BIOENGINEERING FOR COASTAL BANK STABILIZATION: CASE STUDIES

Lee Wieshar and Leslie Fields, Woods Hole Group, Falmouth, MA

MR. O'CONNELL: We have two individuals presenting the next session. First up is Dr. Lee Wieshar. Lee has over twenty years of experience in the field of oceanography and coastal engineering. He has worked on projects requiring the evaluation of near shore processes, sediment transport, inlet dynamics, erosion control, and marsh restoration. He has a BS in engineering from Michigan State University, an MS in coastal geology from Virginia Institute of Marine Science and College of William and Mary, and a Ph.D. in nearshore processes and sediment transport from Purdue University. Lee's also worked for the Army Corps of Engineers' Coastal Engineering Research Center for eight years.

His co-presenter is Leslie Fields. Leslie has over fifteen years of experience in geological and coastal processes evaluation. She has overseen the design and construction of projects involving both soft and hard coastal engineering structures. Leslie is well versed in all permitting requirements on the local, state, and federal level for coastal construction. She has a BS in geology from Southern Methodist University, and an MA in coastal geology from Rutgers. She worked at the Coastal Engineering Research Center for five years, and has been with the Woods Hole Group in Falmouth for the last thirteen years.

Together they're going to present and discuss several case studies involving coastal bank stabilization using fill, terracing, plants, and bio-logs, both here on the Cape, and on the Islands. Lee.

MR. WEISHER: I'm glad to be here today. As Jim said, I'm going to present an introduction and two case studies, and Leslie will present another two. What we're going to talk about today is how we approach a project. When we go into a project, we look at site processes and the (state) wetlands regulations to see what our possible solutions might be. Then, depending upon what the site dictates and what the regulations allow us we develop a solution to the problem. Here are some of the different types of what we call soft engineering solutions. We don't approach a problem by saying one solution fits all. We try and match the solution to the problem based on the geomorphology and coastal processes of the site. And, of course, what we're going to talk about today is bioengineering. The two projects I'm going to present are going to show how we approached the problem and developed a solution.

Now, there are some advantages of bioengineering, which I'm sure you've been talking about this morning. Some advantages are they increase the stability of the bank, beach, or dune. During previous presentations we've been talking about beach grasses and planting. Beach grass can grow up through three feet of accretion of sand in a year. And indeed, we have built dunes just by using sand fencing and beach grass. In many of these projects there has been an accumulation of three plus feet a year and the beach grass has kept up.

Conversely, when we have overwashes, and/or the dunes shift, and there's beach grass underneath, we'll oftentimes just wait and see what happens, and the beach grass most often grows up through several feet of sand.

Beach grass stabilized dunes enhance habitat and provides a potential sediment source during storms. The engineering solution itself doesn't, because a potential soft engineering solution tends to fail and require maintenance. The failing of the soft engineering solution oftentimes provides sediment derived from erosion and replaces sediment from the coastal bank. This erosion process allows sediment to get back into the system and may dissipate limited amounts of the wave energy.

Soft engineering solutions have disadvantages. Soft engineering solutions may fail during severe conditions. We all know that. Therefore they will require maintenance. The frequency of maintenance depends on the coastal processes on the site. Additionally installation and construction may be costly and often requires heavy machinery on the beach.

A lot of times we will go to a commission meeting and show a soft engineering design, and the Conservation Commission, not so much anymore, but when we started this about ten years ago, the Conservation Administrators would go absolutely crazy because of the fact that you have a large front-end payloader on the site because you have to move and place these bio-logs on the site. The bio-logs are big and they're heavy. The commissions just didn't realize what was required to construct a project. So now we're careful to give a construction methodology and to explain exactly how the project is going to be constructed, so there are no surprises.

Design considerations. When we look at the site, we try to look at the processes that are there. We look at the wave energy, the currents, and geomorphology of the beach. You're going to see this in my first example. We had all of these processes to deal with. We also looked at the tide range, site run-off, width of the beach, and other geomorphologic features that may be present. All of these go into dictating what's possible and what might help the project succeed.

The first project I'm going to show is on Nantucket Sound, on the Island of Nantucket

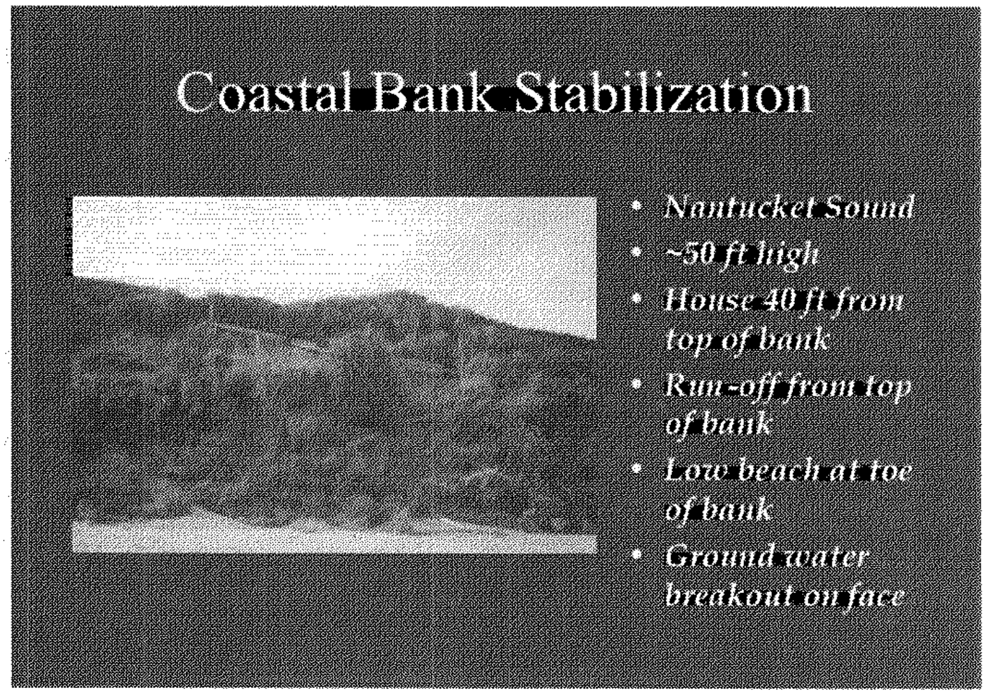

Fig 26. Coastal bank proposed for restoration on Nantucket

(**Figure 26**). This project had about a fifty-foot high coastal bank. This is what the bank looked like pre-restoration. There was actually a pathway (beach access) that was cut into the face of the coastal bank. People traversed the bank in a zigzag pattern. There was a handrail that was at the edge of the path and had failed. The new owners purchased the property for multiple millions of dollars and decided that because their house was only forty feet away from the top of a fifty-foot coastal bank, they might want to do something to stabilize the erosion.

