SAMPLING OF DETENTION PONDS IN SUPPORT OF THE ENVIRONMENTAL RESTORATION PROGRAM AT ROCKY FLATS

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ABSTRACT

Three series of detention ponds were constructed along Walnut and Woman Creeks on Rocky Flats Plant (RFP) property to contain runoff and plant-generated wastes. More recently, the ponds have been used for spill control, runoff capture, temporary storage, and as NPDES discharge points. Diversion of discharges is practiced. However, because no permanent, floodproof structure is in place to divert the water from the ponds around downstream metropolitan water supply reservoirs, the strictest risk-based water quality standards currently developed have been applied to the quality of the water in the ponds. A two-part sampling and analysis program has been implemented by the Environmental Restoration (ER) Department of EG&G Rocky Flats. Sampling during discharge is in response to agreements between the Department of Energy (DOE) and the Colorado Department of Health (CDH). The characterization of ambient water quality anticipates possible future regulatory changes. The analytical services for the RFP have been developed to include most analytes listed under promulgated standards, and to achieve the lowest possible detection limits for those analytes.

INTRODUCTION

Three series of detention ponds were constructed at Rocky Flats Plant (RFP) to capture and control all runoff and plant-generated discharges. In the past, several of the ponds were used to hold low-level radioactive laundry and plant process effluents. More recently, the ponds have been used for spill control, runoff capture, temporary storage, and as NPDES discharge points. The ponds are within drainages which would, in the natural state, flow into reservoirs that provide irrigation storage and municipal supply.

Cooperative efforts between the Department of Energy (DOE), EG&G Rocky Flats, the Colorado Water Quality Control Commission (WQCC), the Colorado Department of Health (CDH), and downstream municipalities and water users have resulted in the development of the present program involving sampling, treatment, diversions, and controlled discharges. Two comprehensive sampling programs were implemented by the Environmental Restoration (ER) Department of EG&G Rocky Flats to (1) provide analyses of predischarge and discharge water quality, and (2) construct a database of ambient water quality in the terminal ponds. Analytical services are performed under the direction of an EG&G guidance document, which specifies methodology, quality control and assurance, and data quality objectives.

HISTORICAL OVERVIEW

The A, B, and C series detention ponds are currently used to capture and control all runoff and plant generated discharges from the RFP. This includes all precipitation runoff, sewage treatment plant (STP) effluent, and flow from the South Interceptor Ditch. The A series and B series ponds are located in North and South Walnut Creek, respectively, while the two C series ponds are located in Woman Creek on the south side of the plant (Fig. 1a). North and South Walnut Creeks merge and flow as Walnut Creek to the Great Western Reservoir, which is the water supply for the city of Broomfield. Woman Creek flows into Standley Lake or Mower Resevoir, which supplies irrigation storage and is the municipal water supply for the City of Westminster. Stream flows and water transfers between ponds have a complex history that depends on plant requirements and, more recently, on environmental regulations.

Several ponds within both the A and B series were originally used to hold low level radioactive laundry effluent, cooling tower blowdown, steam condensate-containing chrome and algicide, and treated process wastewater. At one time, Pond A-2 received both process wastewater and laundry wastewater pumped over from Pond B-2 (Fig. 1b). Ponds A-1 and A-2 currently are only used for spill control, and North Walnut Creek flows are diverted around them and into Pond A-3(an NPDES discharge point), which consequently receives much of the northern plant runoff. Pond A-4, constructed after 1979, was designed for surface water control and additional storage capacity from A-3, and now also serves as an NPDES discharge point.

Similarly, ponds B-1 and B-2 are now used exclusively for spill control, and South Walnut Creek flows are diverted around them into either B-3 or B-4. At one time, Ponds B-1 through B-4 received low level process waste water and low level laundry effluent, which contributed to the present elevated levels of radionuclides in B-1 through B-4 bottom sediments. Pond reconstruction activities between 1971 and 1973 disturbed bottom sediments upstream of B-1, and also contributed to the total plutonium inventory of the B-series ponds. Currently, Pond B-3 receives non-radioac-

