

MASON COUNTY PLANNING ADVISORY COMMISSION

Minutes
November 15, 2004

(Note audio tape (#2) dated November 15, 2004
counter (#) for exact details of discussion)

(This document is not intended to be a verbatim transcript)

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1. CALL TO ORDER

The meeting was called to order by Chair Bill Dewey at 6:00 p.m.

2. ROLL CALL

Members Present: Bill Dewey, Steve Clayton, Wendy Ervin, Terri Jeffreys, Tim Wing, Mark Drain, and Diane Edgin.

Staff Present: Bob Fink, Darren Nienaber, Allan Borden.

3. APPROVAL OF MINUTES

None.

4. NEW BUSINESS

(#0100) Bill Dewey: We first have some scheduling issues for the next three months because of the holidays. We will need to shift our meetings from the third Monday. December 13th was the second Monday and that was the meeting we proposed for December.

(#0118) Wendy Ervin: I have a problem with that. I'm the Secretary of the Mason County Republican Central Committee and that's our meeting night. I could meet on the first Monday.

(#0130) Bob Fink: That's December 6th. We could certainly do it that day ...

(#0138) Steve Clayton: That's the Pertteet presentation day and we will need to be in Belfair for that.

(#0144) Bob Fink: Yes, I will need to be at that meeting. Is Tuesday the 14th a good day?

(#0162) PAC: Yes, that will work; December 14th.

(#0190) Bill Dewey: So in January the 17th is a holiday.

(#0200) Steve Clayton: What about Tuesday the 18th?

(#0202) Bill Dewey: Will the 18th work for people?

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(#0205) PAC: That should be okay.

(#0215) Bill Dewey: Okay, we'll go with the 18th of January. What about February? The 21st is a holiday as well. What about the 22nd?

(#0225) Steve Clayton: That's the fourth Tuesday of the month and the BOCC will be having their meeting that night.

(#0232) Bob Fink: That's right.

(#0235) PAC: The 15th would work.

(#0238) Bill Dewey: Okay, we'll have our February meeting on the 15th. Let's move on to our presentation on Low Impact Development. I appreciate people coming tonight for this presentation. We also thank the Puget Sound Action Team for being here tonight. This is something I get exposed to pretty regularly with my involvement with the Puget Sound Council and some of the pilot projects that have been done so I'm looking forward to your presentation tonight.

(#0270) Stuart Glasoe: I'll start with introducing who we are as staff of the Action Team and then talk about who the Action Team is and then introduce the topic. My name is Stuart Glasoe. I'm the liaison to Mason County on our staff. We have staff dedicated around the Puget Sound Region and we avail ourselves to work with Planning Commissions, Washington Planning Councils, Local Governments, Tribes; anybody who is working on the issues that we're working on related to the health of Puget Sound. In addition to being the liaison to Mason County and Thurston County, I'm also our lead for the shellfish protection program so some of what I might interject tonight will relate to the effects of development on shellfish resources in addition to a more general discussion of LID and stormwater management.

This is Bruce Wulkan and he is our stormwater lead on our staff. Most of the rest of the night Bruce will be talking. So this is a chance for me to participate as well. Bruce has been a leader not only in the region but nationally advocating for and integrating LID into land use planning, into stormwater management and as such Puget Sound now is recognized as a leader on LID in the nation as one of the areas where we're trying to put into practice these practices that help mitigate the impacts of development on the landscape and our water resources. As far as the Action Team itself, I did bring brochures to hand out to you. This explains who the Puget Sound Action Team is and what we're working on. Very simply if you go to the back of the brochure it shows that there are three main parts to who we are as an organization. We have support staff of about twenty plus people. We report to two bodies; we report to Puget Sound Council, which is a stakeholders group that includes, for example, Bill Dewey as a representative of the shellfish industry, and many other interests. We also report to the Puget Sound Action Team, which consists of representatives from a number of state agencies, local government, local tribes, as well as some federal government representation as well. There are a number of priority issues that we continue to focus on. Our group has been in existence in one form or another for about twenty years. We used to be known as the Puget Sound Water Quality Authority and now we're known as the Puget Sound Action Team. Stormwater management has always been a priority issue as we have put together the Puget Sound Water Quality Management Plan and we've overseen the implementation of that for over two decades. It's always been our priority issue and I can't imagine when it's not going to be a priority issue. The topic tonight of LID is an outgrowth of stormwater management. A couple of things that would put this discussion in proper context, the Puget Sound Region, like many other coastal areas around the country, is a fast growing, rapidly urbanizing environment. Washington State has a population of about six million people now, two-thirds, which means about four million, live in the twelve counties around Puget Sound. That population is growing at approximately 20% a decade. We don't see any reason why that isn't going to continue to some extent. It isn't just the population growth but it is the population growth coupled with the landscape changes that put increasing pressure on our aquatic resources and makes stormwater management, growth management, sewage management and so many other things all the more important as we try to find ways to accommodate growth and prosper economically and protect our environment. I think it's all the more challenging in a place like Puget Sound because I come from North Dakota and I can tell you that the resources you have in Puget Sound are more sensitive than the resources that I have where I come from. The salmon bearing streams, the shellfish resources, have evolved here over thousands of years and are used to a cool, wet climate, forested

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watersheds, clean water and as more and more people build here it changes our landscapes from those forested landscapes to built houses, roads, other impervious surfaces and other changes that go along with it that has a dramatic effect on the health of those resources. There's a growing body of science from the last twenty years that shows very strong correlations between landscape changes and the health of those aquatic resources, whether they're shellfish growing areas or salmon bearing streams and other things. Two key indicators are increases in impervious and decreases in forest cover and the increase in impervious surfaces contributes directly to the stormwater that we need to manage properly. The idea of LID comes from the fact that conventional stormwater management techniques have a limited ability to mitigate impacts. What we see through our LID development is that there are a lot of things we could be doing to live more lightly on the landscape to preserve vegetative cover, to reduce impervious surfaces, to increase infiltration to try to mimic natural conditions before we develop these properties and then after they're developed. So I just wanted to set the context for you a little bit. The remainder of the meeting will be devoted to this whole concept of LID; what it is and what the practices are and how we can incorporate those into our stormwater management programs. I'll turn it over to Bruce for his presentation and then we can take any questions you may have.

(#0470) John Diehl: I see your focus tonight is going to be on stormwater. There are other reasons why we ought to be working toward LID so why just narrowly look at stormwater when the prescription needs to be concerned with a variety of sources.

(#0480) Bruce Wulkan: The quick answer to that is LID was really developed on the East Coast in the Maryland area as a better way to manage stormwater. That's the genesis of LID. Folks have discovered along the way that you also get pretty attractive looking developments in communities if you do LID and there are a number of other benefits as well.

(#0500) John Diehl: But you wouldn't necessarily get a prescription for how to better manage wildlife resources except indirectly in so far as maybe aquatic resources might be implemented.

(#0510) Stuart Glasoe: I think another way to look at it is that there's a whole body of practices and approaches that are part of smart growth. LID is part of one component of what would be a larger discussion of smart growth.

(#0520) Bruce Wulkan: There's a sustainable element. Sustainable development includes energy efficiency and all these other things and LID is arguably one small component of that.

(#0525) John Diehl: Do you think there are any inconsistencies ... are there any other considerations that you're giving up if you focus on the stormwater solution?

(#0530) Bruce Wulkan: There's no inconsistencies. If you're talking about LID and smart growth, for example, there's nothing inconsistent between the two. Or LID and this idea of green development or sustainable development; there's nothing inconsistent between the two. Most sustainable development briefly touch on stormwater development but there's nothing inconsistent.

