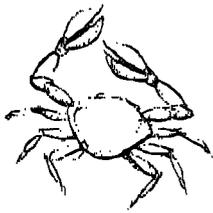


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cc: Chris
JFK
Lynne
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FAX

**Environmental
Stewardship
Concepts**

Date: 8-17-07
To: HON. CHRIS L. COONS
From: PETER deFUR

RE: RAP - HERCULES
302-395-5268

Peter L. deFur, Ph.D. 1108 Westbriar Dr., Ste. F.
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Richmond, VA 23238
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**Environmental
Stewardship
Concepts**

August 16, 2007

The Hon. Christopher L. Coons, Esq.
County Executive of New Castle County
87 Read's Way
New Castle, DE 19720

Re: The Delaware National Remedial Action Plan

Dear County Executive Coons:

I am writing regarding the plan to develop part of the former Hercules Golf Course for residential use. The site includes 9 holes of the former golf course and a wooded lot once owned and used by Hercules, Inc. The two parcels are immediately adjacent to the Hercules Research Center, a RCRA cleanup site. The neighbors have studied the environmental test results and...

the environmental test results and protested the inadequacy of the Remedial Action Plan and the testing on which it is based. Their homes lie in such close proximity to the areas to be developed that they are certain to have dust from the remediation drift onto their properties. They contacted me for help because of my extensive experience as an environmental expert. (Please see my attached CV) After reading the test results and other documents and visiting the site, I have concluded that their fear for their health and safety is fully justified.

Reports by Brightfields and Tetra Tech on the parcels and the DNREC reports on the adjacent Hercules site document the presence of chemicals in the soil, streams and groundwater. The list of reports and related documents that were used in my evaluation are listed at the end of this memo.

There are several problems with this site and the existing assessment:

1. Documented contamination presents severe health risks.
2. Gaps exist in our knowledge of contamination based on knowledge of the sites former uses.
3. DNREC failed to consider that this parcel was subdivided from a RCRA corrective action site.
4. Homes are located too close to remediation areas that are very high risk.
5. The full potential health risks are unknown and underestimated.
6. Sampling methodology was not standard and left unknown conditions.
7. Dioxin is likely to be in the environment, which means further sampling should be done.

1. Known contamination and risks

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Sampling results from several investigations (summarized and presented in the RIFS report) reveal the presence of a number of toxic metals and pesticides at levels

known to present severe risks to human health. Table 1 indicates which chemicals exceeded the background levels in the different investigations. A number of chemicals (notably lead, mercury, cadmium, thallium and some organic pesticides) exert the greatest health effects on young children and the unborn. Toxic metals in particular can act in combination on the developing nervous system and the permanent effects are magnified (these are described in the ATSDR Toxicological Profiles for arsenic, lead, mercury, thallium). Young children are particularly susceptible to lead, mercury, cadmium, arsenic and thallium because their brains are developing and the neurological functional patterns processes are forming. The impacts on the developing brain are permanent and often result in lowered IQ, learning disabilities and behavioral problems. These health problems have been known for many years in the case of lead and mercury and more recently for other chemicals.

Reports from neighbors confirm the kind of damage that one would predict from these samples has already been done to some. One teenager who was living next to the golf course has suffered a 20 point drop in his I.Q., and severe heart problems. He lived in a neighborhood beside the golf course only 3 years before these brain injuries became apparent and he was diagnosed with arsenic poisoning, but arsenic was the only metal for which he was tested. Even though he avoided going to the County Club, playing golf, and running his dog on the golf course after his trouble became apparent, he still developed heart palpitations so severe he had to wear a heart monitor until his family moved away. Testing did not reveal anything in his residence or lot that would have continued his problem, so the possibility of some form of airborne arsenic is suggested. In my opinion, that mystery needs to be solved before anyone in the same area is safe. His baby sister was found to have excessive antimony and mercury in her system and her development was affected. Brandywine Springs Manor and Canterbury Hills are known to have an unusual number of cases of cancer including one teenager's death from a rare form, and neighbors have related that there have been two other leukemia cases associated with the work site or neighborhood. One young man who worked at the HRC died in his thirties, and his family's lawsuit revealed a vat of benzene was stored under one of the buildings at the Center. While anecdotal evidence will not mean anything in court, it should cause rational public officials some concern about what can be done in the future to insure this area is not further damaged by activity that they can and should regulate.

