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PFAS Discussion: A View on Assessment, Treatment and Remediation from Jacobs

August 26, 2019

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PRESENTATION

Operator:

Good day. My name is Shelby and I'll be your conference operator today. At this time I would like to welcome everyone to the Barclays PFAS conference call, A View on Assessment, Treatment and Remediation from Jacobs. All lines have been placed on mute to prevent any background noise. After the speakers' remarks there will be a question and answer session. If you would like to ask a question during this time, simply press star, then the number one on your telephone keypad. If you would like to withdraw your question, press the pound key. Thank you.

Mr. Adam Seiden, you may begin your conference.

Adam Seiden:

Thank you, Operator, and thank you all that are joining our PFAS call this morning in coordination with Jacobs. My name is Adam Seiden and I am the U.S. Machinery and Construction analyst here at Barclays. Also joining me from Barclays are Julian Mitchell, our U.S. Multi Industrials analyst and Duffy Fischer, our U.S. Chemicals analyst.

The topic of today's discussion, as per the operator, is PFAS chemicals. Our team at Barclays has published several reports on the topic and you can access those either online or reaching out directly to either of the three of us and our respective team.

As the operator said, we will be taking question and answers at the end of this call and you could either indicate your interest by queuing in by press that star, one, or you can send an email to myself at adam.seiden@barclays.com.

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First I want to start with a little bit on PFAS. PFAS is a chemical manufactured for non-stick products, firefighting foam and many other uses. Unlike many other chemicals, PFAS doesn't break down in soil and water and has been linked to several human diseases. The chemical is extraordinarily topical amongst investors in many industries, including those for legacy producers of the material like DuPont Chemours, 3M, JCI and others.

There have been numerous legal actions by several localities including the State of New Jersey and Minnesota, with dollar amounts ranging in the hundreds of millions of dollars.

Our teamed has framed what the liabilities could be for 3M, which was probability weighted around $5 billion and for Chemours with a base case MPV of around $0.5 billion and around $2.5 billion in a downside case.

For our Environmental Services AE businesses like Jacobs and others, PFAS is an incremental revenue opportunity for those companies looking to deploy their knowhow and expertise in a market that still is fairly undefined today. As of July 2019, according to EWG, over 49 states, 175 military sites, 712 sites total and over 1,500 drinking water systems are contaminated with PFAS. With increased discovery and needed clarification on a regulatory framework, total size of the market is certainly still developing today but the revenue opportunity for an A&E business we do think could be sizable.

Today, the Jacobs team is very involved in the assessment, treatment and remediation of PFAS and we're extremely pleased to have from Jacobs Bob Pragada, Jan Walstrom and Bill DiGuiseppi on the call today to discuss their involvement in the industry. We've designed this call to be structured towards investors, learning the ins and outs of the industry while also giving the Street an opportunity to understand more about what is a very tough, complex topic.

With that, Bob, I'll turn it over to you for some opening remarks on your end.

Bob Pragada:

Thank you, Adam. Today's PFAS discussion, as you mentioned, Adam, is a quite serious global environmental threat that we at Jacobs are on the forefront of addressing for our community.

Before we dive into the discussion, turning to Slide 4, I want to provide an overview on Jacobs for those that may be unfamiliar with our company. Jacobs is at a $12 billion market capitalization with over $12 billion in run rate revenue that provides technology-enabled solutions to many of the world's most complex challenges. These solutions are driven by the global expertise of over 50,000 technical professionals in the high value domains of environmental resiliency, critical infrastructure, cybersecurity, space intelligence and nation's safety security.

Moving to Slide 5, while today's discussion is focused on our expertise associated with environmental remediation of the PFAS contaminants, this is a core part of our Buildings, Infrastructure and Advanced Facilities line of business. It is important to recognize that deep technology expertise combined with our global scale and delivery model is a clear competitive differentiator as to why customers rely on Jacobs across multiple end markets and multiple geographies.

Now I'll turn the call over to Jan Walstrom, our Senior Vice President and General Manager of our Global Environmental Solutions business to discuss our environmental solutions in more detail. Jan?

Jan Walstrom:

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Thanks, Bob. As we move to Slide 6, we will talk about an overview of how Jacobs views the environmental market in total. As Bob said, our Buildings, Infrastructure and Advanced Facilities line of business houses our environmental end market solutions but Jacobs is built specifically to be able to provide leveraged solutions both in an end market solution for major customers such as national governments and major multinationals as well as enabling market solutions that are significant in terms of moving forward with major infrastructure and capital investment opportunities.

Slide 6 provides an overview of our broad client base which is global in nature and significantly involves the U.S. federal government, local, regional, provincial and other national governments around the globe as well as private sector multinationals served in countries globally.

Our environmental market is approximating $4 billion at the end of Fiscal Year 2018 and continues to grow this year. Based on how the engineering news record prescribes the environmental market, you see that our revenues are almost equally distributed between end market environmental solutions focused on major growth priorities such as remediation and revitalization, planning and permitting and sustainability and compliance, as well as enabling market work in the nuclear arena supporting decommissioning and decontamination work for major national governments worldwide and water related services which you'll hear about more distinctly here for the PFAS opportunity as well.