Does everyone have a copy of the presentation? Thank you for the introduction, Stuart. I've been with the Action Team since about 1993 and in stormwater management since about 1995 or 1996. I started looking at LID very seriously in about 1999 when we were going to update the Puget Sound Water Quality Management Plan, which is the overall plan to protect historic Puget Sound. I took a look at what they were doing on the East Coast. I mentioned that it really got started in the Maryland area, right around the D.C. area. A gentleman by the name of Larry Kaufman is generally considered the father of LID. Interestingly enough, Larry is an ex-developer who is now director of their environmental protection agency. He got interested in it because he got tired of watching developments go in with the conventional pond technologies, concentrated collection conveyance of stormwater through pipes to ponds and then a slow or quick discharge to streams and rivers and lakes and bays. He thought that conventional technology was expensive; it was not really protecting the resource. Essentially what it was doing was replacing a pasture of forest with impervious surface and it was moving that water that used to soak into the ground there simply to another point and sometimes that point was saltwater and so you're losing that deep water infiltration and recharge of the aquifer. So those were some of the reasons why he got interested in this and actually started developing this. We started getting interested in it on our coast right around 1999 or 2000. As a

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general overview, I'm going to begin to answer the question, 'Why should we even care about LID? What's wrong with what we do right now?' Stuart already started to enumerate on some of this. I'll get into some of the details about LID, like what are the goals, objectives, principles. I also have some examples. I'll talk about implementation of LID around Puget Sound.

Basically with stormwater management there are two major considerations. Water quality and water quantity. With water quantity, there's flooding issues. There's too much water going into streams, especially during the wet seasons. Too much water going into wetlands affects salmon habitat because you're moving that water through the rainy season and you're not getting the water into the aquifer recharge. There's really a shifting of hydrology. With water quality, simply put, stormwater picks up pollutants off of impervious surfaces and discharges it. DOE has just recently named shellfish growing areas that they believe are primarily impacted by stormwater runoff; not agricultural runoff and not offsite runoff. Those are the usual culprits over the years. They now say that stormwater is the major culprit. North Bay is one that they believe this ...

(#0695) Stuart Glasoe: That's the only one ... again, the issue with that is the health reasons. You can have isolated areas of some major development but places like Allyn, Belfair, Hoodspout, we have more concentrated development there. You have a very significant stormwater loading and stormwater impacts associated with that kind of level of development and you have significant resources in those areas.

(#0710) Bruce Wulkan: Every study they've done monitoring stormwater flows shows a really, really high concentration of fecal chloroform bacteria and indicative species used for closing shellfish growing. Sometimes it can be several thousand or ten thousand of these organisms per milliliter and all you need to close a shellfish growing area is an average of fourteen so the stormwater as more and more areas become urbanized are carrying an awful lot of fecal chloroform bacteria from pet waste or a septic drainfield is flooding, and that's creating more and more shellfish closures. In more of our urban areas contaminated sediments can be an issue with heavy metals found in stormwater runoff. It affects fish health. WDFW takes a look at English Sole and are finding a lot of tumors on the livers of the English Sole and that is brought about, they believe, by PAH's, which are ?????????? which are basically a petroleum product and again are found in some stormwater runoff.

(#0760) John Diehl: You didn't mention the low dissolved oxygen here in Hood Canal. Do you associate that with stormwater runoff, too?

(#0765) Bruce Wulkan: It can be if there's a heavy loading of nutrients within that stormwater runoff.

(#0770) John Diehl: I'm asking if anybody has measured that here?

(#0774) Bruce Wulkan: Generally ...

(#0777) Stuart Glasoe: As a part of the work that has gone on in the Hood Canal area so far, one part of that was a preliminary assessment and corrective actions plan that our office put together in conjunction with the Hood Canal Coordinating Council with input from a lot of different interests. We made estimates of nutrient loading to the Hood Canal watershed from various pollution sources and one of the significant pollution sources for loadings of nutrients was identified in stormwater runoff. Those are rough initial estimates that as the Hood Canal dissolved oxygen program goes on we have better information.

(#0800) Bill Dewey: Do you remember what the percentage was?

(#0805) Stuart Glasoe: No. Sewage was in there up at the top.

(#0808) Bruce Wulkan: Sewage might have been around fourth in rankings. It wasn't at the top.

(#0810) Diane Edgin: You're talking about sewage and stormwater runoff and one thing I have never seen mentioned is what phosphates do to water. This is a big issue. Especially in the Mid-West.

(#0825) Bill Dewey: One of the differences in the Mid-West is typically fresh water systems are phosphate

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limited and marine waters are nitrogen limited so in fresh water phosphates are far more critical than nitrogen.

(#0835) Diane Edgin: This is a concern because we do have a lot of fresh water lakes that are highly affected by the development that's going on right now. I don't see it getting that well addressed here.

(#0840) Stuart Glasoe: And wetlands, as well. There are some concerns and interest about the affects of phosphates on the marine environment. Some of the work we're doing now as a part of this project on the canal is looking at phosphate discharges as well as nitrogen and trying to see what the contributions and connections are on aquatic habitats of all kinds; marine and fresh.

(#0866) Bruce Wulkan: Later on we'll be talking about the performance of a certain LID technique and how well does it remove pollutants and we'll talk about how it removes nutrients as part of that. This is a graph that was done by a student at the University of Washington which studies the affects of loss of forest cover, impervious surface cover and then what happens on the streams; what happens on the biological resources in those streams as the landscape changes. This shows simply on the vertical access, VIVI is a benefit index which is just taking a look at macroinvertebrates in streams. On the horizontal access it talks about TIA or Total Impervious Area and all it shows is that in an area where the load level of imperviousness is ten percent total imperviousness they got fairly high scores, 35 or better on this VIVI score, so it had a lot of insects in these areas and in the streams. It was good diversity. That tells you if the bugs are there that the fish will be there. This is what is known as a fairly health watershed, fairly diverse and rich in biological health. As impervious area increases they say in other areas the decline in VIVI index for the biological health of that stream. There's been a lot of different graphs put together and in all of the studies of Puget Sound lowland streams, and their study areas are close to the University of Washington so they tend to be around King, Pierce, Snohomish area streams, but they did see this kind of correlation where when you increased this impervious area of a water shed then the biological health of that watershed declines.

We've also got listings of ESA like Chinook Salmon throughout Puget Sound, and Summer Chum. So between the affects of stormwater, especially with some flows, that's a real concern with the way we're currently managing stormwater runoff. Here we have a picture that shows a badly a really badly undercut stream that is an area that has about 10% impervious and you can see the severe undercutting. The flows are going way too fast and they're not being attenuated and you have exposed roots and a lot of sediment that is covering up the spawning habitat for fish.

(#0988) Terri Jeffreys: When you said 10% impervious; going up how far how far from that stream?

(#0995) Bruce Wulkan: Into the entire watershed. That's an overall throughout the watershed of 10%. To give you an idea, 10% happens fairly quickly. I live in Olympia and my watershed is a lot more than 10% so 10% is a suburban figure if you're not managing stormwater to really hold back the flows.

(#1015) John Diehl: I don't think anyone could argue that there's a correlation of the sort that you're calling attention to but correlation doesn't necessarily mean a causation and I'm wondering to what extent there may be other causes besides sheer imperviousness or whether to some extent imperviousness may be a way we can gauge a variety of impacts because the other impacts will tend to go with the imperviousness.

(#1034) Bruce Wulkan: The science has shown that it's a combination of affects; it's loss of forest cover, impervious surface area, and then it's how well connected the stormwater is through pipes going to that stream. If you can disconnect it, get it into the ground, and not just shoot it through a pipe at a rapid speed then you're going to protect the stream a lot more.

(#1050) Stuart Glasoe: I think you have a good point about distinguishing between correlation and causation. There are a lot of different indicators we look at where we're trying to correlate landscape changes with aquatic habitat impacts. I think one of the good things about impervious cover and why it sometimes seems there's emphasis that is put on it and why it so relates to stormwater management is that those surfaces really are the source of those flows. So it may not be cause and affect but it is directly related to the cause of those impacts. So it's not just correlation; it is causation as well.

