Smithsonian Folklife Festival

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Interviewer - Sherri Richardson-Dodge
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Sherri Richardson-Dodge (SRD): Gordon, could you do an ID for us please?

Gordon Grant: Sure, I'm Gordon Grant. I'm a research hydrologist with the Pacific Northwest Research Station in Corvallis, Oregon. My address is P&W Research Station, c/o Forestry Sciences Laboratory, 3200 Jefferson Way, Corvallis, Oregon 97331. Office phone: 541-750-7328.

SRD: Okay, Gordon, I know you've been a research hydrologist here at the Corvallis Lab for how many years now?

GG: About four hundred.

SRD: About four hundred years? Seems like it sometimes.

GG: [Laughter] Right.

SRD: Really, how long have you been in the field?

GG: So, let's see, I've been working at the Corvallis Lab for about twenty-two years now.

SRD: Okay. And the Corvallis Lab is part of the Pacific Northwest Research Station in Oregon.

GG: Right.

SRD: We'd like to talk to you today about your career but also since you deal with water, we were talking earlier about the Forest Service and its history of providing clean, pure water to communities nationally. Can you tell us something about how that all got started with the Organic Act and so forth?

GG: Sure. You know if you go back to the end of the nineteenth century the key issues facing the country with respect to the forest were that the forests were being looked to as a source of wood that was going to help build the nation, build the railroads and the national forests were clearly, when the national forests became established that was

clearly one of the major roles. The other role though, one that's perhaps lesser known but certainly in my and other people's view equally as important and certainly within the law is equally important, is that the protection of national forests was intended to provide and here is the key phrase that Congress used, favorable conditions of flow. And what that means has been a source of discussion, controversy, court challenges over the last hundred, hundred and twenty years and we're still trying to figure that out. We're still trying to understand what it means to provide favorable conditions of flow. But clearly within the enabling legislation for the Forest Service was that the forests were to be set aside so that the issues people were thinking of at the time were issues of that floods did not occur so that agricultural lands were not inundated by water at inappropriate times and places, so that rivers didn't fill up with sediment. And the protective nature of forests in securing favorable conditions was recognized even back then. So the issue of water and forests as a way of protecting water supply, water quality, water quantity has been with us since the get go.

SRD: And in Portland, Oregon, which is the largest city to Corvallis, which is where you are located, gets their water from a large reserve?

GG: Yes, in fact, if you look at a map of the western U.S. in particular, and you ask where does the water come from, where does the water people in the major cities drink, in Seattle and Portland and Eugene and San Francisco, it comes out of the forest, comes out of the mountains.

SRD: And most people don't realize that.

GG: I think people have a vague notion of it. But I think it's an interesting question to walk down the street and ask people, well, where does your water come from. Most people's first reaction would be the tap but, you know, it's got to get there somehow. And so I think certainly in our region the forests and the mountains are in a sense unsung heroes in their role of providing water for people to drink, and not just in the terms of the quantity of water that's provided out of these mountains but also the quality tends to be quite good. In our region much of our water starts as ground water and is filtered through a vast volcanic hydrologic sponge, if you will, that results in very, very high quality water, very cold, very clear, I mean some of the sweetest water on earth and it comes right out of the ground.

SRD: You've had this romance sort of with water for a long time. I understand it started out as a white water rafting captain, professional. Tell me about that.

GG: Well, I am one who has managed to, you know, turn his recreational hobby into a lifelong passion and career. No, I started, well, if you really want to go back, if you really want to go back, my first interest in water aside from drinking it was I used to spend my summers at Woods Hole, Massachusetts. There was a shower on the beach.

SRD: Is that where you grew up?

GG: Well, I spent my summers there. I grew up on the east coast until I was thirteen and moved out to Oregon. But I spent my summers in Woods Hole, which is a little scientific community right on Cape Cod and there's a beach there, a little, you know, not a very big beach and one of the best parts of this beach was that there was a shower. And the shower was sort of uphill on the beach and then the water from the shower ran down through the sand to the ocean. And it became the job of the children of the town to on a daily basis build a hydrologic engineering works with the water coming out of the shower, a series of dams and canals and rivers, and so forth; the point of which was to see if you could get water all the way down to the ocean. So I spent my, you know, afternoons playing in the sand fascinated by dams and {riverulets 7:00} and how to move water from one place to another. And my fascination with water probably began around then.

