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RESTORATION ADVISORY BOARD

FOR

NAS JRB/ARS WILLOW GROVE

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December 9, 1998

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Meeting held at the Willow Grove Air Reserve Station, at 6:00 p.m. on the above date before Denise A. Ryan, a Court Reporter and Notary Public of the Commonwealth of Pennsylvania.

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FOSTER
COURT REPORTING SERVICE, INC.
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SPEAKERS:

JIM EDMOND, Moderator

CHARANJIT GILL,
Air Force Reserve

NEIL DURANT,
SCOTT SHAW,
HSI Geotrans

JULIE WIDMAN

QUESTIONERS:

TED ROTH
ERIC LINDHULT
RICH PEFFALL

MR. EDMOND: I would like to welcome everyone back to the Naval Air Station, Air Force Reserve Station Restoration Advisory Board. Tonight the Air Force will have the second half of the agenda. They are going to get the status on all their IRP sites and status of all their remediation action, but to open up the meeting I would like to ask any of the community members or anyone else in attendance if they have an agenda item they would like to talk about, any comments they would like to make about past meetings or anything of that nature? We will start with that.

(No response.)

MR. EDMOND: I know that we were going to talk about our Phase II IR. We got comments back from the community. We are waiting for comments back from the regulators. Hopefully by the next meeting we will get all the comments back, they will get to our contractor who will answer them with our help and we will discuss our comments on the Phase II IR. But this

evening if there is no comments or agenda items from the community, we will move on to the Air Force. So is everyone in agreement?

All right; then I will turn it over to Mr. Gill from the Air Force Reserve. He is the program manager for their IR Program, and he will take it from there.

MR. GILL: Thank you. My name is Charanjit Gill and before I turn this over to our experts, Scott Shaw and Julie Widman, they are going to give you the specific information on the sites, I just want to go over I guess on the Air Force side, just give you a brief description of the Installation Restoration Program, so I can let you know -- I guess I am going to start off with, we do have seven sites on the Air Force site and I am going into each site and I am going to give you a really brief description of each site.

I guess we are going to start with Site 1, which is a POL area. We

had a spill there back in '79, 1979, and before that there were a few spills, and we have petroleum type of contamination there. Okay; I don't want to go into the remedial because Scott Shaw is going to go into that.

MR. EDMOND: Would you like me to turn off the lights?

MR. GILL: Yes, please, if you can.

(Discussion off the record.)

MR. GILL: Site No. 2 is an open storage area. We used to store engine oil, hydraulic fluids and some solvents in that area, and back in 1988 we did issue a decision document with no further response action planned since the contamination at Site 2 was pretty much the same as Site 1 because it's located right next to the POL area. So we issued this decision document saying that we weren't going to take any further action on this site and we were going to clean that site with the POL site.

The same thing with Site No.

3, which is the ponding basin, we had a similar type of contamination, a petroleum type of contamination at that site.

Let me go to the next one.

MR. ROTH: Are you going to have handouts of this?

MR. GILL: Yes, I will give you that.

Okay; next one is Site 4, which is the washrack area. We used to wash the aircrafts there and we still do, and that site had a TCE type of contamination in the groundwater, and especially the deep wells have a TCE contamination.

Now we did issue a decision document with no further response action planned for this site but since we got an NPL back in '95 the EPA asked us to reinvestigate that site, which we actually were looking for the source for the TCE contamination and based on the result of the TCE contamination we are going to be doing a further investigation.

The next site is the waste

oil storage area. We used to store a 250-gallon waste oil storage tank there, and we are investigating that site also because of our NPL status, and Julie is going to be discussing that today.

Sites 6 and 7, since there weren't any contamination found, we are not taking any further action on those two sites, the last ones.

I think I am going to ask Scott Shaw to go ahead and give his presentation on Site 1.

MR. DURANT: My name is Neal Durant and I'm here with Scott, Scott is my colleague at HSI Geotrans, and I am going to talk to you about an Aerobic Biodegradation Pilot Study that we are going to conduct in the POL area. I have got 15 copies of my presentation, and I will try to distribute them as evenly as possible. I don't know how many people are here, if there is enough to go around.

Now we should go with dimming the lights, do you think? If anyone wants lights on to take notes, you

can reach a consensus. I just think you can see things better if we keep it dark.

So now without further adeu, we are with HSI Geotrans and we are working with Charanjit to do this Aerobic Biodegradation Pilot Study in the POL area, and what this is going to involve is introducing on oxygen releasing compound into the POL area, hydraulically down-gradient to the POL area to enhance biodegradation in the ground of any JP-4 constituents that are in the subsurface there. This is a very cutting edge technology that is being applied at a lot of sites across the country and we think it could be very successful right here.

So I am just going to cover a little bit of the history of the POL area, just to be a little bit redundant, before 1979 we had a number of releases of JP-4 from above-ground tanks and we are not exactly sure how much was released but anywhere between 5,000 and 30,000 gallons of JP-4 was released. We know that a smaller amount, 150 gallons, was released

as a result of some tank cleaning. That's what went on before 1979.

During 1979 there actually was a documented release of approximately 8,000 gallons from above-ground tanks, and these historical releases of JP-4 is what we are trying to adress today with this Aerobic Biodegradation Pilot Study. And I want to emphasize that, this is just a pilot study. We are testing the applicability of this technology to clean up this contamination. This isn't necessarily going to be the long-term solution but we are testing the feasibility of this technology before we make the next step to a larger scale application.