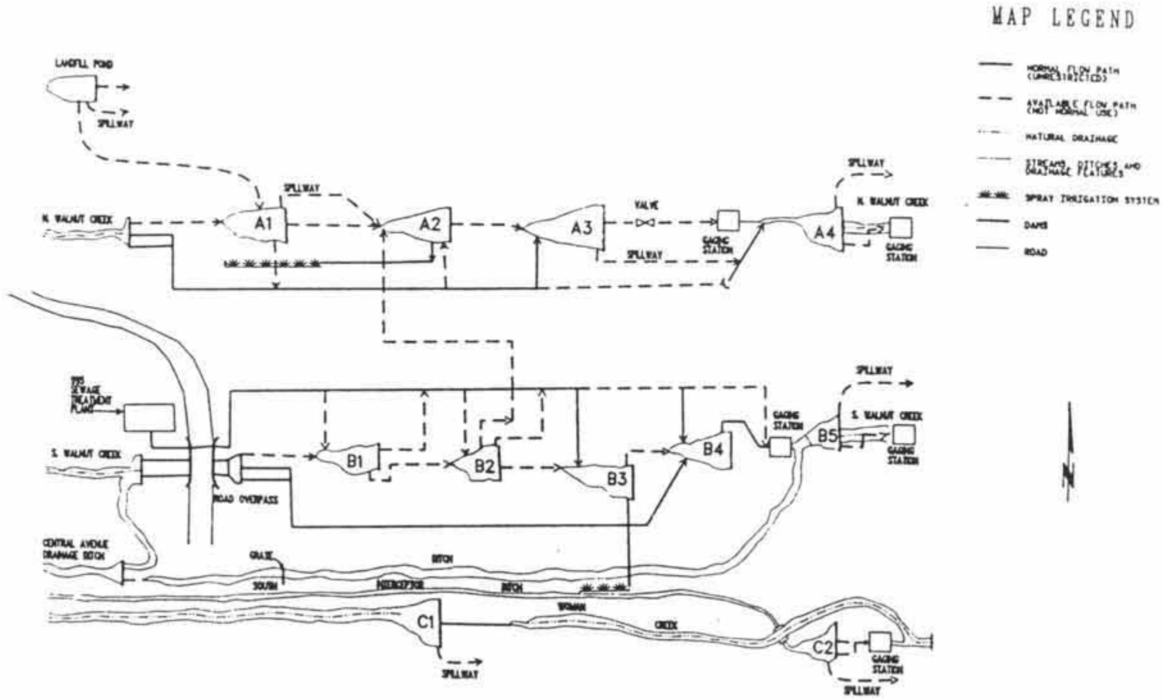

Fig. 1a. Present flow and transfer system at the detention ponds, Rocky Flats Plant.

