

Reviewed 9/21/09
E-mail sent 9/21/09

DRAFT
WORKSHEET 1
Summary Score Sheet

SITE INFORMATION:

Name: Gig Harbor Sportsman Club
Address: 9721 Burnham Drive NW
City: Gig Harbor County: Pierce State: WA Zip: 98332
Section/Township/Range: 31/22N/02E
Latitude: 47° 20' 54.3" N Longitude: 122° 36' 1.3" W
TCP ID #: 2566095

Prepared on 08.13.08 (S. Bell):

Site scored/ranked for the February 2010 update.

SITE DESCRIPTION (management areas, substances of concern, and quantities):

The Gig Harbor Sportsman Club (GHSC) is located on the Gig Harbor Peninsula approximately 4000 feet north of the marine waters of Gig Harbor. The GHSC property lies within the Gig Harbor city limits. Development of the surrounding area has been accelerating in recent years, with significant residential development to the east of the GHSC. Mixed forest on undeveloped land makes up most of the immediate properties bordering the site with athletic fields, a church and a residence also bordering the west side, and a business park bordering the south and southeast corner of the property. The southwest corner of the subject site extends to Burnham Drive NW and forms the access point.

The GHSC is a private shooting range encompassing one L-shaped 30.36 acre parcel. The site is unpaved and the central portion is open, with mixed forest covering the remainder. One building is present and adjacent to a parking area centrally located on the west side side of the property. The club employs a groundskeeper to provide facility maintenance. The groundskeeper resides on the site (**in a mobile home?**) and water is provided from a drinking water well on site.

The GHSC has reportedly operated here since the mid to late 1940's and, as of 2002, had approximately 600 members (**current membership?**). The GHSC contains a shotgun range, including seven trap fields, and a 100-yard combination rifle and pistol range. Targets are mechanically launched at different angles in the trap fields and shotguns used to shoot at them (**just target practice or competitions too?**). The trap fields are oriented to shoot towards the east. The rifle and pistol range is located west of the shotgun range and oriented to shoot towards the north. **Find out if only clay targets have been used; if not, what else.** Contaminants of concern associated with shooting ranges include polycyclic aromatic hydrocarbons (PAH's) associated with a creosote like binder in the clay targets, and lead and arsenic associated with shotgun pellets.

Comment [CM1]: Almost certainly

There are many creeks in this watershed, and some carry water only intermittently. The names "Donkey" and "North" are used interchangeably for several creeks in this general area leading to some potential confusion. The Pierce County Water Programs (PCWP) has collected water quality data in

the past that was attributed to "Donkey Creek". PCWP's drainage maps depict Donkey Creek's headwaters west of SR 16 and the south draining portion of the creek flowing under the highway to the SE and then paralleling along the west side of Burnham Drive NW before discharging into Gig Harbor. For the purposes of this report then, the same name was used for this creek.

The general area of the subject site slopes to the south/southeast with two drainage channels apparent in the topography. One drainage channel starts to the northeast of the GHSC and trends southwest, transecting the southeast corner of the site. Water runs through this channel during the wetter parts of the year, and for the purposes of this report will be referred to as North Creek. The other drainage channel is west of the GHSC and for the purposes of this report will be referred to as Donkey Creek (see the previous paragraph). The Donkey Creek drainage channel trends from northwest to southeast. North Creek runs southwest under Burnham Drive NW and joins Donkey Creek about 1000 feet south of the GHSC. Donkey Creek continues to flow southeastward through the city of Gig Harbor and discharges to the marine waters of Gig Harbor. Donkey Creek is a salmon-bearing stream with both coho and chum salmon occurring there.

Environmental Investigations

Potential site contamination and impact to nearby surface waters were brought to the attention of Ecology by a private citizen who took a number of surface water samples in November and December 2001 and forwarded the results along with his concerns to Ecology. The complaint indicated that background samples collected from North Creek upstream of the GHSC contained dissolved lead concentrations ranging from 0.6 to 0.9 ug/L. A background sample collected from Donkey Creek upstream of where North Creek joins it, showed lead concentrations of 0.2 ug/L. However, samples taken from North Creek in two locations where it flows through the GHSC property showed elevated lead concentrations (163 – 214 ug/L) that declined with distance traveled from the subject site: 19 ug/L at Burnham Drive NW prior to joining Donkey Creek, and 3.5 ug/L in Donkey Creek down stream of where North Creek joins it. Based on this complaint and the apparent contamination of surface waters from the shooting range, an initial investigation (II) was conducted by Tacoma-Pierce County Health Department (TPCHD) at the request of Ecology in 2002.