You know, when I grew up I became particularly entranced by rivers. If you come to the Northwest the rivers are clearly one of the most distinctive parts of the landscape. And I moved out from the east coast to the west coast and the first thing I noticed was, my God, these rivers are something. You know, they're powerful, they're full of rapids, they're loud, they smell good, they look interesting and I got fascinated by the question of where does this river go? Where does it come from and where does it go? And I became really interested in seeing if I could figure that out and so the first thing I did when I got to college was, you know, sort of get all my quarters together and buy myself what was at that time the best raft you could buy, which fit four people. And then I proceeded to try to kill myself in a number of interesting ways [Laughter] while exploring the rivers of Oregon.

SRD: Now you're in Oregon.

GG: In Oregon, that's right, after I moved out and went to college. And I had an endless series of wonderful adventures, narrowly escaping death on a number of occasions, but having a ball and realizing it was possible to actually, you know, get on a river and survive. Eventually the river sort of teaches you how to navigate it up to a point and the more I did it the more I realized this was really something worth doing. I mean rivers appeal to all the senses and they appealed to all of mine plus the sense of adventure. And this was back in the '70s when white water rafting and recreational rafting wasn't really even very well developed.

SRD: So you were ahead of the curve.

GG: I was sort of in the first wave of people who were doing this and so I heard that there was a river company that was actually offering a training school for people who wanted to come work for them and I signed up. I actually got a scholarship to go to River Guide Academy and spent six weeks, some of the best six weeks of my life, going around in a school bus trailing, you know, a trailer full of river gear and running every river we sat our eyes on. And we had, you know, numerous adventures again and just had a ball and I came out of that certified, if there was such a thing, to actually take people down the river and so I did that for about ten years. And it was I owned my own river company for a

while and ran sort of river trips around Oregon, California, and Idaho, and it was a good way to spend a youth. I mean I feel I spent my youth in a good cause.

SRD: It sounds great. Yeah.

GG: You know, you get to see some country you can't see any other way. You learn about rivers in a very direct and in a certain non verbal way that teach you very directly. You experience the power of rivers. You experience the fact that they're inanimate but they have many lifelike qualities. They change. They move. They are transformed sometimes on a daily basis, sometimes hour by hour. And I was impressed by how rivers affected other people. I would take people who lived and worked urban jobs and they would come out and be transformed by just sitting in a boat and going down the river. They would—

SRD: In what way?

GG: Well, it would be cliché to say that relax and so forth but it was more that people became aware and observant about things that they might not have otherwise seen. You would see people, you know, beginning to just look at rocks differently. I would try to do a little education about how is it that you get a boat through complex rapids and what are you looking for and people would start, what about over there, what about over there, and these were clearly things that people weren't, didn't encounter in their daily lives. So it was clear the river spoke to people and not just me.

SRD: It raised their awareness too it sounds like.

GG: Yeah and there were issues that emerged at that time. A dam was being built in California and we were arguing against the dams and, you know, white water river guides want to do. But it was clear it was not, it was recreation but it was something deeper than that so it really, it affected me and I think it affected other people as well.

SRD: How did that bring you around to you came back to get your doctorate?

GG: Yeah, well, I actually, my undergraduate, I majored in rivers as an undergraduate too. This was back in the '70s when you could have, you could have an undergraduate career majoring in whatever you took a fancy to. Actually it was a very good, it turned out to be a very good thing for me. I was at the University of Oregon and they had an independent studies program and I basically organized my program around a study of the Willamette River.

SRD: You designed your own courses.

GG: I designed my own program and was given the latitude to do that. And I went around and, well, at that time I was interested in how people relate to rivers. This was an extension of the experiences I had taking people down rivers. And so I spent a year and a half going around interviewing a whole range of people about their experiences with the

Willamette River. I interviewed, people used to drive logs down the river, found an old guy who actually ran steamboats up and down the river back in the early part of the century. I spoke to Native Americans who used to harvest eels from the falls at Oregon City. I spoke with authors who wrote about the river and I worked with a photographer. We put this into one of these six projector slide and sound shows and called it the Willamette River Chautauqua and went up and down the Willamette Valley showing it to whoever we could convince to watch it.

SRD: Do you still have that?

GG: I still do. I still have pieces of it.

SRD: That would be very interesting maybe to use at the Smithsonian.

GG: I have the tape.

SRD: What's it called?

