LiDAR features are pretty cool. And you can actually even do cross-sections and
LAWRENCE: stuff. You do it in LiDAR. So it's pretty quick, too, in Mapper. I think you turned me onto Global Mapper several years ago, Swiss army knife. But we actually did 67 miles of LiDAR.