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OKLAHOMA GOVERNOR'S WATER CONFERENCE

Thank you, and greetings to you all: water professionals, water planners, water managers, and those wise citizens among you who are just interested in water:

I'm thrilled to be here to talk about two of my favorite subjects, both of which are largely ignored by the people – and that's ALL the people – whose very livelihoods, and lives, depend on them: infrastructure and water.

So, what can I tell you: professional working on water issues, citizens committed to water projects, and here I am, Some guy. Actually, though, I can tell you one thing. Though work with water is underpaid, undervalued, and under priced, what it is NOT is understood.

Which is where I come in, and so I will start with the conclusion of my remarks so that those of you who fall asleep will not miss my central point. Which is that of all the vital steps that must be taken regarding water -- we have to clean our water, we have to protect our water, conserve it, retain it, manage it, plan for it, pay for it -- one of the most important – and one of the easiest, and almost certainly the cheapest – is educate people about it. Questions about water will be among the most important that we face in the coming decades, no thinking person denies this. Yet almost everybody will face those questions almost completely unarmed. That is, most people know next to nothing about their water.

I know this because I spent the last couple years of my life researching and writing a book about the many infrastructure systems that make our almost impossibly convenient American lives possible. And whenever I started talking to the people who treat our water, who channel our water, who test our water, I encountered this remarkable glee, a joy, a gladness. They were just so thrilled somebody asked.

About water, as about most of our miraculous but underappreciated and underfunded infrastructure, I have to quote television host and science historian James Burke, who said “Never have so many people understood so little about so much.”

Here’s my favorite example. In Raleigh, before I started this book, we suffered through a drought -- a major drought, a drought of biblical proportions, where our single reservoir was at less than a third of its capacity and we contemplated what life might be like if we began receiving our water from shiny tanker trucks. Our sluggish city council finally banned lawn watering, and I remember driving near the edge of town and seeing a house with its sprinklers on. Used, no doubt, to criticism, the homeowner had erected a sign: “Don’t worry -- water comes from well and pump.”

Oh, you mean that OTHER water! That water that has nothing to do with the water that fills our reservoirs and recharges our streams and fills everyone ELSE’s wells. Sure! Use all you want. I was shocked. How could he know so little?

Well, we didn't run out of water, and slowly the lake at least stabilized, and soon enough here came a hurricane -- Hana if memory serves. A nice low-wind, fast moving one, with heavy rain bands. And on TV the weather guys were running around in terror, oh my goodness, here's what happened the last time, and sure enough it spent a night going overhead and it dropped five inches of rain and filled up our lakes and the weather guys got on TV the next day and said, "Whew! We really dodged a bullet there." Except no! as a storm water engineer I know told me, we WANTED that bullet!

They just don't know. How can people be so divorced from their surroundings? Anyhow they are -- we are. [New Plant?]

So I set out to fix that by writing a book. And in our brief time together this morning I'll tell you a bit about that book, and about some of the things I was stunned to learn as I reported it.

It all started when my two-year-old had one of those love affairs that two-year-olds have with ordinary objects. With Louie, it was manhole covers. We would be walking down the street in the stroller and he would say, "Daddy, look -- look!," and I would push him and he would turn towards it as we went on, and he would be ... and I would say, "It's okay, Louie, there will be another manhole cover," and there always was. But of course I wanted to tell him what was beneath those manhole covers, and I realized -- beneath them was ... well ... I didn't really know. Sewer was the obvious guess, but of course it turns out that's only occasionally true. Water? Sometimes. Storm drain? Electric? Telephone? Cable? Gas? Traffic signals?

Once I started looking, I was stunned by how much was going on.

Once I got to considering all the systems, I realized that on an average morning, when the alarm went off -- it goes off and I'm like you, right? Wham! So off it goes and I whack the snooze bar and go right back to sleep, which means that I have been supported by two extremely complex systems of infrastructure -- the management of the airwaves that brought me the radio broadcast, and the electrical grid, which kept the clock radio going -- even before I have opened my eyes.

