WITH Dr. Andrew Sharpley, Alex Salki, Dr. Don Flaten and Dwight Williamson, on Manitoba's *Water Protection Act*

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Frontier Centre: The phosphorus load in Lake Winnipeg is increasing. How bad is it? When can we say we have a critical mass and have an environmental emergency?

Alex Salki: There's no doubt that the load is increasing. If we look at the modeling work that's been done by Dr. Ray Hesslein, since 1913 to 2000 we've had roughly more than 10% that the Province reports, it's more like 40 or 50 %, in increased load to the lake. The issue of when we'll reach a critical point, you can answer that in different ways, but from the perspective of Lake Winnipeg, we may have reached that point already because we have a disrupted ecosystem. The food-web structure has changed. You've got a predominance of blue-green algae there now, which is not a normal situation. What we're doing now is producing a product in that ecosystem which is not utilizable by the remaining web components. So ultimately, if this persists for very long, what will happen is that the fish production will ultimately suffer because that blue-green product cannot be consumed and used by the remaining parts of the food web.

FC: If the load is so bad in the lake, why did we have record pickerel catch last year in the south basin?

ASa: Well, the reason for the pickerel catch in the south basin, it's hard to know for sure, we know that record catches in the lake in general are related to the arrival of an exotic species, the rainbow smelt. Certainly in the north basin, the walleye fishery is flourishing because of the smelt. I was up there in the spring of 2002 and 2003, and the fishermen were pulling in tubs of fish full of smelt. So it's very likely that much of the increase in the walleye fishery has been related to that additional food resource. The productivity of the lake has gone up and we're getting more food-web products. Those food-web components are no doubt feeding some of the smaller forage fish like minnows and sticklebacks, which are food supplies for pickerel in the south basin. So that's going on. But the bottom line is, sooner or later the transfer of energy from the algae to the zooplankton to the fish will be disrupted because there's just too much blue-green in that lake.

FC: More than half of the lake's phosphorous load is imported from outside Manitoba, and only about a third of the remainder comes from agriculture. What are we doing about non-ag loading?

ASa: In Manitoba itself, there's no doubt what you're saying, we have 55 to 60 percent of phosphorous, driving towards 60 percent, coming in from external jurisdictions, I'm looking within Manitoba itself. If you look at the balance between point and non-point—and that means municipal waste-water treatment facilities and industrial plants—versus diffuse sources, within Manitoba we're talking about 30 percent point and roughly 70 percent diffuse. So we have a lot of unknowns in Manitoba. In terms of the most effective way, with limited budgeting, to deal with phosphorus, we should hit the municipal point sources, and the City of Winnipeg is of course going ahead with that, so are the other urban centres in Manitoba. I think the trick right now is to be sure that we require the appropriate nutrient management strategy at those point sources. Do we take out both nitrogen and phosphorus, or do we take out phosphorus only? The research that we see so far is telling us to take out phosphorus alone. So that's going to be a political decision. It should be a scientifically based decision, but it will be a policy consideration for the people of Manitoba.

FC: Most phosphorus escapes farms during the spring run-off. Therefore, the only thing we can do about it is reduce the phosphorus loading on the farm. Is that correct?

Dr. Andrew Sharpley: I think that's one of the long-term keys, to reduce what's coming onto the farm so it's more in balance with what's coming off. But like you say most of it's coming off in the spring, so it's also important at how we can minimize losses when you most expect them.

FC: That's when we come into beneficial management practices—or BMPs. You're saying they can effectively reduce that kind of nutrient loading. Can we run through a few? First, overloading with fertilizers. How can farmers act differently?

Dr. Don Flaten: We're advocating that farmers set reasonable yield goals when they're looking at how much fertilizer they need for their crops, to make sure they're not consistently overestimating the expected yield of their crops by a huge amount, to follow their soil-test recommendations

that are based on the analysis of how much phosphorus is already present in the soil, and to be prepared to pull back on their phosphorus fertilization rates when concentrations start to get high.