The effects the neighborhood is experiencing are the result of long term exposures to multiple chemicals, which the EPA describes as "cumulative risk" (See the EPA Framework for Cumulative Risk Assessment, 2003.) These cumulative risks need to be assessed in the neighborhoods around the golf course if that is what it takes to prove that the danger is not theoretical. Long term neighbors have been exposed for many years to the drift of sprayed pesticides; wind-driven dust and debris from grass cutting operations on uneven ground; dust from plowing the course to replant it; storm water run-off into creeks where children play; and contaminated soil where they garden in their own yards.

Some of the neighbors were employees in the chemical industry in the days when little was known of the health threats from many of these substances. They all agree that releases from incinerators were scheduled for evening hours when no one was I

Table 1: Compounds Detected Above Background Concentrations

Chemical:	Soil:	Sediment:	Surface water:	Groundwater:	Background (Soil):
Aluminum	X	X	X		7,800mg/kg
Iron	X	X	X	X	2,300mg/kg
Lead	X	X			400mg/kg
Manganese	X	X	X	X	160mg/kg
Vanadium	X				55mg/kg
Antimony	X				3mg/kg
Barium	X	X	X		550mg/kg
4,4'-DDE	X				3mg/kg
Chlordane	X				2mg/kg
Arsenic	X				11mg/kg
Heptachlor epoxide	X				0.07mg/kg
Dieldrin	X				0.04mg/kg
Aldrin	X				0.04mg/kg
Alpha Chlordane	X	X	X		2mg/kg
Gamma Chlordane	X	X	X		2mg/kg
Cadmium	X				4mg/kg
Mercury	X	X	X		10mg/kg
Thallium	X				18mg/kg
Nickel	X	X			160mg/kg
Zinc		X	X		2,300mg/kg
P,p-DDT		X			0.002mg/kg
P,p-DDE		X			0.003mg/kg
P,p-DDD		X			0.008mg/kg
Endosulfan II		X			0.005mg/kg
Phenanthrene		X			0.5mg/kg
Fluoranthrene		X			0.8mg/kg
Benzo(a)anthracene		X			0.1mg/kg
Benzo(a)pyrene		X			0.1mg/kg
Copper			X		310mg/kg
Chloroform				X	6mg/kg

likely to detect the odors of toxic wastes and that remains a common industry practice today in Delaware.

Many of the chemicals present on the course are known constituents of pesticides and clearly the result of golf course maintenance activities. Older pesticides contained arsenic, lead, and iron; but other chemicals present were not used in pesticides or herbicides. Literature searches, chemical profiles and product sheets reveal no pesticide uses for vanadium, thallium, antimony, chloroform and PAHs. Thus a perfect correlation with the presence of arsenic cannot be assumed until someone finds out how they managed to wind up on a golf course.

Neighbors know through discussions with former employees that Hercules' research was not confined to what is now the present footprint of the Research Center. Outlying buildings once existed and ammunition experiments were conducted in the fields. Incinerators on the research site would have generated ash and dust as well as other emissions not researched for this study. The course was reportedly watered through pipes that drew from the badly contaminated Red Clay Creek adjacent to the present RCRA site. These obvious potential sources of contamination were disregarded entirely by DNREC. A letter from the former Director of Air and Waste Management, John Blevins, suggested several years ago that DNREC could act as a technical consultant to Toll Brothers, so the decision was foregone long before the Memorandum of Understanding. Apparently the County lacked a staff environmental expert, and it chose not to hire an independent consultant who had no position to justify when the neighbors complained, so it is now faced with the problem of what to do when a State agency fails to protect the public. Science seems to have taken a back seat to convenience and budget concerns at DNREC, so the ball has been bounced back to the County with a bad spin on it. You have a lot of paper, but little of substance to protect the neighbors.

2. Gaps in knowledge of contamination

The sampling design and plan were limited in scope and extent regarding chemical analysis and distribution of sampling locations. Neither the soil sampling nor water sampling included a complete list of chemicals that are likely to be present on the site. The list of pesticides in the course log books from 1973 to 1993 contained many chemicals which were not tested in any sampling conducted to date. One notable omission was dioxins in all the forms that are known to be toxic. Dioxin was a known contaminant of two commonly used herbicides, 2,4-D and 2,4,5 -T, one with documented use on the golf course. The other was likely used on the course as a weed killer. The testing failed to measure several industrial compounds notably PCBs that are routinely measured at contaminated sites around the country. PCB's are found on the adjacent RCRA site—the Research Center.

Dioxin sampling was addressed in a memo from DNREC's SIRB office to the County. DNREC contracted with an outside consulting firm (CDM) to investigate the matter of dioxin on the golf course because of the neighbors' complaints of an oversight in this regard. The memo they generated mentioned the lack of testing on other golf courses in other states, but the caveat indicated many states treat courses like Delaware does—as agricultural uses. It did not address the concern that this course is located next to a chemical research center and toxic materials on the course were not limited to those in pesticides. Notwithstanding the two reports cited by DNREC, and the claims of CDM in that report, an extensive literature on dioxins describes their persistence in the environment (EPA 2003b, see also Section 7) as longer than DNREC recognizes.