Our critical outcomes for clients enable them to manage environmental liabilities, enable capital projects and assure operating asset compliance to their most important assets. Bill DiGuiseppi, who is our Emerging Contaminants Leader in the PFAS space will be talking to us about PFAS more distinctly and his work is specific to the remediation and revitalization market area. Bill?

Bill DiGuiseppi:

Thank you, Jan. Moving to Slide 7, really wanted to answer the question why PFAS now? Why is this a big deal and a growing concern at this time, point in time? This sort of timeline here is not a history of the user of PFAS. These compounds were invented in the early part of the previous century and came into commerce in the 40s, 50s and 60s and now represent a very widespread global fluorochemical market for the producers. What occurred is a couple of things that converged at the same time and I have that figure with Flint shown on there. I think that the drinking water issues in Flint, Michigan that became a national news item and a national concern were critical towards making the news media and the public very sensitive to drinking water concerns and that type of lead in drinking water is a current events topic if you've read about Newark's drinking water. They're on bottled water now, so we haven't moved past that necessarily but everybody is sensitive to the topic of drinking water. Between 2013 and 2015, the U.S. EPA under their Safe Drinking Water Act Program mandated that drinking water providers greater than 10,000 recipients had to sample for six PFAS compounds, and what they revealed in that was a large number of people had PFAS in their drinking water and that then was reported through their water providers. They received a mailer, or in the local news media picked up on that and that became a big news item which then led to public meetings and a lot of public concern and more media attention and eventually political action.

Right around that same time in May 2016, the EPA issued a final lifetime drinking water advisory which was a very low number, 80 nanograms per liter or parts per trillion. Everything we've dealt with in our industry or most of it up to now for chlorinated solvents or benzene we've always talked about parts per billion, so parts per trillion is a 1,000 times smaller number or unit. That low number represented the high toxicity that EPA found for these compounds.

Then as public attention, public concern rose, states started to get much more interested and involved and started paying more attention to it. In the center upper portion of that figure is a little logo for the

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Interstate Technology & Regulatory Council. This is a group formed of state regulators and they produce guidance documents and gather information to help state regulators do their job regulating various environmental issues. It's also a group populated by consultants and vendors and academics and others to help support that and Jacobs has leadership roles in several places within that PFAS team but that team ended up having over 600 people on it, pretty much representing all of the states and a lot of other federal agencies and others. So, that group is representative of how important a topic this is to the regulatory community.

Then about a year and a half ago the EPA announced an action program more or less and then just this spring they issued their action plan for PFAS. This is a pretty unprecedented thing. There's never been a U.S. EPA Action Plan around a specific compound or group of compounds. Unfortunately, at the same time other states started moving forward more aggressively. They perceive the EPA's Action Plan as moving too slowly for the amount of community pressure they're under and public concern, so a lot of states are taking action ahead of the U.S. EPA.

Within that Action Plan there are a couple of key things. One is the proposal to issue an MCL, a maximum contaminant level for specific PFAS compounds. That decision will be made this fall, from what we hear, by the end of this year, but what they'll be deciding is whether or not to regulate it with an MCL. They won't be issuing an MCL—that process takes years—so we should hear that. Another element is declaring certain compounds as hazardous substances that would have an effect on a lot of different programs, already established arrangements and cleanups might be reopened, etc.

Then all the way on the right, the last thing is Secretary of Defense started a task force to deal with this. That's how high a level of problem this is in the U.S. As well, there are I think 13 bills in Congress that have PFAS mentioned, either as a funding element or as a requirement to regulate and then to sort of try to move things forward in that direction, a lot of activities are happening towards trying to identify better remedial solutions and I'll go into that a little bit more in detail.

Then, kind of in summary on that slide on the bottom is this timeline. We've gone pretty from in 2014 from a widespread discovery of this as a problem to now, which is a short five years, and we've done a lot of assessment and experimenting with technologies and now we're working towards more detailed investigations. That's a really fast timetable to discovering that we have a problem to trying to implement solutions. We clearly need improvements over the next 10 years or so in toxicology and understanding of behavior in the ground and remedial solutions as well.

That timeline is pretty abbreviated and I'll compare that to a conventional timeline at the end of the slide deck. Are there any questions or comment or anything? I mean from Adam.

Adam Seiden:

No problem. Excellent. Thanks, Bill. That's very interesting seeing that timeline there and you identify some of the improvements that are needed and I think maybe it would be worthwhile to go through some of the challenges that you can see that PFAS presents to Jacobs and to the industry just because it is a forever chemical and what does that mean? What are some of the real complexities that are involved with that?

Bill DiGuiseppi:

Okay, no problem. Moving to Slide 8. The specific challenges, PFAS are a very unique group of compounds. Their behavior is not really like things that we've dealt with before in the industry. This figure is a conceptual site model of a release and migration. This is using, as an example, an airport or an

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aviation, military aviation facility, but a lot of these concepts of movement, migration and where things are would apply to a chemical manufacturing plant or a landfill or some other release location.