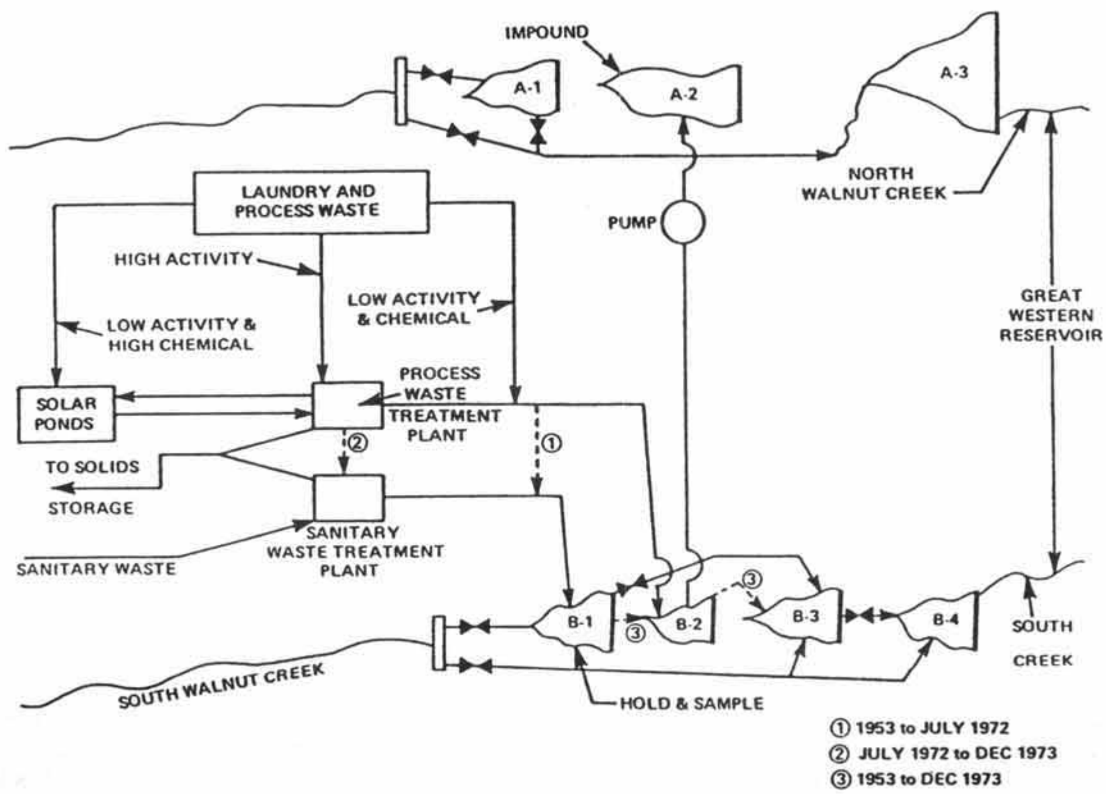

Fig. 1b. Past flow and transfer system at the detention ponds, Rocky Flats Plant.

tive STP effluent, and may also receive South Walnut Creek streamflow and runoff depending on storm events, snowmelt, and pond management practices. Normally, South Walnut Creek is diverted into Pond B-4 which then flows into B-5, an NPDES discharge point.

Pond C-1 and C-2 are located in the Woman Creek drainage; however, only Pond C-1 receives Woman Creek streamflow. Flow from pond C-1 is diverted around C-2 back into the Woman Creek channel or into offsite holding ponds where the water is used for local irrigation. Pond C-2 (an NPDES discharge point) primarily receives flow from the South Interceptor Ditch. The South Interceptor Ditch captures seep flow and runoff from the southern part of the plant including former waste disposal areas and solvent spill sites.

In addition to the contaminant sources described above, other contaminant sources may impact the ponds. These include: wind dispersed soils containing low levels of radionuclides from source areas, past fires in production buildings, and runoff. The runoff may contain contaminants from uncharacterized areas on the plant site upstream of the ponds.

REGULATORY REQUIREMENTS

The Colorado Water Quality Control Commission (WQCC) has promulgated standards for Walnut Creek and Woman Creek, as tributaries within the South Platte River drainage, and as direct tributaries to Big Dry Creek. The natural drainages of the creeks flow to water supply reservoirs for Broomfield, Westminster, Thornton, and Federal Heights. Because no permanent and floodproof structure is in place which will divert these creeks around Standley Lake and Great Western Reservoir, the strictest risk-based water quality standards currently developed have been applied to both creeks downstream of terminal ponds at RFP. The WQCC assumes the following:

1. Only compliance points detailed in the NPDES permit require sampling by the discharger. The Colorado Department of Health (CDH) is responsible for sampling all waters subject to standards imposed by the WQCC.
2. Practical quantitation limits are to be used as compliance thresholds.

The WQCC has the responsibility to certify EPA-NPDES permits under section 401 of the CWA. RFP has established a sampling program to determine if WQCC standards reflect ambient water quality, in the event they are considered for future NPDES permits. The analytical program is designed to detect the regulated compounds at the level of the standards, where possible.

The Agreement in Principle (AIP) is a formal agreement between the DOE and CDH which describes the roles of each agency for sampling and analysis of surface waters at RFP. The AIP is the vehicle for enforcement of the WQCC standards for terminal detention pond discharges. DOE has the responsibility to provide replicate samples to CDH before and during discharge, whereas CDH has the responsibility to assure the water quality of discharges does not affect the safety of downstream water users.

During the spring of 1990 the responsibilities of DOE and CDH as described in the AIP evolved into a working relationship. Water levels in the terminal detention ponds A-4, B-5, and C-2 began to approach the design limits of the impoundment dams. Downstream water users and CDH expressed concern about the quality of water which required immediate discharge. DOE in conjunction with CDH collected a variety of samples from ambient pond water and recycled treated effluent. Concurrence on the quality of water and permission to discharge was requested from CDH by DOE, permission was granted by CDH, and a program involving sampling, treatment, and diversions began.

