MANAGING SHARED WATERS
Day 4 - Infrastructure, Products and Services
June 27, 2002

Larry Hildebrand - Manager, Environment Canada, Atlantic Region

Good morning everyone. Our introducer this morning is Doug Barnes, whom we've seen in a couple of cases but haven't had the pleasure of hearing of his distinguished background.

Doug Barnes is currently the Assistant Deputy Minister, Integrated Environmental Planning Division, at the Ontario Ministry of Environment and Energy. His division is responsible for integrating the overall policy development and planning functions of the ministry. The IEPD develops policies, strategies and programs that support conservation and environmental protection.

Doug has held successive positions in the Ontario public service covering policy development, regional service delivery and financial program development.

It's my pleasure to welcome Doug to the Podium

Doug Barnes - Assistant Deputy Minister, Ontario Ministry of the Environment.

I'm pleased to be here today. I was here on Tuesday and Sunday as well, but it's been a great conference so it's still fun to be here. It's a great pleasure to welcome everybody to this morning's session, as well.

The discussions you will hear about today will provide linkages between infrastructure and the role infrastructure plays in restoring and protecting our water resources.

In Ontario, infrastructure is one of the features that in fact we think protects and helps us deliver what we want in terms of clean water on a daily basis.

In Ontario we've also - and I did mention this the other day - we have a Canada/Ontario Agreement on the Great Lakes, and within that agreement there are all kinds of programs and endeavours that will lead us to infrastructure and improvements in the infrastructure throughout Ontario.

Just as an example, the COA agreement itself commits to reducing harmful pollutants from municipal waste water discharges. As part of that, we will be developing a framework for

municipal waste water, and developing best practices in terms of how to assist the municipalities in identifying and reducing harmful pollutants in sewer systems.

The agreement will also work towards reducing harmful pollutants in storm water by evaluating the performance of new cost-effective technologies for treating storm water. Ontario and Canada have both committed to developing and transferring technology and best practices to assist the municipalities in controlling storm water quality and quantity.

There are a number of projects underway, but what I'd like to do today to really kick off this session is introduce someone who, in all of her careers, had quite a deal of looking at infrastructure and technology, and I'm going to formally go through an introduction of Jane Pagel.

Today's session is about infrastructure. You have a great panel coming forward. In particular Jane Pagel is going to chair this session.

Jane is currently the Vice-President of Jaques Whitford Environmental, Ltd., Canada's largest employee-owned consulting, engineering and environmental services company, with 34 offices internationally. So, she knows what's going on around the world.

Jane holds undergraduate degrees and Masters degrees in Microbiology from the University of Toronto, and a Ph.D. from Columbia Pacific University School of Administration and Management.

She's been a principal with a management consulting firm, Johnson Smith International. She has held positions as Vice-President of Philips Services Corp., President of Zenon Environmental Laboratories, and Head of the Environmental Services Department at the former Ontario Hydro.

And one job she's held in particular, which I think is really credible, she's also been an employee of the Ontario Ministry of the Environment.

Jane has broad experience and recognition in the environmental industry, and serves on a number of boards and councils including the Prime Minister's Advisory Council on Science and Technology, the Canada Foundation for Sustainable Development Technology, the Ontario Premier's Research Excellence Awards Board, and the Canadian Council of Human Resources in the Environment Industry. She is also a member of the Board of Directors for Maxim Analytics Inc.

I'd like to welcome Jane here today.

Jane Pagel - Vice-President, Jaques Whitford Environmental, Ltd.

Thanks, Doug. That was a long introduction. Thank-you.

Well, I'm delighted to have been asked to chair this morning's session, even if I was second choice to Colin Isaacs. I'm pleased to be here for a number of different reasons. From my company's perspective, Jaques Whitford just celebrated their 30th anniversary. It's been in the business of addressing environmental and technological challenges, working in the marine coastal and shelf environments for more than half of those years, and they have developed and applied leading-edge technology and looked at deep see benthic sampling techniques to assess marine ecology, environmental assessment techniques to assess and mitigate pollution impacts on marine sediments. We have many offices in Atlantic Canada and are well aware of some of the issues that you're addressing this week.

From a more personal perspective, it's my very great pleasure today to have the honour to introduce our speakers, in particular our keynote speaker, my former boss and mentor Andrew Benedek, one of Canada's leading entrepreneurs, and really Canada's visionary in seeking to make all of the world's water safe to drink.

Andrew is a chemical engineer. He has a Ph.D. focusing on waste water treatment, and he founded Zenon Environmental Inc. in 1980. His vision was of a world where cost-effective membrane technology could ensure humanity's survival with safe and superior water quality.

Zenon - and I know from my years there - is a company dedicated to solving water quality problems, and this is through the use of advanced membrane techniques. Under Dr. Benedek's leadership, Zenon has grown steadily and has become truly a global leader in membrane technology for water and waste water treatment.

It's my pleasure today to welcome Andrew, and please join me in welcoming Dr. Benedek.

Andrew Benedek - Chairman and CEO, Zenon Environmental, Inc.

Thank-you very much, Jane.

One of the regrets in life, sometimes, is that you have to focus what you do, and about seven years ago we focused on membrane technology only, and at that time we sold our environmental laboratory to Philips, and with that sale our president also moved to Philips, and that was Jane Pagel. We were very sorry to lose her as an executive of the Zenon team.

As far as talking to you this morning, I thought back a little bit to my own beginnings and focus on the environment, particularly because many other people here are people that I've known - the Canadian ones, at least - and that always makes you reflect over your lifetime, what you've been doing and why you've been doing it. And I used to think that the most important thing was to treat water, and if you do a good job treating it the problem goes away.

Well, it doesn't. We are talking about that area as well. What I want to tell you is in fact it takes everyone. A human ecosystem, if you like, needs to interact, and without the so-called tree huggers there'd be no environmental movement. Without the environmental movement there would probably be no change in government policy. Without entrepreneurs within government who want to make things change there'd be no opportunity for entrepreneurs who want to bring about better ways of doing things.

So, all of us have a difficult task because as you all know no one wants to face reality when it comes to the environment. It takes a tremendous amount of dedication - which I'm sure all of you have, here, that's why you're here - and it often takes a lifetime to make a difference.