In the center of this is firefighting foam. That is a really important release or discharge element for a lot of locations. It would apply to airports, military, bulk fuel storage areas, refineries, chemical plants, small municipalities, rail disasters, etc. and it's broad us of AFFF, the firefighting film. Then that material can in some cases migrate with surface water runoff and soil erosion and migrate into surface water bodies. More commonly, most of it sinks into the ground. A lot of it resides in that location because it's pretty sticky in a lot of cases, some of the compounds are, and they stay present in that soil and represent an ongoing source for the groundwater and that's something we need to be looking at, but other compounds within this suite of chemicals are highly mobile and dissolve down into the groundwater and they can migrate miles in the groundwater. The mobile ones are quite mobile.

Some of the stuff can be atmospheric. Concerns from volatilization as it's used and so it kind of impacts just about every media, air, soil, groundwater, surface water, sediment, every media that we deal with. The key think is as you mentioned, Adam, the forever chemicals. The compounds are very recalcitrant. They don't naturally degrade very easily. There are no natural abiotic nonbiological processes, no oxidation occurs in the ground and they're recalcitrant from a bio standpoint. Bugs don't enjoy dissolving them, breaking them down. So they're recalcitrant. Widespread usage, I mentioned how large the industry is worldwide. They're highly mobile in a lot of cases. The toxicity, the evidence is that there's various impacts to humans and ecological receptors at very low concentrations, and then the regulatory realm continually changes, so it's a challenge for those for a number of reasons.

Adam Seiden:

Many investors in the U.S. tend to think about PFAS as a North American centric issue and I think the scope goes a lot beyond that. Maybe could you touch on the extent that other nations, other countries are dealing with PFAS and certainly how Jacobs has been involved in that?

Bill DiGuiseppi:

Sure. Moving on to Slide 9, this is a map of sort of representative regulations that as I mentioned regulations are changing rapidly so tracking this gets to be a challenge, but you can see a wide range of concentrations I have after each country name and those are in micrograms per liter which is parts per billion. I apologize. I mentioned parts per trillion but if you look at the U.S. EPA, for instance, we have 0.07 micrograms per liter, that would be 70 nanograms per liter or 70 parts per trillion, so we kind of mixed the units up some, but micrograms per liter is what we commonly use in the industry. You can see the numbers range from as low as Sweden with 0.09, which isn't as low as our 0.07 but that's for the sum of nine specific compounds whereas ours is for the sum of two compounds, our guideline, so that becomes a much more conservative number. In The Netherlands they have an administrative reporting number that is even lower, so that is 0.0053 micrograms per liter, one of the lowest reporting numbers, notification numbers. It ranges up as high as in the U.K. as 0.3 and in Canada as 0.6. These are health-based acceptable concentrations that don't warrant any concern.

In a lot of these cases the higher numbers are older numbers where they haven't revisited those numbers lately and our thought is that if they revisit them in the current context of knowledge of toxicity, those number might be reduced.

In terms of activity around the world, Australia is kind of synonymous with PFAS problems. You always hear about Australia and the reason is because of several, actually almost 10 years ago Australia had several high very high profile sites that had impacts to agricultural lands, crops, livestock, drinking water

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and that became news items and that was elevated to the regulations and regulators and it actually led to parliamentary hearings which are similar to our congressional hearings, so it went to the highest levels of their government a solid five years ago and at that time there was much more public awareness and the pressure on Australian Defence who was involved in both of these high profile sites was immense and they initiated a program ahead of the U.S. DoD, essentially a year or two ahead where they started assessing their entire portfolio to determine what their liability might be.

Because of that awareness and knowledge and regulations, Australia, they've gone much farther with other industries, airports, refineries, oil industry folks, petrochemical and other chemical industry in Australia. They're kind of the farthest along in assessing overall, I think.

Some other Northern European countries, Sweden and Norway, they've looked at all of their airports and all of their military facilities several years ago and have a handle on their entire liability, I guess.

Canada, they're kind of half way. They've looked—the Canadian Department of National Defence has looked at a number of sites but they haven't quite looked at everything yet. There's been a little bit of looking at airports, a little bit in industry but not that much yet.

We're kind of on the—a few years behind a number of countries. There are a number that are well ahead of us, and then of course there are other countries that haven't really moved forward at all in this realm.

Then just as far as what our profile of work is, we've done a considerable amount of work in Australia for Australian Defence. We're doing chemical industry work, airports, municipal water suppliers, kind of the whole gamut and it's a multidisciplinary thing with these different arenas within the engineering world. We're doing work in Europe for various military groups and industry, chemical industry folks. In Canada, we're doing work for Department of National Defence as well, and in Asia Pacific area we're doing work for petroleum industry folks. It's pretty broad and that's outside of the U.S., which I'll go into in more detail. A pretty broad profile across the world.

Adam Seiden:

Excellent, Maybe to bring it home a little bit, back here to the U.S., if you could maybe just talk a little bit about the status of client momentum, which you have here nicely on the chart, here in the U.S., where that's been going. Then maybe talking a little bit about MCLs, I think you touched on a little bit earlier for the U.S. specifically, but how important is re-establishing MCLs at the federal and EPA level to seeing where it comes through. Is there any pathway or visibility on something like that coming forward here? Then maybe we'll go from there.