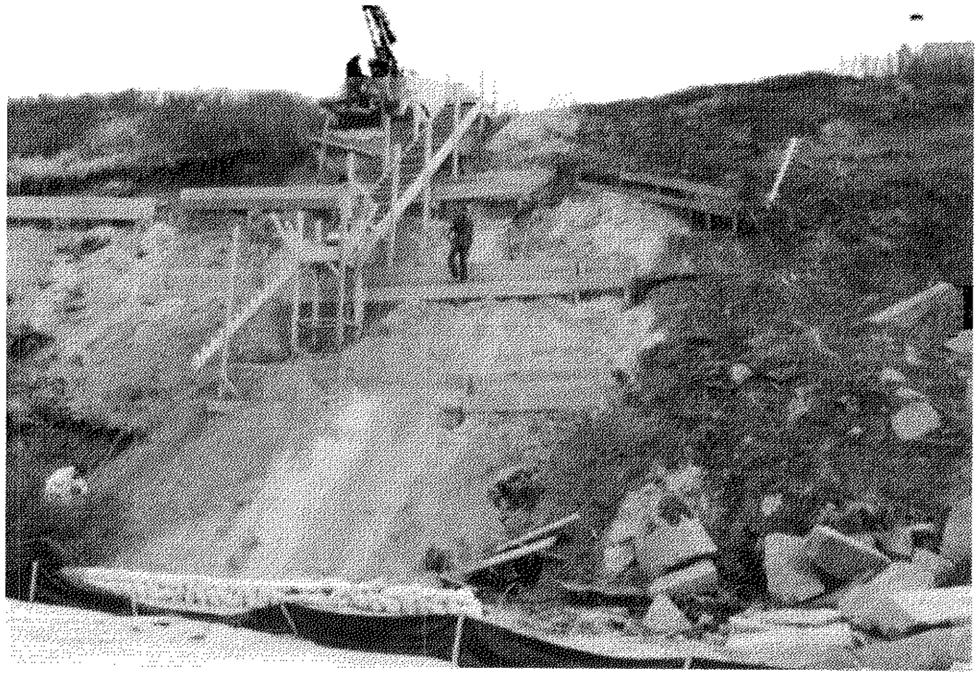

Fig 27. Terraces built across the coastal bank

There were some problems with this site. First of all, because this was a single site on a long stretch of open beach there are no coastal engineering structures along this section of beach. So, first of all, even though it was an old house, it did not make sense to suggest a revetment or other hard engineering solution as an erosion mitigation solution. And so we started looking at what the project required. We had about six hundred feet of coastal beach to restore. Our objective was to restore the bank and restore vegetation to the bank. Also, you'll see in one of the slides, we also had a big clay head in the middle of the project that was channeling runoff so that we had groundwater that periodically broke out of the bank and caused erosion from the breakout. We designed and permitted the project in the fall of 1992. Construction was completed in 1993. I'll show you how the project has lasted.

Erosion began at this site during one of the large storms in the early 1990's. It eroded the beach and eroded the face of the coastal bank. Now this is the same location, this is actually the same handrail that you saw, has fallen down. The erosion left us with a very crenulated coastal bank, very steep. The erosion mitigation design had to consider all these factors.

Here is the clay head, located at one of the terminus ends of the project. You can see where groundwater breaks out of here and essentially strips the sandy material off the bank.

A look at another section of the bank. This is, again, very steep. You can see that the vegetation is sliding down the face of the bank.

This is just a section of the plan showing one of the two properties that we were restoring. Basically, you can see the top of the coastal bank is about fifty some feet. The house is situated right about here. We had a challenge of how do we develop a reasonable slope, while not allowing the top to retreat landward? We needed to maintain a stable slope, and in our estimation, that required bringing material into the site. So bringing the material into the site, you can't just dump it down onto the bank face — from forty feet up in the air and expect that it's going to stay there. These factors created a rather large engineering challenge for us.

We solved the problem by building a series of timber terraces across the face of the bank at the steepest locations, and then filled behind them (**Figure 27**). The purpose of the terraces was to catch the material as it was poured down over the bank, so that as we poured the material from the top, the terraces would catch the sand and prevent it from cascading down to the beach. The contractor got a little over aggressive, even though we over-designed these. He managed to pull out a couple of them, which was rather distressing.

We also had a stairway that we had to incorporate into the design because the homeowner wanted a stairway. I'll show you some construction diagrams or pictures that show how we completed the construction.

This is the steep part of the bank. We don't really know where these rocks came from; they were there. They essentially made this section of the bank a little headland. So our design challenge was that the bank curves in here, and out here. The clay headland is right here. As we transverse the bank curves back in and we had a steep section with the grass that was sliding down the bank.

So we first poured some material over the top shown there. And then we started constructing the terraces. So we evened out that first bank section, and, because we wanted to end up with a smooth, evenly sloped bank to plant, we put these in so that we'd catch the cover material, and also where we had actually slump faces the terraces helped reinforce the slump faces.

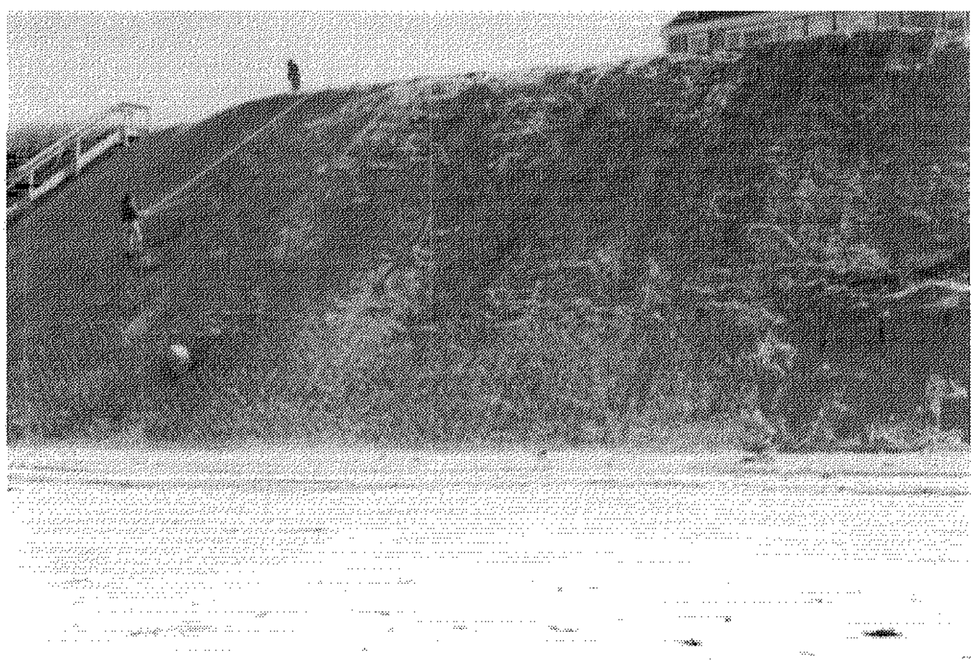

Fig 28. Coastal bank with fill and jute netting being planted

Now, here is the project as it looked before — just before we started planting it. All the materials are in place. Basically, the coastal stairs are there. While we still have a very steep slope here, it is now more reasonable and more able to accept plants.