The Environmental Monitoring and Assessment Division (EMAD) within the ER Department of EG&G Rocky Flats is responsible for designing and implementing two sampling programs: 1) the primary program supports the Clean Water Act Division (CWAD) and assesses water quality before and after tertiary treatment of effluent prior to and during discharge from the terminal ponds, and 2) the secondary program characterizes ambient water quality in the terminal ponds.

DISCHARGE SAMPLING PROGRAM

Approval to discharge pond water is based on replicate samples collected by EG&G and analyzed by both the CDH laboratories and offsite commercial laboratories. The analytical suite analyzed by EG&G contract laboratories matches at a minimum, all analyses performed by CDH. The current program is outlined in Table I. CDH developed this list and schedule to include many of the analytes listed in the WQCC standards. Prior to discharge, all analytes listed for the weekly, biweekly, monthly, and discharge event are collected from ambient water. This sample is collected as a depth composite when conditions allow. When the ponds are ice covered or high winds hamper sampling, a grab sample from the pond shore is collected. After approval to discharge is received, the Table I schedule is implemented. In addition to split sampling conducted with CDH, EG&G collects total suspended solids (TSS) and gross alpha daily from treated effluent. Effluent samples are collected from valves integrated into the treatment system. Currently, all water discharged from the terminal ponds passes through 10 μm prefilters and then through granulated activated carbon.

To optimize detained water storage and available treatment facilities, terminal pond B-5 water is transferred as

TABLE I

Discharge Split Sampling

Weekly	Bi-Weekly	Monthly	Each Event
Triazine Herbicides	Filtered Mn	Phenoxyacid Herbicides	BNAs
Gross Alpha, Beta	Nitrate/Nitrite as N	Organochlorine Pesticides	VOCs
Tritium	Ammonia, pH, Temp	Organosulfur Pesticides	
		PCBs	
		Filtered Metals - As, Ba, Cd, Cr, Pb, Hg, Se, Ag	
		$^{239/240}Pu$	
		^{241}Am	
		^{235}U, ^{238}U, $^{233/234}U$	

needed to pond A-4, where the water is treated and discharged into Walnut Creek. Flow from Walnut Creek is diverted around Great Western Reservoir via the Broomfield Diversion Canal. Instead of flowing into Woman Creek, treated effluent from pond C-2 is piped directly into the Broomfield Diversion Canal. Water in the Broomfield Diversion Canal flows directly into Big Dry Creek and ultimately into the South Platte River downstream of Denver.

AMBIENT WATER SAMPLING

The ambient water sampling program includes a more comprehensive parameter list than the discharge sampling program. The program is designed to construct a database of ambient water quality in the terminal ponds using the WQCC promulgated standards as a guideline. This information will be used by both DOE and CDH to determine if the applied standards are appropriate to the RFP.

The program includes both weekly and monthly sampling of each terminal pond. Samples are collected weekly as a depth composite from a single location at the deepest point in the pond for the parameters listed in Table II. The depth composite is composed of equal aliquots of water from the following depths: .5 meters below the water surface, midpoint, and .5 meters above the bottom. In addition, field parameters are measured at 4 locations within each pond. A set of parameters are measured at each sample composite depth. This is repeated near the pond inlet and *at two locations* which transect the deepest part of the pond. These parameters include pH, temperature, total alkalinity, dissolved oxygen, and conductivity. The Hydrolab Scout®, coupled with a Compaq 286® laptop computer, is used to measure most of these field parameters in-situ. The instrument is used for pond profiling and for collecting depth-specific parameters in conjunction with water-quality sample collection. The resulting data are compiled for the first three weeks of each month. Using these data EMAD determines dimensional characteristics of each pond. If the weekly characterization identifies stratification, vertical or areal, pond water quality may be heterogenous. To test this assumption, a subset of indicator analytes (volatile organics, filtered metals, water quality parameters) may be collected monthly at specific depths in the ponds depending on the degree of heterogeneity.