Bill DiGuiseppi:

Sure. On Slide 10 we have just a kind of a simple graph which is representative of our observations and conversations with competitors as well as our own observations within what we're doing and what we've seen is if you go back a couple of years, say five years, it was dominantly the work was U.S. national government, primarily U.S. DoD was moving forward ahead of the regulations because they recognized that they had a large and pending liability and they wanted to understand the extent of that, and other national governments in Australia and elsewhere were also starting to get an understanding of what their liability was. Then in 2016 that kind of expanded a little bit on the DoD side and other governments. We started to see more municipal water providers and others, landfills and airports and others, looking at this topic as well as private sector folks. Then what we've seen just in the last couple of years is much more diversification, much more interest and work to try to, again, understand their liability, assess and evaluate, as well as reacting. The municipal water providers having to provide clean drinking water to

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their folks, we've seen an increase in water treatment in that arena and really this is fundamentally driven by regulations, as you said. In some cases folks are going ahead of them, but in others, for instance in California in March, the State issued order against airports and landfills requiring them to sample for PFAS, so those folks in that state when from having not much motivation to look at it to all of a sudden a requirement, and that's only Phase 1 of their three-phase program. The second phase will be bulk fuel storage areas and refineries and some industrial folks and then I believe Phase 3 is wastewater plants and other things. We're seeing state regulations drive it in a lot of respects.

But then as you mentioned, the EPA, people look to the EPA for leadership in this and they have stated that by the end of this year they will make a determination of whether to regulate PFOA and PFOS, two specific compounds, with an MCL, which has the rule of law behind it. It's a promulgated requirement that all states have to at least follow that or be more conservative. Again, that's a determination of whether to do it or not. It's not a determination that imposes it right then. That process is a many-year process, two to three years kind of at the soonest before that MCL would come into law.

Another EPA regulatory direction that could have a bigger impact sooner is a determination of whether or not PFOS/PFOA or all PFAS within the class are hazardous substances. One of the house bills actually mandates that EPA define all PFAS as hazardous substances. If they do that then under—it would be CERCLA, under the Superfund law. All Superfund sites would then be required to look for that or at least assess the site usage and see if it might be there, but there could be reopeners of closed Superfund sites. There would be renegotiation of PRP responsible party contributions to sites. Additionally, if they declare that then certain states have trigger laws where anything that's a hazardous substance at the state level would require sampling as well. That actually—that determination is supposed to be made by the end of this year as well and if they do decide to define it as a hazardous substance, it still takes three to six months or so, maybe as much as nine months to get that put into law, but that could be a much faster process and that would have a big impact fairly quickly.

I would add that the breadth of this work and this diversification really requires a multidisciplinary approach. We are interacting with folks in Water and Aviation and Environmental, supporting that, so our BIAF line of business is structured really to capitalize on that by having all of us together in the same place and we have a great ability to have folks like me, who is in the environmental arena, work directly for folks on the Water side if they have issues. We are able to bring our expertise worldwide to wherever the problems lie.

Then just to kind of go a little bit into where everybody is, so the U.S. national government DoD has assessed pretty much all of their installations. They are now on the cusp of detailed investigations to define how much needs to be remediated and whether things need to remediated. That's a difficult question to ask with the regulatory uncertainty but that's kind of where they are.

Municipal folks are really just—drinking water people have implemented treatment or have modified their water supplies to provide clean water to folks, but they're deep in assessing what they need to do to continue to provide clean water. Wastewater hasn't really been looked at much but most studies show that a lot of wastewater is impacted because it's in so many consumer products. Landfills are only just starting to be looked at and most landfills have PFAS in the leachate. Airports, pretty much every airport uses firefighting foam. They're required by FAA to train with firefighting foam, but in the U.S. only a handful of airports have been sampled.

Then, as far as private sector goes, most of the private sector folks are having a wait and see attitude. If they're in states that have promulgated requirements they're moving forward, but otherwise they're just holding off, waiting for the regulations to get settled kind of at a national level.

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Great. That's really helpful background around each of the individual areas that are focusing on PFAS but would it be possible to dive into a bit on cost? I think a lot of investors are trying to get their arms around the timing which we've talked about, but also funding and then thinking about what the typical assessment cost is or remediation cost could be. I don't know if there's any rules of thumb that you look at that could maybe be helpful for us to be thinking about along the cost line.

Jan Walstrom:

Adam, this is Jan. Let me jump in here and try and frame this broadly for our industry. While the PFAS contaminants themselves are a bit different in terms of behavior from a chemical perspective, the way the industry approaches this and the regulation that we need to follow in terms of assessing, characterizing, determining technologies, potential remediation and solutions is no different, and so you can use the general rule of thumb that we have gone by for the more conventional contaminants like the chlorinated solvent spending and others. It really is no different for our industry in terms of how we need to go about what we're doing; the fact of the matter is we've got a different kind of chemical constituent to deal with and we have the uncertainty on the regulatory side, and Bill is going to come into a discussion here on treatment technologies about conventional and developing ones that will be the differentiator of how we actually move forward in the next five to 10 years.