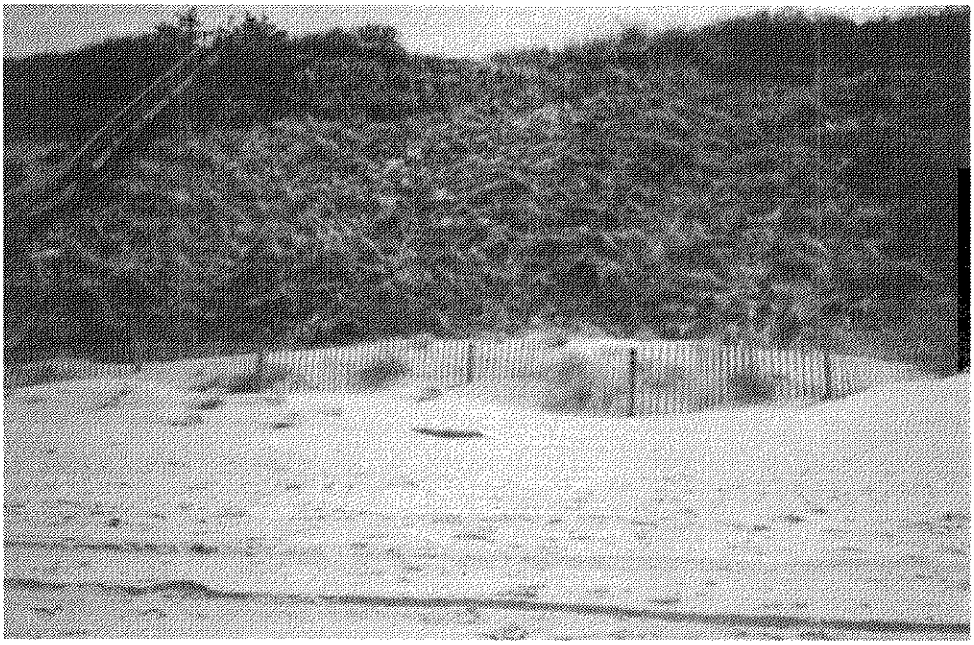
Fig 29. Completed bank stabilization project

The next step was installing jute netting. We put jute net all the way across the face of the bank. All during this process the neighbors were all terribly intrigued about what was going on and wondering what was going to happen next, and when we put all this net across the face, they were wondering what was going to happen. We had to put all personnel in harnesses and climbing gear **(Figure 28)**. The climbing ropes were fastened to stakes driven into the ground. These stakes were iron bars driven into the ground about ten feet. The planters had to rope down the bank face. Then they went over, walked up the stairs, and roped down again. They're planting beach grass here, and they're also planting *Rosa Rugosa*, which we suggested shouldn't be done in the first year because of the steep bank slope. However, the client basically said, my wife likes roses, I'm your boss, and I want roses. So we planted roses.

Here is the project now, we have this whole section planted. I was able to suggest that the very bottom of the bank be only beach grass initially because the beach grass grows quite rapidly in here, and basically we didn't want it to be out-competed early on by the roses as they gained canopy.

We then installed sand fencing in front of the bank on the coastal bank because of the fact one of the controlling parameters here is that we had a very narrow beach to work with. Basically we wanted to do is provide every possible bit of protection to the bank face. Here is one of the cases where we increased the elevation of the beach by about four and a half feet, just by using sand fencing and beach grass on the slope.

This is about a year and a half after it was done. This is what it looked like in March **(Figure 29)**. Now, I have to be quite honest with you. Even though it looks fairly fine here, we're going back after next month for the first time for maintenance since 1993. There's about a two foot, two and a half foot erosion scarp here, we're going back just to fix the toe. But that's a pretty good success considering the fact that the construction was completed in 1993, and we've had no problems since then.

AUDIENCE MEMBER: Do you know what the grade of that slope is? Roughly?

MR. WEISHER: It's just slightly less than forty-five degrees. It's very steep. If you were to step over the edge, you would not stop until you hit the bottom.

This is again what we are looking at right here. This is the area where we had the breakout. The way we dealt with that in the design is we actually channeled the water to go down into the beach, and we had a couple of storms which dumped a lot of rain on the face of the bank. I think what happened here is that we actually had some breakout of the water from the bank, plus some wave action. What you can see now is that in this section of the bank we have some mature roses, which are now six or seven years old. They've propagated. They have a tremendous overstory, and they're starting to crowd out the Cape American Beach Grass.

And so we've been suggesting for the last couple of years that we go in and we actually prune the roses back down, do a limited fertilizing application to encourage the beach grass to come back. We made this recommendation because we have found that the beach grass gets crowded out as the canopy grows up on these steep faces. We really depend on the root structure to hold the steep slope. So if you look at the root ball to canopy ratio on the Rosa Rugs, we don't have an aggressive root structure to hold the bank because the canopy gets to be ungainly if you don't prune it back. And so when the wind and the rain actually comes down and drives at that bank, what happens is that we start to get rivulets forming on the bank just due to the rain hitting this fifty-foot high bank.

We're going to apply for a maintenance permit this spring. I was just at the site and saw the beach grass is still there, although it is having a hard time struggling underneath the canopy of the roses.

We are now going to take a look at a site in Cotuit Bay. This is more of straight application of fiber rolls. The objective was to protect the house. The site had an eroding coastal bank, extremely sandy soils, and no clays outcrops to deal with this time. There was a very narrow beach that dictated some of the design considerations. We had to stabilize about three hundred and forty feet of the coastal bank. And again, this project was completed in 1993.

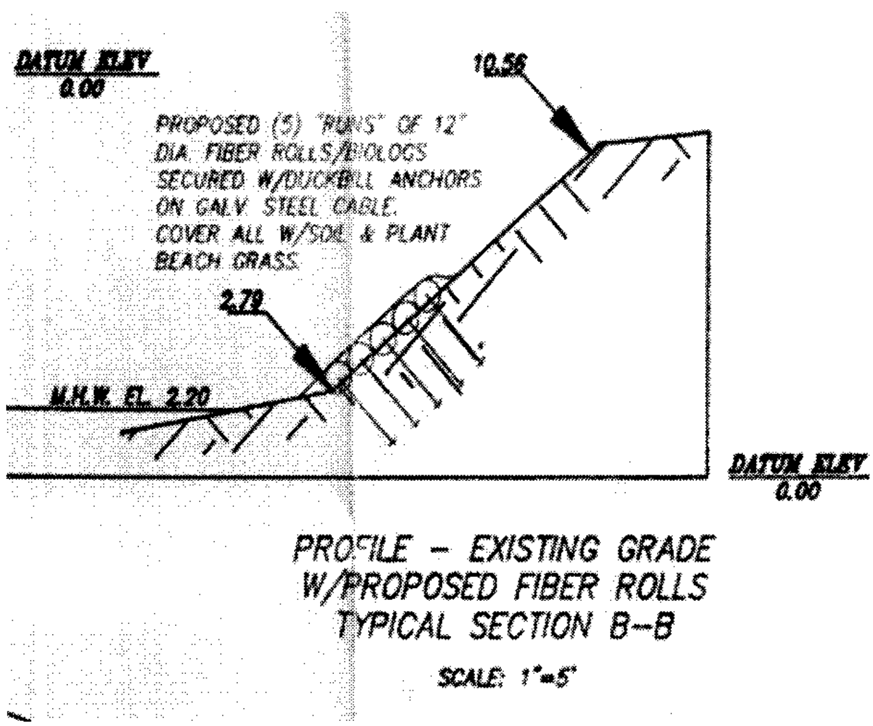

Fig 30. Design schematic for bank stabilization on Cotuit Bay

Here is Cotuit Bay. This is the site. This is Tim's Point, which is a sandy spit. Tim's Cove is an anchorage for the Oyster Harbors area. Predomi-