The TPCHD's II was conducted from April through September 2002. A visual survey occurred on 05.09.02 and significant quantities of broken targets and shot pellets were noted on the field. Water samples were also collected from two points in North Creek where it flowed across the southeast section of the subject property. Field measurements of pH in the water were collected and the samples analyzed for total and dissolved lead. Duplicate samples were collected for the dissolved lead analysis to compare sample collection methodologies of field filtering versus lab filtering. All dissolved lead samples were preserved at the lab. An additional surface water sample was collected from Donkey Creek at 96th St NW, upstream of where North Creek joins it, and submitted for the same analyses. For each sampling location, relatively little variability between total or dissolved lead analyses was found. Significant differences in lead concentrations between locations were found, as well as a significant difference in the pH and hardness of the waters in North Creek versus Donkey Creek. The analytical results are tabulated below.

date format

5.09.02 sampling	pH	Hardness	Total Lead (mg/L)	Dissolved Lead, (mg/L) (field filtered)	Dissolved Lead, (mg/L) (lab filtered)
N. Creek, #1	6.0	13	0.210	0.231	0.208

N. Creek, #2	6.2	14	0.0191	0.0195	0.0211
Donkey Cr.	7.6	51	ND	ND	ND

Water quality standard calculations for dissolved lead in fresh water were performed using hardness levels detected. Both samples collected from North Creek, on the GHSC property, significantly exceeded acute and chronic water quality standards and lend credence to similar numbers obtained from the N. Creek samples collected by the complainant (which ranged from 163 to 214 ug/L). See the table below; the analytical results cited in the table below for dissolved lead are from the field filtered samples.

Sample ID	Hardness	Lead (ug/L), Acute WQ Std	Lead (ug/L) Chronic WQ Std	Dissolved Lead (ug/L) Analytical Result
N. Creek, #1	13	6.62	0.237	231
N. Creek, #2	14	7.20	0.281	19.5

Because of the water sample results, the TPCHD returned to the GHSC to collect soil samples on 08.26.02. Water was not present in the creek on that date. Soil sample #1 was collected at the east margin of the trap field, below about six inches of broken target pieces. Soil sample #2 was collected further east, at the top of the drainage channel slope above the location where N. Creek #1 water sample was collected in May, from a friable mulch pile. Target pieces were visible at this location in the mixed forest, despite its distance of about 250 feet from the back edge of the trap field. Soil sample #3 was collected from the edge of the creek, adjacent to the location of N. Creek #1 water sample; an intact target was visible at this location on the surface of the soil. Soil sample #4 was collected from an area closer to the trap field, about 200 feet east of the field and south of a well defined path, about three inches below an approximate four foot diameter accumulation of shot pellets. The samples were analyzed for pH, RCRA 8 metals, and semi-volatile organic compounds. The presence of arsenic, lead, naphthalene, and carcinogenic polycyclic aromatic compounds (cPAH's) was found in concentrations significantly exceeding the state cleanup levels (CUL). The pH of the soils collected from the mulch pile above the drainage channel and from the edge of the creek was significantly lower than the more neutral pH of the field, indicative of acidic conditions. The analytical results are tabulated below in pH units and mg/kg.

	pH	Arsenic CUL = 20	Lead CUL - 250	Naphthalenes CUL = 5	cPAH's CUL = 0.1
Sample #1 (field)	7.55	9.29	111	6.2	3761
Sample #2 (mulch pile)	4.16	208	55900	ND	0.156
Sample #3 (creek bank)	3.95	33.6	3470	ND	44.96
Sample #4 (shot pile)	6.85	374	24100	0.277	92.5

The initial investigation was concluded with a recommendation to list the subject site as contaminated due to the significant lead contamination of the North Creek surface water, and the significant contamination of site soils with arsenic, lead, naphthalenes, and cPAH's.

u vs μ

date format

The GHSC was subsequently included on the Confirmed and Suspected Contaminated Sites List on 12.27.02 and entered Ecology's Voluntary Cleanup Program (VCP) on 05.13.03. The managers of the subject site, along with their consultants met with Ecology to discuss required remedial actions. A prospective buyer of the subject site intended to conduct the required remediation efforts, but the sale of the property never occurred, and neither did any remediation. The GHSC was removed from the VCP on 05.09.06 due to inactivity.