(#1068) Bruce Wulkan: If the stormwater is all connected from those impervious surfaces through pipes directly to the stream; if you have a direct connection then it's also a cause as well as an indicator. We look

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at loss of forest cover as a better indicator than just impervious surface. The reason why we see differences in watershed as it's developed ... don't worry about the numbers here. The basic idea is that in a mature, coniferous Pacific Northwest forest and also over in the United Kingdom studies show that less than 1% of the rainfall that hits that forest runs off as surface runoff. The vast majority is intercepted by the branches of the trees and either evaporated back or taken up by the vegetation or infiltration. Part of that infiltration goes to a shallow, interflow and into deep groundwater. This just shows you that surface water runoff is very small and most of it is being taken up by the vegetation and then slowly infiltrated or evaporated.

(#1115) Terri Jeffreys: What would hamper it from going down into the deeper groundwater? Is it a matter of over saturation that makes it finally go down into there?

(#1122) Bruce Wulkan: A lot of things will change. If the soil is not saturated then there's a greater likelihood that you would get it deeper. It depends on what type of soils you've got. A lot of times you'll have lenses of good perking soils and then down lower you'll have a hard, till mantle layer that's like a hardpan and it will just not infiltrate very well. Then under those scenarios you'd get the water infiltrating down and hitting that hardpan and then it's going to go sideways.

(#1150) Terri Jeffreys: So your numbers would change depending on the soil types?

(#1155) Bruce Wulkan: The last piece of the puzzle is that in a mature, coniferous Pacific Northwest forest you have something called the forest duff layer. It is fairly thick and picture it as a big sponge and that is going to capture an awful lot of that moisture even if you've got clay underneath. Then I'll talk about what happens in our current development practices. What we typically do when we develop a site is we clear the land of vegetation and we strip away that forest duff layer so we've lost the wonderful sponge capacity that nature has provided and then we'll cover it over with houses and parking lots and driveways and the surface runoff increases dramatically. For a suburban area it's around 30% surface runoff whereas we had less than 1% before. The water is moving a different way than it did before. We've got fewer trees so we have less evaporation and we've got lower groundwater recharge because we've got this impervious surface and we've lost that forest duff layer. Over the course of a few decades we've developed this mitigation based way to manage stormwater. It's called flood management. It was to prevent floods in our towns and cities and that works really well. Unfortunately, when you move that water so quickly that's how you can get those impacted streams. That's how you get impacted wetlands. That's how you could get a depletion in aquifers because you're not getting that deep water infiltration.

(#1255) Wendy Ervin: Is the inter flow just a small seepage of water that ... you've got that going down to where you have your runoff. Does the inter flow become surface runoff that does not go deeper? How does the surface runoff and the inter flow relate?

(#1270) Bruce Wulkan: The inter flow will eventually go down slope and eventually hit that stream or river so interestingly enough some stormwater modelers argue that inter flows also can be tough on a stream. It's not as bad as surface runoff. It doesn't hit the stream as quickly but it still hits the stream. So if you're getting an excess amount of water into a stream up here you could see very localized affects on that stream.

(#1295) John Diehl: Obviously there would be advantages to minimizing the impacts from the urbanized land cover but I'm interested, and you've given a very general picture here and we all know that runoff rates vary enormously even under natural conditions because of slope and geology, and so I'm wondering if we got to the point that we were saying we want to regulate to try to minimize these urbanized impacts would it make sense to take a count of the greater rates of runoff where slopes are steeper or where the geology promotes greater runoff?

(#1333) Bruce Wulkan: There's a few different answers to that. To varying degrees we already regulate how much runoff is coming off a development site. DOE, in their manual, has a flow control and a treatment standard, there are some jurisdictions that require stormwater permits, which Mason County does not, are already regulated and there are a lot of different conditions that would change or alter surface runoff.

(#1355) John Diehl: What I'm getting at is let's say you have a given regulation that said that on a parcel you couldn't have more than 'X%' impermeable. Would there be a greater payoff in terms of impacts or

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minimizing impacts under some conditions like steeper slopes and other conditions?

(#1375) Bruce Wulkan: I'd rather address steeper slopes this way that there are certain conditions where you'll have a super steep slope and you will not want to infiltrate and you will not want to clear very much vegetation because you could de-stabilize that steep slope. What I'll get into when I start talking about LID is that LID really calls for a very careful assessment of the site. You have to understand what the soils are, you have to understand what sort of land use you're going to be doing at that site; that's where it really starts. I'll show you a chart here that shows growth projects by the Office of Financial Management. It's between 2000 and 2020. In Mason they project growth of approximately 41%. Of the counties around here there aren't many slow growing counties. Growth is going to happen. It really comes down to how we're going to develop the land and how we're going to manage stormwater in order to meet the multiple objectives.

The conventional stormwater management practices that we've been using while it achieves a lot of our goals like flood management it has not been fully protective of our aquatic resources as evidenced by our degraded shellfish growing areas. DOE typically shows that around 30% of all of the water on the state's 303D list, list of impaired waters, are on the list due to stormwater runoff and they currently say that stormwater is the leading greatest problems in terms of affecting water quality. A lot of science is pointing out the limitations of conventional practices so the real challenge is how we can better protect our aquatic resources.

Stormwater is really expensive. We've got to do this efficiently; we don't have an endless supply of cash. So it has to be cost effective.

Existing stormwater infrastructure, catch basins, pipes, detention ponds, they tend to be very expensive to build, costly to maintain; local governments are all struggling to maintain municipal structures. Stormwater facilities on private lands are equally difficult to maintain. And they are limited at meeting other objectives other than flood control. An example of a stormwater detention pond in Olympia is that we often have to put chain gates around them to keep kids out and make sure there's no danger of drowning and they're often not that attractive.

Definition of LID. It's a really long definition but I'll let you read it. Couple of keys are that we're really just talking about parcel and subdivision scale. We're not talking about watershed wide or an entire huge area. When it talks about onsite natural features we're talking about native vegetation, native soils, native natural drainage paths. Small scale hydrologic controls is just a fancy for for BMP's, Best Management Practices, that are distributed throughout the site. So instead of just piping everything to a big pond we're going to distribute these hydrologic controls throughout the site and we're going to try to manage and treat stormwater as close to where it falls on that imperious surface, get it back into the ground, because the ground can help us treat it.

(#1588) Stuart Glasoe: One of the things that we emphasize when we're talking about LID is that LID is not an alternative to stormwater management but it is a part of a good comprehensive stormwater management program. In addition, you don't lead with LID but you lead with good land use planning. You need to determine the appropriate of patterns of land densities that are suitable with the objectives you're trying to protect and the kind of growth you're trying to accommodate. You then couple that with good stormwater management. One of the dangers with LID is people see it as something for people toglom onto that can allow for any kind of growth anywhere. You still need to have good land use planning and then couple it with good stormwater management and LID.

(#1625) Bruce Wulkan: LID can really be done in a variety of settings. Anything from rural to highly urban, residential and industrial commercial, can and have used LID techniques and can be done either on new development or as a retrofit. It's a very flexible set of tools for stormwater. Other benefits of LID is it has been shown to actually reduce infrastructure costs actually lowering the overall bill for stormwater management on a given site. Because the uses allow vegetation, it can make subdivisions or an individual house or a strip mall more attractive. LID uses more narrow roads so it gets people out walking more and can have traffic calming affects as well as people slow down on a more narrow road.

(#1668) Tim Wing: How does it get people out walking more?

(#1672) Bruce Wulkan: Comparing an area of Seattle, some of the projects have only 14 foot wide streets

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and people are very comfortable walking down them or on the sidewalk and enjoy how pretty it is.

(#1700) Bill Dewey: Would another benefit of LID be to reduce maintenance problems? You have infrastructure problems but comparing the overall LID stormwater control to a stormwater pond and piping, etc., the maintenance is lower for an LID?

(#1705) Bruce Wulkan: Yes, LID maintenance can be cheaper but it really depends on what technique you use. When we get to bioretention I'll show you that information. Bioretention requires some mulching of the top layer. So here are some of the key elements of LID. First, Conservation. When you take a look at a site you want to try to conserve some of that native vegetation and the good soils on that site. A lot of times the site will have lenses of really good infiltrative soils and then some lousy soils. You want to protect those soils that will infiltrate well because that's where you're going to discharge your stormwater into. Site planning starts very early. You want to take a look at the site and you want to start thinking LID before they actually start clearing the site and laying out the roads, buildings, utilities. If you just come in after the fact then it's almost going to be too late at that point. It also has to do with disconnection and minimization of impervious surfaces, like roadways and parking lots. The disconnection is awfully important. I've mentioned the small scale controls. Public education can be awfully important because people aren't used to seeing a lot of these techniques and you have to teach them about what they are and what they need to do.