But sometimes it's good to look back, and if you look back to 20 some-odd years ago in Canada, when I started as a young chemical engineer, industry could put out whatever it produced into our big lakes, and didn't have to do any treatment. There were gross injustices done to anyone downstream from that particular effluent. And that sort of injustice is now pretty-much gone in Canada.

It doesn't mean that the problem is over. In fact, the problem now is worse than ever. The problem now is reaching epidemic proportions. And the problem is that whereas we have taken care of the aesthetic, unsightly aspects, and perhaps the acute lethality aspects in many parts of the world, but not all, we have not taken care of the globe, and as a result... and we have not had policies that led to intelligent use of water, or even proper accounting for the cost of water. As a result we've been wasting water and ruining water quality.

And so a focus on water, if anything, is more important now than ever, because a crisis is hitting us. I see it everywhere in the world. We do business all over the world and we're seeing, almost like an epidemic, water shortages and water quality issues are hitting... countries are hitting the wall on this right now.

So I'll go through some slides, and hopefully there'll be time for questions.

You all know these statistics, I don't need to go through that, but what's important about these statistics is that we actually are running a global factory that can create new kinds of contaminants, microbial contaminants - we've seen it in Walkerton - and it's normally being created in regions which are warm - typically they're coastal - and it's because of the lack of sanitation that you have the opportunity to mutate and create different kinds of microbial life.

So, given what's happening, what are the solutions? Source management through preservation of our water supplies is the obvious activity. This seems to be very difficult to do. Most countries don't do well at that. Unfortunately, even though it's very important I'm not an expert on that. I'll focus, as you'll see later, more on what is happening in terms of technology for changing infrastructure. That's the area I do know something about.

The actual water distribution, water supply, waste disposal, everything is management. Ultimately everything is government. And unfortunately, in this area there are too many short-term conflicting interests that destroy the long-term interest of all of us, and this is where the problem lies. Ultimately we need to make changes in management.

Those of you who are involved with governments, pushing governments - as Pollution Probe does sometimes - you need to continue that, because ultimately that's where the responsibility lies.

One of the fundamental problems is that we waste water even in really water-short countries. Typically there's no charge. So why not have a charge? If you have someone that can't afford the charge, subsidise that person to a limited extent, so they don't waste water.

Even though I'm very much driven by environmental goals, and that's why I'm here, that's what I've spent my whole life on, I recognise that capitalism works, if there are safeguards limiting its abuse. Unfortunately there's always going to be people who abuse capitalism. You see it every day in the paper these days, the eight years of good stock market circumstances. But we also have those that do the opposite, those that honestly, ethically, do their best.

By the way, for those of you who don't know, our company, because of our values, has been, in an independent survey of the 250 largest companies, on a business ethics survey we appear number one in the country, number one in Canada. That's because we're always driven by the values that Jane talked about.

If you allow freedom for creativity of human beings, and you set the incentives correctly - if they succeed they get rewarded - ultimately things get resolved. In fact, we believe that what we do will have a dramatic impact on the water crisis, because we live in a country where these things are alive.

Now, the reality is that very rarely, if anywhere, are those incentives and the basic structure of capitalism properly implemented. It isn't even done in business, so it's clearly not done in the environmental area. So, things don't go like they could, like they should.

What typically happens, as I said earlier, is water is free, very often, and water is wasted by ridiculous subsidies, very often, even in countries which can not afford to subsidise their consumers.

So naturally, as a result of that, when you have an underpriced commodity people waste it. So as a result you have, as I indicated in the beginning, an epidemic of water shortages that's happening around the globe. Most of you probably know this. I experienced it first-hand because we have offices in many of these countries and we see that.

As a simple example, I was in Israel five years ago. I met with the Water Commissioner at the time, and his biggest focus was, 'How do we get cheap water to farmers?' And I kept telling him that maybe he should consider how to manage his water resources, because not far away Saudi Arabia didn't do that, decided to be an exporter of wheat, and as a result of that they pumped out their groundwater aquifers in no time, and now almost every drop of water has to come from desalinated sea water.

Well, at that time the Commissioner and I didn't get along very well so I left and gave up on Israel, and two years ago there was a new Commissioner. He actually looked at the issues, and lo and behold, water became the number one issue for the country. The Sea of Galilee, which had been there since time immemorial, was below the red line. The aquifers were going salty and were being pumped out, and they had to start desalinating. Some of these plants cost, like, $600 million, and they built many, many of these all of a sudden because they know they'll

be out of water. It is still cheaper to desalinate than to truck water from Turkey, which was an alternate solution.

I went through this as an example because this is happening in a lot of countries today. Perhaps the most significant one is China. If you look at China alone they have a billion people, and the fact that in the north - especially north-east where Beijing is - there's not enough rain, and water shortages are becoming greater and greater. And China is developing. What they're going to be doing is they're going to be pumping water from the south to the north at an enormous cost, and they're going to be reusing water. Otherwise they're out of water.

And so on it goes around the globe.

Now, what I want to talk to you about is an area that I do know something about, technology and what is happening in this field, so that you can see that technology can have an impact, and there are solutions that are technology-based.

They do need intelligent water commissioners who understand the problem, governments that understand the problem and all kinds of suppliers or services that can provide what is needed.

When we started the company, I realised that having watched government in this part of the world - perhaps it would have been worse if I'd been elsewhere - I realised that governments have a very difficult problem acting in the long term interests, as I said earlier. And because the only thing I knew was technology, I felt that that's what the world needs. And I decided, without really knowing much about this particular brand of technology, that membranes are where the solutions will come from.

The reason I believed membranes are where the solutions will come from is very simple. It's because nature works by membranes. Every organ in your body separates molecules by membranes. Every tree and its roots uses membranes to suck water through the membrane wall of the root, every leaf, everything in nature works by membranes. So, in a way, if you want to separate precisely, as the body does, membranes are the answer.

And what my hope was, if we can make membranes cost-effective enough to treat waste water, at similar costs as to what the concrete structures that we use now in the developed world cost, and the water out of membranes is as good as drinking water, you actually re-use the water

instead of polluting. My focus was the industrial pollution problems that plagued North America at that time.