On two dates in April 2008, Ecology's Toxic Studies Unit sampled three locations along North Creek, and two locations along Donkey Creek for lead and copper concentrations, as well as hardness and total suspended solids. Addition sampling scheduled in May 2008 was cancelled because North Creek was dry. Results were generally consistent between the two sampling dates, and also correlated with the results of TPCHD's 2002 sampling efforts. Dissolved lead concentrations ranging from 178 to 200 ug/L were found in North Creek just downstream of the GHSC. North Creek water samples taken upstream from the GHSC (and further upstream from TPCHD's "upstream" sample) were significantly less at 0.82 ug/L, leading Ecology to conclude that the GHSC was the source of the dissolved lead in North Creek. Furthermore, the concentrations of dissolved lead found in North Creek waters down stream of the GHSC were cited by Ecology as the highest found in Washington State surface waters.

Dissolved copper concentrations in the 2008 Ecology samples collected both upstream and downstream of the GHSC were described as slightly above both acute and chronic water quality criteria. The GHSC was not cited by Ecology as the likely source of the elevated copper concentrations in North Creek and the data was limited; therefore, copper concentrations were not considered in the ranking process of this site. *(Do I need to expand on the copper concentrations at all?)*

Hardness values in North Creek and Donkey Creek as measured in Ecology's 2008 sampling were generally consistent between the two sampling dates and also correlated with TPCHD's 2002 sampling results. Immediately upstream and downstream of the GHSC, North Creek water hardness was measured at 11 to 12 mg/L by Ecology. Further downstream on North Creek, near Burnham Drive, the hardness value measured by Ecology was 26 – 39.9 mg/L, showing an increase in hardness with distance traveled from the GHSC. At both sampling locations on Donkey Creek, upstream and downstream of where North Creek joins, Ecology found hardness concentrations ranging from 51 to 57.3 mg/L.

Ecology's 2008 sampling results are tabulated below; ranges for detected concentrations are presented and encompass both sampling dates. The first value in each range given is from samples collected on 04.10.08 and the second value in each range is from samples collected on 04.21.08 at the same locations.

date format

Comment [CM2]: No. Inasmuch as Cu has no bearing on this ranking, I don't believe you need to comment further.

Comment [CM3]: Increasing Hardness, of course, depresses Pb+2 mobility

Add CM's comment

April 2008 Sampling	Hardness, mg/L	Dissolved Lead, ug/L
N Creek 1 (upstream)	12.5 – 13.0	0.82 – 0.82
N Creek 2 (downstream)	11.1 – 10.0	200 - 178
N Creek 3 (Burnham Dr)	39.9 – 26.0	28.0 – 32.6
Donkey 4 (upstream)	51.0 – 55.5	0.17 – 0.14
Donkey 5 (downstream)	53.3 – 57.3	3.22 – 1.81

The data collected to date indicate that localized conditions at the GHSC include low pH soils, and low hardness concentrations in North Creek water as compared to Donkey Creek that increases with distance from the GHSC site. Furthermore, the sampling results show both spatial and temporal consistency. Sampling results in proximity to GHSC consistently show extremely elevated concentrations of dissolved lead in North Creek that significantly exceeds all surface water criteria. Ecology's sampling results also indicate some impact to Donkey Creek water quality conditions downstream of where North Creek joins.

SPECIAL CONSIDERATIONS (include limitations in site file data or data which cannot be accommodated in the model, but which are important in evaluating the risk associated with the site, or any other factor(s) over-riding a decision of no further action for the site):

The extent of the contamination is not known, so the default value of 1 was used in all instances in the model where a value for quantity was needed. Additionally, precipitation data collected from the Pierce County Water Program's Purdy Weather Station was used to determine total and net precipitation instead of the usual Tacoma data. The Purdy Weather Station is located on the Gig Harbor Peninsula, as is the subject site, and better reflects local weather conditions than the weather data customarily used from Tacoma. Data collected from water years (October through September) 2000 through 2008 was averaged.

