DEPARTMENT OF THE NAVY
ENGINEERING FIELD ACTIVITY, WEST
NAVAL FACILITIES ENGINEERING COMMAND
900 COMMODORE DRIVE
SAN BRUNO, CALIFORNIA 94066-2402

IN REPLY REFER TO:

5090
Ser 1841.2/7248
9 June 1997

From: Commanding Officer, Engineering Field Activity (EFA), West, Naval Facilities Engineering Command
To: Restoration Advisory Board (RAB) Members Distribution List, Naval Weapons Station (NWS) Concord, CA

Subj: RESTORATION ADVISORY BOARD (RAB) JUNE 19, 1997 MEETING

Encls: (1) RAB Agenda, June 19, 1997
(2) Draft RAB Meeting Minutes of May 15, 1997

1. There will be a meeting of the NWS Concord RAB on Thursday, June 19, 1996 at the Ambrose Community Center, 3105 Willow Pass Road, Bay Point, CA. Enclosure (1) is the draft agenda for this RAB meeting, which will begin at 7:00 p.m. The main agenda item will be a discussion on RAB comments to the Tidal Area RI report. Some RAB members had already met on the evening of Thursday, May 29, 1997 to consolidate comments in preparation for this meeting.

2. Enclosure (2) is the draft RAB meeting minutes of the May 15, 1997, RAB meeting. This document will be finalized during the RAB meeting scheduled for Thursday, June 19, 1997.

3. If you have any questions or comments regarding the issues discussed in this letter, please contact me at (415) 244-2558, or Mr. John Rosengard, RAB Community Co-chair, at (510) 601-8740.

Ronald Yee

RONALD YEE
By direction

Distribution:
Ms. Elizabeth Robinson Anello
Mr. Steven Bachofer
Mr. Scott Etzel
Mr. Steve Gallo
Mr. Edward Gardner
Ms. Susan Gladstone
Mr. David Kory
Ms. Sylvia Kotecki
Dr. Eugenia McNaughton
Ms. Colleen Monahan

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5090
Ser 1841.2/7248
9 June 1997

Subj: RESTORATION ADVISORY BOARD (RAB) JUNE 19, 1997 MEETING

Ms. Nicole Moutoux
Ms. Connie Peak
Mr. Richard Pieper
Mr. James Pinasco
Mr. Richard Purdue
Ms. Tatiana Roodkowsky
Mr. John Rosengard
Ms. Catie Roy
Mr. Thomas Shirley
Mr. Ronald Yee

NAVAL WEAPONS STATION CONCORD
RESTORATION ADVISORY BOARD

DRAFT MEETING MINUTES

Ambrose Community Center
3105 Willow Pass Road
Bay Point, California

Thursday, May 15, 1997

I. Welcome and Introduction

The Naval Weapons Station (NWS) Concord Restoration Advisory Board (RAB) met on Thursday, May 15, 1997, at the Ambrose Community Center in Bay Point, California. Mr. John Rosengard, the RAB community co-chair, opened the meeting at 7:05 p.m. A list of attendees is attached (Attachment A). Mr. Rosengard reviewed the agenda for this meeting and noted that the main agenda item will be a presentation on the Tidal Area Remedial Investigation (RI) Report. He stated that the report is a four-volume study first presented at last month's meeting. Two copies of the report would be available during the meeting and two copies are being circulated to RAB members.

II. Community Co-Chair's Report

Mr. Rosengard provided an update on new RAB membership. Mr. Gene Sill was approved for membership at the last RAB meeting; however, he was unable to attend tonight's meeting. An application was received from Mr. Larry Steinwalt as a result of the April NWS Concord site tour. The application was circulated for review. He then called for a decision on acceptance of Larry Steinwalt as a new RAB member. Mr. Steinwalt's membership was unanimously approved; Mr. Rosengard will contact him and invite him to attend the June RAB meeting.

Mr. Rosengard informed the board that Tatiana Roodkowsky had received an additional five or six applications and he would follow-up with her on their status.

Mr. Rosengard announced a meeting to be held in two weeks for RAB members only. The purpose of the meeting would be to prepare a comment letter for the Tidal Area RI Report; comments are due at next month's RAB meeting. The meeting will most likely be scheduled for May 29, 1997, at the Pass and Badge Office, 7:00 p.m. Members will be notified when the arrangements are finalized.