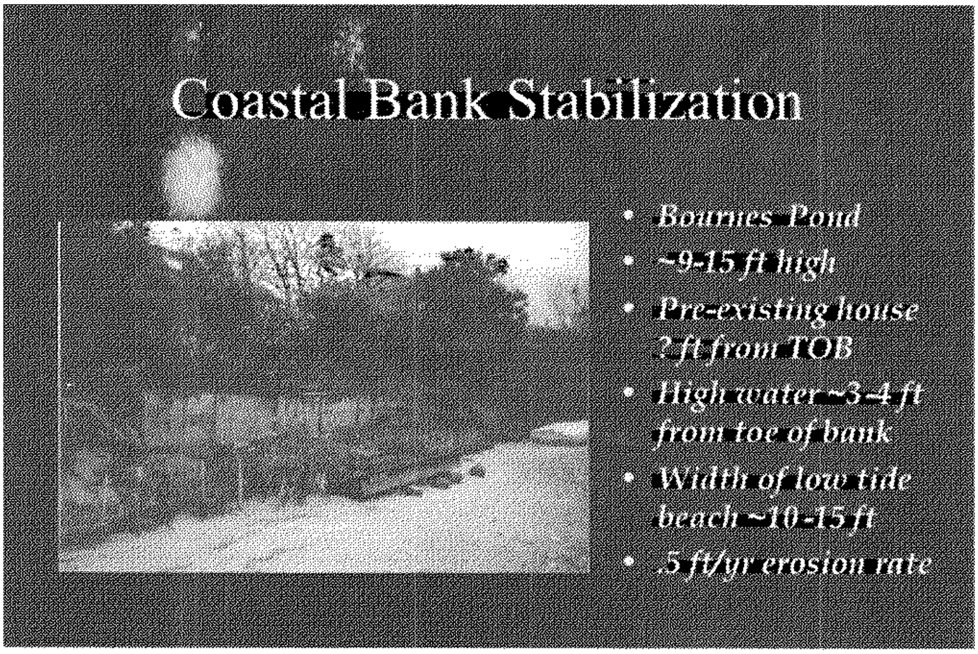

Fig 31. Proposed coastal bank stabilization on Bournes Pond, Falmouth

nant sediment transport is from the south to the north, which also factors into what we can do.

In the best of all worlds, without wetlands protection and other resource concerns, we recommend that we dredge the point, put the sand back down here (updrift), and allow to work its way back downdrift to the spit. However, there are active shellfish grounds in this area right here. And it's been growing because there has been a lot of coastal bank erosion here (updrift).

Therefore, as I said, we had a narrow beach here, which limited what we were able to do because in other circumstances, we would propose a soft solution but also expand the beach width by placing beach nourishment on the beach. But because we knew that this is a growing accreting area and might have navigation concerns, we were concerned about putting too much sand on the beach, because it's not very far from here to the spit.

This is a set of stairs coming down the beach. We put three rows of sandbags again, initially to hold the toe of the bank. The reason for the geotextile bags was is that the beach was very narrow. During extreme high tides or during the moderate storms, the fiber rolls were experiencing wave attack. Our assessment was that had we installed merely the fiber rolls, they would not last very long. If this occurred we would lose the toe of the bank, and then would work up the bank face and the plants wouldn't be able to hold the bank face.

Here is a design schematic **(Figure 30)**. This is the base layer with three bags going up the bank face, fronted with fiber rolls. Next, the bank was reshaped, sand was brought in to ease the slope and the bank was planted.

What you see here is that we have a very narrow beach. This is post-construction after the fiber rolls were put in. Here are the fiber rolls actually being put in on the beach and the bank being planted — a pretty straightforward project. I'll leave this here so you can take a look at it.

And since the time is getting short, I'll allow my co-speaker to take over.

MS. FIELDS: Thank you.

MS FIELDS: I'm going to go over two case studies — both involve coastal bank stabilization. The first one is in Bournes Pond, here in Falmouth **(Figure 31)**. This was essentially a project where there was a pre-existing house. The house was located approximately thirty feet from the top of the bank. It was a house that was built after 1978. It was not eligible for a hard coastal engineering structure. The client didn't want one. We didn't think it was warranted, so we were looking at soft stabilization here. The bank's about nine to fifteen feet high. High water was pretty close to the toe of the bank in this case, around three to four feet from the toe of the bank. We had a very narrow beach, around ten to fifteen feet. All the data that we collected showed that we had an erosion rate of around half a foot per year.

The erosion rate in this particular case had been accelerated by two things. First, the entrance to this pond was stabilized from a very small ephemeral inlet to a large stabilized inlet. That was done in the mid to late 1980s. And that had the effect of increasing the tide range in the pond. And many of the banks within this pond then readjusted as a result of that.

The second thing that really did a number on this bank was Hurricane Bob. It destabilized it, and that was what really prompted the client to give us a call.

Here's what it looked like before the inlet was stabilized, before Hurricane Bob. It was pretty nicely vegetated, still had a narrow beach, but it was in pretty good shape at this point.

This is just a locus map that shows where it is. Again, this is on Bournes Pond, one of the long finger ponds along the south shore of the Cape here in Falmouth.

This, interestingly enough, shows the location of that very small inlet. Right now we have a stabilized inlet right in this location.

Another thing about here is that this is a very low energy wave environment. It's got a limited fetch across Bournes Pond, and it's very narrow.

We looked at a number of things and recommended a number of things to this client. One of the solutions was the bio-logs, which we ended up doing. We also recommended beach nourishment, and we also recommended salt marsh restoration. There is a small patch of salt marsh off of this point of land down here, and we had recommended continuing that in front of the property, in front of the bio-logs. We're sort of doing the two projects in conjunction.

It turned out to be pretty costly, and the client just chose the bio-logs, but we'll keep the other solutions in mind if it's not working out to her satisfaction.

