Andrew Paul

ANDREW: Thank you very much, and I just want to first start to acknowledge my co-author Lauren Makowiecki, who helped with many of the ideas and the work in this presentation. Lauren is at the conference, so after this session, feel free to ask her all of the questions. No, feel free to ask her questions regarding this presentation as well. If we look at Alberta, the pink areas on the map show areas in Alberta that have basin-wide water management plans (Slide 2). If you look at the two Canadian panelists up here, the provinces of BC and Alberta, are comparatively large to US states represented by our panel. The parts of Alberta that don't have management plans in place represent a big area. And if we do look at those areas where the water management plans exist, the first of those plans was in the Saskatchewan basin. That plan came out in 2006. And in that plan, three of the four sub-basins were closed to any new any licenses. There were no new allocations. It had been over allocated. An important piece of work that went into that decision was an instream flow study done in 2003 (Slide 3). Two of the authors on that report or at this conference as well, Kasey Clipperton and Allen Locke. It was an instream flow recommendation to understand full protection to the aquatic ecosystem, and it was the first study in Alberta that looked at all five riverine components, a real ground-breaking study. And this is just a graph from one reach of the Bow River, one of the rivers in that study (Slide 4). The blue line represents natural flows for 1990, the red line represents the full protection IFN recommendation. Compare that to actual flows in the river. There's quite a difference between what the full protection IFN is and what's actually in the river. If you look at the question of how much water can you take out of a river, the simple answer is all of it if you try hard enough (Slide 5).

What we're really looking at, though, is what are impacts associated with taking that water out? The IFN recommendation developed in 2003 was full protection. It's on the left-hand side of this scale. If we look at the same reach of the Bow River when the "no new licenses" ruling was made, we were already in the serious area of environmental impacts. I don't know want to take anything away

from that Saskatchewan River Basin Plan, but on the environmental side, negotiations were occurring when impacts were already quite severe. We can project water license applications forward using population growth rate and the mean rate of water allocation per person in Alberta to get a range of cumulative future water use (Slide 6). Using these projections, it's not unreasonable for us to expect a 22 to 87 percent increase in water allocations in Alberta over the next 20 years. Eighty-seven percent. That's almost as much water as has been allocated in the last 100 years could be allocated in the next 20 years, largely driven by population growth. And remember, a big part of the province doesn't have basin-wide water management plans in place.

What I want to present is work we're doing to implement desktop rules as an interim approach for managing water in those parts of the province where plans don't exist (Slide 7). We still think basin plans are the best way to go, similar to the master agreements Dave Rosgen talked about at lunch today, they take awhile to develop and implement. The pink areas on the map took 100 years for plans to be developed. The desktop approach is an interim approach that gets us through until the more detailed water management plans can be implemented. And our intention in this approach is that when negotiations start happening, rather than being in the serious side of environmental impacts, negotiations occur when there are still parts of the environment that can be conserved and not have to be restored.

Our desktop approach starts at a fully protective IFN recommendation. However, that may not get applied everywhere so let's look at some differing levels of protection. We've called them full, high, and moderate levels of protection. Full protection we ground on what's called the Alberta Desktop method (Slide 8). This came out in 2011. It was based, not entirely, but in a large part on the South Saskatchewan River Basin study.

The differing levels of protection --full, high, or moderate -- depends on a couple of things. First, whether sensitive species are present, which include bull trout, Arctic grayling, rainbow trout, cutthroat trout, and Rocky Mountain sculpin (Slide 9). If you are in one of these orange areas in the province, then you get an increasing level of protection. The other thing that our fisheries biologists said was important when considering the level of protection is stream size (Slide 10). In those small streams uncertainty increases, therefore we should be increasingly precautious.

Because stream order is readily available in existing GIS layers, we've used that as a measurement of stream size. So depending on whether sensitive species are present and stream order, that will dictate which of the three levels of protection would be required. A quick example using the Wapiti River (Slide 11). This is a bit of a hypothetical example because in the Wapiti River basin, there actually is a water management plan being developed now. And some of the people in this room are involved in developing that plan, but we can use it as an example. So the Wapiti River is a 7^{th} order stream near the city of Grand Prairie. There are bull trout and grayling present, so it fits into the sensitive species class, but is a larger river putting it into the high protection category.

On the Y-axis is natural flow in the Wapiti River on a log scale (Slide 12). A couple of lines on the graph to define: the stair step line there s is the 80 percent weekly exceedence discharge; and, the flat line is 30 percent mean annual discharge. Keith in his presentation this morning said I talk a little bit about the DFO screening method. Well, that's it by showing the 30 percent line on that graph, Keith. Applying the high protection level desktop rules are: 1) if you're in the green region, we're proposing up to 15 percent withdrawal of the natural flow; 2) if you're in the yellow region, which is above the 30 percent mean annual discharge line but below the 80 percent weekly exceedence, you can take out five percent of the natural flow; and, 3) if you're below both the 30 percent mean

annual discharge line and 80 percent weekly exceedence, you can withdraw 1% of natural flow.

In preparing our presentations, Claire asked us to look at the principles of riverine stewardship and address how uncertainty applies to them (Slide 13). I really like this picture of the IFC principles. It looks like it was printed in parchment 100 years ago rather than a decade ago. These folks have been around for a while. One of the principles is quantifying the five riverine ecosystem components, the science part. And there are many aspects of uncertainty associated with the desktop approach I present. I just picked as an illustration since Lauren and I have been working on it recently. The relationship between mean annual discharge and stream order.

Certainly, there's a statistical relationship between the two. As mean annual discharge increases, stream order also increases. But you can put some probability bounds around the relationship and see as mean annual discharge decreases probability of falling into several different stream order classifications increases. And if you remember, within the desktop rule set we're saying under stream order five, we had increased levels of protection. There's a lot of uncertainty around using stream order to distinguish among stream size. This is the science part of uncertainty. I completely agree with Larry's presentation this morning. This is the easy part. It's an important part of uncertainty to deal with, but it's the relatively easy part to deal with. Yeah, it can be complex math but we can play around with it. It's quantitative, we can usually work with it.

It's the other aspects of uncertainty that, at least for me, I find very difficult to deal with or to understand. Back to the riverine stewardship principles and the one that states we should recognize limitations and opportunities posed and work within them (Slide 14). Limitations and opportunities seem to change. Using the desktop rule set I presented for the three different levels of protection, Lauren and I applied these to 25 different rivers in Alberta just to look at what it meant. The

Y-axis on this plot is the mean February diversion rate if you applied any one of these rule sets to each of the streams plotted using their mean annual discharge. You get a curvilinear relationship in February diversions. What this implies is there will be real limits to withdrawals if the desktop rules are applied. We can use allocation rates that we've observed in Alberta and apply that to populations to get a growth limit of 10,000 people. In February, the minimum pumping rate for a water truck used in oil and gas is around 20 liters per second, so again, that poses a hard limit on the graph. And this is – although I'm not sure of the correct term but I'm learning more through this conference, is what I've called social uncertainty or the willingness to say no.

When we present this three-tiered desktop method, it's the best thing since sliced bread until someone finds out it says no and they can't take their water. At that point, it's immediately problems or uncertainty with the science and discussions stop there. Both the science and social areas of uncertainty are important; but, the social uncertainty is the one I find difficult to deal with, understand and move forward with. I hope to learn more. And I am just about to end but before I end, because it came up in the last panel session and I know Christopher Estes will ask it if I don't say it, I only had 15 minutes to so could not present it today but we have a connected approach that deals with lakes and wetlands and recognizes that lakes and wetlands are connected to streams. Thank you.