In addition to the indicator analytes listed above, the monthly samples are analyzed for a more comprehensive parameter suite (Table II) to include all analytes listed in the WQCC standards. These samples are collected as a depth composite or as appropriate depending on the analyte. When ponds are ice covered, field parameters are not measured and both weekly and monthly samples are collected as grab samples approximately fourteen feet offshore.

Currently, RFP is sampling in preparation for the worst-case scenario. All ponds are being assessed to determine if it is possible to achieve WQCC water quality standards. Downstream of the ponds, surface water quality is monitored to determine if lower reaches of the creeks affect water quality. Also, upstream stations are included in the sampling effort to establish a baseline water quality.

ANALYTICAL PROGRAM

All analytical services for the Environmental Restoration Program at the Rocky Flats Plant are carried out under the direction of an overall guiding document which serves as the scope of work. The technical requirements are based on the CLP methodology, but further stipulate that non-CLP analyses parallel the quality control requirements of

TABLE II

Extended Parameter List

Monthly Parameters

VOAs EPA - CLP
VOAs EPA - 502.2
BNAs EPA - CLP[1]
Pesticides/PCBs EPA - CLP
Pesticides/PCBs EPA - 608
Triazine Herbicides EPA - 619
Chlorinated Herbicides EPA - 615
Polynuclear Aromatic Hydrocarbons EPA - 610
Dioxin EPA - 613
Metals (TAL-CLP + Cs, Li, Sr, Sn, Mo, Si)
    unfiltered, filtered, potentially dissolved[2]
Chromium (hexavalent)
Cyanide
Oil and Grease
Total Suspended Solids
Total Dissolved Solids
Major Anions (Cl, F, SO_4, CO_3,
    HCO_3,NO_3/NO_2, NO_2)
Orthophosphate
Total Phosphorous
Ammonia
Sulfide as H_2S
Total Organic Carbon
Dissolved Organic Carbon
Acute Toxicity
Radionuclides - unfiltered, filtered
    Gross Alpha, Beta
    $^{239/240}Pu$
    ^{241}Am
    ^{235}U, ^{238}U, $^{233/234}U$
    $^{89/90}Sr$
    ^{137}Cs
    ^{226}Ra, ^{228}Ra
    ^{244}Cm
    ^{237}Np
    $^{230/232}Th$
Tritium

Weekly Parameters

VOAs EPA - CLP
Metals (TAL - CLP + Cs, Li, Sr, Sn, Mo, Si)
    filtered
Total Suspended Solids
Total Dissolved Solids
Major Anions (Cl, F, SO_4, CO_3,
    HCO_3, NO_3/NO_2, NO_2)
Chromium (hexavalent)
Orthophosphate
Ammonia
Total Organic Carbon
Dissolved Organic Carbon
Radionuclides - filtered
    Gross Alpha, Beta
    $^{239/240}Pu$
    ^{241}Am
    ^{235}U, ^{238}U, $^{233/234}U$
    $^{89/90}Sr$
    ^{137}Cs
    ^{226}Ra, ^{228}Ra
Tritium

[1] Additional analytes are reported.

[2] Preserved in nitric acid to a pH less than 2 and filtered 8 to 86 hours later.

the CLP analyses: initial and continuing calibration checks, blanks, duplicates, spikes, and laboratory control samples.

Work is contracted only to laboratories which have successfully passed a pre-award audit conducted by EG&G with the assistance of their data validation contractor. Where possible the EPA audit guidelines are followed, but checklists have also been developed to assist in auditing for non-CLP parameters.

Analytical results are validated by an independent contractor to assure that the data quality objectives have been met. The EPA guidelines are followed for validation of CLP-method data; similar guidelines have been developed for radiochemistry, water quality parameters, and non-CLP organic analyses. In addition to the factors affecting technical excellence, evidentiary considerations are also closely evaluated.

The driving factor thus far has been achieving the lowest possible detection limit for each analyte of interest; for a given sample, either the CLP VOA, or Method 624, and Method 502.2 may both be run. Similarly, both the CLP Pesticide/PCB and Method 608 may be run. Method 619 is run to detect Atrazine and Simazine at lower detection limits, even though they are detected by method 608.

Several of the compounds for which standards have been set are not detected by the methods currently being employed. In most such cases the detection limits do not approach the standards.