Okay. The design was fiber rolls stacked

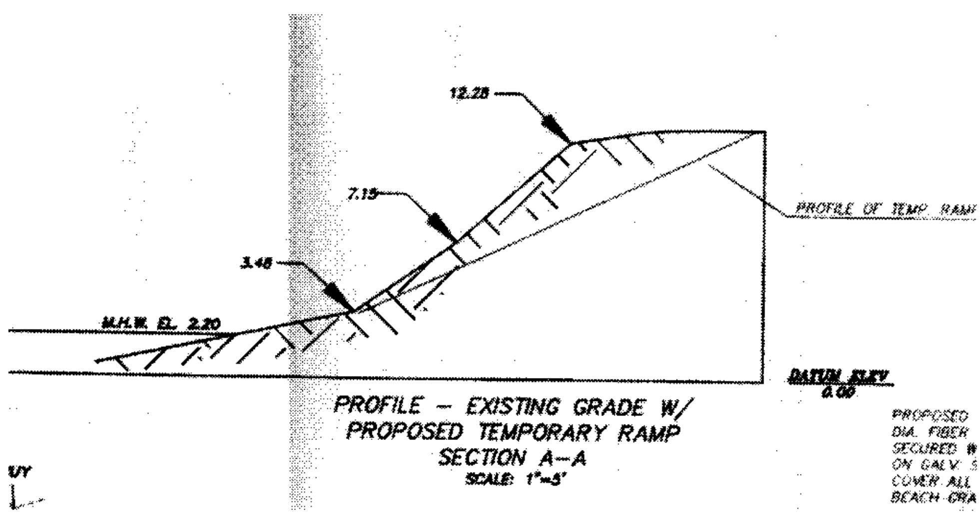

Fig 32. Fiber roll being placed in a trench at bank toe

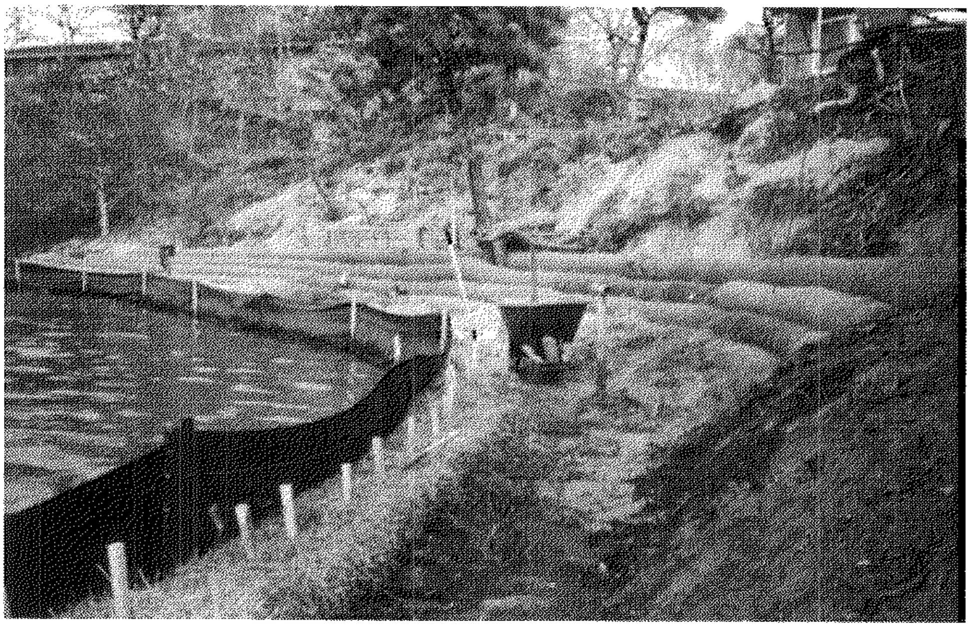

Fig 33. Bournes Pond bank stabilization under construction

five high. We used a twelve-inch diameter fiber roll anchored with duckbills, with galvanized steel cables. We covered it with soil, placed the jute netting and the beach grass on top of that.

So here's a few shots of just some of the construction. Again, the same thing that Lee mentioned. In a lot of these cases you do need heavy machinery to do some of the work. We've got heavy machinery at the top of the bank, sort of smoothing out some of the areas in the bank. A couple of places we had to fill and smooth out so that we could plant satisfactory.

And also the silt fence and staked hay bales at the bottom. We had about a ten foot work zone at the toe of the bank.

The first fiber roll was placed in a trench **(Figure 32)**. A duckbill anchor with a cable was installed to hold it in place.

One of the things that the client wanted to do was to keep a pine tree on the bank face. We had recommended cutting it, flush cutting it so that the wind wouldn't blow it and try to pull it out of the bank, but she really wanted it, and the landscaper determined that the tap root was in good enough shape that he thought he could save it. So that's what we did.

The contractor sort of wove the fiber rolls in and around the tap root. I think it's going to work out nicely.

Here we are during construction (**Figure 33**). We've got about four of them in now.

That's with the tree. And we're able to

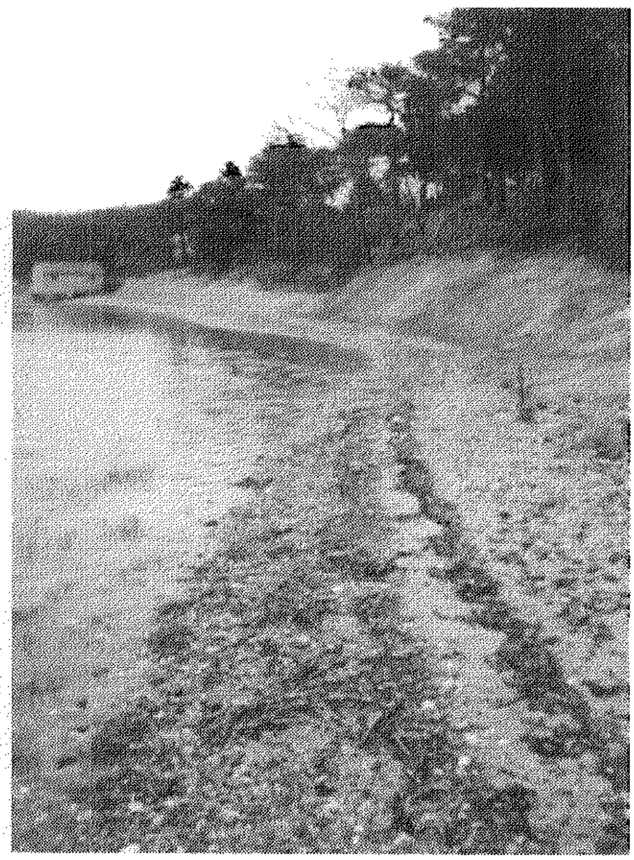

Fig 34. Bournes Pond bank stabilization project completed

bring the fill right up to the level of where the bank had been.

And here's what it looks like now, planted with the jute netting on top (**Figure 34**). This was done last season, so it's really only been in for about four or five months.

The next series of shots are some shots of projects that Anchor Marine constructed. And I know there's a representative from Anchor Marine here in the audience, so if there are questions you have about these, we can always direct them to Jeff from Anchor Marine in the back.

Fig 35. Fiber rolls covered with sediment

This is just another example of fiber roll installation, and again, how heavy machinery is sometimes required in these projects. It causes temporary impacts.