ASh: One thing is getting good long-term advice, too. Sometimes the consultants, at least in the States, may be selling fertilizers, too. That's been changing a lot, so the farm consultant is not selling a product, it's more a complete package of nutrient management advice.

FC: Do we need more soil testing?

ASh: Are soil tests required here when you add something? That's only fairly recently in some states in the U.S. It wasn't required for a long time to have a soil test.

DF: That may be changing as the result of some of the ways that regulatory proposals are being set up here. Soil testing in fields on an annual basis could become more or less a universal requirement for anybody that wants to apply any form of nutrient. It's not obvious, or right up front in the regulation, but it may be in fact the end result.

ASh: It's happened in the States with the regulations. You have to do that, but the other question is how often. Is it once in a rotation, or every year? Prior to that, though, a lot of farms didn't test the soil. It wasn't important to know what was there when we started. That's now a key.

FC: Are there not cost-effective GPS systems available to prevent over-fertilization?

DF: The GPS just tells you where you are, just like with fishing. It doesn't tell you what to do where you are. GPS has helped, I guess, in some places to apply manure and fertilizer more accurately and avoid overlaps, but in terms of actually determining the right rate to apply, a GPS does very little to help you with that particular issue. You can use a GPS and still put on four or five times as much phosphorus as you require if you're putting on manure, let's say, at a nitrogen-based rate. The GPS technology is one tool that might be used to help solve the problem a little, but it's not a very substantial part of the package.

ASh: We've concluded the same thing. With nitrogen it's different, because you can have real-time sensors that can see how green the crop is and that can vary nitrogen application, but with phosphorus it doesn't work like that. We visited some farms in Maryland, and I remember one guy had GPS and his consultant was telling him, "You have a map and you can do this precision application." But the cost the guy was charging to do this GPS was quite high. You have to wonder whether it was really worth it. It was nice for him to show his pals over coffee, but really was he getting a benefit out of it? You have to question that. It's a good sales pitch, but . . .

DF: And then some of our nutrient forms are extremely variable in composition. For example, the concentration of phosphorus in our liquid manures varies dramatically during the process of pumping out the manure storage. With all the variability in the phosphorus concentration in the product we're applying, to have a very precise geographic system of following the pattern in the field when you might have a twenty-fold difference from one tank load to the next, in terms of the phosphorus concentration, it kind of defeats the purpose of the precision on the geography side.

ASh: That's exactly right. You can go to extreme lengths in mapping and that, but in many cases the applicators are not that sophisticated.

DF: During the pump-out from the storage itself, there's so much variability that you ultimately have a lot less control over exactly what rate of nutrient is being applied in a manure system compared to a commercial fertilizer.

FC: One of the big issues in Manitoba is livestock. Dr. Sharpley, you talked about remedies that livestock producers can use, like customized feed rations to lower phytic acid levels, and adding enzymes to break down phosphorus better. How widespread are those remedies in use?

ASh: More and more. The large companies have bought into that, so they're much more widely spread, at least the phytase. The hybrids probably less so, but there's a lot more of that now going on. I'm familiar with some of the feed operators in Pennsylvania; they will even sell it now as an organic source. There's this boom in organic farming. If you use phytase to cut down on mineral supplements, you can use this pitch, "This is environmentally friendly; it's an organic source of phosphorus." They can somehow put this "bio" label on it.

DF: But if you want to take on a policy-related issue, one could be that the Canadian Food Inspection Agency has minimum concentrations of phosphorus that are required in commercially prepared feeds in Canada. Those standards do not take into consideration the benefits that have been gained in our knowledge of how to use feed phosphorus more efficiently. The legal minimums do not take into consideration these new enzyme additives that are now available. We've got a federal regulation which is forcing commercial feed manufacturers to overfeed phosphorus to their customers. That's an example of something that's got to change.

FC: How effective can careful management of manure storage and treatment be, of composting it and injecting of it deeper into soil? How much can you rely on those kinds of strategies to reduce phosphorus loss into waterways?

ASh: Very effective. Storage and treatment of manure allows you to apply it at the best time, the best time either with the weather or when the crop needs it. You can minimize run-off.