GG: It's called the Willamette River Chautauqua and somewhere I have the soundtrack. I know I have the soundtrack. I haven't thrown that out. The slides I think are sort of in different piece, somewhat dispersed to the six winds. But so I did that for a while and then but I realized, I mean my background was in science. My father was a biologist, is a biologist. And my early training in college was in biochemistry and so I found myself attracted beyond the social dynamics of rivers back into the question how do rivers work. And some of it was probably encouraged by when you're a river guide there are two questions you get asked all the time. One is what do you do in the wintertime and the second is how deep is the river, which I never understood the question because the river is, you know, it's shallow and it's deep.

SRD: And what were the answers to them? I want to hear myself.

GG: Well, my problem was I never had a good answer to either question. You know, what do I do in the wintertime, well, you know, I taught banjo and skied and waited for summer, you know.

SRD: That's great. That's sounds like a good thing to do.

GG: But then the question how deep is the river, well, I didn't have a good, we had a range of answers from everything, well, it's deep enough to float the boat or that kind of thing. There was a third question that sometimes people would ask, which is will we end up in the same place as where we started, which suggested a true misunderstanding of how rivers work. [Laughter] And we'd sometimes get that question too. A river is not a Disneyland ride.

So I found myself, although I couldn't come up with a good answer for how deep is the river, I did find myself spending a lot of time thinking about well, why does the river

look the way it does. I mean when you're a guide you spend a lot of time sitting on a boat, rowing a boat, and looking at rapids and looking at places to camp and bars and things. And I found myself increasingly interested in what is it that makes the river look the way it does; why does it have canyons here and rapids there and, you know, why do the waves look the way they do. And sometimes the river is choked with sediments; sometimes it's clear; what's that all about. And I didn't even know that there was a science, a name for the science at that time. This was back, you know, this was sort of getting towards the latter part of the '70s. But when I decided to go back to graduate school I sort of hunted around for places that looked like they had courses on rivers in their course catalog and ended up through serendipity, which incidentally was the name of my river company, Serendipity River Trips, going to Johns Hopkins University in Baltimore and meeting there one of the great gurus of river science.

SRD: Who is that?

GG: That's M. Gordon Wolman who is commonly and far and wide known as Reds Wolman for the color of his hair and Reds Wolman is one of the true patron saints for the field that I found—

SRD: What do you call this field?

GG: The field is a mouthful. It's fluvial geomorphology.

SRD: What does that mean to lay people? How would you translate that?

GG: Well, if you tell somebody you're a fluvial geomorphologist you can watch their eyes kind of glaze over. [Laughter] It sounds like one of those truly esoteric fields.

SRD: It does.

GG: But basically geomorphology is a branch of geology, or if you're in Britain, physical geography, that concerns itself with the processes and the landforms operating at the surface of the earth and then fluvial has to do with rivers. So you put those together, fluvial geomorphology is the study of the way that river processes and landforms behave on the earth's surface.

SRD: Oh, okay.

GG: So it's a piece of geology that really concerns itself with river dynamics and river behavior, river evolution, and how landscapes evolve in response to rivers and their evolution.

SRD: And so that led you to do a lot of work with other scientists here in the United States and abroad. I know you've done a lot of work on, you know, looking at so called disasters that involved floods and you've done extensive work here in Oregon about the major flood here in what, in '96? Can you kind of tell us about, give us some highlights

of where your work has taken you and something about the flood of '96 which you, I don't know, you have this term.

GG: I got inundated by. [Laughter] Well, my research has really spanned a range of issues. I started off working on questions about how does a river know whether the watershed that it drains has been harvested for trees. And that's basically the reason I have the job I have with the Forest Service is because this has been an ongoing concern for the Forest Service. Is how do we manage these forestlands in ways that do not degrade downstream resources, do not affect water and river channels and fish downstream. And so my early work was really focused on this question of so called cumulative effects; what's the cumulative effect of cutting trees and building roads and watersheds on downstream channels. And from that I got interested in a whole range of river processes. Most of my work, most of the focus of my work, at least in my early career, was on mountain rivers. It was sort of a direct carry through from my time as a guide. I was very interested in high energy rivers, lots of rapids, lots of dynamic geology, and the sort of contrasts you get in mountain settings. I've since expanded that to include all rivers because they're all fascinating in one form or another, even ones that are slow, meandering, sandy, and haven't seen a mountain for many, many thousands of miles.

The work on rivers is both involves looking at fundamental, essentially the fundamental physics of rivers. There's sort of a fundamental side that everyone who plays with rivers is interested in and it's very often the tools of physics that one uses to help understand rivers, the tools of geology, the tools of physics, the tools of hydrology, the tools of hydraulics. But in reality the motivation for much of this is also dictated by real genuine human issues and concerns.

SRD: And what are some of those issues?