Bruce shows example of a LID on a single family lot. The rooftop runoff is not tightlined into the stream or into a stormwater area. Instead, the rooftop runoff is allowed to disburse over lawn area and you can amend soils with compost and that will greatly increase the infiltrative capacity of soils. It also will increase plant health and you'll reduce watering needs. Typically there are a lot of specification of how much compost you have to do. People around our area lead by folks in King and Snohomish Counties have now gotten the science down on this so there are very specific soil mixes they recommend. This is a bioretention area and simply described it is just a dug out area anywhere from a foot deep to several feet deep and it has been backfilled with compost amended soil and then an array of native plants and/or ornamental plants and water is allowed just to perk into these areas. You've also got an open swale here and no curving gutter so you don't have the stormwater hitting the street and then hitting the curb and going into a catchbasin but instead it just naturally goes into this swale. There are many different permeable pavements, as well, that I can show you. These porous pavements do a wonderful job of just allowing water to just infiltrate down. Overall, you want to reduce the imperviousness of a site by shortening the driveway, narrowing the roads and reducing the overall length of roads, doing different types of turnarounds. If you reduce the amount of impervious surface then you reduce the amount of stormwater you've got to deal with.

(#1915) Terri Jeffreys: What would be an example of disconnecting impervious surface?

(#1918) Bruce Wulkan: This is all pretty well disconnected because there's no chance for the stormwater to really gather and go into a pipe and be discharged to a stream. The stormwater from the road is just going to go into this grassy swale. Let's say you have a 100-year storm event. Sometimes you'll have some sort of an overflow where once this system gets overloaded it will be allowed to discharge to another bioretention or swale further down so you can handle the larger storms. But by doing this, this is all disconnected. By virtue of comparison, you could have curb and gutter with a catchbasin right there; the stormwater would run down the road into the catchbasin and then go through pipes and eventually be discharged out into a stream or river of Puget Sound. Where I live in Olympia that's what happens.

(#1970) Tim Wing: With typical soils around here how big of a lot do you need before you're able to really deal with all of the runoff from the house on that lot? We're typically developing quarter acre lots around here.

(#1988) Bruce Wulkan: It's very doable. I'll give you an example of an actual development of a site in Pierce County that's called Meadow on the Highlands. That is about a nine acre site within the UGA. They've got thirty six units on there. They were facing that very same situation. They had a very steep slope; it's currently pasture right now and they do have lousy soils and they do discharge down to the stream which is salmon bearing. So they reduced down the lot size to 4,000 sf lots. That's a small lot. I live on about a 5,000 sf lot in the city of Olympia so they actually went down smaller than an eighth of an acre. They're around a tenth of an acre. That's really challenging because past a certain point if you've got so much rooftop you start to run

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out of places to put that runoff so then you just do the best you can. You try to infiltrate as much as you can on your lawn area and put bioretention around and you try to do the best you can. When you're talking quarter acre lots that's plenty big enough in order to do these types of things.

(#2045) Allan Borden: You're talking thirty six acres total, four lots per acre, that's nine acres out of thirty six that has houses on it so that means ...

(#2052) Bruce Wulkan: Did I say thirty six acres? It's thirty six homes on nine acres. Which is six units per acre.

(#2058) Tim Wing: Is some of it steep slope without anything on it?

(#2060) Bruce Wulkan: All of it is steep slope and they're actually revegetating that. A very common thing is to cluster those homes and that allows you to get the same units or density so the developer still gets the same number of buildable lots ...

(#2075) Tim Wing: And it also puts the houses on even smaller pieces of property.

(#2078) Bruce Wulkan: Yes, it can.

(#2080) Steve Clayton: You said it was thirty six units on nine acres with quarter lots so basically you're bouncing them down to 4,000 sf lots and using the rest for stormwater and other such uses. So it averages out to quarter acre lots but they only own 4,000 sf.

(#2092) Bruce Wulkan: But they did cluster it so they brought down each individual lot size ...

(#2095) Steve Clayton: Then they treat their stormwater on site on that 4,000 sf ...

(#2115) John Diehl: Have studies been done to ... gravel is fairly pervious but it then gets compacted.

(#2120) Bruce Wulkan: Gravel is different than impervious pavement. I want to show you a picture of that single family development. Here's an example of a subdivision in Maryland where they did this. It's an open street design so you don't have curbs and gutters. This is actually a bioretention area.

(#2155) Bill Dewey: On your roof runoff diagram you had a rain garden. Would you typically run roof runoff out to your rain garden?

(#2168) Bruce Wulkan: This goes back to what DOE wants you to do as well. The old way of hardlining the roof runoff through a downspout to a stormwater system are kind of gone. So now what you want to do in LID is disperse it across your lawn but because lawns do not function and they don't allow as much infiltration as you need that's why you still need that rain garden. We need either compost amended soils, which are really going to function a lot better than a typical lawn, or you need some kind of rain garden. So that's what you want to do to disconnect the rooftop runoff. A tremendous amount of water is generated by a rooftop. I've got a small house and my rooftop is around 25,000 gals per year.

(#2205) Warren Dawes: Can you estimate the difference between ... typically in the past you go out and get a rural lot that's cleared and you put a house on it and you've got your driveway and the street going by and judging by the number of riding lawnmowers that are sold in this country, a lot covered with lawn compared with a LID, do you have any sort of rough estimate as to the amount of perviousness you get with those two approaches? We pretty well understand that lawns do allow runoff to pass but do you have any quantification on that?

(#2240) Bruce Wulkan: They've taken a look at how a lawn on a compacted ... if you've got the forest duff layer that's scraped away and compacted soil and you put down one of the usual turf grasses you've got a significant amount of runoff. It's not as bad as a parking lot in terms of the amount of runoff but it's a lot more than you get over a forest or over other things. DOE has actually quantified that so that there are different curve numbers with different land uses and the lowest curve number is forest; the lowest amount of runoff.

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Then there's just pasture and grass and then the next is just hard impervious. So they've actually quantified that and that's where you have the closest answer to your question; quantification of just how much runoff you get from grass. A lot can be improved if you add compost and tilling of your soil before you do grass.

(#2298) Wendy Ervin: It appears from this one picture that if the grass is in a contour that also improves it because the water is going to be pooling in those ditch areas.

(#2310) Bruce Wulkan: Grassy swales; right. So this is just a comparison between the curb and gutter and the open road design where you do have these grassy swales and the runoff is allowed to go into that. We've kind of gone beyond some of the open grassy swales and I'll show you some of the examples we have up in our area. We don't just want to do the open grassy swales anymore because we know better ways to do it but in a lot of rural settings it's still far better to have an open road ditch system than to have curb and gutter. Down here just simply shows a house that is raised up and it's got sloping all towards the street so all of this rooftop runoff is going directly to the street to a catchbasin to a collection system and then discharges versus an area over here where this is actually a bioretention area with the soil mix and the vegetation and the rooftop runoff and the driveway is discharged here. So it's a paragon shift in the way we look at stormwater. We're looking at stormwater in LID as more of a resource; not as a waste. We don't want to discharge it as quickly as possible. We want to hold onto it to infiltrate it.

(#2380) Wendy Ervin: In making LID decisions what does single story and multiple story have? Because the footprint is the same is it ignored how tall the building is?

(#2395) Bruce Wulkan: It's actually not ignored. The City of Olympia in their most pristine watershed they require LID within this subbasin and one thing they did was they took a look at the footprints of the houses and they changed the footprints of the houses to make them more skinny and a little bit more narrow so they actually altered ...

(#2414) Wendy Ervin: So they're going for height instead of footprint.