Bill DiGuiseppi:

Just moving to Slide 11 then to sum up the technologies, I've got these broken out into sort of conventional or currently available technologies on this page and the next slide is more developing technologies. You might have heard this is a difficult compound to treat and it definitely is, and none of these are—I would say none of these are perfect technologies. Our gold standard is to have a technology that is low-cost, easily implemented, reliable, well proven and preferably green, sustainable technology. For chlorinated solvents, for instance, we now primarily inject sugars or other relatively innocuous food grade substances into the ground, it stimulates bioactivity and the bugs consume or through enzymes they secrete can destroy these compounds, so that's kind of what we're hoping to achieve is to get to that stage, but we're not there.

The technologies we have now are all sort of pretty good ideas. They're adequate to solve the problem at the moment but they're not idea.

Just to go through them quickly, the first two, carbon sorption and ion exchange sorption, this is basically having a media of beads (phon) essentially or particles in a big tank and the water flows through and it grabs onto the PFAS and holds them and allows them to be removed from the water. Carbon is then typically sent back to the vendor and they reactivate the carbon at high temperature, driving the PFAS off of the carbon and treating the PFAS in their own vapor stream emissions controls. For ion exchange media, typically it's a single use resin where you can either incinerate it or landfill it when you're done, when it's full, but it's a much smaller volume that you're dealing with. It's more effective per volume, so you'd have a smaller volume needing to go to a landfill or go to an incinerator.

Membrane filtration is just like reverse osmosis, the typical screen filter sort of concept. It rejects the water and the PFAS on the upstream side and lets clean water through. The downside of that is you have this PFAS laden reject water that you have to do something with so you typically require an additional step to capture that, so you need a multiphase sort of treatment.

Then coagulation/flocculation is a common wastewater technology that has been applied to PFAS in Europe at several full scale sites and it's mostly good for high concentration but it allows the PFAS to glom onto these particles and settle to the bottom and then you have to deal with treating that sludge,

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incinerating that or landfilling that sludge. Again, that could be a pre-step for something that is a better technology and it could preserve the length of the technology if you had, for instance, ion exchange after that.

We're doing—I've got this little column off on the right of where we're active in research. We've been looking at enhancing carbon to try to get more bed life out of it, essentially longer duration before it's treated—before it needs reactivation. We are working with the vendors of cutting edge ion exchange media, different materials are available. We're evaluating all those materials, several of those to try to identify the one that is the most cost effective for the types of waters that we have and the contamination levels that we have. We've done some membrane filtration research. Not all membranes are the same; some pass some of the PFAS through so we want to make sure that we get the right membrane when we do apply that technology and we've worked with a vendor from Europe on coagulation and we've also looked at other coagulants to try to enhance that and bring it to a lower cost per volume treated.

This research, some of it has been internally funded through our own innovation grants and other programs within the company, and others have been funded by U.S. DoD or other national governments over time.

Soil remediation, the straightforward current technologies, which, again, I said these aren't all perfect technologies. Capping, you can certainly prevent leaching through a body of soil if it's impacted. The downside with that is you end up with that body of contaminated soil onsite, you have to maintain the cap, you have to monitor forever pretty much, so that's not really an ideal solution. Disposal, digging and hauling to a landfill is an option, however at this point PFAS are not regulated, much I should say. Some states do regulate it as a hazardous substance. You can't dispose of it in those states. More states are going to implement those types of rules; the EPA might, so you'd have to have a specifically permitted landfill, and then also some landfills are already turning away PFAS waste because they're afraid of the impacts to their own future operations.

Incineration is cooking it at very high temperatures above 1100 C. You can break down those molecules completely. It's a very high-cost option. There aren't that many incinerators around at all at this point because of the regulations being in limbo. There's no such thing as a permitted PFAS treatment incinerator in the U.S. Doesn't mean they're not legal to take it there; it just means that there's no regulations around that, so that will evolve over time and change that.

Then the last one is stabilization. This has been used extensively in Australia and in Europe using a mixture of clay and carbon and other proprietary materials to bind up the soil so that leaching water can't carry the PFAS out of the soil. Again, it may bind it up but we don't know how long it binds it up and we also have the issue of you now have this block of soil on your site that has to be maintained and monitored and you can't build on it, typically, and it will be there forever, so that's not really a solution anybody likes.

Adam Seiden:

Maybe a question on current technology and then moving on to the developing technology. When it comes to a typical treatment using GAC (phon), what is the split between labor versus materials, if there's any way to either quantify that on a percentage basis, something like that, and then maybe then moving that over to the developing technology and what new advancements are being developed in the industry and by Jacobs to help solve some of these treatment solution issues?

Bill DiGuiseppi:

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For any of these, these water treatment technologies or water design installation oversight and operation contracts or projects, and so on some cases we're doing the design and others are doing the construction, in some cases we're doing all of it. The typical rule of thumb in the industry is 90% is subcontractors and materials and supplies and other things and 10% is the engineering oversight and design front end on that. Again, some of the cases we would be the prime on a design/build example or we would be a designer for some and would pass that construction on to a construction firm.