Just to give a little appreciation for the history of investigations in this area, in 1988 there was a remedial investigation that discovered LNAPL near the POL area. "LNAPL" stands for Light Nonaqueous Phase Liquid. It's an immiscible phase. It just means that it is pure JP-4 or some literal residual in the ground. That was

discovered near the POL area in 1988.

In 1992 there was a supplemental remedial investigation conducted that delineated the extent of that LNAPL contamination. That 1992 investigation also did some laboratory studies which observed that the likelihood of bacteria in the ground in the POL area were capable of degrading the JP-4 constituents. So as early as 1992 we had encouraging evidence that the soils in the POL area are capable of biodegrading the JB-4 constituents.

In 1996 to 1997 there was a further characterization of the LNAPL or the extent of the JP-4 contamination. And we need to -- we did it in '92 and we did it again in '96 and '97. We need to periodically monitor the extent of contamination. And as I will show you, what we have seen is that the extent of the plume has shrunk over time, and we think this is due to natural biodegradation mechanisms. Also in '96 and '97 we evaluated our ability to enhance the

existing soil vapor extraction system, which I will talk a little bit more about. In the next slide I will talk about that.

Under the history of remedial measures, in 1992 as I mentioned there was a laboratory biotreatability study done where they were looking at the ability of the native bacteria to degrade the JP-4. In 1993 there was a passive recovery trench installed to collect or intercept any groundwater contamination that was migrating from the POL area. There was also a soil vapor extraction system installed. That's what "SVE" stands for.

Basically in soild vapor extraction, it's just what it sounds like, you are extracting the vapors that are coming off the JP-4 on the groundwater. Because JP-4 is volatile, we can extract those vapors. Unfortunately, the performance of the SVE system was poor due to a high water level. The water table at this site fluctuates pretty dramatically and historically it's been pretty high at

certain areas, particularly down by Park Creek Tributary.

When this SVE system was running, the water table was too high to effectively remove a lot of vapors, so in 1997 we modified that system to use a combined soil vapor extraction and a groundwater extraction. We did a pilot test of this technology where we were simultaneously trying to extract vapor and pump groundwater to draw the water table down. Unfortunately, we didn't get a significant amount of improvement with that modification, so after 1997 we sort of went back to what we knew to be what we observed in 1992, which is the occurrence of these bacteria that are capable of biodegrading the JP-4, and where we are today is putting our efforts into examining more closely this question, to what extent can we use the existing bacteria to enhance natural biodegradation to contain and ultimately remediate and remove any of the JP-4 constituents in the subsurface and POL area.

MR. ROTH: That JP-4 is sitting on top of the water?

MR. DURANT: In general, yes, because it's --

MR. ROTH: So high water pushes it up?

MR. DURANT: That's right.

As things stand right now, the water table is very low. So the water table is approximately at least, what, about 15 feet below ground surface, Scott?

MR. SHAW: I took several measurements and it's about 15 feet.

MR. LINDHULT: Is the LNAPL in the soil or bedrock?

MR. DURANT: The bedrock, it occurs in the POL area around 8 or 9 feet below ground surface. So I think it's not defined to any specific -- it's not just sitting on top of the bedrock. It's basically, when you get to the top of the bedrock, as you may know, there is a weathered region, a saprolite region, so there is going to be a little bit of residual -- our conceptual model is that

there is a residual, little blebs on top of that saprolite and that may extend down a couple feet into the saprolite, but it probably is in that interface between just maybe a foot above the saprolite and maybe a couple feet below the saprolite.

MR. LINDHULT: So it's not necessarily in the fractures of the bedrock?

MR. DURANT: No; especially given -- we expect that in the spring, when the water table gets pretty high, which it really does in most years, it can get as high as to the ground surface, that that's going to really exert a buoyancy which is going to prevent downward migration.

MR. ROTH: But we are dealing with a liquid, and there is a meniscus between the two.

MR. DURANT: Yes, there would be a meniscus between the two.

Scott, maybe you could add some detail to this, but I think it's our conceptual understanding that there isn't a continuous pool of JP-4. Our conceptual

model is that there is residual blebs, what they call ganglia, that might be caught in the pore space in the interstices of the soil and in the top of that weathered bedrock. But in our conceptual model to my understanding there isn't a large continuous pool sitting on top of the water table.

Is there anything you want to add to that?

MR. SHAW: That's consistent with when I observed. I just finished installing the six monitoring wells around the perimeter of the POL area. I did not observe any free product, a pool as it were, of LNAPL in any of the wells that we installed. That's fairly consistent with what we expect to see.

MR. ROTH: One thing though, is if the water level goes down and the fuel oil goes down with it, when the water level comes back up, won't it go into domes just as it does in --

MR. DURANT: There will be some resistance but ultimately as the water

comes back, there might be some caught beneath the water table as the water table rises in the spring, but that rising of the water table will also capture some and bring it back up.

MR. ROTH: Right.

MR. DURANT: So to an extent the movement of the water table doesn't help us because it makes that LNAPL a moving target between seasons. So that's a little bit of -- that's a factor that we have to consider and that's a factor that we are considering right now in our design for this pilot test. It's just it's an unfortunate occurrence of nature for what we are trying to do.

MR. ROTH: Thank you.