(#2418) Bruce Wulkan: Now they're not requiring super skinny houses but it's just that you could not do a 3,500 sf rambler single story there right now. So onto the West Coast. Has anybody been to the "C" Streets in Seattle? It's a really beautiful development. The idea is that this is in the street right of way. This street was going to undergo a street redesign. They were going to put in curbs and gutters because it was hard gravel area on both sides and Seattle as part of their beautification of all of Seattle was going to go in and do a redesign. A couple of engineers with Seattle Public Utilities convinced management to instead put in a curve linear street design and they would narrow up the street to a total of 14 feet plus 2 feet on each shoulder. They put in these long linear bioswales, compost amended soils and an array of different plants and they would run the sidewalk through there only on one side of the street. Before they did this they were only willing to do it in a neighborhood where they could get 90% or better affirmative rate by the residents. They got everyone on this block to do it except one. So they went ahead and did it and it is now part of their natural drainages program. They're now duplicating this in a fifteen block area just a couple of blocks away from this and while 'C' Streets was expensive being the first one, they now say that for the same size block, a 330 square foot block, they can do this design cheaper than they can do a conventional street design.

(#2525) Wendy Ervin: Are the property owners in charge of maintaining this?

(#2532) Bruce Wulkan: They're not in charge of it but they love to do it because they instantly gain this great garden in front of their house. It's in the street right of way and once a year Seattle staff come by and they check on it and all they have to do in an area like this is do the weeding. In the very beginning to establish the plants they had to do some watering but once they got established, because they're mostly all native, watering needs are not great. Seattle staff will take care of this but the people enjoy taking care of it because it's a great amenity in front of their house.

(#2562) Terri Jeffreys: So is the sidewalk on the easement?

(#2566) Bruce Wulkan: Yes, the sidewalk is part of the easement.

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(#2570) Terri Jeffreys: So it's about five feet where the cars are parked?

(#2574) Bruce Wulkan: Right. This is a really safe thing for a municipality to do. They don't have to rely on owners who might one day decide they don't like this garden and say they're going to rip it out and put in a parking spot. The city owns the property.

(#2590) Diane Edgin: Is that a one way street?

(#2594) Bruce Wulkan: This is a two way street. Cars can pass both ways but very slowly.

(#2605) Diane Edgin: You said on this first block that there was one person that wasn't interested. Did they ignore the property in front of his house?

(#2615) Bruce Wulkan: She requested that her lawn continue all the way out to the street so that's what we did. Even though it's city right of way.

(#2625) Wendy Ervin: So she mows and maintains that lawn?

(#2628) Bruce Wulkan: Yes.

(#2630) Diane Edgin: Putting in that kind of landscaping is expensive for a homeowner to do.

(#2644) Bruce Wulkan: Right.

(#2646) Wendy Ervin: Are there no driveways to the houses? It appears to be straight parking.

(#2648) Bruce Wulkan: What they did was they asked people how much parking they wanted and they developed a parking plan for everyone and then when they showed it to them they asked them if they needed that much parking? Can you take out some of that and actually put in some more gardens? The city said they could do that.

(#2668) John Diehl: Some of the owners do have garages, I assume?

(#2670) Bruce Wulkan: Yes, and there are also alleys. I showed this to you because even though this is the City of Seattle they monitored the flow from this and they've shown that there's a 98% reduction in total volume of stormwater running through there. There was no stormwater management here before and now they put in these special gardens and there's a 98% reduction. We were astounded by that. We were hoping to get 60% reduction. They've got nearby salmon bearing streams that are now enjoying the benefits of the reduced amount of stormwater going there. Now the streets could even be eighteen or twenty feet wide. It all comes down to a safety issue. Fire and safety people have to be comfortable with the size of roads you put in there. The Seattle Fire Marshall was comfortable with this. We talked to Pierce County and they said we will fall on our swords if you put in anything less than twenty four feet. We talked to another jurisdiction and it's a different number. The key is we're getting away from those big thirty six foot wide streets. They don't have to be that big.

(#2800) John Diehl: Was anything done to modify the alleys?

(#2806) Bruce Wulkan: No. Those there are just straight gravel. Here is the City of Bellingham. They have a city hall parking lot that was discharging down eventually to Lake Whatcom. They wanted to get some reduced flows so they wanted to put in a bioretention rain garden. All they did was take out a few of the parking slots and put in an engineered soil mix and a bunch of plantings. They were able to put this in really cheaply because they had a lot of volunteers.

(#2880) Wendy Ervin: What was the effect of these rain gardens?

(#2900) Bruce Wulkan: We got limited monitoring data so we asked them to do some more monitoring and they came up with an 89% reduction in volume over a limited time.

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(#2950) Tim Wing: How do they measure that?

(#2955) Bruce Wulkan: They have a gauge down at a weir at a discharge point and it's set up to essentially record the flood.

(#2975) Tim Wing: So they measured it a year before they did this and then after?

(#2980) Bruce Wulkan: What they did was they measured after to see how much was going off there and they did a calculation of the runoff of that parking lot.

(#3000) Steve Clayton: Do you have established recommendations for counties and their parking requirements for different projects to give credit for this sort of application? Generally with strip malls you build as many parking spots as you have to and if you pull out some parking spots to put this in then you won't be within the ordinance.

(#3020) Bruce Wulkan: There are now credits in the DOE manual and within this LID guidance manual that our office is putting together actually credits putting in the bioretention where you would do calculation to figure out how big a stormwater detention pond you would have to build or if you put one of these in or porous pavement it allows you to reduce the size of the pond so that's essentially a credit. If you're talking about putting in a pond and losing buildable lots or worse case scenario having to acquire property for room for the pond that's a huge incentive.

(#3070) Stuart Glasoe: I don't know about the land use plan as most of the rest of you. You have requirements for minimum parking spaces for most kinds of development. I have seen developments that don't come close to using the parking spaces that they put in. A good example is the office building that we used to have our office and that parking lot, if you went there at 4:00 on the day before Thanksgiving in the afternoon, it wouldn't be two thirds full. There are opportunities to retrofit or downsize parking lots to adjust your standards that still allow businesses to do as much as they need to do for economic development to give their customers a place to park so I think that's an issue to revisit at some time.

(#3115) Terri Jeffreys: Right, we do a lot of things because it's always been done that way.

(#3125) Tim Wing: Some of it needs to be intergovernmental. There are other agencies telling these developers you must have all these spots if you're going to have this much square footage in your building. Then you build a parking lot that's three times bigger than they need and then you come in and say you should add this and we need some cooperation to figure out how to utilize that space better so you get better control of the water and you don't overbuild the parking lot. The problem you face is the business that goes in it now may only use half the parking lot but the next business that goes in there maybe will need the whole thing. How much of this technology is integrated into our county regs now for stormwater management?

(#3200) Darren Nienaber: Not much.

(#3210) Tim Wing: We just built a new building and there's a stormwater detention pond there the size of Lake Washington. There is a bioswale associated with it but it's not this. It took up a big part of the property.

(#3275) Allan Borden: You could put in techniques and actually create a new building area there.

(#3285) Bob Fink: The use of LID techniques and BAS practices are not prohibited under current county regulations. What they've developed recently, as I understand it, is the engineering and documentation so that they can calculate the benefits of these so that you control that stormwater and mitigate it and you use any technique that you choose to use. There's a lot of choices and the question always remains as to what is the most cost effective or what fits into your development plan.

(#3320) Tim Wing: So a developer could come in with a plan and propose it and if he can justify what it does and it takes up less space then you'll approve it?

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(#3340) Bob Fink: Right. If it meets the standards then it can be used.

(#3350) Bruce Wulkan: It's really key to take a look at the municipal codes, subdivision codes, to see whether it does or does not mandate curb and gutter or catchbasins. A lot of local jurisdictions do mandate that.

(#3375) Bob Fink: We do have certain road standards but we don't really have urban road standards. We don't have requirements like with a curb and gutter as a technique. We do have requirements that you have a certain number of parking places. Those certainly could be revisited as things have changed over the last twenty years from when those standards were first adopted.