III. Approval of April RAB Meeting Minutes

Mr. Rosengard called for discussion on the April meeting minutes. No comments were made and

the minutes were accepted as presented. Mr. Rosengard commended the community relations contractor, Gutierrez-Palmenberg, Incorporated, for the quality of the meeting minutes and the timeliness of their submittal.

IV. Presentation on the Tidal Area RI Report

Mr. Rosengard noted that the RI Report is an important document for defining the location of contamination. The Tidal Area RI Report involves a key portion of NWS Concord along the Port Section of the tidal zone. Mr. Rosengard introduced Mr. Jim Polek of Montgomery Watson (team member to PRC in conducting the environmental study at NWS Concord) to begin the presentation.

Overview of Tidal Area RI Report

Mr. Polek distributed an executive summary of the report (Attachment B). He then provided a brief history of the Navy's Installation Restoration Program (IRP) leading up to the Remedial Investigation at NWS Concord. The significant chronology of events are as follows:

- An initial Assessment Study Report was produced in 1983
- A Site Investigation Report was produced in 1992
- Confirmation sampling was performed in 1993
- NWS Concord was added to the Superfund National Priority List in 1994
- A Remedial Investigation was conducted in 1995 for four Tidal Area sites (Site 1 - Tidal Area Landfill, Site 2 - R Area Disposal, Site 9 - Froid and Taylor Roads, and Site 11 - Wood Hogger)

Mr. Polek explained the main components of a Remedial Investigation. The first step is to develop objectives to characterize the chemicals in the soil and water. Field work is next performed, collecting soil and water samples. The data is then evaluated to delineate the nature and extent of the chemicals, to assess human health and ecological risk, and to assess the fate and transport of chemicals. The final step is to recommend an action.

Mr. Polek next reviewed the structure of the multi-volume RI report. The report includes an introduction, a description of the setting, the investigation methods, applicable or relevant and appropriate requirements, the geology and hydrology of the site, site-specific results, the human health risk assessment, the ecological risk assessment, the fate and transport of chemicals and the Navy's recommendations. Mr. Polek outlined the components of the Human Health Risk Assessment to include the identification of sites having human access, comparison of concentrations of chemicals with screening criteria using a conservative approach; and evaluation

of human health risk associations.

Mr. Polek provided a review of the four Tidal Area RI sites.

Site 1 - Tidal Area Landfill

The Tidal Area Landfill served as the major disposal area for NWS Concord from 1944 to 1979. Samples were collected at 8 locations around the perimeter of the landfill. Arsenic and beryllium were found to be present at ambient levels. The site was determined not to pose a risk to ecological receptors. The recommendations were to proceed to the Feasibility Study (FS) which includes two alternatives for consideration: a presumptive remedy of capping the landfill, or no further action. PRC also recommends assessing the potential groundwater pathway underlying the landfill.

Site 2 - R Area Disposal

The R Area Disposal site was used for the disposal of materials generated during the segregation of conventional munitions from the late 1940s until 1976. The entire area was investigated; 111 surface soil samples, 20 subsurface soil samples, and surface water and sediment samples from the sluice were taken. Results indicated the presence of five polyaromatic hydrocarbons (PAHs), and seven metals in the soil; benzo(a)pyrene and some metals in the sediment; and pesticides and a volatile organic compound (VOC) in the surface water. Arsenic, dibenz(a,h)anthracene, and benzo(a)pyrene were considered the chemicals of concern. It was determined that the chemical concentrations posed much less of an ecological risk than the physical stressors to the wetland. No further action and no further groundwater sampling were recommended for this site.

Site 9 - Froid and Taylor Roads

A piece of spent ordnance was found near the intersection of these two roads as well as some scrap metal and other debris. Nine soil samples were taken at two different depths, as well as two surface water sampling locations. Benzo(a)pyrene, arsenic and lead were found in the soil and hydrocarbons and nine metals were found in the surface water. The arsenic, benzo(a)pyrene, and lead pose concerns to human health; ecological risk is minimal because the site provides marginal habitat. No further action and no further groundwater sampling were proposed for this site.