A matrix is being constructed that will avoid the unnecessary duplication of analyses for many of the analytes. Although the lowest possible detection limit may not be achieved, in the case of a compound which has not been found in the past, the detection limits will be adequate to assure that it will be identified in a timely manner if it is present in significant quantities.

Table III illustrates the specific standards that have been proposed by the Colorado Water Quality Control Commission, and the method detection limits (MDL) and practical quantitation limits (PQL) that are obtainable by the methods currently being utilized.

SUMMARY AND CONCLUSION

Water releases from RFP terminal ponds are dependent on environmental regulations and the cooperative efforts of all parties involved. The two monitoring programs implemented by the ER Department of EG&G Rocky Flats which assess water quality prior to and during discharge and characterize ambient water quality in the terminal ponds resulted from interaction between DOE, EG&G, CDH and the Colorado WQCC. The programs provide data with which CDH can verify that the water quality of discharges does not affect the safety of downstream water users, as well as data to characterize water quality in the terminal ponds. The discharge sampling program reflects immediate CDH concerns but does not consider the possible inclusion of WQCC standards into the NPDES permit. This resulted in the development of an ambient water quality monitoring program. The ambient monitoring program will take the following course in 1991:

1. EG&G will continue to monitor the terminal ponds for WQCC parameters.
2. EG&G will expand or reduce the program, based on data analysis and budgetary constraints.
3. Technical improvements in monitoring and sampling will be incorporated into the program, where possible.

Data are needed to determine whether it is possible to achieve WQCC water quality standards, many of which are below current detection limits. The analytical program associated with detention pond sampling at RFP is driven by the goal of achieving the lowest possible detection limit for each analyte of interest; however, in some cases, the detection limits do not approach WQCC standards. The current analytical program will also be revised in 1991 as follows:

1. Methods will be consolidated to reduce redundancy while maintaining effectiveness.
2. New methods will be developed to achieve lower detection limits.
3. The program will be reevaluated for cost-effectiveness.