GG: Well, for example, the issue [tape goes blank for a few seconds].

SRD: So, Gordon, you've said several times that you related rivers to people and people understanding rivers. Can you tell us why that's important, why you think it's important that people have an understanding about rivers? And I guess rivers are made up of water. Maybe that sounds silly but water is an issue for a lot of communities. I know in your career you have and you continue to be called upon as a consultant or to help large and small cities manage their water and help them come to a decision if they should remove a dam or not. Can you kind of give us some highlights of that?

GG: Sure. Well, when I think about how most people probably experience rivers and water, they experience it as it comes out of the tap or goes down their toilet or maybe on their way to work when they cross it on a bridge, cross a river on a bridge. And probably in many cases don't give water too much of a second thought until we encounter some of the extremes of nature, a drought or a flood; a drought where people, you can't water your lawn or wash your car anymore or a flood where the river comes and finds you and suddenly you've got a river in your front yard. But these issues, these water issues, are with us all the time and they are only going to become more important as the crunch

between available water supplies, burgeoning population, increasing demands for rivers for a whole set of reasons, human, industrial, agricultural, ecological and so forth. And so these water issues involve how do we balance that mix of expectations and objectives for water, one against the other. So my research is sort of somewhere in there trying to figure out, well, you know, how, for example, how do rivers behave during floods in ways that might directly affect people. And it's one thing to do this work in the abstract. When I first started my career and was out looking at rivers, essentially to look at the forest harvesting on rivers, one of the things that jumped out at me was you couldn't look at a river today without reference to the floods of the past. That the river in a sense recorded its own history and it recorded it in deposits by the river itself, by the age of the vegetation, by rotting log jams that obviously had been in place from earlier times. And in our region that flood had happened in 1964, the Christmas flood of 1964.

SRD: Here in Oregon?

GG: Here in Oregon, throughout the Northwest. It was a major regional flood, huge flood. And so I found that a lot of my work, early work, involved having to read through what this one event, this one singular event did to these rivers because they all still reflected this history. And so, you know, there was a fair amount of time spent at night sitting around with colleagues wondering, God, I wonder what it would have been like to have actually seen something like that. There were old timers who would tell me stories of landslides and roads closed and lots of water. We were working on these rivers but it was in 1996 that I was fortunate enough to have what really I think of as one in a career event, which is we actually got to witness a comparable flood. Not only did we witness it but we saw it coming. Through the miracle of the Internet I came in one morning and it had been raining for a day, which was not unusual in Oregon, but it was a big snowpack out there and they were predicting warm temperatures and it just smelled like a flood. There's a particular smell in the air and it's real because the air is coming up from the subtropics, a subtropical jet that locks in place.

SRD: I know you can smell rain coming.

GG: You can smell rain but there's a particular constellation of wetness and warmth really in the middle of winter that is a, you know, you walk out of your house, smells like flood weather, you know.

SRD: Okay. Some of us walk out of our house.

GG: The river geeks walk out and say smells like flood, smells like a flood. And so I got on the Internet just to see what was happening. My gosh, they were predicting four more days of solid rain, major rain for our region and I knew that we had a big snowpack up there, unusually big snowpack for early February. And my instincts said this is going to be big. It's going to be worth going to watch because my advisor in graduate school said I never want to catch any of you running away from a flood. So I took his words to heart and I, you know, got some of my other colleagues and said, you know, we ought to get

up there. Grabbed the video camera, which turned out to be, the only thing you can do in a flood is just sort of stand there, gape at it, and photograph it.

SRD: And you did some recording.

GG: Yeah, well, I had a camera there and we went up to our experimental forest.

SRD: Which is?

GG: We went up to the H.J. Andrews Experimental Forest, which is about fifty miles east of Eugene in the western Cascades of Oregon. This is an area we had done lots of research. We had lots of small watershed monitoring sites with gauges. We knew the landscape and one of the nice things about spending, investing in a place is you get to know it, you get a feeling for that place. You really know where to go.

SRD: Which is a big plus.

GG: Which is a big plus, exactly, plus we had facilities to stay up there and so forth, which turned out to be providential since we got locked in because the road was shut down. So I mean I remember it very, very vividly. We went up there and it was raining hard.

SRD: Was it torrential rain when you were traveling there?