So we focused on membranes, and it's now becoming clear that that intuition - which is all it was, an intuition - is proving itself. In fact, all the water-short countries are going to membranes to solve their water problems.

I'll talk to you about two types of membranes. Reverse osmosis, which is the original membrane technology. This technology is the most cost-effective way to desalinate water today. And the second area, which we are a global leader in - we've developed it with the recognition of the problem - is filtering water at the molecular level, down to the size of a virus, using membranes. This is area is called ultrafiltration, or microfiltration.

I also want to give you an idea of costs, because when you're thinking of management of infrastructure you have to think about preserving, but you also have to think about getting new supply. And of course, sea water - relative to other supplies, in abundance, particularly, obviously, in coastal areas - is enormous. And so this is a frontier that we will ultimately have to protect more than we do now, but it is still available, and costs are coming down.

Some of the recent plants - big plants - in the world are coming in around 70 cents U.S. per cubic meter. This is cubic meter of water treated. There is one plant which is even lower than that, but that's a special case. I would say you can count on that kind of a price range for big plants. That gives you an idea.

China, just to pump water from the Yangtze up, you're going to spend about $1 a cubic meter, just the energy to pump the water up. So, in fact, if you're in a coastal area, you're better to get the water from the sea than to pump from somewhere far away.

Also, many of the desalination plants in the world, particularly in the Middle East, have been multiple effect units, and the reason for that is that the early membranes weren't as reliable as they are today, and particularly the pre-treatment - which has now been solved by membrane filtration and other improved filtration techniques - wasn't reliable either. But all the new plants in Singapore and Israel are going membranes. Reverse osmosis membranes, and sometimes ultrafiltration membranes, ahead of the reverse osmosis.

Now, talking about filtration membranes, this is a major change that will affect not just the coastal regions but all of us. Throughout history, since Egyptian times, we've been treating

water by settling it, adding chemicals - that's a little bit later - and filtering it through sand. And waste water we've been biologically treating and settling.

Now, these require huge concrete structures, and they're relatively cost-effective but they don't provide the quality that the world needs today. They don't allow you to re-use water, and they don't provide protection against some of the parasites that are being created or have been around for some time and are mutating.

Direct filtration of that water, for either drinking or treating waste water through membranes for re-use is where the world is going to go, not just because of us, because... what's going to happen is it's happening a little bit like the way computers changed from vacuum tubes. I consider the conventional treatment that you see around the world today as vacuum tubes, and in came the solid state chip. Ultimately those things kept getting cheaper, and eventually there were no more vacuum tubes.

The same thing is happening right now in the water field. The membrane is essentially like a chip that can be improved dramatically. We're very, very far from what's in your body in sophistication, but it is, just like the computer chip, getting more sophisticated in the factory as well.

So, using membranes you can take almost any dirty water. For example, some of the water in Egypt - we've done some testing - you wind up with half the water as sewage discharge in the canal. In the Nile it's not as bad but it's still pretty bad water. Conventional treatments don't do it justice. These membranes, for about 10 cents as opposed to 70 cents, you can draw on any kind of water and treat it, unless it's sewage which would make it a little more expensive, but the water will become re-usable even from the sewage at about 25 cents a cubic meter. That gives you some perspective. 10 cents to 70 cents is where it's at to get water if you need to get it using membranes.

By the way, these costs are pretty-much the lowest-cost way to do things, now, and the best, by far, in quality.

A couple of simple explanations on membranes. Membranes, because of desalination, have always been pressurised. What made a big difference in this field, in filtration in particular, is that we realised that we don't need the pressure just because desalination is done that way, but you do need it because of reverse osmosis.

So, we went to a simple suction, using atmospheric pressure, and just immersed the membrane naked, if you like, into water, just like the root of a tree that goes into water and seeks out water, and through pressure differential, osmosis differential, it creates a flow. We essentially do the same with membranes, so it's very low-pressure, very simple kind of membrane, and this is what fuelled our growth, this invention.

I don't want to bore you with technical details, here. I'm glad to answer any if you want, but it's essentially put into a tank or into any kind of river or open body of water, and you find some way to apply suction. You're talking about suction on the order of .1 to .5 atmospheres.

This is an interesting curve. It's our own internal curve. It shows you how dramatically the cost of this technology is going down. In our particular case it's been going down about 30% a year -it's not as fast as the chips, but it's still dramatic - which means that the costs will just keep on getting better, and conventional vacuum tubes, if you like, will be gone. And that means enormous implications for infrastructure investment.

This just tells you our prognosis of what's going to happen. Essentially there'll be almost no re-use of water without membranes. Already there are plants that do it today without membranes, but they don't do a good job, and the cost is, even if they don't do a good job, is more expensive than with membranes, so ultimately it's got to go to membranes, but it never was 100%. Even today there are some people who love vacuum tubes.

So let's focus on what this really means to infrastructure, having this technology available. I keep referring to the electronics revolution because that's the one that most people understand best. Our revolution in the water field is slower, because governments take a longer time to acquire things, to change, but it is happening almost like a revolution. In this province, in Ontario, where I used to think you can't ever sell anything if you're based in Canada - which we are, our head office is in Canada - it's gone almost wholesale from no membrane plants six years ago to all new plants being membrane plants.

But as that happens, you have to start thinking differently, because now you have a chip that is reliable, that you can put anywhere, and scale is not important. It will work equally well on a small scale as on a large scale, and typically it's more cost-effective relative to conventional treatment, on a small scale.

Prior to this revolution in membranes the world was always looking at shutting down the little plants in water infrastructure and building mainframes, big plants, centrally-located, which are easier to manage. But that, of course, meant a major amount of transfer stations, energy, pumping up and down, and a tremendous amount of pipework. And putting the water, sometimes, not as it should be, into probably the nicest part of the city.

As this technology gets a hold of the planners - that's what probably will take the longest time, because planning is usually many, many years before actually things happen - you'll see the same revolution that happened in computers. Mainframes will go to minis, and will go to micros. So, the minis are beginning are beginning to happen now.