We're doing a little of each I guess, overall.

Then, moving to Slide 12, go ahead.

Adam Seiden:

Excellent. Then on the developing technologies.

Bill DiGuiseppi:

Slide 12, this is just an example of a subsample of some of the developing technologies. There's actually, if you wanted to see the five-page table of things people are attempting to try to make work, you go to the Interstate Technology & Regulatory Council, ITRC page, this massive table we compiled—I was the leader of that remediation group—showing all the different things that are being attempted. Most of those are kind of I guess the likelihood of them being scalable and functional and cost effective at high volumes is less.

I chose this subset. These are things that we are specifically focused on that we think have tremendous potential to bring the cost down overall in the industry.

Oxidation is adding a chemical reagent either above ground or sometimes we do it in situ and it destroys organic contaminants. It's a very common application for chlorinated solvents or petroleum products. We have done research, both self-funded and for others. We're currently working on a research project with U.S. DoD looking at oxidation. What we see is some—as you've heard, PFAS is a big complicated group of compounds. Some of the compounds can be destroyed through oxidation. Some of them appear to be recalcitrant so they don't oxidize readily, and at this point there's really no full-scale field demonstrated technologies for oxidation yet that anybody has demonstrated to be effective on all of the key PFAS that we're concerned about, but we do think that the right combination of oxidants may crack that nut or at least be a part of a treatment train, perhaps oxidizing first to remove most of the mass and then doing something else to the remainder.

Biotreatment is something, as Adam mentioned, these are considered recalcitrant and they're pretty much considered nonbiodegradable overall at this time, but I would point out that if you rolled the clock back 30 years, everybody thought that TCE, trichlorethylene, was nonbiodegradable. People thought MTBE, methyl tert-butyl ether, which is a gas additive, was nonbiodegradable, and then more recently, 1,4-Dioxane, just 10 short years ago was considered nonbiodegradable. All three of those, over the intervening time, we figured out the right combination of bacteria and nutrients and oxygen or lack of oxygen, the right conditions to make that work.

We are actually actively engaged in research, self-funded research with two key universities, UCLA and University of Colorado, looking at using, developing better tools to understand what bacteria are present, which ones are active, the metagenomics and genetic mapping sort of work. We're actively engaged in that to find the right bugs and then figure out what the right conditions are to degrade those. That's something for a water treatment we could build bioreactors, that sort of a concept, for the water treatment.

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Again, this may not be a complete solution but it may be part of it and bio is always the greener solution. We really prefer to have a green bio sort of solution of a treatment train.

The third one there, the in situ sequestration, the idea is to inject a liquid into the ground or inject something into the ground that basically makes the aquifer, the earth into a filter and the PFAS sorb to the materials in the aquifer and don't migrate any further. This could be a containment option. It's a better option than installing wells and pumping and treating because of the high operation and maintenance costs to pump and treat, so to protect a surface water body, for instance, or protect a drinking water well you could inject this material upgradient. We're actively engaged with two different universities on U.S. DoD research grants to move that technology forward. The bench work is all done and actually one of them is going to be moving to field test in the next six or eight months. That's progressing and we think that could be a very effective alternative to pump and treat.

Then, soil remediation, as I mentioned with the other conventional options, none of them are good, so we really need some constructive, permanent solution. We've put a lot of effort into looking at thermal desorption, so unlike incineration, which is at 1000 C, thermal desorption is 300 to 350 C, Centigrade, drive the PFAS off of the soil and then capture it and treat it in the off-gas, which is you can treat it with carbon, send it back to the vendor for reactivation or destroy it with a high-temperature oxidizer on the off-gas. We've been looking at this internally funded for about five years and have done proof-of-concept at the bench scale, the lab and bench scale. We have a demonstration in the field that just occurred this summer under U.S. DoD funding and we're shortlisted for an in situ field demonstration where we're a sub to the U.S. DoD for another DoD grant.

Then I mentioned bio piles. They're taking that whole what I described for bio treatment for water, the right bacteria or fungi, the right place, the right application. If you do it above ground in a bio pile, you are much better able to control the biological processes, the amount of oxygen, etc., and nutrients, so that one needs a lot more development but if we can get it right for groundwater than we can apply that to soil piles as well. These would be—both of these would be onsite, destructive, permanent removal of liability type solutions and we believe that we can get the costs way down below incineration costs or other disposal costs.

Adam Seiden:

You mentioned some of these in your last comments, but in the investor world we tend to look at asbestos, PCBs, glyphosate. You did mention MTBE. These are all environmental or health issues that have affected stocks that we look at here on the investor side. Now, I guess what I'm interested in is a little bit of what can we learn from some of these historical environmental issues, maybe some you mentioned, maybe some others within the contaminant space that could help Jacobs and the industry better address PFAS?