MR. DURANT: I should add that, I mean, if you are familiar with these types of investigations, detecting LNAPL in its pure phase is very hard, very difficult at many sites, and this is one of the most elusive challenges that faces many people, many investigators who are looking at constituents in the subsurface.

This is just a simple schematic, for any of you that are new to this, of what -- this isn't for this site in particular; this is just a simple schematic of what constituents in the groundwater, oil constituents or JP-4 constituents in the subsurface might look like. This shows a facility, and the red area is a groundwater plume with the most, the highest concentrations of constituents and as you move down to the lower left, that's the direction of groundwater flow. The concentrations of the constituents in the groundwater plume and the subsurface become more and more dilute, less and less concentrated, and what we are seeing increasingly in research, and here at this facility as well, is that bacteria in the ground possess the capability to degrade many types of industrial compounds, and many of these are in JP-4. JP-4 is a very common candidate for biodegradation, remediation by biodegradation.

Okay; so back to Willow Grove, this is a depiction of the POL

area. We see the POL area here highlighted in red in 1992, and in the cross-hatched region, that is the extent of what 1992 was measured to be the extent of pure phase JP-4 contamination. Again, this is just residual blebs that might be detected in wells. It extended down to Park Creek Tributary, as you can see in the left-hand side of the figure. This yellow delineated region is the extent of this dissolved phase plume. So this isn't JP-4 anymore; it's just the dissolved phase constituents that were detected in the groundwater.

So that's what the situation looked like in 1992. In 1996 the extent of the JP-4 contamination has attenuated, it has shrunk relative to 1992, and we think that this in part is due to natural biodegradation mechanisms.

This figure also shows the location of the passive recovery trench that was installed in 1993 to address -- to capture any migration from the POL area. Also the soil vapor extraction wells are shown here that were installed as part of

the pilot test that operated in 1994 to May 1996. So those were the two measures, the passive recovery trench and the SVE system, that had been operated through 1996.

Now we come to 1998. When the steering committee for the POL area remediation made a collective decision after reviewing the performance of the SVE test and looking at the current technology, they decided that we wanted to test what we call ORC, which is an oxygen release compound, and this oxygen release compound, as I will show, stimulates biodegeneration but this ORC is a magnesium peroxide, and we have the formula for magnesium oxide, and when we put this magnesium peroxide in the ground and we expose it to water, it hydrolyzes and releases oxygen, then this oxygen can be used for biodegradation.

In this example I have shown benzine and oxygen are used by bacteria to create more bacteria and they also release carbon dioxide. But that oxygen is crucial or helps a lot, should I say, for benzine biodegradation. The only other thing I can

show in this bottom equation is the presence of bacteria to cause reaction, it happened, but they are there at the site.

So this oxygen is released by the ORC is really a key ingredient to getting those JP-4 constituents to degrade, and that's what we want to test at the site, is how well will this compound serve us here at Willow Grove.

This schematic shows how ORC or oxygen release compound is implemented at a number of sites; and this is not -- this cartoon does not pertain to Willow Grove directly, but it shows that this is a subsurface schematic, in the upper left-hand corner, you can barely see it, was the site of an underground storage tank which in this cartoon leaked and then in the center of the figure you have a source, a source of contamination, and the way it's being treated is borings have been drilled in the ground and these borings have been backfilled with ORC, this ORC slurry, this magnesium peroxide slurry, and that slurry, which is in the ground, is in groundwater,

releases oxygen over time.

So in this schematic here, the ORC is releasing oxygen to treat the source zone, then it's also being put down-gradient. Groundwater flows this way. They have put in a number of wells or borings here and backfilled them with ORC to create and what they have got is an oxygen barrier, so this is an oxygenated zone to act as a barrier for migration of contaminants coming off of the source area.

So this is a technology that's been developed by Regenesis, a company out in California, and this is how they are pushing -- this is how they have been applying the technology at a number of sites.

MR. ROTH: What does magnesium peroxide do to our drinking water?

MR. DURANT: Magnesium is a natural salt.

MR. ROTH: It's in our water, yes.

MR. DURANT: It doesn't affect the water. In some cases magnesium, what happens is it hydrolyzes and that hydrolyzed product, which is magnesium hydroxide, is largely in many cases insoluble, so it stays put, it doesn't dissolve, and the concentrations of magnesium around -- for the applications that we are using here are not significantly elevated beyond what is a normal health based level.

Magnesium generally, it's just like a salt like sodium, is not considered to be in any way -- to exceed health base levels.

MR. ROTH: But we are not contaminating our water with something to get rid of something else --

MR. DURANT: No, No.

MR. ROTH: -- hopefully.

MR. DURANT: No, definitely not. I couldn't even tell you what the drinking water standard is for magnesium. When you treat your home water for hardness, you are treating it many times

for magnesium.

MR. ROTH: That's right, you are making water harder.

MR. DURANT: But it's not what I would say to compare in any way with the level of what we are treating when we are removing the JP-4 constituents.

So at Willow Grove, this schematic focuses specifically on the POL area and this shows the layout of the pilot test, what we are going to focus on.

This is hydraulically up-gradient and that's hydraulically down-gradient, and what we have proposed for the design of the pilot study is install an ORC fence line, which is an array of borings, Geoprobe borings or well borings, in which we would backfill them with ORC slurry and this would provide an oxygen source that would flow down into the POL area to provide a treatment zone to begin to target this POL area, this JP-4 source.