The CDM report made several simplifying errors. First, the CDM memo concluded that the sole source was 2,4-D; concluded erroneously that the 2005 technical instructions on application rate was applicable for the past 50 years; and that the

Instructions were followed carefully by the applicators. Furthermore, the memo and analysis fail to account for the high level of dioxin in these herbicides- up to 10%- when as little as 1 part per trillion is toxic (see EPA 2003). The memo makes no mention of the Hercules incinerator facility which likely produced dioxins of varying congeners. There are no logs of pesticide use prior to 1970, when 2,4-D contained incredibly dangerous quantities of dioxin (see Section 7 below). It is also unacceptable to assume that all procedures were followed correctly after guidelines for the use of the pesticide were changed.

Having concluded that all of the contamination comes from golf course maintenance activities, the sampling was not designed to look for chemicals throughout the site. DNREC failed to consider contamination that may have been derived from other sources. Specifically, atmospheric deposition from the adjacent Hercules incinerators or fugitive emissions from labs and waste pipes was not even mentioned. Other contamination could have been derived from flooding or groundwater flowing onto the parcel from the adjacent and uphill research labs. Water pumped onto the golf course from Red Clay Creek (and Hyde Run or local groundwater known to be contaminated with some chemicals) is a logical means by which contaminants could be introduced onto large areas of the course. Sampling was too limited because EPA guidelines were not consulted due to the original assumption.

A County employee reported that two waste pipes drain from the Research Center onto the golf course parcel, and one can see that greater contamination was measured in roughly the outfall areas he indicated. Hercules has contaminated wells, and there may be a connection with those. Brightfields indicated at a public hearing that they rapidly reached the conclusion that a correlation existed between arsenic and the levels of other toxic material on the course and they believed that arsenic at unsafe levels was limited to the greens. For this reason, they chose not to test other areas more thoroughly, and DNREC did not object. Had EPA protocols for testing been followed, when a sample proved to have unsafe levels of a mineral or chemical, more tests would have been taken in widening circles around it until the limits of the contaminated spot were established. This protocol was not used except on two greens, so at the other highly contaminated locations, no one knows how widespread the contamination actually is. How can one develop a risk free work plan without such knowledge?

The Hercules research facility has already been subject to a RCRA Corrective Action (federal Resource Conservation and Recovery Act) ordered by the EPA and overseen by DNREC for many years. Combined with the presence of rare metals such as antimony that are associated with munitions related activities like those that Hercules performed, this work should have served as conclusive evidence that the property was affected by more than pesticide applications.

3. This site was part of a larger tract of land

The cleanup was a corrective action to address contamination from several different operations. One of the areas of concern that required corrective action was one or more incinerators that were dismantled. In none of the analyses of the building site I have read is the contamination that would obviously result from incineration of

chemical wastes considered. DNREC's official conclusion that all contamination on the site was caused by the lawful application of pesticides, was irrational based upon the evidence. In fact, the contamination contains so many high levels of chemicals in discreet areas that one can only conclude that they may have been brought to the site. One explanation, of course, is that soil was brought from somewhere to build up the greens on the golf course. However, it could have been soil dug up when the sand traps were created. No testing was done in sand traps which sit close to the contaminated greens and catch run-off from them. No reference is made to them at all, and this is a major oversight.

Not only was the sampling design inadequate and predicated totally on historical use of the land as a golf course, but no other patterns were explored, although Hercules was known to have performed munitions experiments away from the main laboratory area. The wooded area on Parcel 10 was assumed to be in a natural state because it is today heavily wooded, but old photos clearly revealed the location of another lab building. Therefore, testing was not adequate to identify possible contamination in woods that will be removed for the construction of homes. Former employees have revealed that film processes were researched in the demolished lab as its last use, and the slope of the hill leads to, among other things, a wetland area and neighboring homes. In order to provide adequate protection for those families, testing for other metals and chemicals is needed.

The wooded area south of the newest development, known as Tall Trees, was not sampled at all and plans call for many of the trees to be removed and lots created. The trees developed on that section rather recently, and former uses included a barn. In roughly the area around Tall Trees and where tennis courts now sit, homes were once located along Hercules Road—including one occupied by the head of golf course maintenance. Chemicals could have been stored in his yard.