Give me another couple minutes and let me stumble off to the bathroom and that's two more vital and enormously expensive systems -- water and wastewater. Well, wait a minute -- clean water? Every second of every day? RIGHT IN MY HOUSE? And the next time I get a water-borne illness will be the first? Of anybody I know in my entire life? Hokey smokes -- who figured that out? And how does it work? And since when? How does it get there? What happens to it when I'm done with it?

And the tone for my day is set. Get on the road -- well, somebody paved that road. With what? How often? Since when? And why is the street 33 feet wide, and not 36 or 27? Pick up my cell phone to call my wife and tell her I'm driving -- can't go two feet without making a cell phone call, right? -- and a dozen more questions come to mind: like, WHAT? A personal communication module that enables me, standing anywhere in the country, to push a few buttons and see, hear, or talk to anything in this entire world? HOW? WHY? Since WHEN?

That kind of thinking will get a writer writing, and after a couple years of research, not nearly enough money, and a few months in the fetal position crying as I tried to understand it all, my recent book, "On the Grid," came out. In it, I traced all the infrastructure systems that support my ordinary house in Raleigh, NC. And we talk about the modern water treatment plant and the Roman Aqueducts, and we go to the nuclear plant and see the 4000-year-old sewers of Mohenjo Daro and John Snow's cholera map and on and on and on. And in each system we look to its history and its function and its future, but the point is this:

That book turns out to be fundamentally two love letters, both to recipients not highly accustomed to receiving love letters. The first love letter is to the people who create and maintain all these systems that make our preposterously easy lives possible. That is, engineers, please listen: I love you. and to all you engineers out there please, let me tell you: thank you thank you thank you. You're doing god's work here on earth, cleaning our water and settling out our poop and killing pathogens and bringing us reliable power and smooth roads and dependable internet service. You make our lives possible. I thank you.

As for the second love letter ... well, I'll get to that.

First, infrastructure – and water.

Now you might have thought, as I did that chapter one of a book like this would be WATER. Because, as we all know – no water, no life, right? We could probably get by without cell

phones, though don't try to tell your teenager that. And when the electrical grid went down in 2003 and 50 million northeasterners found themselves in the dark (don't they sort of deserve it?), they all complained a whole bunch but they mostly got through it, right? But try doing without water and you're dead in about 72 hours. We know this. Use tainted water? You may go even faster. Cholera can kill you in hours, as we know from Haiti even today.

So I naturally thought the very first chapter of my book would be about the pipes bringing fresh water to our homes – our most vital infrastructure, the one without which we could not live.

Of course I was wrong. First because I discovered I needed to write an entire chapter on surveying, satellite navigation, and Graphical Information Systems, all of which underpin every single infrastructure move any agency makes, right? Lots of us here can talk about GIS.

Okay. But second – and I need to tell you I was stunned by this – before I got to freshwater pipes it turned out I needed to write about another kind of water. I need to talk about the stormwater management system. Because as I learned – and as many of you know – your first interaction with water isn't to drink it. Your first interaction with water is to get out of the way. Or, get IT out of the way. Your first interaction with water is to make sure you and it can live together without it ruining your life.

That is, even as I whacked the snooze bar on that average morning, the stormwater system

was keeping rainwater off the roads, keeping rivers in their banks, keeping my buildings dry, my feet warm, and my two adorable children free of disease.

Now, note that I said making sure you and water can live together without water ruining your life. Because as I quickly discovered, we've been living together just fine, and we've found ways to mostly make water not ruin our lives – but for the last century or so we've been ruining its life in a big way.

I'm not going to give you all kinds of information about the Clean Water Act and stuff like that, except to say it gives us hope, because we passed it and we implemented it and pollution by large industrial sources largely stopped. That is, we can figure this out – we can solve this. We can make change and make it work.

But of course the next thing we learned was that we were still wrecking our water, only now we had nobody to blame but ourselves. We were wrecking it with our fertilizer and our brake dust and our pet waste and our construction site silt and the runoff from our driveway oil changes.