Then we also had a couple monitoring wells here, which Scott

installed recently, and the intent is to use these wells to monitor the performance of this ORC injection array just to make sure that we can detect lots of oxygen coming off, that things are operating the way they should.

Again, this is a pilot study where we are testing the performance of this technology at Willow Grove.

We also propose to put in an ORC fence line down-gradient of the POL area. And at this edge of the POL area what we really wanted to do was to create an oxygenated fence line or barrier to capture any JP-4 coming off the POL area and we were going to both monitor wells up-gradient and down-gradient of the fence line to monitor the performance of JP-4 removal across that fence line. So we'd have a measure of both up-gradient and a measure down-gradient, and we have got five wells shown that we were going to monitor.

MR. LINDHULT: My question was, you get a greater concentration of oxygen in the groundwater but when you

anticipate the degradation across the site, do you anticipate there still being residual oxygen by the time it gets to the down-gradient?

MR. DURANT: That's a good question. The oxygen saturation, the most we can hope to get in water is approximately -- it's temperature dependent but the most we can probably hope to get is about 10 milligrams per liter at the subsurface temperatures. So for this ORC fence line, it's releasing oxygen up-gradient of the source, we expect that we will have an oxygenated zone perhaps 20 to 50 feet down-gradient of this fence line, but once we move into the POL area itself the oxygen will all be consumed.

So really what the intent of this fence line is just to begin to get at the source of the JP-4 on this up-gradient portion. This fence line down here, however, is really intended to target what is the plume, the dissolve phase that's coming off of the POL area, and we expect that this zone here between this edge of

the POL area and the fence here, that this will be oxygenated and that we will be able to measure that oxygen.

But that's our conceptual model, that's our hypothesis, and this is really what we are trying to test the performance of in doing this pilot test. I mean that question you asked is really something that we are really trying to get at, which is how effective, how much, what zone is going to be oxygenated by this ORC technology. We have some goals but the data aren't in yet.

MR. LINDHULT: And I am curious about this slurry, what do you anticipate its lifetime to be and when it goes, do you have to auger it out and replace it?

MR. DURANT: The slurry, basically the way -- our protocol for the pilot test is to do a single injection, and as I will show in the schedule, we hope to do an injection around January if the water levels are permitting, and we expect that single injection to last between six and

nine months. At that time, we are prepared to do a reinjection, at about anywhere between six and nine months, if we see a dramatic reduction in the performance of oxygen release.

And the way we are going to do that is, the borings that we are going to install initially are going to be equipped with reusable injection ports so we will be able to come back later in time and inject more ORC slurry.

But we don't need to extract the original slurry that was in the ground. What happens is that slurry hardens over time and that magnesium hydroxide shrinks, so there will be space created over time as that magnesium peroxide is converted into magnesium hydroxide.

So I showed you the layout of the pilot test and what we intend to do. We actually intended to start this pilot test -- we had hoped that it would be underway right now, but we have run into some problems, and the problem is that

there hasn't been enough rain this year. I think that rain levels have been three times less than they are normally, and what that has done here at Willow Grove is it's significantly lowered the water table.

If we look at -- we have shown basically eight wells, eight wells that we were interested in for this pilot test, and the top six or the top five were installed recently so we don't have data for them for 1997, but if you look at the bottom three wells, DM-3, DM-4 and DM-5, you can see their water level in January of '97, and that number there is the water column in feet. Okay; so you have got 5 feet of water to sample in DM-3 in January of '97, while in October of '98 DM-3 is dry. That 5 feet of water has dropped completely down.

And as we measure through October, Scott has been coming back bi-monthly to measure water levels, and we keep hoping the water levels are going to come back up, but we just haven't had enough rain, and we can't really

successfully hope to start this test until water levels come back up and return to what they were in January of '97. So we are really hoping for rain in the month of December so that we can get things started in January, because in order for this ORC pilot test to work, to measure the performance that we are really trying to get at, we need to have water in the wells to do so. So these drought effects are holding us up at this point in time.

So for Schedule, we started the monitoring well installation in October, and that went pretty smoothly. We installed a total of six wells, four of them targeted on the pilot test area and then two sentinel wells which we were trying to define the up-gradient extent of JP-4.

So those six wells were installed by the middle or end of October and then we began groundwater sampling, and this groundwater sampling is important to get a reference on background or ambient concentrations for the performance of the

ORC. And we started that in the beginning of November and we had hoped, as I mentioned, to get down to the ORC emplacement, which is on the bottom category there, but it looks like right now our plan is to wait until mid-January to get this started, and the commencement of this, of putting the ORC in the ground -- the test starts as soon as we put the ORC in the ground. We can't do that until we have confirmed the water levels to support it. So that's where we are at right now, and hopefully we will get some rain.

Are there any other questions I can answer?

MR. LINDHULT: Question about the groundwater itself, it's obviously lacking oxygen. Is it also lacking nutrients or is it sufficiently --

MR. DURANT: It's definitely lacking oxygen.

With regard to phosphorous, I don't think we know the answer to that question. I think that when people first started doing bioremediation, there was

sort of a consensus that subsurface was nutrient deficient. I think what we are seeing now is that the role of nutrients is actually much less than what we thought it was originally.

Actually I brought a paper that I wrote on the subject. The supply of nitrogen and phosphorus in the ground is often sufficient to support biodegradation at this level or at this rate.

Scott, you measured -- Scott measured nitrate when you were here last?