No further study was done by scanning the course. There is good reason to believe that a dump exists between Hole 9 and the power station. Two former employees at separate times and to different people indicated it exists. Because we know that the site was once part of a larger chemical research facility, it should have been investigated for such dumping more thoroughly. Had consideration been given to that fact, the investigation would have included an industrial list of chemicals (SW846).

4. Location of homes too close to remediation areas that are high risk

Remediation plans should give consideration to the exposure of families who have no trees and very little distance to prevent contaminated soil from being blown onto their property while digging takes place. Because of its proximity to greens with high levels of contamination, Brandywine Springs Manor is at great risk should the winds blow on days that digging will take place. Anyone servicing the neighbors such as mailmen, tradesmen, or lawn care companies will share the risk. Parts of this development are also likely to experience problems from the run-off that will leave this property if care is not taken to control it. These are the families that have arguably

been at greatest routine risk through past exposure. In addition to those adjacent to the course, those who have Hyde Run in their back yards would appear to be equally exposed. What their children have played in and what rose on the mists from Hyde Run may be indicated by the few sediment samples that were taken, and those were very troubling.

Remediation by the method proposed, while typical of what is done in cleanups, is simply not adequate for such a situation. The geography and topography and level of contamination and proximity all argue for extreme measures to protect neighbors who have already been exposed to a dangerous, silent, and invidious private nuisance—chemical contamination.

The neighbors asked for tenting over the worst greens while digging and loading takes place. While this is an unusual request, it makes sense given the level of risk. Workers can wear protective suits, but the land and homes of neighbors will be contaminated if the most harmful soil is not totally contained. They also asked for additional measures to protect against run-off. Those make sense also, and I would urge that the County cooperate on these points. If the developer continues to fight over tenting, then an agreement should be worked out about how water can be used to prevent any dust from rising from the work. Toll Brothers has made vague statements, but they have not been held to concrete promises about how watering will be done, and they will not suffer any consequences for raising dust that will harm workers and neighbors. Their plan calls for the use of trained workers and an OSHA site safety officer, so there is some hope that they will attempt to restrict dust, but the neighbors are not satisfied with a little hope.

If Toll Brothers is allowed to treat a brownfield next to homes like dumps that are far from populated areas, you will set a bad precedent for remedial projects in New Castle County. The residents in these homes and the individuals associated with them are not responsible for the contamination and should not be subjected to any risks beyond the already unacceptable levels they are already experiencing (See Section 1.). Given their proximity to the cleanup the basic measures outlined in the Remedial Work Plan are insufficient. To date, Brightfields and Toll Brothers have not exhibited a significant amount of concern for the people affected by their actions.

5. Health Risks are Unknown and Underestimated

The lack of sufficient information as well as weaknesses in the risk assessment leaves the health risk to the neighbors unclear at best and underestimated in my judgment. The evaluation in the RI/FS that is labeled as "cumulative risk" is not a cumulative risk assessment as explained in official EPA documents, but is a multi-pathway exposure assessment. A cumulative risk assessment considers multiple stresses over long periods to both individuals and communities. Many chemicals that were not assessed (other pesticides, industrial chemicals, explosives and breakdown products) may be present and contribute to health risk. The present chemicals were assessed individually, not together, the extra sensitivity of children was not included, and the cumulative effects of long term exposure in neighboring residential areas was not conducted. These factors all contribute to the conclusion that the health risks have

not been adequately assessed and as presently described in the RI/FS are underestimates of the true risks. The underestimates are true for workers on the course, the residential properties immediately adjacent to the course, to those who frequently used the course, and particularly to children who fall into either one or both of the latter two categories.

The current plan intends on estimating residential exposures by using a combination of PM 10 data and the site-wide 95% UCL arsenic concentration. This approach would significantly underestimate the amount of arsenic residents are exposed to. The dust disturbed by any cleanup activities would be far higher than the site-wide UCL since these activities will be focused on the most contaminated areas of the property. This means that the dust in the air could have arsenic concentrations higher than 400 ppm while risk estimatlons are using a value just over 8 ppm.

6. Proposed Sampling Methodology

Much of the Plan was a description of what will take place after the digging is done. Very little is directed to details of what happens while the work is taking place. The assumption is made that it is alright to permit a "safe" level of dust to drift to the monitors that will be placed at the perimeter of the property and whose readings will be averaged every two hours. Any dust is unacceptable due to the high percentage of contaminants in the greens. The dust monitors being used cannot measure the contamination, only the concentration or density of the dust.

The proposed plan calls for the use of field portable x-ray florescence (FPXRF) technology to determine the effectiveness of certain cleanup operations at the site. FPXRF has a great deal of potential and has made great strides in the past decade but is still no substitute for laboratory testing. A review of EPA verification reports reveals that a number of factors influence the accuracy and usefulness of this technology that must be considered at each site where it is used.