There again, just the machinery carrying a bunch of the heavy fiber rolls.

This is an example of how fiber rolls can be covered with sediment (**Figure 35**). Again, another Anchor Marine project. You really wouldn't even know that they were there in this case.

And here's a very good example of how they dealt with a return using fiber rolls (**Figure 36**). We still have to worry about end effects at the end of these soft structures. So they brought the fiber rolls around the end of the natural bank to minimize any sort of end effect erosion. And I thought this was a very nice treatment of that.

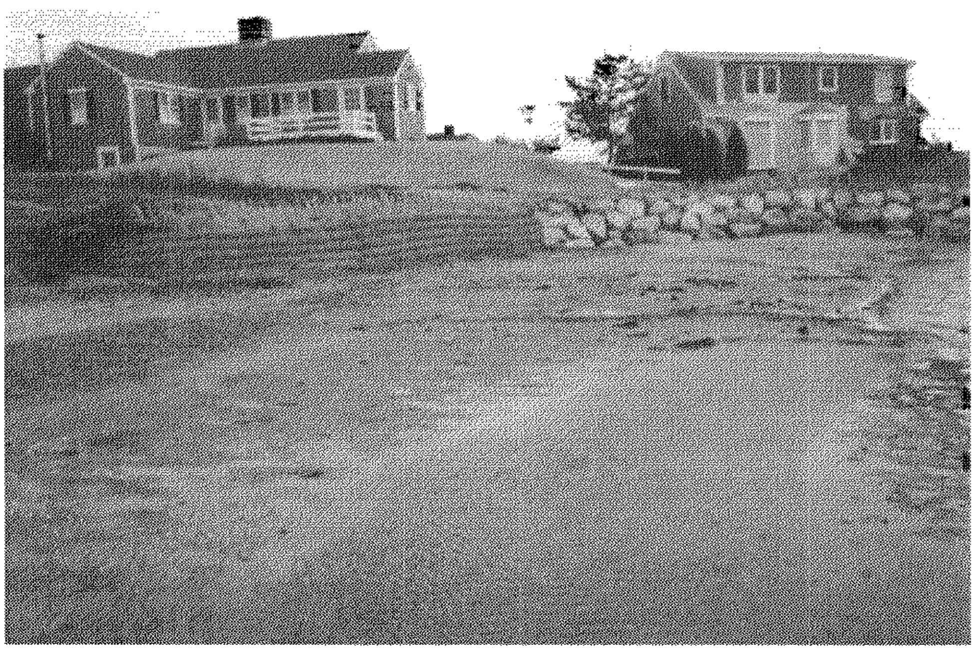

Fig 36. Using fiber rolls to construct a return

An example of how

they can abut a hard coastal engineering structure.

Just briefly, this is another project that we did with fiber rolls, and you really can't even see them. This is in North Falmouth. The fiber rolls are right down here. This has been in for about five or six years. We have two layers of fiber rolls here, and we planted the bank with beach grass. It's been wonderfully successful. The only thing that we've noticed recently is that they're really starting to degrade, so we're expecting that in the next say three years or so, they'll likely have to come in and replace the fiber rolls.

That's the same project. This was our project here, and it terminated at the property line. This property owner here didn't do anything for a while, or I think maybe they just planted with grass. Since then, they've gone in and placed fiber rolls along this stretch here as well and planted beach grass. So it's doing nicely.

All right. The next case study. This is moving over to Peconic Bay (**Figure 37**). Over in this area, they have a client who's got a large game preserve, five hundred acre game preserve. It's an island in the middle of Peconic Bay. And they have very high coastal banks, ten to forty feet high. High water is about fifty feet out from the toe of the bank. We have a lot of surface runoff issues on this particular project. And I wanted to bring out some issues related to that.

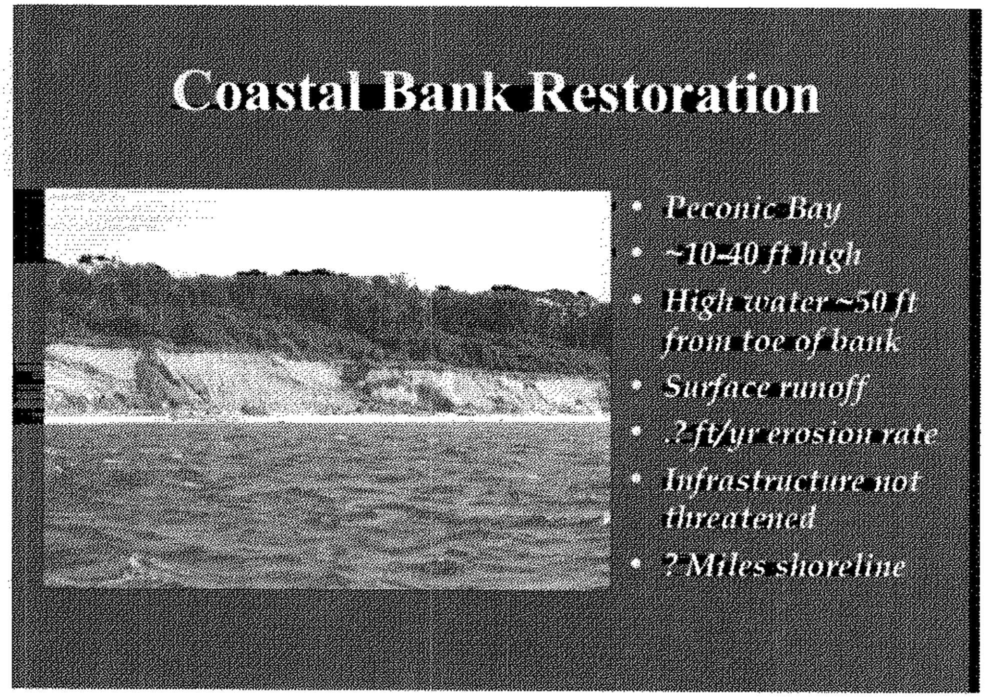

Fig 37. Bank stabilization proposal on Peconic Bay

We have an erosion rate here of around four-tenths of a foot per year. In this particular area there's going to be infrastructure that's threatened. Again, it's a five hundred acre island, there's a house in the middle of it, but the client just wanted to try something along this two-mile stretch of shoreline, to see if we could arrest some of the erosion.

And this is an example that I wanted to point out that shows effects of surface runoff. Before you go in and decide on a solution for these coastal banks, you have to really ask yourself, what's causing the erosion. Is it erosion at the toe from wave activity, or is it erosion from surface runoff? And this is a good example of surface runoff. What you get when you have surface runoff are these little erosion rivulets and channels. And so I just caution you all to look for that when you're analyzing these situations.

We also have some groundwater breakout that is causing a lot of erosion in this area. Again, here's an example of surface runoff effects as well as wave erosion at the toe. This is an example of where we just see erosion effect from surface runoff. The vegetation is gone. Where runoff is not a factor, the vegetation is growing nicely. There's not really any wave effect in this particular site, mainly because it's protected by a point of land.