What it does for you, if you locate it in the valleys, you're building several plants like this, even though there's a sewage plant centrally, the cost of pumping up from the valley to get it into the main sewer is sometimes more than treating the water, and in most of these places they're water-short. So then they take the water, treat it locally from the village in the valley, and re-use it right there. So you get double value, you don't have to pump water up, you don't have to pump water in. So that will happen, and ultimately you're going to go to the personal computer as well.

Here's a picture of the minis. You have little... if you have developments in different parts, in the valleys as I've indicated, instead of having the one mainframe - which you do now, everybody's pumping - you will wind up treating the water and using it for irrigation or other uses, aesthetic uses, reservoirs, parks, more and more this will happen.

The final thought I want to leave you with is that everything in today's world is going to nanotechnology. Everything in today's world is going to personal technology. And I believe water is going there as well. And we are going to help make it happen.

If you look at a home... I'll give you an example. Our building, our head office in Oakville, is on a parcel of land where it would take eight years to get permission to build a pipeline, and then it would take many years to build that pipeline, with major costs. So we said, 'That's great, because we don't need a pipeline, we don't need a sewer, we're going to re-use our water.' So we live by the sword, to speak, and we built a beautiful campus without infrastructure. That's a building, but now we're working on making it cost-effective on an individual home basis, and the same thing's going to happen.

Today we have little municipalities where the mayor's cousin is running the water plant, and he may not be trained, and we had inadequate water treatment. One example of that is Walkerton, the famous Walkerton, but it's happening everywhere, in little towns. Why not give the individual homeowner an appliance, much as he has a refrigerator, a hot water heater, why not have in his home a water treatment device that will guarantee him safe water, and also give him a waste water treatment device that if he is water-short he can re-use the water.

We already have the water product, and soon either we or someone else will have the waste water product that actually gives guaranteed quality water.

What is very interesting in the water use area is that we use water all the time. All of us are drinking water that's re-used. When you think about it - probably all of you remember this old example - the last breath of Julius Caesar, you're all breathing 503 molecules of his last breath. Same thing is happening with water. We're all drinking water that's been used.

But sometimes it's dramatic. As some of you may know, again, if you go to the mouth of the Mississippi, that water has gone through somebody's stomach seven times before it gets to New Orleans. And each time it's probably been treated so-so. They may still leave a lot of particles in there, potentially parasites. Whereas if we treat our own waste water, and we treat it well, I'd much rather drink that water.

As an example, in one of the countries of fine chocolates, Belgium, we just inaugurated a plant this summer where we're taking sewage, and for the first time in Europe it's essentially untouched, and distributing it as drinking water. But again, Belgium, where it rains all the time, in a coastal area of Belgium there are water shortages because of too many people. So this is a solution, a cost-effective solution, and I believe hygienically good solution for that community.

Thank-you very much for listening.

Jane Pagel

Andrew, thank-you. I think everybody was as mesmerised as I was with your words of wisdom and inspiration and practicality. That was wonderful to hear, in the face of an epidemic of water shortages and water quality crises to hear the advice to Pollution Probe to keep nudging government, and critical importance of government policies, the conventional treatment being likened to vacuum tubes before the PC. It was a wonderful talk.

And looking at the future of in-home water treatment and water treatment, and nanotechnology, and the great technological advances that membrane technologies offer.

Now, Andrew will take some questions and have some discussion now, and then we'll move to our second speaker, but we'll open it up now for some questions.

There are floor mikes. If you can come up to them and use them, and identify yourself.

Questions and Answers

AN: I'm (Avi Nokom?), from the Ministry of Land Water and Environment from Eritrea, Africa - not East Africa.

Of course, membrane technologies are being tried in various countries like India and also in Africa, but then in some of the coastal environments, you know, where small communities live, don't you think that solar distillation, or solar stills, would be ideal, because they are small communities?

That's number one. My second question is, what would be the capital cost, because you're talking of the operational cost, maybe built in, the capital cost. So, what would be the separation of the capital cost and operational costs, and what would be the life of this membrane equipment or infrastructure? Thank-you.

AB: Of course there is not one answer. Membranes is a very key part of the answer, but solar distillation, if we can get the costs in line, may be a very good answer.

As far as answering your second question, that's a very difficult question because you've got to define the flow, you've got to define a lot of things before I can give you capital cost, but the typical capital cost, if you like, for a water plant, I can give it to you I'm afraid in gallons. I'll try to translate that into cubic meters.

If you're buying a water plant, you're looking these days – for a big water plant, and it gets higher as you go smaller - it's about 20 cents on the big end and maybe a dollar on the small end per gallon of water treated per day. So in cubic meters, that's about 200 times higher on costs. So that would make $40 per cubic meter a day that you're going to treat, in capital terms. So if it's a 100,000 cubic meter a day plant, you're looking at $4 million, I think, if my math is correct, just to give you an example. And waste water is roughly twice the cost of a water plant.

As far as membranes lasting, what's happening... membranes are a tricky substance, as it is in our body. I honestly think if you could clean our membranes we'd live a lot longer, in our body. Membranes do fail, and membranes can be mishandled, so there has to be a lot of development. Some of the early attempts at membranes often failed, particularly in less developed countries. That's changing now. We're seeing the less developed countries very excited about what this technology can do, particularly in water use.

The reason it's changing is because the cost and the longevity, and the ease of use, is coming down. It's a normal evolution of technology.

SB: Hi, my name's Sean Brilliant. I'm with the Atlantic Coastal Action Program in St. John, New Brunswick. And actually, my town has the advantage of the local pulp mill - one of our local pulp mills - actually using membrane technology and showing phenomenal success with it.

I have a couple of... I'm looking for a couple quick answers, Dr. Benedek. I'm thinking two things in particular with respect to this membrane technology. One, membranes in the human body are produced using water. And two, if you use membranes to remove impurities then you're having a concentration of impurities. So, my pair of questions are what are the production impacts and disposal impacts of using these membranes?

AB: The industrial impacts, first. Like any industrial process, it uses water, and it needs membranes to make pure enough water, but it's one of the chicken or the egg stories. The water that's produced needs treatment. It has residual chemicals in it, but they're easily treatable biologically.