MR. SHAW: Right.

MR. DURANT: Do you remember if you got any hits?

MR. SHAW: We measured nitrate from the lab results and they were just recently back. They were not appreciable, wouldn't consider the concentrations to be too high. The thing we did notice was in groundwater samples from the three wells immediately down-gradient the oxygen levels were basically zero and from the two wells up-gradient they are approximately two

parts per million or two milligrams per --

MR. DURANT: But the two parameters we would measure if you wanted to go out and do a correct assessment, to answer your question directly, would be you would measure nitrate and you would measure ammonium, and you can't measure phosphorus in groundwater because it's all stuck to the sediment. It's pointless to measure phosphate, orthophosphate, in groundwater because you shouldn't find any. Even if there is lots in the ground, you really shouldn't find any in significant concentrations.

To my knowledge, I don't know if ammonium has been measured in the groundwater at the site. Nevertheless, I think many times the rule of nutrients is overemphasized, that this technology can work very effectively under the right conditions without adding nutrients.

Thank you.

MR. GILL: Julie is going to talk about Site 2, 3, 4 and 5, right?

MS. WIDMAN: Yes, exactly.

I have got some handouts as well. These are actually drawings.

Basically what I am going to do is go over the status of the sites that we haven't discussed yet and that Gill went into a little bit of detail on when he was speaking, namely the washrack area, the former drum storage area, the waste oil tank and the ponding basin; and there they all are with their IRP designations.

Just to give you an idea of, you know, the timing of what we have been doing at these sites, we started work on the washrack/trickling filter back last fall, in November of '97, put in our soil borings, did some soil sampling, installed monitoring wells and sampled those, and basically wrapped that work up in January of '98.

In April of '98 we submitted a draft report to EPA that presented our findings from that investigation and also made a recommendation that we needed to install one more monitoring well, and that well went in in October of this year. It

was just sampled last month. So we really don't have any results out of that well yet, but we should, you know, essentially have wrapped up the investigation of the washrack and trickling filter area with the work we just completed.

The other IRP sites that we are talking about here, we submitted a work plan to EPA in June of '98 and just completed the fieldwork portion of that work plan last month. We did some soil samplings, surface water sediment sampling, and all of those samples have been submitted to the lab but we don't have those results yet. So this is kind of where we are at this point.

I want to spend a little bit of time on the washrack/trickling filter site because this is the one that actually I guess led to the NPL listing. This is the big one.

When we started work on this site, we really had three objective: There was a well-documented TCE plume beneath the washrack area itself and beneath the Privet

Road compound, so we wanted to find out if the washrack area itself was the source of that TCE; we also wanted to find out if it was the source of TCE beneath the Privet Road landfill; and finally if it wasn't, we wanted to determine if maybe there was another Air Reserve Station source that might have been contributing to that, the groundwater contamination that we see. I guess I should mention, the location of the sites that I am talking about is on the first two drawings that I handed out, if you need to orient yourself relative to the base.

For the other sites, our objectives are a little less complex. All of these sites have been proposed for no further remedial action in the past and essentially what we are doing was confirming that there really aren't problems there that need to be addressed. So we are looking to see, you know, that we really understand the nature and extent of any contaminants that still remain at the open drum storage area, the ponding basin

or the former waste oil storage area.

Going into the source identification study -- and this is relative just to the washrack/trickling filter -- there were several different investigative activities we performed last fall. As I mentioned earlier, we did some soil borings, some soil sampling right in the area of the former trickling filter, right in the area where you would expect there to be any soil contamination remaining if there was some there. We installed three intermediate level monitoring wells, one shallow one. We put wells in up-gradient of the washrack, meaning they were between the Privet Road Compound and the washrack area, and down-gradient.

When we did that monitoring well installation, we did a variety of I guess investigative techniques on those bore holes themselves to get as much information, subsurface information as we could when we were putting those wells in the ground, and those different techniques

are listed here. We did down-hole geophysics, which helps us understand the lithology beneath the ground, what the rock types are like and where the fractures are, we did down-hole TV, which I imagine some of you were here last year when I showed the video of one of those bore holes that shows you where the fractures actually are, and we also did what is called a vertical flow meter, which measures groundwater flow between the fracture zones and the bore hole. All of these things again are geared at giving us a complete picture of what the subsurface conditions are like.

Probably one of the most valuable things we did was to do some continuous water level measurements when we were drilling the bore holes, and what I mean by this is when we were set up on a bore hole and we were advancing that, we put continuous water level monitors in nearby wells, because if you are drilling a bore hole with an air hammer system, which generally that's how monitoring wells are drilled around here, the air that's forced

down into the bore hole in order for the bit to advance actually blows water out of the hole and what this does essentially is simulate pumping that hole. As you are drilling it, you are essentially pumping it like you would a well, because the water gets blown out bringing the cuttings with it.

So if you are doing this in one location, you can look in holes that are adjacent to that and see if you see any influence, because if the zones that you are coming across as you are drilling are connected, you should see water level response in nearby wells; and we actually did see this. So we know that the wells that we put in around the washrack are hydraulically connected to the wells that are installed up-gradient of the washrack around the Privet Road Compound, meaning they screen the same zones, and that contaminants that are migrating from the area of the Privet Road Compound are going to be intercepted by the wells that we installed.