Different models have varying capabilities to detect specific metals both in general and across soil mediums. The presence and composition of other metals in the sample can also affect results (EPA 2006a-g). The most recent EPA verification of this technology noted that for many metals, XRF technology has detection levels that are above risk-based action levels. Even with recent advances, XRF still has difficulty detecting some compounds of concern such as antimony and vanadium at concentrations that can produce adverse health effects.

7. The Persistence of Dioxin In the Environment and the Need for Further Sampling

Previous investigations at the site have not examined dioxins in any sort of detail. The 4 samples tested for 2,3,7,8 TCDD are insufficient, not only because of the small number but also because the procedures used give little useful data. Where were the samples taken? Were they surface samples or soil cores? Why weren't all congeners sampled? The risks from dioxins are real and the only real controversy surrounding

them is manufactured by those with a vested interest in marginalizing their impact on human health. A recent reassessment by the EPA and a review by the National Academy of Sciences have reaffirmed the dangers of these compounds. The conclusions of these documents stand in stark contrast to the tone of a DNREC memo by Stephen Johnson on May 1, 2007.

Extensive research has been performed on the degradation of PCBs in soils and they are persistent in the environment as well as in tissues. Dioxins can persist on the surface of soils for 18-30 years, and if buried can remain for as long as 200 (Gilpin et al 2003). Considering the massive concentrations of 2,3,7,8 TCDD estimated to be contained in pre-1970 2,4,5-T (as much as 70,000 ppt- EPA 2003), there is a real need for sampling in areas that have had historical applications of this pesticide like the site in question. 2,3,7,8-TCDD is not the only dioxin that has been identified in 2,4,5-T. HxCDDs have also been found in extremely high concentrations in the pesticide. These congeners were not sampled by Brightfields.

In addition to pesticide application, dioxins could have potentially been released into soils by an incinerator operated by Hercules adjacent to the golf course. The rationales for not sampling dioxins presented in the May 1 DNREC memo do not consider the incinerator or the potential for other activities at the site besides the golf course. Incinerators have been identified as one of the primary sources of dioxins in the environment, and the role of even this small facility should not be discounted. There is simply not enough information regarding dioxins at this site to move forward safely.

Other concerns:

The RI/FS report includes the remediation options and recommends removing some soil, and mixing some contaminated soil with clean soil. It indicates a number of areas should be capped or covered with impervious material or clean soil. The first two options are retained in the Remedial Action Plan (July 9, 2007), but no mention is made of the third option, capping or covering some soils with an impervious surface. The Work Plan needs to clearly state if these options have been removed from consideration.

The excavation planning talks about storage areas for the contaminated soil if it cannot be loaded in trucks right away. That means assuming the risk of twice handling it and building up a large pile of contaminated material above ground. This makes no sense at all and is even inefficient for the developer. They propose to cover that with plastic overnight and on weekends. No pile should be allowed to be built with material from the greens. Run-off problems already inadequately controlled will increase.

Blending soils with unknown concentrations of toxic materials to try and achieve a certain level of one toxic mineral is not a customary practice. In this instance, it is a very bad idea. Just because the arsenic levels are somewhat lower than other parts of the course is no guarantee that other materials might not be more dangerous and wind up released in a worse form. Full laboratory testing of the many contaminants that

could be present would be needed to insure this process is safe. One fairway to be dug is just behind a row of houses in Brandywine Springs Manor. While 37 ppm of arsenic is not a huge amount, it is too much to send to their backyards along with other toxic material. Large areas will be uncovered with no guarantee of protection, and no one knows how contained the material is when placed in the machine that will do the blending.

Brightfields indicated at the March 21 hearing that they would leave the work site uncovered and unattended on evenings and weekends. They now say they will cover open pits with straw and have an employee on standby. That is not much improvement. Imagine if a storm came up while the site was in this state. Winds could blow this soil all around. Drenching rains could cause all ditches and holding ponds to overflow and cascade downhill to Hyde Run and Hercules Road where houses will be flooded. Not more than two miles away, a tornado swept through a few years ago and leveled a school gym on a nearby plateau like this one. Bad weather incidents must be included in the calculations and plans. Once the site is opened, it should not be left uncovered when not being worked.

In conclusion, this site is badly contaminated and requires a more thorough assessment prior to remediation and development. The present levels of contaminated soil and water pose serious health threats to the neighbors and workers. The remediation needs to be conducted with all available precautions for the adjacent residents as well as the workers. Checking monitors in two hours to see if too much dust went into neighboring yards show a total disrespect for their rights as human beings and landowners. Procedures have to be firmly established in greater detail than a general reference to some standard with which the neighbors are not familiar and consequences should be developed for violations of the agreements on procedures.