GG: It wasn't torrential, it was just, it wasn't torrential but it was consistently hard, which for Oregon is somewhat unusual. And we got up there and there was snow on the ground at our main administrative site and things were melting. There were just puddles everywhere you know. But, you know, the creeks looked, you know, up but, you know, we'd come up running after a flood before and nothing had happened. Well, maybe we blew it again this time. Went out to dinner and while we were at dinner, just between the time we came into this restaurant for dinner and came back out, the parking lot just filled up with water. I mean we literally had to wade our way back to the car and oh, my gosh, I've never seen this before. We got driving back up to the forest and the snow, the road was sort of was a tire track and then snow, lots of snow on either side, but as we came up this snowy road we began—

SRD: What month is this?

GG: This is February, early February 1996, February 6, 1996. And we came up and there was brown mud had started to flow down the road and the mud had to come from somewhere. It didn't come from the road. It had to come from landslides and so we knew that landslides were beginning to be trouble. We drove up to one of our watersheds and actually a landslide and a debris flow, which is a liquid, very rapidly moving mass of mud, water, rocks and wood, had come down the hill and was what we were seeing. Oh, my gosh, we were excited so we parked our car, we jumped into a snow cat, which is Caterpillar tread for navigating in snowy conditions, headed up the road to check out the

other watershed and as we're coming up there we're starting to see boulders setting on the road and then we see a Volkswagen sized boulder sitting on the road and then we couldn't to any further. We got out in the rain and another one of our experimental watersheds had been destroyed by debris flow. Now you'd think that a bunch of people whose job it was to keep these watersheds going would have been, oh, my gosh, you know, our work has been destroyed. We were like kids in a candy store. This was crazy too because it's raining, there are landslides kicking off around us, we're standing in a shooting gallery where debris flow has just come through. And another one in fact came through later that night. We were in heaven. We were just ecstatic that this was going on on our watch. And so we went back home, went to bed, got up in the morning and the first thing I remember is we were sitting above the creek that we had seen the day before, big but nothing to speak of, and the first thing I remember is you could hear the creek. You could hear the boulders crashing in the creek and this was, we had never heard this before. We took the camera and went down to the creek at first daylight.

SRD: Did you have a boat?

GG: No, God, you didn't want to get anywhere close to this creek in a boat or raft. There were hundred foot long by, you know, three foot in diameter Douglas fir trees rafting down this creek. It was unlike, I mean this was a creek that you could—

SRD: You have film footage, right?

GG: We have film, yep, we have film footage.

SRD: That would be interesting.

GG: And, you know, you can wade across this creek in the summertime. Now it was standing waves and logs and the thing that really jumped out at me was how this place that we thought we knew because we'd studied it, we'd mapped it, we knew, it looked completely different. It looked like a completely kind of place because suddenly water was filling up what had previously been air. Water was occupying all the areas that had previously been dry. So there was water everywhere. There was water on the roads, water coming off the sides of the hills, water, mean there was just water. The landscape was just oozing everywhere. And I remember also being aware of how the, you would actually sense how an increase in the rain would go directly into an increase in the river. Normally, you know, the water falls on the ground, it soaks through, there's a delay that might last hours if not days between a rainstorm and when it shows up in the creek. It was like the atmosphere and the river were intimately coupled together and, you know, the rain would switch on and the river would come up and I'd never seen anything like that. You felt yourself part of a coupled landscape that, you know, I'd never even read about that. It was just fascinating. And then just watching what was happening, listening to the boulders, watching this wood come down the channel that previously you could just wade in. And I remember turning to Fred Swanson, who I was with at the time, and thinking about all the work we were going to end up doing on this flood and all the studies we would do and all that and realizing that we would never be closer to it than at

this moment. You know, there was a certain feeling of, you know, that this was really a special event we were seeing. And sure enough we spend the whole day running after the thing and finding where, oh, my God, look at this and that. And then we turned on the radio that evening and discovered this was number one national news, that our flood, we felt very, this was our flood that they were talking about.

SRD: How did it impact the surrounding communities?

GG: Well, we were hearing, you know, it impacted the whole Willamette Valley among other places. I mean it was the upstream communities there was water everywhere, people were stranded. Corvallis where I lived was an island for a while. The concern was that it was going to get into downtown Portland. And in fact, the people in Portland mobilized to build an additional temporary barricade down the river wall to try to keep the water out. As it turns out, it didn't get that high. But it was a singular event and then became, as the water receded, a whole set of questions emerged. Whose flood was this anyway? Was it God's flood? Was it Forest Service's flood? Was it a human augmented flood or was it just a natural event? And that turns out to be a very tricky question to answer. It's not easy to tease apart how much of this event would have happened, you know, a thousand years ago. Floods happen. I mean everyone who studies rivers knows that floods are just part of what happens to rivers. But because we operate in the landscape as well, we build roads, we cut trees, we build reservoirs, we manipulate the landscape and so that became a big piece of our research then was to try and figure out how much of this flood really would have happened regardless of human intervention and perhaps more importantly, what can human beings do in the future that might mitigate these effects.