So storm water was my introduction to actual infrastructure. I followed a drop of water from my yard to my storm drains, to my creek, and to the Neuse River and to the Atlantic. I clambered beneath the city of Raleigh in attractively arched brick culverts -- though none of this Phantom of the Opera stuff down there; I never found a spot large enough in which to practice my violin. I spent days with stormwater engineers, and they taught me about swales and slope and drainage basins and all this kind of stuff, but the fundamental thing

they taught me is that everything we've ever done about stormwater for the last century has been wrong. They taught me about curb and gutter.

And some of that is intuitive, right? You can see near your local creeks and gullies that something's wrong, and it's easy to figure it out: the water is tainted, so that's obviously from our runoff, since that's where it comes from. And the banks are scoured and carved deep into the earth, and that's obviously a result of the enormous acreages of impervious surfaces we've covered our neighborhoods with that pour water into streams at volumes and force levels they were not designed by nature to absorb.

In fact, I'll tell you an instructive story about this.

In Raleigh, in 1949 the first big shopping center opened between Atlanta and Washington opened. The standard stuff – a few blocks of tony stores and about ten million acres of asphalt parking. And before the center was even open for business, the little Pigeon House Branch creek, which drains the area – and now starts its flow underground, beneath a parking lot – had gone completely mad. The newspaper called it “rambunctious,” and the local neighbors freaked out.

So city engineers looked things over and they figured out what to do to help the neighbors of the Pigeon House. “We're gonna channelize it, we're gonna deepen it, and we're gonna straighten it out.” And they went home and slept great. They had solved a problem. And of course now the entire profession of stormwater management is undoing every single one of those solutions.

And I don't want to look backwards to those engineers and beat them up for not knowing then what we know now: that's the past, and you have to accept it. Vast expanses of impervious surfaces were new then – parking lots were new. We had to learn what a mess they were. You have to live life forwards, so I don't much blame them for that approach.

But we do know better now. For the last century we have treated water like a problem: like a thing that we need to get rid of because it gets in the way of our cars. I have heard a modern suburb called a machine for turning rainwater into garbage.

Not, mind you, that it's hard to understand why people worried about stormwater once they started paving. Consider Raleigh, a city of 142 square miles. And on an average rainy day in Raleigh we get around a half-inch of rain. Drizzly, a couple hard rains – you might not even mention to your mom on the phone that it was raining. I took out my calculator and figured something out. If you put out a big bucket, and you caught all of Raleigh's rain during that boring, unexceptional rainy day, and you called your friend in Buffalo and said, "Hey, buddy, do me a favor – dam the Niagara river, will you?" And then you took a giant helicopter and flew that bucket full of the water from Raleigh's boring nothing rainy day, and you poured it into the dry bed of the Niagara river?

It would run Niagara Falls.

FOR AN HOUR.

So that's a lot of water, and it's no wonder that water is a problem in cities and suburbs. Stormwater management is serious stuff. I mean Rome – Rome Italy – was founded on an engineering project – it still exists – called the Cloaca Maxima. Which sounds classical and latin and all but what it means is the Great Big Sewer. People lived in the hills -- seven hills of Rome, right? -- and they used the middle spot for gatherings. But it was marshy, so they drained it. Which meant they needed a big trench sloping downward, which was eventually tiled and then covered. The Cloaca Maxima. You can still go see it. So people have figured for a long time that the first thing you need to do is manage the runoff. It's just that once we started paving everything in sight, we made a mess of it.

And so, as storm water engineers here can tell you, how amazing is it that after a hundred years of mistakes, we're not only trying to do better – but that it's working?

In the Piedmont, where I live, according to studies, undisturbed forest, can absorb nearly a foot of rain in an hour. That is, between leaves and leaf litter and understory and evapotranspiration, forest earth can absorb pretty much anything the sky can throw at it. All at once. The worst hurricane we've ever had would barely leave a puddle.

But turn that into farmland, then let the forest reclaim it? We call that "disturbed forest," and it can take less than 2 inches an hour before water starts running off. The best lawn in town, on that compacted soil, might absorb half an inch of rain – a 24th of its original rate. TO say nothing of plain old p[avement and building roofs. So you can see what we've been dealing with.

On a more local level, the Pigeon House -- remember it? It comes from the shopping center - - it starts under that shopping center and eventually takes my storm water. Near its source, it runs at about .02 cfs most of the time. But when it rains hard, that .02 cfs goes to more than 100 cfs IN ABOUT 15 MINUTES. That is, its volume increases by a factor of FIVE THOUSAND.