ROUTE SCORES:

Surface Water/Human Health: 26.9 Surface Water/Environmental: 48.3
 Air/Human Health: 48.5 Air/Environmental: 14.9
 Groundwater/Human Health: 63.5

OVERALL RANK: 1

Comment [CM4]: The WQ lead for this WRIA (in NWRO) will want to be in the loop on this.

WORKSHEET 2
Route Documentation

1. SURFACE WATER ROUTE

- a. List those substances to be considered for scoring: **Source: 1,2**
Arsenic, lead, naphthalene, and carcinogenic polycyclic aromatic hydrocarbons (cPAHs).
- b. Explain basis for choice of substance(s) to be used in scoring.
Arsenic, lead, naphthalene and benzo(a)pyrene will be scored for the surface water route due to levels detected in soil and because these substances are available to the surface water route through less than perfect containment. Benzo(a)pyrene was selected as a representative of the group of cPAHs.
- c. List those management units to be considered for scoring: **Source: 1,2**
Spills, discharges, and contaminated soils with no run on/run off control
- d. Explain basis for choice of unit to be used in scoring:
Contaminated soil and surface water verified by sampling and analysis.

2. AIR ROUTE

- a. List those substances to be considered for scoring: **Source: 1,2**
Arsenic, lead, naphthalene, and carcinogenic polycyclic aromatic hydrocarbons (cPAHs).
- b. Explain basis for choice of substance(s) to be used in scoring:
Arsenic, lead, naphthalene, and carcinogenic polycyclic aromatic hydrocarbons (cPAHs) will be scored for the air route due to levels detected in soil and because these substances are available to the air route through less than perfect containment.
- c. List those management units to be considered for scoring: **Source: 1,2**
Contaminated soil, discharges, spills with no vapor collection system.
- d. Explain basis for choice of unit to be used in scoring:
Contaminated soil verified by sampling and analysis.

3. **GROUNDWATER ROUTE**

- a. List those substances to be considered for scoring:

Source: 1,2

Arsenic, lead, naphthalene, and carcinogenic polycyclic aromatic hydrocarbons (cPAHs).

- b. Explain basis for choice of substance(s) to be used in scoring:

Arsenic, lead, naphthalene, and carcinogenic polycyclic aromatic hydrocarbons (cPAHs) will be scored for the groundwater route due to levels detected in soil and available to the groundwater route.

- c. List those management units to be considered for scoring:

Source: 1,2

Contaminated soil/spill/discharge due to documented contamination of soil with the above listed substances.

- d. Explain basis for choice of unit to be used in scoring:

Contaminated soil verified by sampling and analysis.

WORKSHEET 4
 Surface Water Route

1.0 SUBSTANCE CHARACTERISTICS

1.1 Human Toxicity										
Substance	Drinking Water Standard (µg/L)	Value	Acute Toxicity (mg/kg-bw)	Value	Chronic Toxicity (mg/kg/day)	Value	Carcinogenicity		Value	
							WOE	PF*		
1 Arsenic	10	8	763 (rat)	5	0.001	5	A	1.75	7	
2 Lead	5	8	--	ND	--	ND	B2	--	ND	
3 Naphthalene	160	4	490 (rat)	5	0.004	3	--	--	--	
4 Benzo(a)pyrene	0.2	10	50 (rat)	10	--	--	B2	12	7	
5										

*Potency Factor

Source: 2,3
Highest Value: 10
 (Max = 10)
Plus 2 Bonus Points? 2
Final Toxicity Value: 12
 (Max = 12)

1.2 Environmental Toxicity () Freshwater (x) Marine				
Substance	Acute Water Quality Criteria		Non-Human Mammalian Acute Toxicity	
	(µg/L)	Value	(mg/kg)	Value
1 Arsenic	69	6		
2 Lead	140	4		
3 Naphthalene	2350	2		
4 Benzo(a)pyrene	300	4		
5				

Source: 2,3
Highest Value: 6
 (Max = 10)