(#3398) Allan Borden: In Belfair at the Theler Center, for a long time they had an existing parking lot and they expanded to the south. It was a gravel lot and they wanted to pave it and the engineer who reviewed that proposal to pave it got the company to agree to put in the things very similar to that except they don't have retentive soils but they have little isles in the middle where water is supposed to go.

(#3442) Bob Fink: They've learned a lot about these techniques in just the last few years.

(#3450) Bill Dewey: I brought this up before the PAC when we were talking about the Belfair UGA and the part of it that's sitting on the CARA I was suggesting that maybe one of our recommendations should be that we start looking at LID practices there. It's a learning process and that's what we're doing here tonight.

(#3475) Tim Wing: I heartily support that. I was not in favor of the plan as it was. It focuses on way too much development down where it's so close to the river and so close to the canal. It postponed the bypass which would have developed more up on top of the hill farther from the water. This is really a good idea but it's not the only problem we might encounter.

(#3500) Wendy Ervin: This particular little island of growth as it grows it's going to get large and unruly, does it just work better the larger the plants grow; is the process better that way or does it need maintenance?

(#3520) Bruce Wulkan: There's certain plants that you want to plant in the street right of way and certain plants that you want to plant in the bioretention itself. The actual plant list have been researched and will be in this LID guidance manual so the neat thing about this guidance manual is that even though this is a brand new science it will have all the soils listed that are recommended and all the plants that are recommended for bioretention. It's going to have specifications for green roofs. I'll get to that in a minute. The actual aggregate you want to use in permeable pavement. It's going to have the 'how to's' and it is for an engineer audience. We in this region have moved beyond the 'it looks good' and now are at 'how are we specifically going to do this'? Local governments want to know exactly where in their books and where in the regulations are the hurdles for this. If the owner in a community has to apply for too many variances they're not going to bother.

(#3600) Terri Jeffreys: I think a lot about getting rid of the curbs and have thought of them as safety hazards. Then you've got your fire codes and safety issues, do you address how the public policy will have to change?

(#3625) Bruce Wulkan: The best way I've seen that work is that if you've got a street without curb then you want to have that swale; a depression area that really tells you to not drive in there. That's a way to keep vehicles out of there and then you have the sidewalk a little bit away from the road and on the other side of the swale. One of the good things about these bioretention swales is they are built to infiltrate a certain rate and only pond a certain rate and so typically they pond only a few inches and draw down within a few hours. When comparing that to a detention pond it's a lot better because a pond is always full. The idea of having bioretention on somebody's yard that is going to be damp and soggy sometimes you've got to be very attentive to your market. Some people don't want that or like that. Some practitioners of LID around the sound are much more comfortable putting LID in the street right of way and the municipality has more control over it. They are much more comfortable putting it on municipal property than they are putting an individual rain garden on someone's property. My advise to that is that if you are going to have individual rain gardens on individual properties then there should be associated with that some kind of covenant to the deed of that property that says that you cannot just rip up that rain garden and put in lawn because if you do then you've lost that stormwater management.

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(#0130) Wendy Ervin: I'd just like to say something quick about your idea about putting in a covenant that you can't rip up the rain garden; you are then dictating how someone can use their own private property and so you get into a property rights issue. It might be nice to have a rain garden but it's also nice when you pay for a piece of property and pay for the taxes to be able to use it as you wish.

(#0142) Allan Borden: You have to be careful when a house is developed and it calls for stormwater management to have a rain garden that has to be maintained. Even when the ownership changes they have to maintain that responsibility.

(#0150) Bruce Wulkan: That's the way it's worked best on the East Coast is when they first did the subdivision and they had rain gardens on individual properties those owners were told you don't have a big stormwater pond but in exchange you do have this bioretention area so don't rip it up and then they had to do public education with each subsequent sale of the house.

(#0160) Tim Wing: Did that work?

(#0162) Bruce Wulkan: Yes, it did work. I did talk to some of the residents in one subdivision and almost all of them were happy with it. I did talk to one resident who was not happy and I asked him why? He showed me the rain garden and then he showed me a wet area of the property and they had put the rain garden in the wrong place. Part of his property was ponding up and what they needed to do was move the rain garden to where the water was so that worked.

(#0185) Steve Clayton: On comparing this to the 'C' Street is that the same application?

(#0195) Bruce Wulkan: The specifications change. If you talk to practitioners around the sound so far there are at least three or four different ways to do a bioretention. The 'C' Street project they went with a smaller soil profile. Some soil profiles go down ten feet. So they do vary in depth and the type of soil you create.

(#0215) Steve Clayton: So it's not just scraping off the top and adding amendments it's actually rather an in-depth process.

(#0222) Bruce Wulkan: In the LID guidance manual we're recommending going down at least twelve inches.

(#0226) Steve Clayton: Is that for residential or street application?

(#0230) Bruce Wulkan: It's an equation. It could be for residential or it could be for a street provided it's big enough to accommodate the amount of stormwater going in.

(#0245) Diane Edgin: Have you known of any track record where this has actually been adopted as BMP?

(#0258) Bruce Wulkan: Definitely in Prince George's County, Maryland and so the majority of development there use LID. Fairfax County, Virginia, had stated in an ordinance that they were going to get away from stormwater ponds. Pierce County and King County have a new chapter on LID. Okay, this here is a bioretention area at Evergreen State College. There are no curbs; the water from the road just sheet flows into this large bioretention area. Permeable pavement; this is a porous concrete that was put in an alleyway up in Bellingham. This product kind of looks like a rice crispy; it's rough and when you walk over it, it is ADA approved. There are two other products out now that are smooth to the touch and they absorb rainfall very well. The infiltration rates of porous concrete are outstanding. They're on the order of 1,000 to 1,500 inches per hour.

(#0350) Terri Jeffreys: So freezing and cracking isn't a problem?

(#0352) Bruce Wulkan: Interestingly enough, if you look at the research, this has been laid down in areas that do have freeze and thaw conditions and it has held up well. However, if you do talk to any engineers they are worried about what's going to happen in the subgrade once you get water down there and it freezes. You definitely have to install these things very carefully. Infiltration rates do decrease over time. They often

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decrease over 15% or more but if you're starting out with an infiltration rate of 1,000 even if they go down to 10 inches an hour or 7 inches an hour that's enough to handle a design storm. Also, controlling sediment is very important.

(#0375) Wendy Ervin: Do they silt up, is that why they loose their ability?

(#0380) Bruce Wulkan: Yes.

(#0382) Mark Drain: Is there a lot of subgrade preparation?

(#0384) Bruce Wulkan: Yes, there is a lot of subgrade preparation but in the LID guidance manual is shows that it's not excessive. You do have to prepare the subgrade, there's a choker course, an aggregate course and you also have to do a preparation in a conventional one as well. The problems we have right now with porous concrete and porous asphalt are that we don't have enough installers around in this region with experience. I know of one that says he knows how to do it; he can give very detailed instruction or he can come out and do it. As far as cost goes on this, I've heard varying amounts. The latest thing I saw was that porous concrete still is more money and porous asphalt is still more money than conventional asphalt or concrete. What you have to build in is if you can reduce your stormwater facilities because of this it may pencil out. The most expensive product is these pavers, ecostone, this is a more compacted subgrade; you don't compact the other subgrade. You do not compact with porous concrete or asphalt. This is compacted and the way you get the infiltration is the voids in between the pavers. You get a bigger credit if you do porous asphalt and concrete. It's a credit towards the size of the ponds you have to build.

(#0490) Tim Wing: How much blacktop area can that much pervious concrete pavers handle? Is it 1:1?

(#0500) Bruce Wulkan: That's a good question. What we're putting in the LID manual is very conservative because we don't want to see these things fail. We're saying do not discharge your conventional asphalt into this area. You want to design your pervious pavement so that it's going to handle the runoff from that area.

(#0512) Steve Clayton: Are you afraid of silting up and compacting?

(#0515) Bruce Wulkan: Exactly. Think of all the dirt and sand that would come along and wash into there. You want to, once a year, go over these things with some kind of suction type sweeper to pick up a lot of the organic debris and you can bring back the infiltrative capacity.