Which is why I definitely was wise to limit myself to dry days with not the slightest forecast of rain when I went into the drains under Raleigh. [Yuppie waders?]

The point isn't that water builds up real fast, which it does, and the point isn't that the way we treat the earth now makes it build up a lot faster. The most important point -- and here's where I really started learning things -- is something a stormwater engineer told me. Yeah, it's bad that the water rages out of those storm drains and ruins the river beds, carving them tens of feet beneath the natural floodplains into which they ought to overflow every couple years. And yeah, it's rotten that all those heavy metals and lawn products poison the streams, too.

But something even more important is what's NOT happening. That is, he told me, "Curb and gutter create a short circuit in the hydrologic cycle." This stunned me -- what an amazing metaphor. Because think of an electrical short circuit. The problem isn't that the electricity gets back to the plug too fast, right? Because big deal. No, the problem is you push down the button on the toaster but you don't get toast. The problem with a short circuit is you don't get the WORK you need the electricity to do.

And it's the same with water. All those other problems are bad, but the key problem is that all that stormwater has a job to do. It needs to trickle down into the earth. It needs to recharge the ground water, which creates the base flow for streams. Most of our streams now have low base flows, right? Part of that is because as climate changes we get a little droughtier than we're used to, but part of it is because where's the water that's supposed to be recharging it? Oh yeah – it raged down the creekbeds and was gone an hour after the rain.

So instead of feeding the plants and helping the earthworms turn the soil and charging the streams and trickling down into the aquifer itself, it's on its way to the ocean, where it turns into saltwater that doesn't help you, me, or the ecosystem.

And so again – amazing to say – we're changing, and it works. We've figured out – or, okay, you stormwater engineers, stand up, take a bow – have figured out that the job isn't to GET RID of that stormwater – the object is TO KEEP IT RIGHT WHERE IT IS.

And then it trickles in, and does all its jobs. Did you know that on Long Island, where they started retaining stormwater decades ago, the couple million residents sucking water out of the aquifer still doesn't drain it. They started with retention ponds, and since then – THAT AQUIFER IS ACTUALLY RISING.

It's an amazingly simple solution – and it works perfectly.

But here's where education comes in. Raleigh has a couple wonderful projects with streams

and creeks. They replaced meanders, so the water flows more naturally and creates pools and habitat for fish and other fauna, they've built check dams to slow things down. It all works. And in one park near my house – remember, I focused all my research on my neighborhood, which is what you do when you've got little kids – my last book was about the odyssey, travelling all over the Mediterranean. Then I had kids. This book? I explored the sewers. Anyhow, in a park near my house they city built an award-winning constructed wetland that is an absolutely stunningly beautiful, healthy riverine marsh now.

But they almost couldn't. Because when you go to a civic meeting and tell a neighborhood that you're going to give them a "Constructed Wetland," they come at you with torches and pitchforks. They hear "wetland" and they think "Everglades." They think you're going to back up a truck and say, "We got your alligators – where you want 'em? And hurry up, cuz the guy with the first shipment of mosquitoes is waiting right behind me." That's what they think.

The engineer told me she learned to tell people she was building them a water garden. Oooh. Everybody's happy.

Same thing with bioretention areas – you know, the little anti-trees in parking lots? Concave instead of convex? She learned to call those "rain gardens." Again – win win.

And it's actually win-win-win-win... as many wins as you can count. Because among the things that happens to water as it trickles through the earth instead of running down the street is ... treatment people? It gets clean! That's how the whole thing is designed!

I didn't spend my entire research time for this book tromping around drainages and storm sewers underneath the city of Raleigh, even though I promise you, that was extremely cool. I went to treatment plants and pipe rodeos and all the rest. I spent hours at the wastewater treatment plant, with the usual enlightenments: it doesn't smell bad, it's actually a rather peaceful place, we use our poop for fertilizer (and now we're thinking about using it for fuel!), all the rest.