FC: Zero tillage, contour terracing, cover crops, filter strips, stream-bank fencing and portable water systems are all techniques you mentioned with which growers can reduce phosphorus entry into waterways. How

widespread are these practices now? Do we need to use them much more?

ASh: I think they're done to the best of farmers' ability right now. In places where they can put terracing in or do contour ploughing, in our part of the world everybody would do it. Tillage, yes; the problem sometimes with tillage is you get invasion, if you are no till, you may get surface compaction. There are compromises, so I think every individual is probably tailored to suit his or her needs best. They're widely used.

DF: If we take a look at what's going on in western Canada, in effect we have no ploughing. We don't have the types of slopes and management systems that really are conducive to contour terracing. We're already in pretty much a conservation tillage kind of system and, in my opinion, the most important BMP we need to look at is phosphorus balance, just making sure that our soil-test phosphorus concentrations don't build too high. In a world where phosphorus fertilizer is relatively expensive, surely that's something we can employ right away.

ASh: I agree. In those areas in the U.S. that are exactly the same—Oklahoma and Arkansas, where we have a lot of poultry operations—most of those are grazed pastures. There's no tillage operation, so you cut down the number of effective BMPs drastically. There's a limit to what you can do.

DF: Then you've got to look at that soil-test phosphorus issue.

FC: If the average farmer did everything you said he could do right, how much can he expect to reduce his nutrient-loading into waterways?

ASh: About 75 percent. You can't reduce it to pristine levels. A lot of people would expect to get close, but you can't.

DF: You have to frame that question. You're comparing what to what? What's your high nutrient-loading comparison to your so-called low nutrient-loading? One of the things we haven't talked about today is data collected in Alberta, where they've looked at situations comparing native rangeland to cultivated agricultural land with high concentrations of soil-test phosphorus. They found relatively little difference in phosphorus concentration in the water coming off the native rangeland, which is their control site, compared to their cultivated agricultural land. What systems are you wanting to compare to determine that difference? We have almost do data to go with here in Manitoba to show substantial reductions in phosphorus loss for any particular BMPs. I think that's an open question here for which we don't have an answer. You might have a lot better information from collecting research data over a number of years in the U.S. But we don't have very much.

FC: Why do we have such a poverty of information? Don't we have a huge infrastructure in place for ag science?

DF: I wouldn't necessarily agree. If you take a look, for example, at the University of Manitoba, at how many people we have dedicated towards nutrient management per se, I'm the only soil fertility person working in that area in our department. We used to have four or five people working on that; there's only one now. There's one person with Agriculture Canada in the Brandon research centre, and there's one person with the province who's focused on soil fertility and nutrient management. We actually have a relatively small group of people supported by the public infrastructure that are working at this environmental, agronomic interface. We have no field-scale hydrologists in this province at all, no scientist dedicated to looking at water management at the field scale, not one. We're actually not that well equipped.

ASh: It's the same with us. You see quite a bit of research going on, but at land-grant universities in the U.S., the agriculture departments tend to take the greatest hits, especially in extension personnel. They've received big cuts over the last three or four years, and those are part of the key to get the message out to the farmers. It's not a good situation.

DF: This isn't the type of research that's normally attractive to industry funders, either, because it doesn't have a lot of opportunities to capitalize with respect to a new technology or a new variety, or whatever. So the entrepreneurial return on that investment is pretty meagre. We've been fortunate that in Manitoba we've had the livestock producers stepping forward to see this as a pro-active, long-term investment that'll give them some return. Steve Sheppard's work on buffer strips, for example, and some of our own, has been supported by groups like the Manitoba Livestock Manure Management Initiative. But in general industry funding is not readily forthcoming for a lot of this type of research. It really belongs in the public domain for this long-term kind of work.

ASh: Even within our system, and at the USDA Agriculture Research Service, that's changing, too. Although it's critical research that's needed, we can see in the last year or two there's been a dramatic change in emphasis to bio-security, terrorism, the spread of animal diseases like anthrax. That's where a lot of the priorities at the ARS are going.

FC: Can you describe the Chesapeake Bay Project and what it's achieved?