(#0540) Terri Jeffreys: When we start mandating how much impervious surface we have these techniques allow you a bigger house or building?

(#0545) Bruce Wulkan: These will allow you to effectively take 50% of that out of the equation. I will show you different techniques of LID around the sound.

(#0550) Wendy Ervin: Are those sold in sheets or individual bricks?

(#0580) Bruce Wulkan: It used to be individual but now it's done in sheets. They now have a mechanical application of these big squares and that has reduced the cost for the stormwater.

(#0590) John Diehl: Is there an ongoing problem of compaction?

(#0595) Bruce Wulkan: Not on this. This is actually compacted at subgrade so that's not a problem. I've shown you porous concrete so far and then this is pavers. There's a bunch of others. There's a plastic grid system. It's called gravel pave. It's an uncompacted subgrade and over time that kind of plastic lattice filled with gravel or planted with grass does not compact over time. One unit that sells it drives their heavy trucks over it all the time and it never breaks if you install it correctly. It has a very good shelf life. So in the LID manual we talk about the life spans of these things and these things last just as long. Here's a green roof in Seattle. This is downtown Seattle. This is called an extensive green roof. Without going into too much detail, it's two times the green roof. It has a six inch soil profile. The Europeans have been doing green roofs for a long time. Places in Germany actually require that all new office buildings have a green roof. Green roofs

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around here a while ago were considered way far out. This is now becoming a regular thing and it's because we now have manufacturers that know how to put them in. They know how to install the impermeable membrane that will not allow green roofs to leak. You also need to know what kind of soil profile to put down and they're discovering, cost effective wise, that a two or three inch soil profile is all you need. The City of Portland is going great guns on green roofs. They have monitoring data that show that over time you can reduce stormwater from a roof by 50% from putting in a green roof. If you start putting in green roofs in various urban environments a 50% reduction is really huge. Even within a village, if you're worried about runoff going into a salmon bearing stream this can be a good thing.

(#0698) Bob Fink: Does standard construction have to be changed to carry that load?

(#0700) Bruce Wulkan: It doesn't as long as you don't go deeper than about a two or three inch profile. Don't just use dirt because dirt as a normal soil is too heavy but instead you use a media filter which is actually light weight but its still will allow for plant growth. So they've actually engineered the soil profiles.

(#0715) Allan Borden: I was just down in Portland and saw the one of the buildings that has that and the excess water that they get is routed to bioswales right along the parking lot so very little of the water even enters the stormwater system.

(#0724) Bruce Wulkan: Portland has a neat incentive where if you put on a green roof on a building you get to exceed the height restrictions and you get to go taller. That's more rental income for the building owner so that's a nice economic incentive.

(#0732) Diane Edgin: Is there any evidence that the big box stores are going to be using this?

(#0736) Bruce Wulkan: We just met with Costco and King County got an EPA grant to work with Costco to redo their standards for development and I'm part of the technical resource committee and so I'm going to recommend some kind of a green roof as well.

(#0750) John Diehl: Have these been around long enough to know how long they'll last?

(#0752) Bruce Wulkan: What they're finding in Europe is that green roofs will last between two times and two and a half times longer than conventional roofs so if you build in the whole life cycle a green roof costs money and it will add to the additional costs but if you start to build in the longer life of the roof and you build in energy savings and stormwater then it starts to pencil out.

(#0766) John Diehl: A conventional flat roof is a relatively cheaper and relatively short life. Is that what you're comparing it to?

(#0770) Bruce Wulkan: Yes. It's comparing it to a conventional roof.

(#0777) John Diehl: I haven't priced these lately but I'm guessing that a flat roof can be put on for maybe a third of the cost or half of the cost of a 40 year asphalt shingle roof. So this might be comparable to a comp shingle roof, is that what you're saying?

(#0795) Bruce Wulkan: I've got figures in my head for a green roof for an extensive green roof is about ten to twelve dollars a square foot for new construction and more for a retrofit. I'm trying to remember the cost for a conventional roof.

(#0810) John Diehl: That's just the final surface; that's not any structure?

(#0812) Bruce Wulkan: That's the entire green roof.

(#0814) John Diehl: That includes labor?

(#0818) Bruce Wulkan: Yes, labor and soil.

(#0820) Wendy Ervin: So the water that comes down and stays and then evaporates?

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(#0825) Bruce Wulkan: Some of it evaporates and then some of it discharges out of here. It will take care of something on the order of 60%+ in the dry season and then well more than 50% during the wet season.

(#0844) Wendy Ervin: Is it filtered as the overflow leaves so it doesn't carry your potting soil away.

(#0846) Bruce Wulkan: Yes, that's not a problem.

(#0852) Diane Edgin: They appear to have some sort of a slope to them.

(#0855) Bruce Wulkan: Yes, you don't just want them to be completely flat because you don't want the water to pond up on them. It's just gravity; like about 1% slope. Let me move quickly through these next slides. Rainwater collection is another LID technique. It can greatly reduce the amount of water that's flowing off your roof. You can use the plumbed toilets. More and more places are starting to do that. This other one is up in San Juan Island. This is for a residential house where drinking water is in short supply up there. They collect the rainwater and they put it through a filtering process and this becomes their potable water as well as their irrigation water. This one here is an interesting product. This is a low impact foundation. With typical foundations you dig down a decent amount and then you lay in your concrete. With this product you do a light feathering of the top so you're not compacting the soil and you lay down these concrete things at grade and you're putting these hollow tubes and then you drive pins in and then you put your house on top of that. So it's a pinned through the tube down into the earth and then you attach the house to it. What that allows is it allows subsurface flows to actually flow underneath the house and you protect the infiltrative capacity of all these soils. It's a very interesting concept. It's gone in in a number of locations and there is also credit in the DOE manual for this product.

(#0930) Wendy Ervin: How about moisture in the house? If they've got some flows of water underneath ...

(#0940) Bruce Wulkan: People were worried about that so they did testing to check the humidity levels in the crawl space of the house and they remained consistent with other ones so you're not getting excessive moisture buildup underneath the house. Instead, you're just allowing that water to go subsurface underneath the house.

(#0950) John Diehl: You still use an impermeable barrier underneath the house, right?

(#0955) Bruce Wulkan: Right; on top of this. So here we have that nine acre, thirty six units; this is what they did. Smaller lots, bioretention areas in a circular turnaround and they've reduced the size of the turnaround. This did meet fire and safety concerns in Pierce County. They protected some existing vegetation and then they had to replant because this whole area was a horse pasture. They've got bioretention areas. I don't know if they used permeable pavement. It looks like they used a permeable paving edge. This is a really tough site that they're currently developing. We gave money to WSU to monitor pre-construction and then they got other money to monitor post-construction. This is going to tell us a lot about how well it works to pull all of these techniques together to protect a salmon bearing stream down here.

Here are regulations and ordinances around Puget Sound. These are the jurisdictions that in some way have brought LID in. This is from a survey we did in 2004 where we asked that very question. It's also some of my own knowledge of jurisdictions that I know have done it. Pierce County has a new chapter. King County has a new chapter. King County identified three demonstration projects where they said we want to do LID in these designated projects. And that's what they're doing. Snohomish County passed a zero discharge ordinance where they asked people to do these projects. Lacey and Tumwater had zero runoff ordinances and they haven't had that many people step forward so there's a real mix. I think you can either require LID in a very sensitive area or wherever you want. You can either identify demonstration projects or you can simply put it out in the street but I think you need incentives for developers to step forward to do it.

(#1075) John Diehl: I don't know what you meant when you referred to Lacey having a zero discharge policy but no one is stepping forward.

(#1082) Bruce Wulkan: Lacey's ordinance basically says that we are willing to waive all of our standard

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stormwater municipal requirements if you follow these performance standards. But no one has really stepped forward.

(#1092) Terri Jeffreys: Would the monthly stormwater fees be waived if they used these techniques?