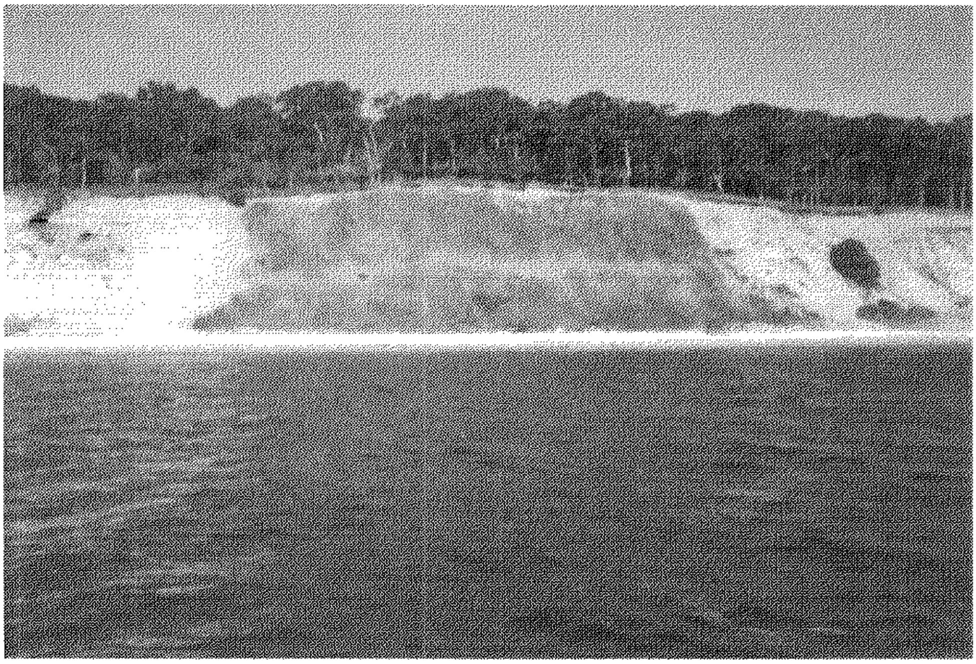

Fig 38. Bank Stabilization by grading and planting

AUDIENCE MEMBER: Question?

MS. FIELDS: Yes.

AUDIENCE MEMBER: In that case where it was the surface runoff that was the major contributor to the erosion, was anything done to mitigate that?

MS. FIELDS: Yes. I'll explain what we did. It wasn't entirely successful, but it was our stab at what we were going to do.

This is just another case along the same shoreline. Again, in Peconic Bay. The client owns the entire island. And really all we did was we went in and we smoothed off the grade of the bank and planted it with beach grass **(Figure 38)** — densely spaced beach grass, twelve inches on center. We used bare root beach grass, three culms per hole, and it was fertilized twice; once in April and once again in August. It's been pretty successful, although you can see an area where it's sort of slumped in this area here.

One of the other things that we did up at the top was to try to control the surface runoff with berms. So we located a berm up at the top, and we also looked at some sort of French drains in order to mitigate the problem. But those are the two solutions that we've used to control the surface runoff. And I hope that answers your question.

I'm going to close with the next two slides. Again, this guy owns a game preserve. He's got lots of trees, woods, woodlands, so his solution before we came to the project was to put dead wood down here. And there are massive piles of dead wood at the base of this bank – massive. And ordinarily we'd encourage him against doing this now, but right now we've recommended just to leave them there because they are so dense that they're actually being effective. But I wouldn't recommend that people go out and do that in the future. For now, we're just going to leave it.

Remember, we've got two miles or more of shoreline, so that's fine for this little stretch here. And this is from the ground, an example of what all that dead wood looks like there (**Figure 39**).

So I'll close with that, and if you have any questions for either Dr. Wieshar or myself, I'm sure we'd be happy to answer them.

Yes?

MR. STERINGER: Paul Steringer with the Corps. My question is with the Bournes Pond site, one of the last ones you showed there. You talked about replacing the coir logs there. Are there other ways — my understanding behind the core log was it was just there long enough in order to get proper roots established there. Could you have done more with the plantings in that area in order to stabilize that area vegetatively without having to go to a replacement totally?

MS. FIELDS: The site that I showed where we're going to have to replace the fiber rolls is actually up in North Falmouth. So it's not in Bournes Pond. And we won't recommend that they replace them until there's a storm that comes in and moves them around and erodes some of the material behind the fiber rolls.

Fig 39. Dead wood dumped at bank toe to dampen wave energy

AUDIENCE MEMBER: But do you try to go with shrubs as well as herbaceous out there, to try to get diversity?

MS. FIELDS: In that area, we have used some shrubby plants. There was some of that material existing when we looked through and we tried to leave it there.

But we've been careful to tell the client that it's really a maintenance situation.

I hope that answers your question. You know, the fiber rolls are going to last maybe eight to ten years. And after that point, if there's a big storm, these people need to expect that they have to maintain the coastal banks.

Yes?

AUDIENCE MEMBER: What is the material used to connect the fiber rolls, and is there any part of the fiber roll that is not biodegradable?

MS. FIELDS: I'm really not an expert on this, but the older fiber rolls were sort of held together with this jute netting. And recently they've started making them with more of a polysynthetic type material, which in my mind is a lot — it's preferable especially in an area where the wave activity is going to get to that fiber roll frequently.

So I would look for the manufacturers that create these products with the poly netting. And they're held in place with these galvanized cables that are attached to those duckbill anchors.

MR. WIESHER: To answer and to expand on that is that what we found is in installing the bio-logs is that the jute around the coconut fiber is more exposed to the elements and it degrades due to ice forming in the little fibers there. If you think about it, if you've seen the fiber roll, they're very dense coconut, but the jute itself is the weak link in there, so that the wrapping was actually coming apart and then allowing the fiber roll to degrade.

Yes?

AUDIENCE MEMBER: Leslie, a couple of those pictures that you just showed were projects of the designer Bradard, Trainor and Wilcox, and they looked very nice when they first went in, as your picture showed, and we had good success with one of them and fair success with another. And later on, I'll be happy to comment, particularly about the one where we have the stone interface with fiber roll interface in the inter-tidal zone. It's an interesting project.

MS. FIELDS: Okay. Yes?

AUDIENCE MEMBER: There's another product I found on the Web, and they're called rice straw watties. I've forgotten the name of the company, but have you had any experience with those? They tout them as being the same as fiber rolls at half the cost.

MS. FIELDS: No, I've never heard of them. I'd be interested to learn about them.

AUDIENCE MEMBER: On their Web site, they show them stabilizing banks like along highway projects and things like that. Basically the same application as fiber rolls can be used on, and they say they can be used on shorefront protection as well.

MS. FIELDS: Is it a mat?

AUDIENCE MEMBER: No. They look exactly like fiber rolls. They're just made of rice straw instead of the coconut fibers.

MS. FIELDS: Yeah, it would be interesting to look into it.