Sincerely,



Peter L. deFur, Ph.D.

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August 16, 2007

The Honorable Christopher L. Coons
County Executive, New Castle County
[Via fax]

Re: The Delaware National Remedial Action Plan and the MLCA Working Group

Dear Chris:

Bill Dunne just told me a little while ago that you are leaving for vacation tomorrow. Please, I beg you, leave behind an order not to allow the permit for remediation of the Delaware National property to be issued while you are away.

I believe I can negotiate the differences between the residents and Toll Brothers with a little more time. Everyone has been on vacation, DNREC has been adding more last minute material to the Plan we are supposed to comment on by tomorrow, and I have had our consultant at work trying to produce more data for you and to speak more specifically to the problem so that you can understand that the neighbors are being reasonable when they object to an inadequate Remedial Plan. I am attaching a list of the known contaminants that bother me the most with this letter, but no one can tell you how close the work sites are to the houses. You can toss a ball from the back yard of many houses in Brandywine Springs Manor to heavily contaminated areas that will be dug up—specifically the 5th Green and fairway is one huge problem. The brains of some smart children are at risk. Isn't that worth holding up action until you can insure you protect them?

If you will give us just a little time, I can get my technical work group back together—those are the neighbors with a lot of degrees in biology, chemical engineering, chemistry, etc with our consultant—and we can suggest a few clauses that could be added to the plan to make it meaningful. I realize we are not likely to get anyone to do any more testing unless we take all of you to court. More testing would not be meaningful unless it is followed by a good remedial plan, so getting a good plan is the critical point to me.

Please. I have been worried about the timing on all this because it reminds me of the way Sherry used to operate. Werner has stalled acting on this until August when everyone is away—even though he has had all this on his desk for a very long time.

Hurriedly,



Christine Whitehead

WORST LOCATIONS FOR FOUR TOXIC MATERIALS

I. Tri-State Testing + Washington Group Testing + GLA Labs

A. Guidelines

	Arsenic	Lead	Chlordane	DDE & T	Location	Page
OSHA	10 ug/m ³ per 8 hrs.		.5 mg/m ³ per 8 hrs.	1 mg/m ³ per 8 hr	workplace	
DNREC	11	400	2	4.4	heptachlor epoxide .07 [in mg./kg].	
ATSDR		10 ug/L				
EPA	.01 ppm drkng w		2 ppb drkng w			

B. Test Results

	mg/kg		ug/kg			
	Arsenic	Lead	Chlordane	DDE or T		
PH 2	150	360	3,900	2,500 E 910 T	practice tees by tennis parking lot entrance close to Hercules Road	5
PH D			3,900	3,000 E 1,100 T	?	6 - 7
PH D 2					toxaphene 100 ?	
PH D 3.5 - 1			470		?	22
PH D 4				660 E 57 T	may be rough on north of course near HRC	
PH 6	240	100	79,000	500 E 240 T	top of green on 2 nd (mid SE of course) 1,200 heptachlor epoxide (.0004 mg/L water)	11
.5-1			trace	trace		
PH 8				1,300 E	fairway of third hole; N.E. near HRC	12
PH 10			3,800		4th tee; next to unnamed creek	15
PH 12	390	2,000	96,000D		west side of 5 th green just above	16
.5-1	37	27	1,800D		Brandywine Springs Manor	7
1 - 1.5			590			
PH 18				670 E 220 T	rough near 8 th tee	22
PH 23	1,100	3,400	230,000	1,200 E	practice green 3, north side. mid course	27 - 28
.5-1	79	250	14,000	820 E 1,200 T	heptachlor epoxide 530 D	8 - 9
1-1.5	62	22	470		hepachlor epoxide 530 D	
PH 27						
.5 - 1			100	400D E	fairway 8, SE part of course	13