1.3 Substance Quantity (areal extent)	
Explain Basis: unknown	Source: 1,2 Value: 1 (Max = 10)

2.0 MIGRATION POTENTIAL

		Source	Value
2.1	Containment: Spills, discharges, and contaminated soil Explain basis: Contaminated surface soil with no known run-on/runoff control	1, 2	10 (Max = 10)
2.2	Surface Soil Permeability: Gravelly sandy loam	1, 2	1 (Max = 7)
2.3	Total Annual Precipitation: 35.08" (average from Purdy Weather Station)	2, 9	3 (Max = 5)
2.4	Max 2yr/24hr Precipitation: >2.0 inches, <2.5 inches	2	3 (Max = 5)
2.5	Flood Plain: Not in a flood plain	2, 11	0 (Max = 2)
2.6	Terrain Slope: ~20 foot drop over 400 feet = 5%	2, 11	2 (Max = 5)

3.0 TARGETS

		Source	Value
3.1	Distance to Surface Water: North creek runs through the site (0 feet)	2, 11	10 (Max = 10)
3.2	Population Served within 2 miles (see WARM Scoring Manual Regarding Direction): 0	2, 6	0 (Max = 75)
3.3	Area Irrigated by surface water within 2 miles: 0	2, 6	0 (Max = 30)
3.4	Distance to Nearest Fishery Resource: 400' west (coho in Donkey Creek)	2, 11	12 (Max = 12)
3.5	Distance to, and Name(s) of, Nearest Sensitive Environment(s): A wetland is about 40 feet south of the site.	2, 11	12 (Max = 12)

4.0 RELEASE

Explain Basis: Samples from North Creek contained dissolved lead in concentrations exceeding the water quality standards for both chronic and acute ranges in fresh water.	Source: 1,2 Value: 5 (Max = 5)
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WORKSHEET 5
 Air Route

1.0 SUBSTANCE CHARACTERISTICS

1.1 Introduction

1.2 Human Toxicity										
Substance	Air Standard (µg/m ³)	Value	Acute Toxicity (mg/m ³)	Value	Chronic Toxicity (mg/kg/day)	Value	Carcinogenicity		Value	
							WOE	PF*		
1 Arsenic	0.00023	10	--	ND	--	ND	A	50	9	
2 Lead	0.5	10	--	ND	--	ND	B2	--	ND	
3 Naphthalene	166.5	4	--	ND	--	ND	--	--	ND	
4 Benzo(a)pyrene	0.0006	10	--	ND	--	ND	B2	--	ND	
5										

* Potency Factor

Source: 2,3
Highest Value: 10
 (Max = 10)
Plus 2 Bonus Points? 2
Final Toxicity Value: 12
 (Max = 12)

1.3 Mobility (Use numbers to refer to above listed substances)				
1.3.1 Gaseous Mobility		1.3.2 Particulate Mobility		
Vapor Pressure(s) (mmHg)		Soil Type	Erodibility	Climatic Factor
1	Arsenic= 0.0E+00 = 1	Gravelly sandy loam	56/tons/acre/year	1-10
2	Lead= 0.0E+00 = 1	Gravelly sandy loam	56/tons/acre/year	1-10
3	Naphthalene=8.2E-02=3			
4	Benzo(a)pyrene= 5.6E-09=1	Gravelly sandy loam	56/tons/acre/year	1-10
5				

Source: 2, 3
Value: 3
 (Max = 4)

Source: 1, 2, 3
Value: 1
 (Max = 4)

1.4 Highest Human Health Toxicity/ Mobility Matrix Value (from Table A-7)

Final Matrix Value: 18
 (Max = 24)

1.5 Environmental Toxicity/Mobility					
Substance	Non-human Mammalian Inhalation Toxicity (mg/m ³)	Acute Value	Mobility	Value	Matrix Value
1	Arsenic	--	ND		
2	Lead	--	ND		
3	Naphthalene	--	ND		
4	Benzo(a)pyrene	--	ND		
5					

Highest Environmental Toxicity/Mobility Matrix Value (from Table A-7) = Final Matrix Value: NS
 (Max = 24)

1.6 Substance Quantity (areal extent)	
Explain Basis: Unknown	Source: 1,2 Value: 1 (Max = 10)

2.0 MIGRATION POTENTIAL

	Source	Value
2.1 Containment: Spills, discharges, and soil contamination; no cover or containment	1, 2	10 (Max = 10)