ASh: It's a huge operation. It's outstanding, probably excellent. It's got a lot of different groups on board. What's it achieved? Dramatic reductions in inputs to the Bay. You can show increases in the diversity of the shellfish; they've come back come having some dominant shellfish that were predatory back to what farmers are able to sell. There's been a general improvement in the health of the Bay, so I think it's been a visibly successful program. On the other hand, there are probably a few bays and tributaries that haven't responded as well as we would have liked. So it's one of those learning processes. They thought, "We've got it figured," and we're going to have these target reductions by a certain date. But it kind of comes back, and now we

think there's a lot more actually coming in through the atmosphere.

FC: One feature of the approach they've used is cross-education between stakeholders. Does that have to happen farm by farm? How do you get the information out there quickly to people?

ASh: In the U.S., I suppose it's field days and extension days. It's going to change. In the old way of doing it, the farmers who needed to get educated didn't go to those types of functions, so you were preaching to the choir.

FC: Your use of "farmer leaders" and peer pressure to encourage better practices was fascinating. Can you say a few words about that?

ASh: We've seen a lot of that. We know one or two farmers in the community are looked upon highly and others will talk to them. If you can educate or work with one or two and just show them the benefits, they will show the benefits to other farmers, just with coffee-shop talk and other stuff that creates peer pressure.

DF: Andrew made a very important point this morning when he mentioned that this created the opportunity for dialogue between farmers and researchers. And it's not just education of the farmer by scientists, it's also education of scientists by the farmer. Anytime we've been able to work the producers in at the ground level of a project, it's been beneficial both ways. It enables rapid uptake, but also it helps design and refine the plan for that research so it addresses the needs of the producer. That means it's going in the right direction when it starts. So, for example, this evening we have a supper meeting with the Manitoba Cattle Producers Association, because they and the Dairy Farmers of Manitoba are investing $100,000 over the next three years into manure-management research on a project. We're meeting with them to fine-tune our research plan. We've done work with the Manitoba Pork Council, we've done work in close collaboration with some of the large companies that are into beef and pork production in the province. When we collaborate with them, we learn something from the process. They've been very supportive of that work and have led the way in support, as opposed to public funding, to be honest.

ASh: I recently e-mailed someone saying exactly what you said, "Thanks for your collaboration. I know every time we go out, I've learned a heck of a lot more from visiting you than you have from talking to us." You're right, Don. The researchers learn a lot. A great bit of what I've presented in a certain way reflects what I've heard from farmers—a mountain of paperwork, why things work, why things don't work.

FC: Both have you have emphasized that different sites have different problems. How can government regulate flexibly enough to handle all circumstances?

DF: One of the things that's built into the current proposal on phosphorus is that the management response would be governed by the soil-test phosphorus concentration at that particular field. Already, in my opinion, even though that's a blanket sort of regulatory proposal, it still ends up putting the challenge on the farmer to test that field and then adapt management strategies to suit the level of soil-test phosphorus on that particular field. That's one big step toward recognizing the site-specific variability we see. What Andrew has done with his colleagues is take it those extra steps and not just look at soil-test phosphorus as a criterion, but also take a look at other factors like management and transport and the risk of phosphorus actually coming off that site.

ASh: In the U.S., they tried to have a national strategy and left the states to implement it as they see fit. One of the keys was having a level playing field so that one state wasn't in an advantage over another, or that agriculture was given more benefit than other interests. You don't get farm systems, like California dairy, for example, moving to Texas because there were no water quality laws in Texas. That's one of the keys, you do it across all provinces. There's some structure which allows the provinces to be a little bit more flexible, because they all have the same problem but not on the same type of land base. You've got to have regulations, and they have to be fairly well regimented otherwise people are going to step outside to get around it. But do you have to have them—and this is one of the things we really struggled with—in black and white? You've got a limit, you know, our plan was like, you can't go above eighty pounds. Well, eighty-one, I'm sorry. Well, we said, wait, that's stupid. That's only one pound. Go for this guy that's up to sixty pounds twice. Where do you draw the line? You've got to have it in black and white but, having said that, it's a real challenge.