The second question, in terms of the contaminants building up, in waste water - I didn't explain it to you well - what we do is we combine membranes - the membranes stop the contaminants - and biology degrades the contaminants. So if you have a relatively clean waste stream, you essentially have nothing but carbon dioxide and water, if it's a membrane bioreactor, which is the most common way we treat waste water.

SP: [inaudible]

AB: The membranes themselves are not biodegradable because they wouldn't last very long. They may be biodegradable, but not in the ten years or so that they typically would last. And this becomes, unfortunately, a waste problem. We're trying to find a way, and we may we able to rejuvenate them so they last much longer. It it's a waste problem we handle it the same way other waste gets handled. But normally there's no accumulation of contaminants because they are disposed of separately. They are degraded.

IC: Indira Chakravati(?) from the Institute of Public Health, the Ministry of Health and Family Welfare, Government of India. That was an excellent presentation, sir.

There are two sets of questions that I have for you. The first one is that the part of India I live in - that's Calcutta - we have an immense problem of arsenic poisoning in the whole region of Esingol(?), which covers Bangladesh, China, Mongolia, _____. I would like to know how much of the arsenic can be removed by the filters that you remove, and the sludge that comes out from the filter, after the filtration, how do you treat it? Because we are using a whole lot of domestic filters and other kinds of filters, but the problem is the sludge, because it's concentrated arsenic. It's a geological problem, so it's increasing every day. New areas are coming up the more groundwater we use.

That's number one, and the second set of questions I have for you, sir, we have... ...an intermittent water supply in India, and that's the reason what happens when there's no water, there's a vacuum created, there are cracks in the pipe, and the sewage lines run next to the pipeline so they get into the drinking water taps, and therefore we use very high chlorination to keep our water safe for drinking.

In situations like this, do you think filters can be used at substations or at domestic points, and how expensive would that be? Thank-you.

AB: The first question, on arsenic, I'm aware of the problem, and it's a grave one, one of the most serious ecological water problems in the world.

We have been interested in working in Bangladesh in particular. If any of you can help us do that we'd welcome it, even as a... we sometimes do projects... every year we do a practical project which we actually don't get paid for - currently we're doing one in Vietnam - just to help people and teach my employees about what it is to help people rather than do a job.

So one of the areas that interests me is arsenic. We are working on arsenic elsewhere but not in Bangladesh. And unfortunately, it does create a sludge. There are ways to handle it, but the best way, I believe, economically, to handle it is to add iron and then filter the precipitate with a membrane.

The advantage of what we have is we get very, very high quality water, essentially no arsenic, because of the membrane, but we still create a sludge. There are ways to re-use that sludge. There's been a fair amount of research done. It's not cost-effective right now, but it can be used in various ways, and maybe we can talk about that later.

We created a product for the armies of the world where you actually hand-carry this product, and you put it down anywhere - it has a gasoline engine - and that's the type of product I was thinking would be very good for villages.

Now, your second question was about treating in the home. That's exactly why we developed our home unit, because of situations that you're talking about.

RV: (Rima Vidam?), Hydrology and Environment, Mississauga. I would like to ask you how membranes behave in daily dynamics of concentration. Let's say I estimated for Etobicoke Creek daily concentrations and loads of chlorine... chlorides, and it varied from 4 tonnes per day to 1.5 thousand tonnes per day. So, how will... how effectiveness of membrane will affect on this variation, daily dynamic?

AB: That's an interesting question. The filters are independent of what's in the feed. You can feed turbidity from 0 to 100,000. It makes no difference at all to the membranes. It does make a difference on some aspects of designing waste water treatment, but fundamentally membranes are insensitive to concentration in the feed, except maybe if you're doing sea water desalination you may not reach the potable water requirement as easily in the Gulf as you do in the Mediterranean, but in fact it's very similar technology in both places.

RV: Thank-you.

GL: I'm Gapal(?) L_____, of Dar es Salaam. I would like to ask two questions, one in connection with the previous question, actually.

My question is, when we are talking of waste water treatment, I think waste water could contain both organic and inorganic compounds, so as far as _____ is concerned I found that microbes can be biodegraded or something like that, but we have chemicals

like DDTs which cannot easily be biodegraded. Now, how efficiently could your membrane system could get rid of these inorganic compounds like pesticides which are available in other parts of the world?

And my second question regards the removal of fluorides. For example, in Tanzania we have some parts of our country which have a lot of fluorides in the water, so the question is how efficient is your technology for the removal of these fluorides, which cause a lot of problems in those parts of the world? Thank-you very much.

AB: As far as degrading a wide variety of organics, normally what happens is the bacteria adapt with a membrane because your bacteria are retained almost in a prison for a long time, and they can adapt.

It's surprising how wide a range of chemicals we're able to remove. Our technology is used in Italy for all the pharmaceutical waste waters, even those that take small batches from anywhere, and it's effective.

There are some that are harder to get rid of. These are the very small molecular weights, things that go through the membrane so they're not retained adequately, because this is a filter that's only virus-sized. And if they're not biodegradable, and they're small, then they go through the membrane.

And for this purpose, we either add powdered carbon to the membrane process as an addition, to absorb, or recently there's been very good research on ultraviolet technology which could be used post-membrane, or just by itself after good filtration.

Now, your second question, would you remind helping me to remember? Oh, the fluoride. The second question was on fluoride. I don't think membranes are a particularly good way to handle fluoride. It can be handled, but there might be absorbents that are better for fluoride.

JP: We have time for just one last question, I think.

SK: Ziggy Klein, Great Lakes United. I was wondering how do you see the use of living machines fit into the use of waste water treatment? I presume you know what I mean by the term living machines?

AB: Yes, I understand... let me tell you what I think I understand. This is a water treatment system where biology is used to treat the water, various components of it.

SK: In various stages.

AB: Various stages. We just think it's... we do the same, except we use a membrane as well, and we think it's more cost-effective and more reliable to use membranes.

SK: Thank-you.

Jane Pagel

Thank-you again, Andrew. We were really privileged to have heard you, and there may be some time for questions at the end of the panel.