MR. WIESHER: It's called wattles that you're talking about. Basically, it's temporary erosion control, in lieu of a hay bale. It's a very effective product for that. Not for these type of applications. They don't last long enough and doesn't have enough density.

MR. WIESHER: So it's almost like a quick replacement for a hay bale because it can be done continuously, they can contour it, follow the contour line, and it will act as a very good sediment stop temporary during construction — or during a highway type project. Wattles were installed out at Route 495 in Marlboro, but the product is not suitable for these types of shoreline applications. It doesn't have enough density.

MS. FIELDS; Yes?

AUDIENCE MEMBER: I don't know if you've had any experience with storm events. Will these fiber rolls float?

MS. FIELDS: No, they don't float.

AUDIENCE MEMBER: Do they sink to the bottom?

MS. FIELDS: The ends of them can sort of get moved around by the waves.

AUDIENCE MEMBER: But during another hurricane or whatever, aren't they going to go somewhere?

MS. FIELDS: Sort of roll out seaward on the beach or maybe a piece of it will still be anchored to the bank, and the other end of it would come free and might come loose — I've never seen any stranded out in the middle of the water.

MR. WIESHER: Let me answer that. Any structure, soft or hard, can go anywhere in a major event.

MS. FIELDS: That's true, yes.

MR. WIESHER: It's all due to the event. Anything that can be designed is being designed to protect for the majority of the storms. The Blizzard of '78 was a seventy-year event or so — Hurricane Bob was a 25-year event. Those were two rare events.

The answer is yeah they can move. But it depends on the frequency of the storm.

AUDIENCE MEMBER: Well, I was just wondering. It seems like if they could move easily, it would be obviously a hazard to navigation and so forth.

MR. WIESHER: They don't move easily, first of all. And if we put them down with the duckbill anchors and the stainless steel, what happens is that typically they will roll forward — they'll loosen the duckbill anchor, but they don't pull free. But the problem with that is that once they pull away from the toe of the bank, you get water behind them; or if they're hit with wave energy, they actually can oscillate back and forth.

Now, these things aren't like jumping back and forth. The things weigh several tons when they get full of sand and water after a while. But they can move — they can roll enough that you'll have some enhanced toe erosion, hence soft solution, hence maintenance, hence that's why it's a soft solution as opposed to a rock structure, where you have to tell the homeowner right up front, you're going to have maintenance on this.

When we go into a project, depending upon the site, we'll say you have annual maintenance, you have once every two to three year maintenance, you have once every five year maintenance. The Nantucket project that I showed, we told him that he ought to bankroll eighty thousand dollars to spend on his bank every five years. So just start putting it away because you're going to spend eighty grand in five years. So it's been over — it's been almost ten, and he hasn't spent a nickel, so he's been the big winner. But, you know, we tell people right up front, it's going to be a maintenance issue, this isn't something you're going to walk away from, you need to plan on it.

And it's a management issue. So when we go in and talk about soft solutions, we talk about managing the shoreline erosion, managing the beach as opposed to an erosion control device because of the fact that we really aren't controlling erosion, we're just doing a temporary mitigation.

MS. FIELDS: It's really what you were talking about at Duxbury Beach. I mean, you talked about an evolving management plan, and I think that's a great example of that.

Yes?

MR. WILLIAMS: Peter Williams of Vine Associates. I'm curious. Your application of the bio-logs, are you using them more for the backing of the slope and not for an exposed toe protection, or do you use it for both?

MS. FIELDS: We use it for toe protection of the bank, to keep the waves, the everyday waves and the low to moderate storm event waves from striking the toe of the bank, so that the vegetation can start taking hold and helping to stabilize it.

MR. WILLIAMS: Well, in the Bourne Pond, you show it going all the way up the bank. And that appeared that it was sort of the backbone of bank, to hold it in place. In the situation where you have it at the toe of the bank, do you see shorter life spans for those roles?

MS. FIELDS: I haven't seen or had enough projects to be able to answer that question.

MR. WIESHER: I can answer that a little bit. The project that I showed in Cotuit Bay, we had another project that was immediately adjacent to that. And for whatever reason, whether we had a set of bad fiber rolls, whether we had animals getting into it, or whether we had ice, well, there's pheasants on there, and they like coconut rolls for making their nests.

MS. FIELDS: So do fox.

MR. WIESHER: We went in and found these places where the coconut roll had been actually plucked out, and so we're sitting here wondering — one of the maintenance guys came over and said oh, yeah, we see pheasants are down here all the time. This is great. So we actually had to pull that out, and it was a little more exposed, and so actually, the revetment went in after the fact about four or five years after we had placed the coconut roll in. So it really depends on the site and the conditions that you experience. We've had other sites that are in embayments that are just high water, very little waves, that have lasted for eight, nine years without any problem.

MR. O'CONNELL: So they also increase wildlife habitat?

MS. FIELDS: You're leading into the next talk, right?

MR. O'CONNELL: We saw the fox den in the Falmouth project.

MS. FIELDS: Yeah, North Falmouth.

MR. O'CONNELL: I have one question. What is the typical cost of one of these projects? Oftentimes, in my experience, a regulator may say, we don't want the hard alternative first. Have you tried the non-structural? Can you compare the costs of a small bank project, say a ten to fifteen foot high bank with a toe revetment, to a bio-log project with jute netting? Are the costs comparable?

MS. FIELDS: I know that the price tag on that Bourne's Pond project, which was a hundred and twenty linear feet, five high, was around twenty, twenty-one thousand for construction. So what's the cost per linear foot of a revetment? Roughly?

MR. WIESHER: Well, in that area, it wouldn't be comparable.

MS. FIELDS: Five hundred?

AUDIENCE MEMBER: A linear foot.

MS. FIELDS: Five hundred a linear foot, so five hundred times one twenty (for a stone revetment). So it's a lot more for the hard structure (revetment).

MR. O'CONNELL: But then factoring in the maintenance — the annual maintenance requirements over a ten or twenty-year period.

MR. WIESHER: Yeah, I would be careful on that because of the fact that Bourne's Pond didn't have a wave issue to deal with or just mostly high water, so the construction was pretty straight-forward. You can go spend up to two hundred dollars a linear foot easily for a soft structure without much problem — on a pond location. But again, if you were going to look at a revetment at Bournes Pond, you would probably only look at a base rock level for a toe protection. You wouldn't have armored the entire bank. So it would probably be less than five hundred dollars per linear foot. It's going to be by location. It's going to take a lot of different things. I mean, you would probably look at maybe having in an energy zone a rock toe, and any vegetation above it, if you want try to get it in a high-energy zone. But most of the stuff is for low energy.

If I had to guess, I'd say you'd probably save about a third to a quarter on a soft solution.

MR. O'CONNELL: Soft alternative, you mean?

MR. WIESHER: Yes, right. That would be an initial cost. Maintenance is something else.

MR. O'CONNELL: Thank you Leslie and Lee. Now for our last speaker before the break. I do hope you stay for the open discussion following the break. It's going to give you an opportunity to talk about all of the issues and anything else we may not have covered. It should be quite interesting.