Let's see, other things we did, we did Packard testing, which gave us a vertical profile of contaminants. We were able to look and see what concentrations were at specific depth intervals in the bore holes. We essentially looked for fracture zones and went down there and tested them for contaminant concentrations. We also did more typical stuff, water level measurements that showed us what the potential metric surface looked like and then monitoring well sampling and analysis.

What did this show us? Well, it indicated that the washrack trickling filter area itself is not a source of the TCE or the PCE for that matter that we see in the monitoring wells in the area of the Privet Road Compound and it also demonstrated that the Privet Road Compound may be the source of some of those contaminants but it also could be a different source located further up-gradient based on the hydraulics.

MR. PEFFALL: Could they be sources outside of the base?

MS. WIDMAN: Yes. I mean it's the kind of thing where you can't exactly point a finger and say, "There it is." All you can do is point a finger and say, "There it isn't," which is essentially what we did.

Now, these conclusions were based on several lines of evidence. As I mentioned, we did a lot of work to characterize the subsurface and we found that -- well, we found exactly what the Navy found, that we have a fractured bedrock aquifer, it has a shallow water table in the weathered portion of the rock and then there is an intermediate zone at depth where the water is somewhat semi-artesian. These zones are connected, they are not isolated in any way, but it's a more limited connection vertically than it is horizontally. And we came to that understanding based on looking at water level response when we were doing our drilling.

Looking at the characteristics of flow in these zones -- I believe it's Figure 3 that I put together here shows groundwater flow in that shallow water table zone -- we see that it's basically towards the northwest. This is a regional groundwater flow direction, meaning it's from the area of the Privet Road Compound towards the washrack. This gradient doesn't respond or switch directions based on pumping of the Navy supply wells, so therefore the washrack area itself is always down-gradient of the Privet Road Compound in the shallow zone, it's never up-gradient, meaning it cannot be a source of contaminants to Privet Road in the shallow zone.

If we look at flow in the intermediate zone, which is actually where most of our concern lies because this is where we see higher concentrations of TCE, we see what is shown in Figure 4 under what I would call this nonpumping conditions of the Navy wells. I can't call this normal because the Navy supply wells operate very

frequently. But if they are shut off, you see the kind of flow pattern that I have in Figure 4, meaning groundwater flows to the northwest in the intermediate zone similar to what we saw in the shallow zone and that flow direction under those circumstances has the washrack down-gradient of the Privet Road Compound.

If we turn the Navy supply wells on, we see an actually somewhat different picture, and that's what I have shown in Figure 5 in the handout, and when the Navy supply wells are operating, there is essentially a break in the groundwater flow field and I guess what you could say a stagnation zone or a groundwater divide develops somewhat to the west of the Privet Road Compound. What this means is that on the east or southeast side of this divide, because the supply wells are operating, groundwater flows towards those supply wells as opposed to flowing to the northwest as it does when they are not operating. On the other side of that divide, groundwater flow is not impacted by

the Navy's operation of these wells and flow remains to the northwest.

Now, what is critical about this picture is that that divide occurs up-gradient or southeast of the washrack area itself. What this means is that when the Navy supply wells are operating, the washrack remains down-gradient of the Privet Road Compound, it is not up-gradient, and groundwater can't flow from the washrack towards the Privet Road Compound. There is a break there. The groundwater, once it gets west of that landfill, is caught in the regional gradient and always flows to the northwest.

This -- I'm sorry; do you have a question, Jim?

MR. EDMOND: What impact would the Air Force well, production well have on this plume if the Air Force well was working?

MS. WIDMAN: They would play tug of war. I guess it would really depend on how you operated them, what the relative

pumping rates were, you know, while the Air Force -- if the Air Force supply wells were operating and the Navy wells were not, you know, just in theory, what would happen is this plume that underlies the Privet Road Compound and the washrack area would speed up its travel to the northwest because it would be drawn into the well.

If you were operating both of them at the same time, I think this divide that we see would shift position. I don't know where it would be exactly, but it wouldn't look exactly like this.

But operation of the Air Force well would essentially just pull things more rapidly to the northwest.

MR. EDMOND: Thank you.

MR. ROTH: I believe from what I read in the papers, there is a water main installation project going on down off County Line Road because of contamination, and that would be roughly where this water is flowing to at this point, and I had not realized that there was any water flow in that direction. There is also a water main

scheduled to be put in because of muddy water, I don't know what else is in it, down about, oh, maybe a mile off the end of this runway here, heading in a southeasterly direction. I wonder if that's coming off the base.

MS. WIDMAN: Well, the extent of groundwater contamination associated with this plume, the down-gradient extent, isn't completely defined but by the time you get down-gradient of the washrack essentially where our monitoring Well 2B is, your concentrations are essentailly down at or below MCL's, so it's unlikely that you would see anything at all if you moved much further away from that site. I mean you have almost diluted it into nonexistence, you know, where we had monitoring wells.

MR. ROTH: They had been chasing their tail on the County Line Road side, trying to find out the source of pollution, if I remember what was in the paper correctly.

MS. WIDMAN: Well, I

guess --

MR. EDMOND: There was a DEP advisory about that, and that's pretty far from the air station.

MS. REIGH: That's the other military --

MR. EDMOND: It's up County Line past -- it's around the nursery there on County Line.

MR. ROTH: I was thinking there was one down there towards Linda Lane.

MR. EDMOND: I don't know about that, but I know that the state gave Horsham money to pipe water into those people's homes, and that's I would say a good couple miles from the base. That's at the other end of County Line Road.