Our third speaker, Bodine King, is unable to be with us, so we just have two speakers after this, so hopefully if Dr. Benedek can stay with us we may have time for more questions.

Our next speaker, George Kuper, is President and CEO of the Council of Great Lakes Industries, and during the last three decades George has been the recognised leader in the U.S. national effort to establish a productivity growth policy.

In 1975 he was nominated by President Gerald Ford and confirmed by the U.S. Senate to serve as Executive Director of the then newly-created National Center for Productivity and Quality of Working Life.

While he was Executive Director, in the middle 80s, of the Washington DC based Manufacturing Studies Board of the National Academy of Sciences, George Kuper was the originator and one of the principal founders of the National Center for Manufacturing Sciences. That was a major cooperative research effort among U.S. manufacturers.

Before joining the Council of Great Lakes Industries, George spent six years as President and CEO of the Industrial Technology Institute, ITI, which was a not-for-profit manufacturing research development and deployment organisation. It was based in Ann Arbor, Michigan.

George has been the founding principal in four corporations and director of five additional companies. He's published dozens of papers and books, served on editorial boards of four journals, and has lectured extensively in the U.S., Europe and South Africa.

Very impressive bio, and I'm afraid I've left out many more of the impressive roles he's had. George?

George Kuper - President, Council of Great Lakes Industries

[panel presentation not transcribed]

Jane Pagel

Thank-you, George, for covering industry's role and reasons for being involved in managing shared waters, and the specific factors with respect to the Great Lakes, and some of the role of sustainable development thinking and positive change through market forces. I was especially interested in the seven key success factors.

I think, given the time - we have one more speaker - maybe we'll hold questions until after we've heard from Steve Halls.

Steve is currently the Director of the UNEP International Environmental Technology Centre. It's based in Japan. He's an engineer and a biologist by training, and has been a research professor and an environmental scientist for the past 20 years. He's carried out many projects during this time. Many of them have been with supernational bodies such as European Commission, the World Bank, the World Health Organisation. He's worked with NGOs, with various government departments, agencies and organisations, and a variety of different industries.

Dr. Halls is currently the Secretary General of the European Society for Environment and Development. It's based in Brussels. This is a pan-European organisation whose aims include the promotion of sustainable development, environmental standards, and professional development.

In his 22-year career, Steve has worked in almost 30 countries world-wide, which is amazing. I don't know how he's fit all this in, in what seems relatively few years.

Please join me in welcoming Dr. Halls.

Steven Halls - Director, UNEP International Environmental Technology Centre

Good morning, ladies and gentlemen. It is a great pleasure and an honour to be here today.

I'm going to address the issue of technologies, and we have heard from Andrew and from George their role and their importance. However, we must not assume that they are the panacea

for solving all of our problems, and we must develop them, apply them and use them in cautious and, hopefully, sustainable manners.

But before I go on to my main part of my presentation, I just want to talk a little bit about UNEP International Environmental Technology Centre. We are a part of the Division of Technology, Industry and Economics. This is based in Paris, although my office is based in Japan. We have two offices in Japan, one in Osaka City - which is the industrial heartland of Japan - and we have another office just to the north-east of Kyoto on the shores of Lake Biwa, a beautiful, wonderful place. And in fact, based upon what George was saying about the application of rainwater re-use systems, our buildings, our offices, are based upon exactly those principles.

Our main function is the implementation of Chapter 34 of Agenda 21 which came out of the Rio Process, and that is the promotion and transfer of environmentally sound technologies. Our main focus is developing countries, and countries with economies in transition around the world. Most of those countries share waters. Many of them are facing increasing problems, not just politically, but particularly environmental ones, of how they're going to manage that shared resource.

IETC focuses on, specifically, catalysing activities, facilitating interaction between parties. We create implementation strategies and help transform and instigate change. We try to bring harmonising approaches to those discussions, to those interactions, and in particular in the area of technology development we try to bring about a certain degree of congruency and agreement. But above all, we work in the process of transferring information to help local decision makers become more sustainable, not just at the local level but with the global level also.

Within the area of water we are specifically interested in integrating the urban and the more rural aspects of water resource management. We work in the areas of development of tools and techniques. We help in identifying, selecting and the use of appropriate environmentally sound technologies specifically in these two key areas that I've touched upon.

But of course we have to first start off by understanding what is an environmentally sound technology. Not all technologies are good for the environment. Many of the issues and problems that we face today are brought about by technologies, either their design, their

operation, or lack of maintenance has given rise - and will continue to give rise - to environmental challenges.

If we can design, use and operate technologies that are environmentally sound, whilst we will not overcome some of the challenges that we face in the near term, they will certainly help us move in that direction. And certainly what Andrew was saying, and particularly, I think, what George was saying also, we must take into consideration how we're going to stimulate and develop markets and opportunities for these new environmentally sound technologies, but I'm not going to touch upon that now.

But environmentally sound technologies are those that by definition, from Agenda 21, Chapter 34, are those technologies which protect the environment, are less polluting, use all resources in a more sustainable manner, recycle more of their wastes and products, handle residual wastes in a more acceptable manner than the technologies for which they are substitutes. A very broad definition.

The definition also applies not just to individual pieces of equipment but all types of technology, their transition to becoming more environmentally sound, also. So, existing technologies can be improved to become more environmentally sound.

It covers the full spectrum of technologies, and it tries to capture the full life cycle flow of material, energy - and in particular water - throughout the production and consumption systems.

Environmentally sound technologies can give rise to significant environmental benefits, but equally they give rise to substantial economic benefits. In most cases, the application of environmentally sound technologies leads to reduced operating costs and reduced waste disposal costs.

Very significant linkage needs to be firmly established. We are not just talking about only environmental benefits, there must be the concomitant economic benefits as well.

But so far the promotion, uptake and use of environmentally sound technologies around the world is rather slow, and we're trying to understand some of the reasons for that process. And it is clear that we need greater involvement - and in particular through public awareness - of the benefits of these technologies, and in particular in areas where we're trying to manage shared resources - and particularly water - this is very important indeed.

We need more information that will facilitate responsible and careful decisions being made. We need more sound knowledge based upon sound science, and I was very pleased to hear Minister Anderson say this at the beginning of this conference this week.