3.0 TARGETS

	Source	Value
3.1 Nearest Population: North Harbor Business Campus is immediately adjacent	2, 11	10 (Max = 10)
3.2 Distance to [and name(s) of] nearest sensitive environment(s): A wetland is about 40 feet south of the site	2, 11	7 (Max = 7)
3.3 Population within 0.5 mile: $\sqrt{2626} = 51.24$	2, 11	51 (Max = 75)

4.0 RELEASE

Explain Basis for scoring a release to air: No confirmation of a release to air	Source: 1,2 Value: 0 (Max = 5)
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WORKSHEET 6
 Groundwater Route

1.0 SUBSTANCE CHARACTERISTICS

1.1 Human Toxicity										
Substance	Drinking Water Standard (µg/L)	Value	Acute Toxicity (mg/kg-bw)	Value	Chronic Toxicity (mg/kg/day)	Value	Carcinogenicity		Value	
							WOE	PF*		
1 Arsenic	10	8	763 (rat)	5	0.001	5	A	1.75	7	
2 Lead	5	8	--	ND	--	ND	B2	--	ND	
3 Naphthalene	160	4	490 (rat)	5	0.004	3	--	--	--	
4 Benzo(a)pyrene	0.2	10	50 (rat)	10	--	--	B2	12	7	
5										

* Potency Factor

Source: 2, 3
Highest Value: 10
 (Max = 10)
Plus 2 Bonus Points? 2
Final Toxicity Value: 12
 (Max = 12)

1.2 Mobility (use numbers to refer to above listed substances)	
Cations/Anions [Coefficient of Aqueous Migration (K)] OR	Solubility (mg/L)
1= Arsenic = 3 (K > 1.0 = 3, from scoring manual)	1=
2= Lead = 2 (K = 0.1 – 1.0, from scoring manual)	2=
	3= Naphthalene = 1 (3.0E+01)
	4= Benzo(a)pyrene = 0 (1.2E-03)
	5=

Source: 2, 3
Value: 3
 (Max = 3)

1.3 Substance Quantity (volume): Unknown	
Explain basis:	Source: 1, 2 Value: 1 (Max=10)

2.0 MIGRATION POTENTIAL

		Source	Value
2.1	Containment (explain basis): Contaminated soil with no cap, liner, or leachate collection system	1, 2	10 (Max = 10)
2.2	Net precipitation: Nov-April, 25.5-6.4 = 19.1 inches	2, 9	2 (Max = 5)
2.3	Subsurface hydraulic conductivity: Gravelly sandy loam	1, 2	4 (Max = 4)
2.4	Vertical depth to groundwater: ~50 feet	1, 2	6 (Max = 8)

3.0 TARGETS

		Source	Value
3.1	Groundwater usage: Public supply; no alternate unthreatened sources available with minimal hookups	2, 7, 11	9 (Max = 10)
3.2	Distance to nearest drinking water well: There is a well on the site.	2, 7, 11	5 (Max = 5)
3.3	Population served within 2 miles: $\sqrt{17903} = 133$	2, 8, 11	100 (Max = 100)
3.4	Area irrigated by (groundwater) wells within 2 miles: $(0.75)\sqrt{101} = 7.54$	2, 6	8 (Max = 50)

4.0 RELEASE

		Source	Value
	Explain basis for scoring a release to groundwater: No known release	1, 2	0 (Max = 5)

SOURCES USED IN SCORING

1. Tacoma-Pierce County Health Department Site Hazard Assessment File/Ecology TCP File
2. Washington State Department of Ecology, WARM Scoring Manual, April 1992.
3. Washington State Department of Ecology, Toxicology Database for Use in Washington Ranking Method Scoring, January 1992.
4. U.S. Department of Interior Geological Survey Topographical Map
5. Soil Survey of Pierce County, U.S.D.A. Soil Conservation Service
6. Water Rights Information System (WRIS), Ecology
7. Department of Ecology/Tacoma-Pierce County Health Department Well Logs
8. Washington State Department of Health Public Water Supply System
9. Washington Climate for Pierce County, National Weather Service Forecast Office
10. Department of Fish and Wildlife, Catalog of Washington Streams and Salmon
11. Pierce County Geographic Information System Countyview Database