We got that advisory last week and we went "Oh, Oh, no one told us this," and we went looking and it's pretty far out.

MS. WIDMAN: One thing to keep in mind about this entire area is that there is a regional groundwater problem

with low levels of solvents similar to what we see here at the base, so it's very difficult to attribute a couple parts per billion of any solvents to any one thing. I mean it's regional. I think most of the supply wells in Horsham Township are contaminated, based on studies that Ron Sloto did. These are really, really low level concentrations.

Have we got anything else?

I guess I did go over this already, the important point being on the hydrogeology is that pumping the Navy supply wells in and of itself is not enough to reverse the gradient and bring flow back towards Privet Road from the washrack area.

And as I mentioned previously too, by looking at water levels during drilling we can see that there is hydraulic connection among the fracture zones in the intermediate zone, so we know that contamination in this area is hydraulically connected, meaning that contaminants that are present in the area

of Privet Road can travel towards the washrack and be detected in those monitoring wells. Because when you are installing one monitoring well you see a response in a nearby well saying, okay, these zones talk to each other.

Just looking at the contaminant distribution that we saw, see what this tells us about what the source can be, the soil samples in the washrack area itself around the trickling filter that we took, they didn't have any target VOCs in them, we didn't see TCE, we didn't see PCE. We saw a couple of laboratory contaminants, common laboratory contaminants, but nothing that we are looking for in the groundwater. We did see some SVOCs, semi-volatile organics, in the soils but they were very, very low concentrations and, you know, they are not a concern in terms of a groundwater impact.

So we did not see a source in the soil in the trickling filter/ washrack area for the contamination we see

in the groundwater underneath it.

If we look at contaminant distribution in the shallow zone, again looking at it to see what it tells us about source, TCE is the most commonly detected VOC. TCE is the most commonly detected VOC in both zones actually. Generally there are lower concentrations in the shallow zone relative to the intermediate zone, meaning that it doesn't really look like the shallow zone is, you know, much of a source area. When you have higher concentrations at depth, that can mean your source is actually further away. You would expect, especially with something like TCE that doesn't degrade easily under aerobic conditions, as, for instance, the JP-4 constituents that HSI Geotrans is talking about, you wouldn't really expect to see a decreasing concentration -- or I should say an increasing concentration trend with depth when you have concentrations at this level if the soils themselves were sources.

And I guess I mentioned the

PCE, PCE had a really limited distribution in the shallow zone but it's really only down-gradient of Privet Road, it wasn't down-gradient of the washrack.

Oh, and TCE was detected up-gradient of the washrack. So meaning that there is a source in the shallow zone up-gradient of the washrack that could then impact wells down-gradient of the washrack.

If we look at our contaminant distribution in the intermediate zone, our highest concentrations were seen in Well 7I. This has historically been the case essentially as long as groundwater has been monitored in this area. So with the highest concentrations being up-gradient of the washrack, again it doesn't suggest that the washrack is causing those concentrations. Concentrations are actually equivalent to -- well, actually they are much less than 7I down-gradient of the washrack.

Again, in terms of PCE distribution, tetrachloroethene, that was

only seen in wells down-gradient of Privet Road.

I guess probably for the Navy's sake, when I am talking about down-gradient of Privet Road, I am not in that point saying that Privet Road is the source. It's down -- I should say, maybe I should be talking about northwest of Privet Road or something, because the actual source of these things is kind of hard to point a finger at. As I said, we can determine where it's not coming from but it's more difficult to determine where it is coming from. I can tell what direction it's coming from but not exactly where the actual source itself is located.

This I guess is just information that reinforces what I said, TCE is present up-gradient of the washrack actually in several wells, 7I, 5B, 4B. These are all shown I believe on figure -- I guess both Figures 4 and 5. And as I said, the concentrations are really not higher than they are up-gradient of the washrack as you would expect if the

washrack were a continuing source.

My one piece of information from the new well we installed, as I mentioned previously, in our report on our source identification study, the draft report, we recommended installing another up-gradient monitoring well to see if there was another potential source location for all this TCE that's being detected, and that well was installed along the base boundary, and I actually drew it in by hand on Figures 4 and 5, and that's well 6B.

While I don't have water level information from that well to tell you exactly what the flow field looks like, we are safe in assuming that's an up-gradient location based on our understanding of groundwater flow, and that well did contain concentrations of TCE when we were doing our Packard testing. They weren't particularly high, but there was TCE in it. And that well, you know, looks at least in a preliminary sense at best to be side-gradient of Privet Road. Without having, you know, the benefit of a new

water table map I can't tell you exactly where it is, but this is evidence that there is, you know, another source out there somewhere, not just the Privet Road Compound.

So what is the source? Notice I put "Privet Road Compound?" Because we don't really know for sure. We just know it's coming from that direction. We also know it's coming from up-gradient of the washrack in a slightly different direction, meaning in the location of our new well 6B. So, again, no, you know, decisive pointing a finger at one location but certainly there are source areas up-gradient of the washrack and trickling filter site that, you know, are impacting groundwater and the washrack and tickling filter site does not appear to be.

I guess I really already hit all these points regarding why we don't believe the washrack is the source itself, so I probably don't need to go over those again.