We need, also, to understand - and again I'll reinforce what George was saying - about the partnership that we need to establish with industry. As I'm sure you're aware, the Secretary General of the United Nations, (Kofi Anan), has been polling for a public/private partnership. We need far more of that if we are going to move forward and achieve the goals of sustainable development.

But also we need to understand we go about the process of designing, identifying, selecting and using environmentally sound technologies.

Before we can do that, or even during the process of undertaking that task, we need better information. We need to be able to clearly define what is an environmentally sound technology - how do we go about the process of selecting the process of selecting that technology.

We need to, again, find mechanisms - and perhaps the market is one mechanism - to enhance the adoption and use of environmentally sound technologies. We need to develop and facilitate other mechanisms for their transfer and dissemination. But we also need some very good information about the quantity and qualifying of technologies. What are their real benefits, can they really perform better than other more traditional or conventional technologies, because only then will we actually see the real benefits to the environment, and of course some of the economic benefits also.

We need baselines, we need benchmarks, we need codes of practice, and indicators - that will help us in assessing performance, on a continual basis, and for modifying future strategies and development of technologies. And it is that challenge that UNEP IETC, in particular, is undertaking.

We recognise that all around the world environmentally sound technologies are not being taken up. Why? Because people do not have confidence. They do not understand what they are, or how to select them, or how to evaluate them clearly.

So, we have undertaken the development of a strategic framework and an initiative to bring about a certain degree of harmony, to understand what the necessary mechanisms are to

identify those environmentally sound technologies by development of criteria and guidelines to assist decision makers in this process.

We're undertaking this initiative in the context of understanding how we are going to move toward sustainability. We are looking very clearly at the baseline situation. We need information. We need qualitative and quantitative information about the performance, the environmental benefits, of those technologies. That is a major task. Getting good data, getting good information is a major challenge. Without that information it would be very difficult for claims to be made about the benefits of such technologies.

Of course, associated with that data collection, verification, validation of that information, then can come the opportunity...with good information can we set about that incremental improvement.

As I've said, we are based in Japan, and there's one word in Japanese which encapsulates that approach, kaizen, continual improvement. Incrementally, maybe sometimes almost quantumly, but we must continually move forward in improving the performance of technologies. But without that good data to start off with, it's very difficult.

We heard also about the role of innovation. We need to find innovative solutions. Let me give you an example. Over a hundred years ago the city of Tokyo undertook the decision to implement combined storm water and waste water sewage collection systems. Perhaps, now, that's not the best approach, but what they've done is through the application of kaizen and also looking at the problem from different perspectives they have made major innovative leaps forward in improving the performance of their system such that it now rivals the more widely-accepted separate systems.

Innovation is going to be the major driver of how we build a sustainable future in the 21st century, and in particular innovative technologies, as we have heard from Andrew - and others, they're not the only ones – but they will be very, very important in helping us move forward.

Of course we're all moving towards that goal of sustainability, whatever that may be. I will not address that topic any further.

IETC is undertaking this initiative on the basis of a wide, consultative process. This initiative is, as I have already indicated, to develop criteria and guidelines for the selection of environmentally sound technologies and their performance evaluation.

We're working with industry, development banks and agencies, national governments, academic institutions. Also within the UN system itself we're working with our own research organisations. We have cooperation centres, we have regional offices around the world. But all of this means that we are embarking upon a major activity.

This activity has to involve other stakeholders, NGOs, civil society, other relevant organisations, and we are undertaking this process over the next five years.

This initiative, as I have indicated, is about increasing awareness and information sharing based upon relevant projects and experiences of environmentally sound technologies.

We're building upon the institutional and intellectual capacities already available, and in particular in developing countries. We recognise that in many parts of the developing world there are already good technologies but they have never been externalised, they have never been applied in the most appropriate and environmentally friendly manner.

Our consultative process has begun. We held, in March of this year, the first international seminar in Osaka in Japan, and this will be an ongoing process. We also hold regional stakeholder discussions, expert meetings, and sectoral meetings. We want the involvement and engagement of industry in particular, because if we can help shape and drive forward the development and design of new technologies, or the improvement of existing ones, then this will help the process in achieving our goal of sustainability.

I've indicated that we are working across a broad range of different stakeholders, and this is a multi-year commitment. However, we have to recognise that we cannot do everything all of the time, so we have tackled certain key areas first, waste, construction, and water. These are crucial industry sectors that we feel need to start adopting and using better technologies, environmentally sound technologies, to meet some of the challenges that have been clearly articulated this morning.

We have set up a whole series of networks and web sites for discussion, and let me say that there will be a web site that is associated with the water sector - in all of its guises - to discuss the issues of technology development, issues surrounding technology, the management of technology. We're not just talking about engineering solutions. Sometimes a soft solution, a management systems approach, is much more beneficial. So there'll be a whole series of issues and discussion ideas, and opportunities.

We will of course make this known once it is established - within the next two weeks - to the delegates here, so if you wish to participate you will receive from us an invitation to participate. The web site is not publicly accessible yet, it is only by invitation at this moment.

We are trying to involve other organisations, and so I welcome any approaches, any opportunities to discuss with you about your organisation, your country, your particular concerns of how we might be able better to serve you.

We're in the process, also, of recognising and taking action, and setting up decentralised systems. When you access information on the Internet, most times you go to a single point for that information. We have recognised that that is not the most appropriate or efficient use of the information. So we are in the process of setting up a global network, on a regional basis, to better serve countries' organisations in those regions.

The first one has been established in Asia-Pacific region, and it will be networked into our existing system in Japan, but it will also link to other servers and other mirror sites around the world. This is to facilitate the creation of web sites in multiple languages serving those regions, those countries, providing you access to information which is more appropriate to finding the local solutions, in particular local environmentally sound technologies.

To facilitate that we have been pushing the envelop of technology ourselves. We have created a knowledge management tool which we call ESTIS(?), and there are three components of ESTIS, ESTIS Builder, ESTIS Community, and ESTIS Global. I will not go into them in great depth, but just to say they work in 172 different languages. You can search for information anywhere in the world. The only proviso is that when you retrieve the information you can only make use of it if you speak the language that you retrieve the information in.