PH 32									
.5 - 1			450	1,700D E	"	fairway 3rd		19	
				1,000D T					
PH 33	32	9	440	1,600D E	"	next to HRC road middle		20	
				530D T					
PH 34	68.5	360	50,000			9 th green below tennis ct - near road		4	
.5-1	210	770	22,000	200 E				5	
PH 35	500	2,000	110,000			also high chlordane - 3 rd green NE		5	
.5-1	64.4		33,000	230 T		near waste pipe from Research Center		6	
PH 36	1,100	260	47,000 D	370 E		4 th green - SE corner of first parcel		7	
				340 T		heptachlor epoxide 550			
PH 37	390	1,600	24,000	230 E		1 st green - midcourse - N of 5 th & close		9	
.5 - 1	73.8	53.6	2,100	160 T		to Brandywine Springs Manor		10	
PH 45									
1-1.5	60.4					2 nd Green			
Series stopped at PH 46 and began Series 76471 @ PH 47 at 0 -.5. Testing for mostly arsenic.									
PH 47				410 E		rough, mid-course		4	
.5 - 1				95 E				5	
PH 51			2,000	330 E		5 th green		8	
				130 T					
PH 53	26.8					1 st tee			
PH 58	28.3					rough, 9 th hole			
PH 59	84.9					rough near 8 th green			
PH 65	check all lists again							17	
TF 1				210 E		mid N. course rough below HRC road			
TF 3			4,900	990 E		5 th fairway, near green			
				330 T					

GLA LABS METALS TESTING mg/kg & PESTICIDE TESTING ug/kg

PH 71	180	860	71,000	310 T	practice green 3	4, 7, 14
Plus barium 35, chromium 120, mercury 24.6, heptachlor epoxide 840						
PH 72	220	840	71,000	340 E	practice green 3	8
				320 E	heptachlor epoxide 1100	8
Plus barium 35, chromium 120, mercury 26.7, cadmium 13						
PH 73	290	1,200	69,000	279 T	4 th green	
					heptachlor epoxide 920	9
Plus barium 56, chromium 160, mercury 40, cadmium 13						
PH 74	210	920	47,000		4 th green	10
					Heptachlor epoxide 540	
Plus barium 50, chromium 140, mercury 37.7, cadmium 140						
PH 71 through 74 all have excessive alpha and gamma chlordane in the thousands of ugs/kg						

Results are for tests at surface unless otherwise noted.

SEDIMENT SAMPLES WITH EXCESS

[Should the banks be stripped or stabilized. Toll wants to place riprap.]

- SED 01 barium 77.1/20; iron 18,100; DDT .0021/.002; acenaphthene .41/.09; anthracene .41/.3; benzoanthracene .41/.1; benzopyrene .41/.1 This is located in Hyde Run at the split.
- SED 02 barium 85.3/20; iron 35,200; acnaphthene.39/.09; anthracene .41/.3; benzoanthracene.39/.1; benzopyrene .30/.1 This is located on almost at the split but on the unnamed tributary.
- SED 03 barium 133/20; iron 22,600; nickel 29.8/21; acenaphthene .55/.09; penanthrene .58/.5; flouranthene 1.1/.8; benzoanthracene .42/.1; benzopyrene .42/.1. Hyde Run further north.
- SED 04 barium 68.6/20; iron 17,900; acenaphthalene .45/.9; flourene 45/.1; peneanthrene .057/.5; This is on the little ditch that runs up toward Tall Trees from Hyde Run.
- SED 05 barium 84.5/20; iron 12,400; DDT .002/.0022; acenaphthene .44/.09; .44/.3; benzoanthracene .44/.1; benzopyrene .44/.1. Next to the cart path at the woods on the unnamed creek north of Hyde Run.
- SED 06 no data available - in woods near top of unnamed creek or ditch east of fairway 7.
- SED 07 barium 125/20; iron 17,100; acenaphthene .44/.09; anthracene .45/.3; benzoanthracene .45/.1; benzopyrene.45/.1. This is at the juncture of the unnamed creek to the east and Red Clay Ck.
- SED 08 barium 113/20; iron 19,300; mercury .33/.2; zinc 156/150. SE unnamed creek.
- SED 09 barium 475/20; iron 8,160; lead 60.7/47; lead .784/.2; zinc 225/150. Below 2nd green.
- SED 10 barium 74.4/20; iron 15,300; nickel 23.8/21; zinc 188/150. N mid-course at HRC road

SURFACE WATER SAMPLES

Hyde Run and tributaries: aluminum 87 results 301, 978, 575, 277
 barium 4 " 54.8, 48.4 62.5 57, 37.4 56.3 70.7, 82.3, 101
 copper 12 " 28.1, 78
 iron 1000 " 1,250, 1,060, 1,150
 zinc 110 " 135

Unnamed creek flowing to Red Clay Creek: aluminum 87 results 622, 633
 barium 4 " 70.7, 82.3
 copper 12 " 28.1
 alpha chlordane .0004 " .014
 gamma chlordane .004 " .065

SW 5 has excess barium, pesticides, and SVOCs.