I guess in terms of the PCE,

the tetrachloroethene, it's a slightly different problem because where it's been detected historically at elevated concentrations is in the Navy supply wells themselves and while when those wells are operational the Privet Road Compound would be considered up-gradient and a potential source, those wells are much deeper than the Privet Road wells, meaning they draw water from several other horizons -- 300 feet, Jim, is it?

MR. COLTER: 300; something like that.

MS. WIDMAN: The intermediate wells at Privet Road and the washrack are down 100 feet or less. As far as we know, the Navy wells were constructed as open holes. What that means is they screen a very long length of rock, they draw the water from, you know, an interval, you know, that could be a couple hundred feet thick I guess. I don't really know for sure. Maybe you know better than I.

What that allows them to do is bring water in from a lot of other

areas. So saying what causes PCE or TCE for that matter in those wells I guess from my perspective is not something I would want to try to do, especially knowing that there is a regional problem, you know, with solvents in groundwater in this area.

Unless you know the answer, Jim.

MR. COLTER: Not yet.

MS. WIDMAN: The other IRP sites, not too much to say about these because we just really have done the sampling and we don't have any results yet.

I know that I mentioned our objective, which was just to see if there is a problem at any of these sites or see if they really are candidates for no further action, we don't have to do anything at them.

Gil already talked about I guess our background on each of these a little bit. Obviously this being the former drum storage area. It was first used a very long time ago. There was

reported leakage -- I mean this is I guess anecdotal reports of leakage, and when we went out there to choose sampling locations this time around, we based them on an aerial photograph from 1964 and in this aerial photograph it appears that there is some soil staining out there so with EPA's concurrence we picked several locations outside of the fence where there appear to be staining and also inside the fence.

I guess I could say that there has been work done at this location in the past and not really all that much found, as this slide demonstrates, which is why it was proposed for no further action. And also it's right next to the POL area where there have been known spills and problems, so any groundwater impacts that might be in the area of the former drum storage area are far more likely due to the many gallons of fuel that are known to have been spilled at the POL.

This is just a brief summary of the samples we collected, six borings based on, you know, apparent historical

soil staining. I am looking at this photograph with an analysis for a pretty broad suite of compounds, volatiles, semi-volatiles, pesticides, PCBs, metals. Essentially anything and everything that might possibly have been stored there in the past we are analyzing these soils for to give us an idea of what conditions actually are, keeping in mind that previous sampling indicated that there wasn't a problem.

The ponding basin, it's a man-made structure releasing to the stream there to the northwest. There was also a couple of rounds of previous work out here where the sediments were sampled and at one point there were concentrations of semi-volatiles, PAHs, stand for polycyclic aeromatic hydrocarbons, suggesting that they may exceed some of EPA's ecological screen studies, not human health but ecological.

So what we did last month is we went out and took a series of paired surface water and sediment samples starting

in the basin itself, in the center, along the edges, immediately adjacent to the outfall, and then outside of the basin working our way down that intermittent stream towards Graeme Park, with the last sample location in the little pond there at Graeme Park. And, again, we have done a pretty extensive suite of analysis on these samples I mean that are being analyzed right now, so this should allow us to determine whether or not, you know, there really is, you know, concentrations in these sediments or surface water that are a problem and that can be attributed to the ponding basin.

Gill also talked about the former waste oil storage area. Again, it has not been used for quite some time. There was historical reports of spillage but a sample was selected in that area in 1989 and no problems were seen. And when we went out, we essentially took samples to confirm that there is not a problem there.

We did five shallow soil borings looking for some visible, you know,

field screening type of evidence of contamination, meaning either staining or odors or, you know, something that would say, "sample here," and we didn't see anything, but we did sample three of those borings, actually at two different depths, and we are analyzing them for the constituents that are listed there.

What is left? Well, we have sampled the monitoring wells around our new well so we need to complete our analysis of groundwater flow in that area looking at the concentrations, you know, now that we have that well to fill in the picture more to the southeast and see what that tells us about our source of TCE, actually both at I would say Privet Road and at the washrack. That well is useful on both counts.

We do need to evaluate the sampling results for the other IRP sites when they become available, and also use those results to do an ecological screen to insure that if there is anything there, it's not causing a problem.

And that's it. Questions?

MR. LINDHULT: I have a question in the washrack area, in Well I-57 picked up an estimated concentration of carbon tetrachloride. Has that been detected at any other well at any other time?

MS. WIDMAN: I believe that carbon tech might have been detected once or twice historically, estimated. It's not something that we can look at and say, okay, there is an historical presence of this compound, keeping in mind that they have been analyzing groundwater in this area since 1989.

MR. ROTH: Bottom line, do you drink the water when you are on base?

MS. WIDMAN: Of course. That's why there are those big air strippers over by the Navy supply wells. And I would imagine if you are drinking public water that comes out of a well anywhere in this area, it's probably treated. It's a very regional problem.

MR. GILL: That's all we have. Any questions?

MR. EDMOND: Any questions on the Air Force presentation?

Well then, any other questions for any of us here?

Any comments?

Well then, I would like to ask the RAB members if the 3rd of March, which is -- no good for you?

April 7 is agreeable with everyone? April 7 it will be.

Since we didn't have a break, anyone who would like coffee, there is coffee back here.

And on behalf of the Air Force and the Navy we wish everyone a good holiday and we will see all of you in 1999.

(Whereupon the meeting adjourned at 7:15 p.m.)

Reporter by: Denise A. Ryan, Court Reporter