TABLE III

Standards vs Detection Limits

Analyte		CAS No.	ORGANICS STANDARD	ADDITIONAL STANDARD	CLP	<----- 624	625	502.2	608	MDL 507	615	619	613	-----> Lowest MDL	PQL
Acrylonitrile		107-13-1		0.058		1								1	10
Aldicarb *	B	116-06-3	10												
Carbofuran *	B	1563-66-2	36												
Aldrin	A	309-00-2	0.002	0.000074	0.05		1.9		0.004					0.004	0.04
Atrazine	H	1912-24-9	3							0.13		0.05		0.05	0.5
Benzene	A	71-43-2	5		5	4.4		0.009						0.009	0.09
Benzidine	A	92-87-5	0.0002	0.00012			44							44	440
Carbon Tetrachloride	A	56-23-5	5		5	2.8		0.01						0.01	0.1
Chlordane	A	57-74-9	0.03	0.00046					0.014					0.014	0.14
Chlorobenzene	B	108-90-7	300		5	6		0.003						0.003	0.03
Chloroform		67-66-3		0.19	5	1.6		0.02						0.02	0.2
Chloroethyl Ether (Bis-2)	A	111-44-4	0.03				5.7							5.7	57
Chloromethyl Ether (Bis) *		542-88-1		0.0000037											
DDT	A	50-29-3	0.1	0.000024	0.1		4.7		0.012					0.012	0.12
Dichlorobenzene 1,2	B	95-50-1	620		10			0.02						0.02	0.2
Dichlorobenzene 1,3	B	541-73-1	620		10		1.9	0.02						0.02	0.2
Dichlorobenzene 1,4	B	106-46-7	75		10			0.01						0.01	0.1
Dichlorobenzidine		91-94-1		0.01			16.5							16.5	165
Dichloroethane 1,2	A	107-06-2	5		5	2.8		0.03						0.03	0.3
Dichloroethylene 1,1	B	75-35-4	7		5	2.8		0.07						0.07	0.7
Dichloroethylene 1,2 cis	B	156-59-2	70		5			0.01						0.01	0.1
Dichloroethylene 1,2 trans	B	156-60-5	70		5	1.6		0.05						0.05	0.5
Dichlorophenol 2,4	B	120-83-2	21		10									10	
Dichlorophenoxyacetic Acid (2,4-D)	B	94-75-7	100								1.2			1.2	12
Dichloropropane 1,2	A	78-87-5	0.56			6		0.006						0.006	0.06
Dieldrin	A	60-57-1	0.002	0.000071	0.1		2.5		0.002					0.002	0.02
Dioxin (2,3,7,8-TCDD)	A	1746-01-6	2.2E-07	0.000000013									0.002	0.002	0.02
Diphenylhydrazine 1,2 *	A	122-66-7	0.05												
Endrin	B	72-20-8	0.2		0.1				0.006					0.006	0.06
Ethylbenzene	B	100-41-4	680		5	7.2		0.005						0.005	0.05
Ethylene Dibromide *	AG	106-93-4	0.0004												
Ethylene Glycol *	BG	107-21-1	7000												
Halomethanes **				0.19				0.02						0.02	0.2
Heptachlor	A	76-44-8	0.008	0.00028	0.05		1.9		0.003					0.003	0.03
Heptachlor Epoxide*	A	1024-57-3	0.004		0.05		2.2		0.083					0.05	0.5
Hexachlorobenzene	A	118-74-1	0.02	0.00072			1.9							1.9	19
Hexachlorobutadiene	B	87-68-3	14	0.45	10		0.9	0.02						0.02	0.2
Hexachlorocyclohexane, Alpha		319-84-6		0.0092					0.003					0.003	0.03
Hexachlorocyclohexane, Beta		319-85-7		0.0163			4.2		0.006					0.006	0.06
Hexachlorocyclohexane, Gamma	A	58-89-9	4	0.0186	0.05				0.004					0.004	0.04
Hexachlorocyclohexane, Technical *				0.0123											
Hexachlorocyclopentadiene	B	77-47-4	49		10									10	
Hexachloroethane *		67-72-1		1.9											
Isophorone	B	78-59-1	1050		10		2.2							2.2	22
Methoxychlor *	B	72-43-5	100												
Nitrobenzene	B	98-95-3	3.5		10		1.9							1.9	19
Nitrosodibutylamine N *		924-16-3		0.0064											
Nitrosodiethylamine N *		55-18-5		0.0008											
Nitrosodimethylamine N *		62-75-9		0.0014											
Nitrosodiphenylamine N		86-30-6		4.9	10									10	
Nitrosopyrrolidine N		930-55-2		0.016			1.9							1.9	19
Pentachlorobenzene *	B	608-93-5	6												
Pentachlorophenol	B	87-86-5	200		50		3.6							3.6	36
Polychlorinated Biphenyls (PCBs)*	A	1336-36-3	0.005	0.000079	0.5				0.2					0.2	2
Polynuclear Aromatic Hydrocarbons		10-53-7		0.0028											1
Simazine	H	122-34-9	4							0.075		0.06		0.06	0.6
Tetrachlorobenzene 1,2,4,5 *	B	95-94-3	2												
Tetrachloroethane 1,1,2,2		79-34-3		0.17		6.9		0.01						0.01	0.1
Tetrachloroethylene	B	127-18-4	10	0.8	5	4.1		0.04						0.04	0.4
Toluene	B	108-88-3	2420		5	6		0.01						0.01	0.1
Toxaphene	A	8001-35-2	5		1				0.24					0.24	2.4
Trichloroethane 1,1,1	B	71-55-6	200		5	3.8		0.03						0.03	0.3
Trichloroethane 1,1,2	B	79-00-5	28	0.6	5	5								5	
Trichloroethylene	A	79-01-6	5		5	1.9		0.01						0.01	0.1
Trichlorophenol 2,4,5	B	95-95-5	700		50									50	
Trichlorophenol 2,4,6	A	88-06-2	2	1.2	10		2.7							2.7	27
Trichlorophenoxypropionic Acid	B	93-72-1	10								0.2			0.2	2
Trihalomethanes (total) ***			100					0.1						0.1	1
Vinyl Chloride	A	75-01-4	2		10			0.02						0.02	0.2

* NOT ANALYZED FOR IN CURRENT PROGRAM
** Chloroform lowest standard
*** Bromodichloromethane + Dibromochloromethane + Bromoform + Chloroform
A Carcinogenic Organic Chemicals Standards
B Non-Carcinogenic Organic Chemicals Standards
G Groundwater Standards H Herbicide Standards