Bill DiGuiseppi:

Slide 13 kind of shows a timeline of what would be a conventional technology that we've dealt with already. Trichloroethylene, chlorinated solvent as an example of that, we had widespread discovery in the 70s and we did the initial assessment of where is the problem, what types of sites in the 80s and then we did detailed investigations and assessments of what type of technologies to apply in the 90s. Then in the 2000s we applied technologies and they were that same sort of group of not particularly perfect technologies, pump and treat, above ground treatment, etc., expensive technologies but they met the need at the time of stopping plumes from moving. But then in the 2010s we optimized a lot of those and

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came up with a bunch of better solutions. Now, here we are in 2020, we have a number of technologies that are good, cost effective, reliable, well developed, etc.

Really, the expectations right now in the PFAS world, everybody wants an answer right away, so if you go to Slide 14 I'm highlighting that 20 years it took us to go from the marginal remedies that were adequate to the good remedies that are green, sustainable, cost effective and reliable, and now that I've superimposed that other timeline from earlier on, we've gone from widespread discovery to detailed investigations in a short five years and there's this expectation from the regulatory community and others that we have the solutions, the perfect solutions right now, and what I would suggest is that there's a lot we don't understand. It's been too fast. We can take the lessons learned from these other compounds and apply it here, but these are unique compounds that have different behaviors, so we need to have some improvements in toxicology understanding so that we get the regulations right, fate and transport so we understand their mobility and migration and everything, and then remedial solution research to understand better the optimum low-cost green solutions.

That's where we are. It's a fast pace, kind of lightning fast but we do think we can do it a lot faster and Jacobs is certainly in a unique position having been involved in this for quite a while and being on the cutting edge of a lot of this research, trying to find those best solutions for our customers.

Adam Seiden:

Thanks, Jan. I think at this point maybe we'll move into Q&A. Operator, if you just want to give instructions and then I'll chime in with a question of mine and then we'll go from there.

Operator:

As a reminder, if you would like to ask a question via the telephone, you may do so by pressing star, then the number one on your telephone keypad. Once again, that's star, one if you would like to ask a question.

Adam Seiden:

Excellent. Maybe just the first one from me here. Thinking about your model and so forth, what's the typical fee structure to the designer for the various forms of treatment or remediation? Could you maybe talk about maybe if the work that's being done in PFAS, is it below, at or above segment margin or something along those lines?

Jan Walstrom:

Sure, Adam. This goes to your question that you asked earlier about assessment all the way through design and remediation, how does it fit in our space? My answer to you on this topic is very consistent with what I said earlier. This is really no different, at least at this point in time, from a segment margin perspective, the kind of work whether we're in the assessment phase, whether we're in the evaluation and design phase, and because Bill outlined the vast majority of what we're working on right now is conventional technology, the segment margins are very, very consistent with what we're experiencing for other constituents as well.

Adam Seiden:

Excellent. Operator, are there any live questions on the line before we go forward?

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Operator:

No, we have no telephone questions.

Adam Seiden:

All right. Maybe one other one from me here. If you go to a bid for a project, what's the level of competition out there? What type of specs—maybe a little bit different question here, but what type of specs does a private company require versus a public? Are there any differences there?

Bill DiGuiseppi:

Other than U.S. DoD work obviously requires much more rigorous quality program and other things so there are additional costs and requirements related to analytical methods and how you deal with the analytical data and data management and other things, but overall they're not vastly different. The problems are of comparable scale, but just the level of complexity of the reporting and requirements and other things.

As far as competition, there are a number of companies out there that are working in this same space and the other large firms are doing similar work to what we're doing and so we see them whenever we go to these competitive bid situations. We're also certainly seeing—one thing for sure, three or four years ago there were half a dozen firms where we were in a smaller pool who were looking at this topic. A lot of the other midsize firms and others weren't really looking at this yet. We're definitely seeing them start to have more awareness of this and so you can look at—just as a measure of it, you can look at conference participation and webinars and all that sort of thing. It's sort of like everybody has kind of figured out now that this is an important topic, so we're seeing much more of the midsize and small firms making a play in these markets as well.

Adam Seiden:

Excellent, thank you. Maybe I'll pass it on to some of my Barclays colleagues here. Duffy, are you on?

Duffy Fischer:

Sure, hi. This is Duffy Fischer, the chemicals analyst. One, if you could, if you went back to some of those past examples, you know, TCE, MTBE, roughly for your market how big did those end up being globally? Then, again, we're doing a lot of extrapolating here, but if you look at PFAS relative to those, how much bigger or smaller does this look to you when you look out kind of at the opportunity set over the next 20 years or so?

Bill DiGuiseppi:

I think that the scale is the market—people are saying this is the asbestos of this generation or whatever. It's definitely big, but if you think about that we spent 40 years working on TCE and petroleum products and that sort of thing, and I don't know what the actual number would be over that whole duration, but I think this is certainly going to be comparable. The complexity and the widespread usage and the difficulty of dealing with this would suggest it will be comparable to what the industry has spent on chlorinated solvents, for instance, over that duration worldwide.

But I guess I would say it appears as if we might end up having to spend that in half the time, in 20 years instead of 40 years because of public awareness, political pressure, regulatory pressure, etc. and

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shareholder pressure on the folks that own the facilities to reduce their liabilities as well. I think it's comparable.