But after hours of touring around, the wastewater plant superintendent drove to the pipe where the effluent, which was all but safe to drink, entered the Neuse River. And I marveled at the bugs eating the stuff, and the UV treatment, and the settling, and all the rest, and the plant superintendent said to me, "We're just doing what a river would do."

And then suddenly I understood: that's right! That's what a river would do. Bad stuff would flow into a river. Much of it is simply diluted; the solid stuff settles to the bottom, where bacteria live that consume it. Pathogens in the water would eventually be killed by exposure to sunlight. A wastewater treatment plant does exactly that stuff – just in a couple hundred acres, not a couple hundred miles of river. I was amazed.

And at the water treatment plant, at the front end of the system, the superintendent said almost the exact same thing: "It's just what the earth would do." And again – of course! The water trickles through the earth, and all that bad stuff is filtered out, whether by plants or by sand or gravel.

I don't mean to sound like a Pollyanna – nobody still knows what to do about chemicals and estrogen and all kinds of stuff, because even if you can filter it out, and sometimes you can't, you still have to do something with it, and nobody can agree on what that is.

But the thing is, we're listening to our planet, and that's been an enormous boon to our relationship with our water. It's getting cleaner, it's getting safer, at least here in the west, and we're learning to conserve it. This is all good stuff.

Except. Remember the well story? Nobody gets it. And here's a secret: nobody gets it because nobody wants to. And it's not that it's not interesting -- it's obviously interesting; I wrote a whole book about it.

You want to know why nobody wants to know? I'll tell you why. Here's why. This is gonna sound like a tangent but it's not.

For my roads chapter I sat and watched traffic with a traffic engineer from Raleigh. We watched buses and bicycles and cars and pedestrians and ladies using strollers as weapons like they do in France, and all kinds of near collisions, and I asked him: how do you do it? How do you manage all these competing constituencies?

When you're planning for traffic, what are the things you never let get out of your head? And I was thinking, speed versus safety, or convenience and thoroughness, or cars versus buses versus people, or asphalt and concrete? And he said, two things are never out of my mind when I try to plan for this stuff: Money and political will.

And that's the entire story there, and we're getting to my second love letter, which you probably thought I forgot didn't you? Nuh unh. This is my work. I know what I'm doing.

Every person I spoke to for this book agreed on one fundamental point: we face no technical challenges we cannot overcome. None. Smart grid? We can do it. High speed rail? Sure! Want to pull all the estrogen out of your wastewater? Easy! Just build a reverse osmosis plant.

The thing is, it all costs. That's the money part. And we have to decide to pay it -- that's the political will.

So that second love letter? That's a love letter to taxes. That's how we do this. That's how we pay to have clean water for ourselves and our children, especially my adorable children. Our country has gone mad, and now believes that taxes are some sort of assault.

Taxes are just our way of saying what we think is important, as a community.

Infrastructure is community -- we create our infrastructure, we are our infrastructure. And you know all the numbers about how poorly we take care of it and how far behind we are -- okay, \$2.2 trillion, according to ASCE, if you need me to say it out loud.

We can't let it fail, and that means we have to do nothing more -- and nothing less -- than open our wallets. It's all our infrastructure, but the good news is we can educate people through water. Water is a special case in that infrastructure world where nobody really

understands things. And I mean, until you've tried to explain electricity and fiber optics and wireless and all this you haven't lived as a But people actually GET water – it occupies space, it has weight, if you put your arm in it you get wet; if it's polluted it stinks, and without it we know we die.

Water works in a way a person can get. And people need to get that.

We need to care for our water -- storm, fresh, waste, ground, aquifer, ocean -- god knows we need to do it for its own and for our sake. But a side benefit is that we can use water to wake people up to all the systems taking care of them.

In 1981, Coevolution Quarterly published a list called, "Where Are You At?" that listed 20 questions to help you focus yourself in your surroundings: when's the next full moon? Where does your garbage go? Point north! And, of course, trace the water you drink from precipitation to tap. Water is fundamental.

The point is simple. Yes, never before have so many understood so little about so much. But we need to recognize: It's immoral to understand so little. We need to understand. It's our duty to understand. For ourselves -- for our kids -- for our planet. We need to understand.

Thank you for being here to understand.