SRD: And what was learned from that that is now helping other communities or is that research?

GG: No, we learned some interesting things. I mean we learned that, we learned that there are what you might call flood hot spots or parts of the landscape that are particularly prone to particular types of flood issues, if you will. Landslides and debris flows aren't just random. They happen in very specific locations. We saw that in '64. We saw it again in '96. We saw how the effects of human activities actually do increase but they don't increase as much as some people would think. I mean the effect of cutting trees probably on an aerial basis might double the number of slides, slide frequency two to three times. Roads do more. The effects of roads are much more pronounced than the effects of cutting trees. We saw that. We saw that practices implemented by the Forest Service and other land management agencies to mitigate against this kind of effect worked to a certain extent. Where roads had been designed to handle flood waters, they did so. They managed to do so.

SRD: So some good came out of it.

GG: Oh, yeah, yeah. We learned things. A more complex story that emerged was we had the city of Salem, which is the state capital of Oregon, actually lost its water supply for

two weeks because of muddy water. The turbidity shut down their filtration plant and the initial reaction on the part of the city was to say to the Forest Service, we've been telling you for years, you're cutting the trees, this is your mud. This is your flood in a sense. We looked at that question rather closely and found that, in fact, the muddy water that happened in the '96 flood was a combination of sort of confounding events. It was landslides, including landslides off of Forest Service's land that had been cut rather intensively in the early '50s and '60s. It was also the way the flood control reservoirs had been operated. It was also where the water filtration plant, the city had chosen to site this plant. There was a combination of factors that contributed to the consequences and take any one of those factors out and you end up with a different result. And I think actually that is a fairly important finding, even though it might strike some people as pedestrian, which is that simple cause and effect relationships don't always apply, particularly when you're dealing with these complex systems. It's confounding. It's combinations of things that really affect it.

SRD: With that finding and sharing that with the officials there in the city of Salem, were you able to help them solve the turbidity problem?

GG: Well, the turbidity problem sort of resolved itself because eventually everything settled out. But it was very interesting what happened, which is that for the first time you had a city, a federal land management agency, Forest Service, you had the Army Corp of Engineers who operated the dams, you had the State Board of Forestry, everyone was talking together because of this event in a way that they had not previously talked about and people were coming up with new solutions. For example, one of the things that hurt the city was that it was blindsided by this turbidity. It didn't expect it, so one of the consequences of the work and the research was implement a monitoring program so that if the turbidity goes up in the headwaters, the city is aware of it and has some time to prepare.

SRD: Oh, okay.

GG: So there's a kind of adaptability. You're not going to get rid of floods. You can't eliminate it but at the same time you can manage it. So another big issue, another place where people encounter rivers and where river issues really play out in I think important ways concerns the way rivers respond to dams. The intensity of dam construction in this country, you'd sort of have to see a historical picture to really believe it. There are literally hundreds of thousands of dams, large and small, mostly small throughout the country, most of which were constructed over the last hundred years or so. The peak of dam construction happened in the '50s and '60s and I think somebody calculated that we were building a dam every eight minutes. Again, most of those are small but some of them are quite large. And dams perhaps are the most direct human intervention in rivers. It's certainly a place where we directly affect the way water moves through the system, the amount of water that moves through the system, and the amount of sediment that moves through the system. And there are all kinds of other effects as well, effects on ecology, effects on temperature, effects on nutrients. And so in the last ten, fifteen years with the aging of this infrastructure of dams that we've created, we've had to face up to

the problem that we have to decide what to do with these aging dams. Do we maintain them? Do we retrofit them to make them more environmentally acceptable, build fish ladders by them? And do we change the way they operate to provide different ranges of flows to achieve different sorts of objectives? Or in some cases do we actually consider removing the dams? And this has been one of the major subjects by researchers, both the effects and consequences of building a dam in the first place and how does a river know, say, downstream that there's a dam downstream. And then what are the consequences to the river if you take the dam off? And the latter is something that we actually know not very much about. We're just beginning to really address this problem in a fairly systematic and scientific fashion. The effects of building dams on rivers has been known, you know, has been the subject of research for quite some time. But even there it's made difficult by the fact that every river is different, every dam is different, and the effects of a dam on a river are not consistent, which is of course, this is bread and butter to science. Are there ways of thinking about the way dams effect rivers and the specifics of how they effect the water and sediment regimes that would let us say predict what the consequences of putting a dam in downstream might be?