My understanding is there is a set of estimates that is going to be coming out soon, published by the Environmental Business Journal, which are just a model of overall sort of liability across a lot of different markets, so that will be interesting to see what that says.

Duffy Fischer:

Then if you broke the opportunity set for you guys down into a couple of different buckets, so the first one maybe like testing, planning, helping communities or whatever figure out what the solution is; the second bucket, just filtering water, and then the third bucket actually remediating the natural resource, whether that was soil or actually going into the aquifer or to the lake and having to clean that up, how do you see those three buckets playing out? Again, maybe take a decade-long view, which ones are bigger than the others?

Bill DiGuiseppi:

Well, one of the—I would say if you had the whole as 100%, I think that upfront assessment part is 5% to 10%, and I even think the water treatment, drinking water treatment part is only 5% to 10% versus the lion's share being the remedial assessment, implementation, operations, etc. Part of the thing that I had not worked in the water—clean water arena much in my career 30 years in, but what I've found is that, for instance, water suppliers have a number of options. I've always approached a pollution problem as having to be treated, but that's not true. For them, they need to provide clean water. They don't have to clean up the water. So in a lot of cases they'll shut down a well that's contributing a problem or they'll buy water from their neighboring community or they'll do something else that doesn't require any treatment, so there's a number of impacted water supplies out there that have actually spent relatively little money to solve their problem. Not every water impact requires those million dollar remedies, and that was an interesting awareness that I didn't realize beforehand.

But I would say the wastewater side of it is going to have certainly sizable costs because that water coming out is still relatively dirty with other things, not contaminants but organics and solids and that doesn't do well on these filtration media. That will be a particular challenge as well.

Duffy Fischer:

Then, Adam, just the last one from me, when you look at your opportunity set, does getting this classified as the hazardous material under CERCLA help or hurt your view of the next 10 years in this arena?

Bill DiGuiseppi:

I don't think it will have a huge impact, mostly because the states are marching ahead, at least in the U.S. is what we're talking about, but they're—New York has declared it a hazardous substance and I can't remember, at least one or two other states have as well. I would expect if EPA doesn't that several other states will. It really depends on where you are in the country. If it does happen at the federal level, it will have a much more rapid impact across the board, but eventually I think everybody will head that way, and again, companies trying to reduce their own individual liabilities are going to start moving forward.

We have several industrial clients who are doing assessment now to get ahead of it because they recognize that ultimately they will need to understand that liability and manage it.

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Duffy Fischer:

Great. Thank you.

Adam Seiden:

Thank you, Duffy. I think we have the Multi Industrials team on for a question or two here.

Julian Mitchell:

Yes, sure. Just looking at it from our angle and trying to break out sort of how many vendors are really supplying that 5% to 10% of the water treatment that you highlighted earlier and maybe even the balance in soils remediation, just looking at previous contracts over the last decade or so, how many vendors typically feed into that, or is there sort of a sole source provider, let's say, if they choose to move forward with membrane versus coagulation. Is there just sort of usually just one provider or multiples, just based on geographic splits?

Bill DiGuiseppi:

You can imagine the competition in that arena is incredibly fierce right now. There are people—and it's interesting. Our position, I get contacted every two weeks from somebody with a new resin or a new filtration system or a destructive story to tell or whatever. Our challenge is weeding through those because a lot of them have pretty limited data, but there are many options of everything. There are a couple of leaders. In carbon, for instance, there's two or three that sort of dominate the market, but there are all kinds of other people nipping at their heels and coming up with unique blends of clay plus carbon and other proprietary things. It's really—it's an interesting arena to work in but the challenge for us then is vetting those on behalf of our customers and making sure that we have confidence in them before we recommend them.

So, there is considerable competition. There's no dominance in any of these arenas.

Julian Mitchell:

Got it. I guess the implication there is that there can be sort of more than one winner per contract? If you have two people with very feasible solutions that both pass the vetting process, they could both be providers on a contract or is that just sort of not how these things work?

Bill DiGuiseppi:

Well, for one thing, I mentioned about treatment trains and so a pretty common thing is to end up with two technologies in a row, one is optimal at higher concentrations and one is optimal at lower concentrations. Anything that you could put ahead of carbon or ahead of ion exchange that will allow the ion exchange or carbon to last two, three, four times longer, that's a huge cost savings. So in many cases we would in fact use multiple technologies and have multiple vendors providing those technologies to get the optimum lifecycle cost treatment.

Julian Mitchell:

Understood. That's all for me. Thanks.

Adam Seiden:

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Thanks, guys. All right, well, I think at that we're right up at about the hour so I do want to thank the Jacobs team for making everyone available here. It's extremely useful and maybe pass it on to Jan or to the team if they have any concluding comments on their end.

Jan Walstrom:

Thanks, Adam. We really appreciate the opportunity to support you and provide additional insight to the investor community, so thanks so much for this.

Adam Seiden:

Great. Thanks so much and have a good day.

Jan Walstrom:

Thank you.

Bill DiGuiseppi:

Thank you.

Operator:

This concludes today's conference call. You may now disconnect.

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