This is being developed. It will be launched next January. It will be given away free of charge to anyone who wishes to use this system. It is designed to encourage greater use of the electronic world, not just the Internet, because information can be shared on CD-ROM or other mechanisms, and it can be disseminated through other mechanisms we're in the process of also developing.

I would, however, wish to point out, particularly in this conference, Managing Shared Waters, I've indicated that technologies are important. If you wish to find technologies that may help address some of your issues, UNEP IETC has a database. It is called Maestro. In there you

will find information about technologies which can be used, not just for waste water treatment, sewage management, water supply, but a whole range of issues including decision support tools which can help in conflict resolution, identifying risks, identifying environmental technologies, and even helping build an environmental management system.

So I do urge you to visit our facilities on our web site. If you are interested you can contact us directly. If you wish to become a user of our systems it's free, I think, so far.

Clearly we need to move forward in development of ESTs, particularly in the area of addressing some of the issues that came out this morning. But again I would just like to come back to the fact that we need to build capacity also. We may provide the information about technologies, but unless they are operated appropriately then often, even though it might be environmentally friendly, it leads to environmental impacts.

So, UNEP IETC has developed an approach on training trainers. We are developing e-learning products that can be accessed on-line or through CD-ROM to enable users to understand how to select and operate environmentally sound technologies, how to undertake waste audits, water audits, energy audits, a whole range of different approaches.

Early next year there will also be a public domain Internet site, emlearning.net, where training materials and courses will be made available. UNEP and UNEP IETC will populate that web site with training materials, as will, I hope, other organisations, not just from within the UN but perhaps even the private sector. We will not claim that all of those training opportunities will be free of charge. They will be from UNEP, but others may wish to receive some form of reimbursement.

We have other complementary programs on environmental management systems, technology assessment, sustainable technology initiatives, urban infrastructure initiatives, and we do undertake very specific targeted capacity-building activities, and we engage with the private sector in these undertakings. It is very important that we do so.

I have said many things about the role of technology. As I've also indicated, not all technologies are good for the environment, but through better engagement of the private sector - in particular, industry - we can start to develop and move forward in a coherent and structured manner. But without clear guidelines, without clear criteria on what constitutes an environmentally sound technology, then that may be increasingly difficult.

Thank-you very much indeed for your attention.

Jane Pagel

Thank-you, Steve, for telling us about the role of UNEP and IETC and sharing with us some of the monumental challenges with environmentally sound technologies and the gathering of baseline data and information and standards. You've got huge challenges ahead of you, and successes.

I think we have a number of announcements, so what I'm going to suggest, perhaps, is if the speakers can remain around here after, we'd like to do some announcements now, and then if you can approach directly the speakers. And Andrew, if he's still here, maybe we'll have a chance for some further dialogue up here at the podium.

Larry Hildebrand

Thank-you, Jane, and thank-you too, of course, to all of speakers this morning.

Just a few announcements.

There have been quite a few requests for the PowerPoint presentations or the texts of speeches made by various speakers. Pollution Probe will be pleased to collect those and will make them available on the web site - Pollution Probe's web site www.pollutionprobe.org - after the conference, or as soon as we can get them. So, we'll try and make that, and I think they'll be a nice addition to the resource kits.

I also wanted to mention, again, about the conference statement. Of course, everything that we've talked about today, all of the information that we've gathered, is going into informing the process of developing a conference statement. The team will be meeting tonight to carry on to try to integrate that information that you provided, to form this conference statement.

It will be brought forward tomorrow morning - that will be the emphasis of the session - so that we can ensure that we've got all of the perspectives, the priorities that we want to emphasise, and that Minister Anderson will carry forward to the World Summit that's coming up in a couple of months' time. I don't know if Minister Anderson would carry it to the World Water Forum as well, but those are two, clear, major events. What we believe to be important, the kinds of points we want to emphasise, will be brought forward.

There's also been a suggestion by one delegate that they, too, may wish to carry this statement forward to the World Summit, and if there are any others, perhaps from international agencies or other countries that wish to do the same, please, please talk to us on the organising committee, and we'd be pleased to discuss how we do that.

I think that's all we need to say right now. I want to invite Patrick Lawrence up to make a few program announcements for this afternoon.

Patrick Lawrence

Thank-you, Larry.

I just wanted to highlight that we've done some consolidations of some sessions, and we've moved a few speakers around. If you want to refer to the program I'll run through these now, and also if you don't have this available with you we've updated all the signs that will go on for sessions outside the doors for the sessions. We will put those up during the lunch hour.

Also a reminder, again, that all session chairs for this afternoon, if they could please meet with me at 1:30 in the lunch room for final instructions and any other corrections to the program.

The session, the speaker that was scheduled for Webster C at... the session from 2:00 to 3:00, the session entitled Depleting Mangroves, that speaker has been moved to the session on Managing Shared Waters: Lessons Learned 3 in Albion A.

Also in the sessions from 2:00 to 3:30, the session entitled Manitoba Canada Appeal of the Garrison North-West Area Water Supply Project that was scheduled for Albion C, we've moved that presentation into Webster B, still within the 2:00 to 3:30 session time. Again, that's been moved at the end of the session on water use in Webster B.

For the 4:00 to 5:30 concurrent sessions, the speakers that were in the session entitled Energy and Transport Impacts on Coastal Regions, those speakers have been moved from that session in Webster C to the session entitled Evaluating Human Impacts scheduled in Albion A from 4:00 to 5:30.

Also, we have cancelled the sessions in the Convention Room, room numbers 202 and 203. The session entitled New Technologies for Coastal Zone management, and the session entitled Ecotourism as a Tool for Coastal Zone Sustainability. Those two sessions occurring from 4:00 to 5:30 have been cancelled.

Thank-you.

Larry Hildebrand

Thank-you for that, Patrick.

And I guess, just before we head off to coffee and then of course to our interactive sessions this morning, I just want to again thank Jane very, very much for ably chairing the session this morning, and ask you to join us in thanking her and our wonderful speakers for this great session.

Thank-you.

[End of Day 4]