(#1100) Bruce Wulkan: No, they haven't done that. That's an idea, though. Also, permit streamlining; you can always say we'll move you way up in the pile if you do this. Island County says you don't have to put forth as much of a proposal if you are willing to do LID. The costs of LID is approximately 20% cheaper. Prince George's County in Maryland maintains that it is always cheaper. If you talk to most people around Puget Sound they say that it's cheaper. It's definitely cheaper than in vault systems. Here's one cost comparison from Maryland. Conventional was a million dollars; LID was \$744,000. They actually increased the lot yield making the developer very happy. The unit cost is lower. You can see the differences here.

(#1168) Tim Wing: What does lot yield mean?

(#1172) Bruce Wulkan: That's the number of lots that a subdivision will have in a given area. Performance; the LID guidance manual is going to go into great detail about the performance of different LID techniques. In general, they are performing extremely well for stuff like metals and hydrocarbons. Excellent for flow control. Nutrients are highly variable. The testing on bioretention, phosphorus is clear across the board. Nitrogen, bioretention has been shown to actually increase the nitrogen so that's been really bad and it's because you've got so much organic matter. There is a way to de-nitrophy within bioretention. Simply put, instead of putting an underdrain at the very bottom of the bioretention swale, you raise it and by raising it you create an area that will be inundated with water; that de-nitrifies the runoff. Those specifications are in the LID manual and those are our best thinking so far of getting nitrogen out of the water. I'd love to test some bioretention for the ability to take out bacteria.

LID is not the only thing you've got to do. There's also land use planning under GMA and all these other things. We've been doing this for a while. We've gone conferences, workshops; there's an awful lot on our website. I encourage you to check it out. Most of all the information I presented to you tonight is on the website. We will also soon have the LID guidance manual on our website. LID has been a priority for the Action Team. That's really good because it's given us money to do a lot of good projects and really focus in on promoting this and finding out more information about it. There's still a lot we don't know.

There's been some questions here I'd like to hit on. Does LID apply to rural areas? Yes, and in a lot of ways it's easier to do it on a 1 to 5 acre lot than it is to do it on 8 units to the acre. You've got more trees and more area to disburse that stormwater runoff. Very applicable to rural areas. What issues have come up with LID? They ask 'what is it'? A lot of scepticism that it won't work in our area with our rainfall and our glacial till soils. Now we're starting to discover that with our glacial till soils that do not perk very well, those are the areas where you really have to do LID because otherwise you're really going to have increased runoff. Was LID considered anywhere but not used? I would say in some jurisdictions like Lacey or Tumwater or Island County; they were a little bit frustrated that it's sort of on the books but no one has stepped forward yet. What caused the hang up there? The stormwater managers in those jurisdictions will tell you different things. Sometimes it's just that there's not enough incentives to do LID. I think with the new DOE manual it's really going to help a lot. Is LID required anywhere? Around the Puget Sound area, the only place it's required that I know of is in the City of Olympia in that one watershed. Are there incentives? Yes, but not enough. For each of our conferences and workshops that we've done since 2000 we teamed up with local master builders and they are very supportive. Especially King, Pierce, Snohomish and Olympia and Kitsap. The National Association of Homebuilders actually developed their own LID brochures; one for local elected officials and one for the development community. So the development community is interested. I do think that a lot more education has to take place with developers and realtors so that more people know about what it is. And that's it.

(#1416) Bill Dewey: Thank you; good job, Bruce. I've been impressed with the amount of questions we've had along the way.

(#1440) Terri Jeffreys: I keep hearing about the DOE Stormwater Manual. Are they incorporating things in the manual?

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(#1445) Bruce Wulkan: Their 2001 version had one chapter in it called 'Onsite Stormwater Management' and that's where you'll find a lot of these techniques. A bunch of us complained there wasn't enough in there so they are now expanding that chapter in the 2004 or 2005 version; they're working on it right now. In the 2001 version, the only credit you got for doing anything for LID was a 15% reduction for doing permeable pavement. The new one is going to have lots more than that. We have credits for green roofs, fire retention, permeable pavement, rainwater harvesting. That's really a big step.

(#1500) Stuart Glasoe: We're also going to be doing more emphasis on stormwater treatment as it relates to bacterial contamination, such as with shellfish growing areas. There is some information out there on a number of techniques with some results related to bacteria contamination. As we continue to encroach on our shellfish growing areas we have an interest in trying to find out what the impacts are and how to mitigate those. There are a number of things that we'll be able to do with treatment techniques but the thing I emphasize as it relates to shellfish contamination is protect your native vegetation and reduce your impervious surfaces to start with and that's to prevent stormwater runoff so you don't have to deal with it in terms of treatment. What nature does naturally with the vegetation and the soils is hard to replicate with bioretention and other things.

(#1560) Bruce Wulkan: Stuart put together a great shellfish organization study that goes into some of those success stories, largely on the East Coast but they did a stormwater retrofit to bring back the shellfish growing areas. That's actually on our website.

(#1595) Tim Wing: Everybody is busy including the staff of this county which is understaffed and overburdened. Do you provide any kind of service where you can come into a small county like this and work with the staff and identify possible integration of some of these plans into the regulations so that it isn't such a complete additional burden to their work?

(#1600) Bruce Wulkan: That's a really good question. I applied to DOE for a grant to carry out certain high priority actions and I got the grant. So I got a grant to provide assistance to local governments to redo their regs to make them more LID friendly. So I've got to spend that in the next year so we've got to figure out how we're going to provide that assistance and which local governments we're going to provide that assistance to.

(#1725) Darren Nienaber: I was going to ask if you would be able to come talk to our Commissioners and also bring in some people from our Public Works Department who have been operating kind of in isolation might do well to have some of the exposure and your experiences from other jurisdictions.

(#1732) Bruce Wulkan: It's really key that Planning Departments and Public Works Departments both talk together when you talk about LID.

(#1745) Bob Fink: Just for the record, the Public Works Staff was invited.

(#1800) Stuart Glasoe: In closing, we think LID holds a lot of promise. I think we need to get things out there for feed back and to pilot it and to test it and to see what works and see what needs to be changed. If you need any feedback or more information let us know. We want to see this grow and improve and we want to get it right. We're not saying we've figured it out; it's going to take many years and maybe decades before we fine tune this.

(#1980) Bill Dewey: That's what's going on in Belfair.

(#1984) Tim Wing: I want to stress that. There's a huge project there that's on the verge of getting planned and I'm not sure if it is going to go. A major element of it is stormwater and I have no idea what they're planning to do there if it's the classic pond or what. I think there's still time to get in front of that. It's the biggest piece of this type of work that's going to happen in this county for probably twenty years so it's something that might be an excellent place for you to look at and see if you want to perhaps get involved with it or pilot it. It's a one mile stretch of road that has major stormwater impact on the Hood Canal and the estuary there. It's a very big project and the engineers that have been looking at it, which include the road, stormwater, sewer and landscaping, they are presenting their results in about a month on could this be done,

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how would this be done and who is going to pay for it and how much it would cost. So it's still at the point where there's no detailed design on how they would manage stormwater.

(#2040) Bruce Wulkan: It's interesting in projects like that to take a look at the drainage plan and ask what is going to happen with the water. Is it going to be tightlined out to the canal and if so do you need flow control and is there any treatment and is there any infiltration going on and what kinds of soils there are. You really have to look at it and see what your game plan is.

(#2062) Tim Wing: It's also interconnected with what will the development regulations be on the lots that are up on the hill from all of this because that's going to have an impact on how much water gets down to the road, to the ditches and then into the stormwater system. A lot of what you're talking about can control and manage that onsite for each home site or building site and not have as much to do with the water that does run off the road.

(#2088) Bruce Wulkan: You're right; that sounds like a potential opportunity. It's interesting because you never know until you start talking to the engineers because a lot of times the engineers say they thought about that but weren't able to do it. Then other times they say maybe that would work.

(#2100) Tim Wing: They've got engineers looking at it but as just kind of an overall look to see how much it might cost.

(#2120) Bill Dewey: I'd like to thank Bruce and Stuart for taking the evening to come here and talk to us about this. They did a great job.

Meeting adjourned.