SRD: So dams may prove to have a positive effect on a river some times?

GG: We build them to have benefits. We build them because we want to stop floods, we want to store water.

SRD: I guess I said that wrong. Dams are kind of viewed as a bad thing often times.

GG: They are viewed as a bad thing but I prefer to think of it in terms of consequences, their range of consequences, some of which are beneficial, some of which are not. And the challenge that we have collectively as a society is how we balance that, you know, how do we extract benefits but not cause things to go downhill recognizing that everything we do, every intervention we do has consequences.

SRD: And haven't you consulted with some communities that actually decided to remove a dam?

GG: Well, dam removal is becoming the big issue.

SRD: Have you helped with your research?

GG: We are actively researching.

SRD: So that they come to that whatever conclusion they need to come to.

GG: Right, we're trying. We don't advocate dam removal or dam maintenance. What we try to do is provide anyone who is thinking about this a clear picture of what they might expect. Because when you think about taking a dam off a river what you're effectively doing, some people think you take a dam off you automatically get the same river that you had before the dam. It doesn't work that way because now you have a history of a

dam. That history has to play through. And, for example, if a dam has stored sediment upstream, that sediment is released when a dam is removed and that sediment has to go somewhere and the movement of the sediment itself transforms the channel. And one of the big unknowns, one of the hardest nuts to crack in this game is to predict where the sediment will go, how fast it will get there, what it will do, what it will do to the bed of the channel, what it will do to spawning gravels, what it will do to ecosystems, what it will do to the potential for downstream flooding, all of which can be affected by sediment. So a lot of our recent work is to look to use a variety of techniques to come at this problem. Where somebody is taking a dam off a river we try to be there. We try to study the, you know, we map it, we measure it, we watch the removal itself, we follow the consequences in terms of the movement of sediment, we examine the changes to the channel of ecology, we look at the way the upstream reservoir is eroded. But that's somewhat of a singular event when somebody takes a dam off. But if we really want to study this we have to do other things. We have to go to the laboratory and actually build models of dams and fill them up with sediment and then play games in the laboratory, test out ideas of rates of removal. If we take a dam off all at once versus slowly does that change the translation of sediment downstream? If we take a dam off in the first year and there's a flood, is that different than if we take a dam off in the first year there's no flood? So we play with these kinds of issues as a way of examining, sort of getting what the likely scenarios for the dam removal are going to be.

SRD: And how does all of this play into your international work or collaborative work with scientists around the world?

GG: Well, the issues of river and water use and so forth are really global and increasingly so. But if you look at the international picture you'll see that countries based on their social context and dimensions, and where they are in the scheme of development, have different perspectives on rivers and dams and such. So, for example, well, in the U.S. we're focused on issues about river restoration and dam removal say. You go to a country like China and they're very consciously and deliberately building large dams on rivers as a way of increasing their development, particularly in regions of the country that are poor and disadvantaged. So they have very large engineering projects. Three Gorges is the most well known but there are other large projects going in as well and that's true in other parts of the developing world. But the Chinese and the development along the Mekong River, development of building dams in India is happening in a different context now.

SRD: Didn't you just come back from China and experienced being blocked off of the road? Can you tell us a little bit about that?

GG: Sure, I'd be happy to.

SRD: That's real life stuff.

GG: Well, the thing is that science is one of the most, the best parts of being in science is that you get to interact with international colleagues who share many of the same ideas

and perspectives that you do. And it really is a world without walls. I mean the last meeting I was at there were fourteen different countries when we went to China. The Chinese invited us to come in because they're interested in learning from our experience so that their dams don't have the same problems perhaps that ours do.

SRD: Is it the rainy season there, July?

GG: Well, in the last trip we had this, we had a meeting in Shanghai and then went to a field trip to see some of these big rivers in western China. Meanwhile the monsoon had started and we are coming down this highway along the Min Zhong River, which is a major tributary of the Yangtze, which is really the focus of the meeting, and come around a bend and there is a traffic jam that stretches for about eight miles down the road and we learn that there's been a landslide. And the landslide incidentally is the result of them building a road higher up in the mountains to accommodate the fact that this whole valley was going to be flooded by a dam.

SRD: Oh, no.