DF: And the way that some of these regulations translate to the individual farm level, not just state by state. The U.S. Environmental Protection Agency has provided the opportunity for individual states to go with soil-test P thresholds, a phosphorous index or some other equivalent system. So there's some flexibility state by state. And then within each farm, let's say you have enough information to support a P index, you can manage your soil-test phosphorous, your application methods and your transport processes, and intercept nutrients with special BMPs. There are options for different political jurisdictions, from state to state, and for individual producers. But it's still a regulatory framework to ensure that at the end of the day, one way or another, you protect water quality.

ASh: What is common across everywhere is, if you're low, then you can probably continue as you are. If you're in a high-risk, then you need to have some P management or some BMPs. That's where it becomes a level everywhere that is the same. I think what we've done is, even though you arrive at this categorization whether there's high, medium or low risk, and how you get there differs, you're still coming at the same categorization at the end, so everybody is treated fairly.

FC: Can you address the relative merits of regulatory approaches versus incentives to reduce nutrient loading?

DF: I firmly believe that in fact there's a whole series of policy initiatives that need to be considered as part of a well-balanced package to make a change in the landscape or, in this case, in the watershed. You need research and development, you need education, you need extension programs, you need incentive programs and you need regulation. You need a well-balanced suite of those initiatives in place to make a real difference. Otherwise, you introduce a regulation for which there's no means of compliance. It's like introducing speed limits where farmers don't have access to an accelerator, a gear-shift lever, a brake pedal and a speedometer. There are certain basic tools that people need in order to comply with regulations, and you've got to have some strategy in place to ensure that the other components are there.

ASh: I couldn't say it any better. In a way, the regulations are an incentive to do something, but you have to have some sort of help, some incentive to help the farmers, too.

DF: You can measure the sincerity of the government's commitment to solving the problem by looking at how much they're investing in the whole package, versus how much they're investing in only the regulatory approach.

Dwight Williamson: It's our view that in order to achieve remedies for Lake Winnipeg and for our other bodies of water in Manitoba that we in fact have to use a combination of approaches. Regulatory, to put in place the upper limits. We have to use education, meaning people on the landscape and in our urban centres are in fact not aware of the right thing to do; they are not aware of what they need to do to on a voluntary basis, which they're capable of doing, to change their practices and reduce their individual contribution. We also know that this issue has larger societal benefits, and governments wherever they're found and however they deal with the same issue, do in fact bring forward a combination of incentives and assistance programs. We are looking at that in Manitoba. We have some programs already in place and we are looking at increasing those and making them more available to meet these priorities. We're looking at topping up and joining with other incentive programs offered by other levels of government.

FC: What form might credits that encourage BMPs take?

DW: These would be incentives so we, the province, could provide additional funds on top of an incentive or an assistance program that might be offered, for example, by the federal government through the Ag Policy Framework. If there are areas that specifically meet our priorities to reduce nutrient loading to our systems, it's those BMPs that we could look at providing an additional top-up for individual producers or individuals working on the landscape. Those are the things that we're exploring. A top-up would be somewhat different than an assistance program. An assistance program might need to be efforts one-on-one to assist in paying a producer or someone on the landscape to make a change, to move livestock, to put in a holding tank instead of a septic field. An incentive program would be of benefit to allow them, to give them more of an encouragement to make a right choice.

ASh: In the states, we saw a couple of examples of credits. Feeding less, bringing it closer to the animal requirements allows them some credit for some kosher programs, or for other BMPs. Having a BMP implementation or planning date, assuring that have done what they said they were going to do, or what was approved, gives them some credit to buy equipment so they are getting some benefit from that. Those are some.

FC: What about tradable credit systems of the kind that have been successful in reducing air pollution, and that have been replicated in the Fox River-Green Bay basin in Wisconsin, the Tar River-Pimlico Sound areas of North Carolina and in Connecticut off Long Island Sound?