SW 10 has excess barium, iron, manganese nickel, zinc, and pesticides, and SVOCs

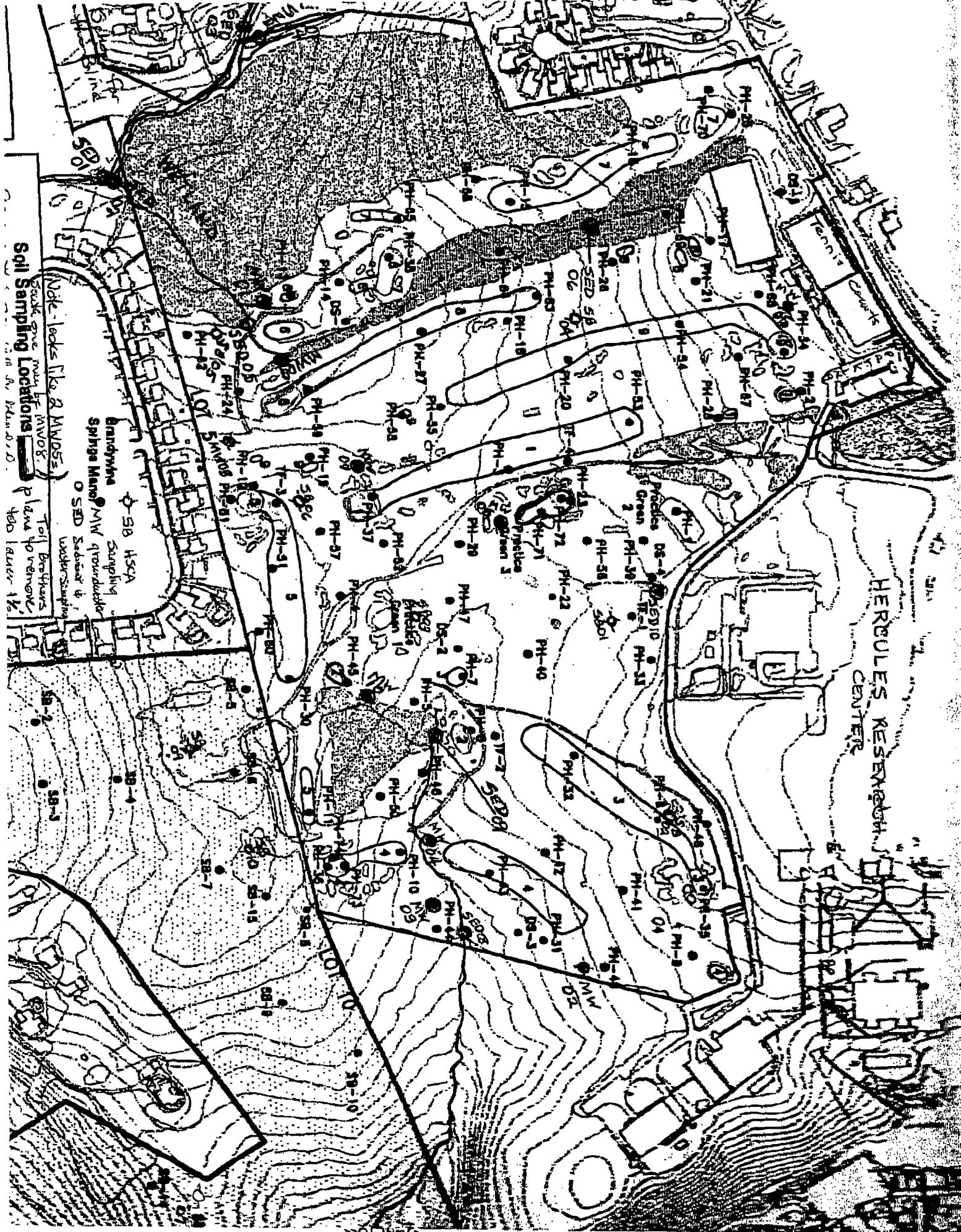
GROUNDWATER ANALYSIS

MW 01,08,09, 07 are on SE side of course toward BSM. Antimony, lead, manganese, thallium and DDT, DDE, DeltaBHC and chloroform exceed standards.

MW 02, 03, 04, 10, 06 drain from HRC toward unnamed tributary of Red Clay Creek or are on it.

No data on 2.

Antimony, beryllium, lead, manganese, thallium, iron, DDT, DDE, DeltaBHC and chloroform are in excess of standards.



Soil Sampling Locations

Note: looks like 8 MWDS

Soil core from MWDS

Soil Barriers

Plan to remove

had lower 1/2

Baranovskaya

Springs Manor

Sampling

SED Subunit 1

under sampling

HERCULES RESEARCH CENTER

LOT 10