GG: So there's one of these cascading sorts of effects. So, you know, we had just been on a ten hour bus ride and now we're stuck in this traffic jam and then they close the road because the landslide is still moving and it's not at all clear we're going to get through. The bus breaks. Then we manage to get back to this town and we end up in this little tiny community. I couldn't even, I wouldn't even be able to put my finger on it on a map. About midnight and we're all starving and we end up at this little restaurant and they manage to come up with these two plates of Sichuan style crawfish. And we sit there, this international group of, you know, twenty scientists from around the world eating crawfish in the rain. And in walks the chief of police from this little town who sits down with us and in the course of hearing our plight, that we were all trying to get home, we have to catch international flights, said okay, tomorrow if it stops raining I'm going to see to it that your bus goes to the front of this line.

SRD: Oh, how nice.

GG: And so we all sleep on the bus, we wake up in the morning, we drive up past all these people wondering how come you get to go, you know, we don't. And we get up to the front and the landslide is still moving and they're trying to destabilize it and so forth. Finally they call in the heavy machinery and in the course of twenty minutes, I mean they do this all the time there, clean up the guy waves us through and we've just been watching boulders roll down, alright, let's go, we're going for it. Drive across it, loud cheering on the bus, we make our plane so it was great. It was a real experience for me, first, what most of the people on planet Earth experience. We are very fortunate in this country that we have the wherewithal most of the time to avoid that kind of issue. But that's not the way most people live. Most of the people, when their road goes out they sit. And I was also struck again about the enormous commonality that the science enterprise and managing water provides. It's really something around which people can agree, even

with very diverse backgrounds and I feel very fortunate to be allowed to play a role in that.

SRD: Different places, that same issue.

GG: Yep.

SRD: Well, before we conclude our talk with you, could you please, you know this interview is profiled with you about your career. As you know, we're turning this tape over for the Smithsonian and you had some great ideas that I was wondering if you could articulate those again about how one might show some of the ways that, the importance of water to the worldwide community. And you had some ideas for potential exhibits that would show people, flood disasters. You said something about a stream table top, three or four different ideas. Could you describe those please?

GG: Sure. Well, you know, going back to where I started, which is that water has been in the forest from the beginning. It's been one of the reasons why the agency was established. And it's also something that people I think everyone can relate to from little kids up to all through the generations. And so one thought would be to have an explicit place where water and the relationship between the forest and water is demonstrated and enlarged upon. And then the question is how would you do that and it seems to me there are a number of different ways to do that. One way and it's certainly a way that certain science museums I've seen have used is to have some sort of stream table, you know, where you actually get to play with the water. You know, water is supplied, there's sediment, there's logs, kids can build dams and so forth. I think with the resources of the Smithsonian and the design expertise of the Smithsonian, one could build a magnificent stream table.

SRD: That would be a hands on experience.

GG: That would be very much a hands on exhibit and you could actually do, I mean, done the right sort of thinking behind it, you could actually run little experiments on it. I mean you could do demonstrations. I mean I've seen these things in the museum and all the kids want to get in there and make little boats and dams, you know, just the same stuff I used to do as a kid I mean. And you can certainly let it run like that but you could also have real demonstrations. You could show what happens to a river. You build a dam, a real dam, on this stream table and then demonstrate what happens when you take a dam off a river. Done with the right kind of dimensions and such you could have, you could model landslides. You could show interactions. You could show the effects of what would happen, of the difference between watersheds that have forests on them and a permeable sub straight versus a parking lot and you could show very directly. Doing that I think would require a little bit of, you know, design thinking and such but I –

SRD: You had some film footage too on flood disasters. You have film footage from different floods around the world or here in the United States. Tell us a little about that.

GG: Sure. This is just another idea, again thinking about what is it that captures people's imagination, that pulls them in, that gives them an opportunity to learn something. We have a variety of things that might go into a disaster film festival.

SRD: Like Disaster Film Festival.

GG: Exactly, so landslides, debris flows, logs floating down channels, my footage from the '96 flood would certainly be available. I have footage from Japan, from other places. We have footage of dams failing. People like to see that stuff but it's also kind of a teachable moment and so I think there would be opportunities to do that as well. So those are just two ideas. I do think water deserves a place in this exhibit in some fashion.

SRD: Well, Gordon, I thank you very much for your time.

GG: I'm happy I —

SRD: It's been really interesting talking to you.

GG: It's been fun.

SRD: Do you have any concluding comments before we wrap up?

GG: No. Just that I look forward to seeing this exhibit. I think it will be very interesting and I think it will give the Forest Service a chance to show off a bit.

SRD: Okay, thank you.

GG: Sure.