DW: We've explored that to some degree. We're still considering that. It's too early, though, to begin to roll something like that out. What we first need to do is turn around this trajectory, to turn around this increasing loading, to put a cap on it first and start to bring it down. Two comments. The Lake Winnipeg Stewardship Board did have considerable discussion about this issue, and they concluded we should not go there, that that was an area would not prove beneficial on the landscape. That was the opinion of the Lake Winnipeg Water Stewardship when they reported back to government on that issue. But we are aware of these programs in other areas. It's similar to the "total maximum daily load" process for air and water pollution. Once you have a very good idea of exactly how many nutrients you need to get out of the system, then as a government it really doesn't matter to us where this comes from, whether it's from urban centres or from the sectors out in the landscape. There could be a mechanism put in place whereby they could do the trading, that they could work with each other to reach the goal. It doesn't make any difference to Lake Winnipeg where the reductions occur, as long as they do occur. So theoretically, sometime in the future, that still could be explored.

We're not yet at the stage to know exactly where the final targets will be for Lake Winnipeg. But what we think is that everyone is still going to have to do their fair share, to do what they can in fact do. And that means that we are going to have to find reductions off of the landscape, out of cottagers, out of detergents, out of the urban and industrial areas. We're going to have to do what we can in each of those areas in any case.

FC: Others have suggested there's not enough information available to support a market of that sort.

DF: That's one of the challenges. You need good information. You need to demonstrate that the credits that are being transacted will actually result in environmental

benefit. But there are other problems as well. One of the other things is that, in a credit trading system, if you challenge an industry as a whole, like agriculture, to come up with a certain reduction and, at the same time, challenge cities to come up with a certain reduction in phosphorus loading and let's say that, because of their astute knowledge, city people are able to buy phosphorus credits from the agricultural community first, and they buy the credits that are the cheapest, and they meet their ten percent reduction goal by spending $20 million, and then agriculture has to meet its ten percent commitment to reduce phosphorus pollution and it has to buy the higher priced credits at $200 million, or something like that. That's the way that competitive system works.

FC: It's my understanding that that's how those systems did play out, that municipal government and industrial polluters were buying from farmers. But that gave farmers money in their pockets to reduce their own contribution.

DF: The third thing you have to be concerned about is the morality of it. This issue has been discussed at least informally within a number of policy groups that I'm familiar with here in Manitoba, and, to put it bluntly, one of those partners in the discussion referred to it as, "What's next? Trading in venereal disease permits?" Where do you draw the line in terms of the morals of commercializing and crediting things that maybe ought to be, what some people would regard as a moral responsibility?

FC: Dr. Sharpley, do you have an opinion on that?

ASh: You'd have to be more specific than that. Pennsylvania is going through it right now. They came out with a proposal and it went up for public review, and it was not very well received. I don't see how agriculture could have complied, or benefited from it, really. They're reworking it now, but the problems are that, like Don says, you're really looking at industries or municipalities and farming; you've got a point source against a non-point source. We need to look at effective reductions in point sources, but the non-point sources are going to be a heck of a lot harder. That's where some of the research we've been talking about today is relevant to nutrient trading. You've got to come up with these efficiencies for different BMPs, because you've got to have those on a site-specific basis to credit them. They don't have that. The ones we saw, there were probably three BMPs that were eligible for the trading, and there's a lot more out there. How effective would it be to trade them? We don't know about how effective BMPs are, which ones will work and how long they will work. There are life expectancies for BMPs. They are going to be effective initially, very much so, but as time goes on they depreciate in value. It's a can of worms.

FC: Were the rules in Manitoba's new *Water Protection Act* subjected to a cost-benefit analysis?

DW: There is some work underway on that, but that work has not yet been completed.

FC: The new regulations apply immediately to new start-ups. Won't that encourage more intensive livestock operations, because large enterprises can better afford to capitalize new technologies and to comply with the burden of paperwork required by mandates? Wouldn't that give an advantage to large ILOs, as opposed to smaller, "mom and pop" start-ups?

DW: That's a point that I'm not certain of. We know that some of the livestock centres in Manitoba are set to go through another series of expansions. If that expansion occurs similar to the way it has been occurring, that's going to be in the large operations. For most of the small agricultural operations, in any case, we haven't seen much change there; there's been some consolidation of small family farms. It is the intention of government—and this why the threshold of 300 animal units is applied—to keep most of the regulatory focus on larger operations. But we don't want to see a large operation approved in a Zone 4 area, so this will put in place the mechanism for that. What we don't want to see, either, is a subdivision with septic fields also expanding or locating in a Zone 4 area. These are things that this would all capture.

FC: Dr. Sharpley said that using a P screening index eliminates 80 percent of fields from the "problem" category. Did we do that indexing here, and are the new rules looking at only the 20 percent of fields that are a problem?

DW: We did not do that here in the same way that Dr. Sharpley and his colleagues in Pennsylvania did. We have covered that in a number of ways. For a sample, we do know that the areas of fields adjacent to streams are more likely to lose nutrients to the streams. Those are the areas where we've identified buffer setbacks, so that's covering the areas that are most likely to lose the greatest amount of nutrients. Our landscape here is different from the landscape in Pennsylvania, flatter for the most part. We know from the work of Dr. Flaten and his colleague, Dr. Silvano—and this is our data in Manitoba—that there was a good correlation between the phosphorus in adjacent streams with concentrations of phosphorus in the soil in adjacent lands, or in that watershed. What we know is that if there are higher levels of phosphorus in the soil in the watershed, there's more than likely a higher chance that phosphorus is going to be high in the adjacent stream. We know that there's that relationship.

FC: Are the nutrient-loading standards based on the precautionary principle, or on actual scientific assessment of damage potential?

DW: I would disagree with that. The residual levels for nitrogen in the proposed regulations are in fact based upon agronomic requirements. These are residuals that a producer can work within which all of our information leads us to believe should not impair productivity. All it will do is assure that the nutrients are managed more precisely on the landscape, to avoid leaving unused nutrients at the end of the growing season. It's those nutrients that are of interest to us, because it's those that leach into the

groundwater or are lost to surface water. So it's not a precautionary approach. It's a very practical approach based upon a recognition of what growing crops can use, and putting in place a mechanism that relies to a large much greater extent in the future on soil-testing than has been the practice in the past.

I would say as well, for phosphorus, the first threshold at 60 parts per million is also based upon the same principle. It's not precautionary, it's based upon some pretty sound evidence that soil scientists have not demonstrated an agronomic need for phosphorus above that level. Anything above 60 is really storing phosphorous in the soil for which there is no agronomic use. If it's remaining available in the soil, it's available then for loss to surface water. We're putting in place some higher-level limits to deal with unsound practices. It should not interfere with normal, good practices or the normal, typical high-levels of agricultural productivity.

FC: If a farmer fails to comply, or cannot comply with the Act's deadlines for P levels, what will happen to him?

DW: For phosphorus, if it's a livestock operation, that's governed by the Livestock, Manure and Mortalities Management regulation. New operations would be required to comply immediately. For existing operations that have developed under past rules—if it proceeds; that's the proposal, it is just out for discussion, and the government may hear reasons why that's too late or too early—they have until November 10, 2013. Essentially, if producers are out of compliance with the thresholds, they simply need to present the government with a plan by November 10, 2008 on how they would in fact achieve compliance by November 10, 2013. They would have from now until then to come into compliance. The information we have is that there are likely some out of compliance, but for the most part those numbers will be small. There will be some areas, particularly in the southeast of the province, where there will be a larger number of appeals. An operation may not be completely out of compliance, but they may have certain fields that are out of compliance. The operator would need to identify a plan for how they propose to come into compliance by 2013.

FC: Are the sanctions that would eventually kick in monetary, or fines? What form would they take?

DW: I don't administer that regulation, but they would be fines. It would be through the normal process. By the end of 2008, we would know which areas have sound plans to achieve compliance. We will know about which areas have simply not filed plans but are out of compliance. If they remain out of compliance by 2013, then the normal steps would be taken. It doesn't mean that the first visit results in a ticket. It means that they're presented with information and timelines to come into compliance and then, if after all that, they persist in remaining out of compliance, then other steps to ensure compliance would take effect.