Site 11 - Wood Hogger

The site consists of an area surrounding the Wood Hogger machinery and potential wood chip disposal areas used between 1969 and 1973. The site surrounds Solid Waste Management Unit (SWMU) 37. This was the most active of the four RI sites. Sampling included 72 surface soil samples, 35 subsurface soil samples, 3 sediment samples and 6 surface water locations from the sluice. PAHs were found in the soil as well as very low levels of dioxins and furans in the incinerator vicinity; metals were found in the surface water; and arsenic and beryllium were found

in the sediments. The wood hogger site may pose a risk to ecological receptors and should be considered within a risk management context.

Mr. Roscngard asked if a naturally occurring landfill material exists at NWS Concord. Mr. Polek noted that the entire area consists of Bay mud which is highly impermeable. The landfill sits on top of the Bay mud; erosion off the site is more of a concern than infiltration into the groundwater. Rich Purdue asked about the depth of the landfill. Mr. Polek stated that the greatest depth is 10 to 15 feet below the surface of the landfill. The water depth varies seasonally and during the winter the landfill contents are in contact with the water. Mr. Purdue asked why the groundwater was not sampled. Mr. Polek stated that the groundwater samples are turbid with particulates making it difficult to analyze just the water. He added that it is more important to sample the surface water and the soil.

John Bosche of PRC noted that capping the landfill and no further action are the two options to be considered for the Tidal Area Landfill site. A cap made of impermeable material will limit infiltration from above and stabilize groundwater fluctuations. Mr. Richard Pieper noted that if the landfill is capped, groundwater monitoring will still continue and the site will be visually inspected as well.

Mr. Purdue asked about the quantity of surface water samples taken, noting that most occurred in the summer. Mr. Polek replied that samples were taken during all four quarters, but the summer data showed the highest concentration of chemicals. Steven Bachofer noted that in the previous Tidal Area Report beryllium was not shown in such high concentrations as in the current report, and asked the reason for this. Mr. Bosche stated that beryllium is showing up in the Bay Area in general and that it may be due to ambient concentrations. Mr. Pieper asked about some of the uses are of beryllium (see attached ATSDR information sheet).

Qualitative Ecological Assessment - Tidal Area Sites

Mr. Bosche distributed a handout summarizing the Qualitative Ecological Assessment (Attachment B). He stated that the assessment is qualitative rather than quantitative. The qualitative ecological assessment determines if ecological effects are expected, if effects are not expected or the range in between where there is a possibility for ecological effects. The underlying basic approach is the same as that used for the Litigation Area.

The four steps to conduct an ecological risk assessment includes problem formulation, exposure assessment, effects assessment, and risk characterization. Data from the RI and ecological assessment were combined and used to evaluate risk. Problem formulation requires evaluation of the site ecology, chemistry data assembled from the RI, determination of assessment end points and screening chemistry data.

Mr. Bosche noted that if more than ten percent of the samples exceeded the chemistry screening levels, then the chemicals were listed as chemicals of potential ecological concern. The exposure and effects assessment includes site soil, sediment, and surface water evaluation, bioassays, and food chain

modeling. In the food chain modeling evaluation, Mr. Bosche pointed out that none of the Tidal Area Sites exceeded the high Hazard Quotient (HQ) level, however, many exceeded the low HQ level.

Mr. Bosche noted that all of the data are like pieces of a puzzle. All the pieces are put together to evaluate ecological risk. The weight of evidence approach is used to look at risk characterization, which leads to a risk management decision. Mr. Bosche stated that the evaluation indicates no acute ecological risk posed at the four sites; however, there is a potential for chronic risk where chemicals occur at highest concentrations at each of the four sites.

Mr. Bachofer questioned the validity of using of the P450 bioassay, noting it is a highly sensitive test. Nicole Moutoux, U.S. EPA, responded that the high sensitivity of this test is recognized and U.S. EPA is currently determining its usefulness. Mr. Bachofer noted that the conclusion of the risk could be based on shaky data. Ms. Moutoux replied that the conclusion is not clear cut but that it is a conservative conclusion.

Mr. Bosche reviewed the preliminary recommendations of the ecological risk assessment. The Tidal Area Landfill was determined to present no immediate risk, although the site should be capped to provide further protection. The R Area Disposal and Froid and Taylor Sites also pose no immediate risk, although there is some potential for long-term risk; no further action was recommended. The Wood Hogger Site is a very disturbed site offering little habitat, although there is the potential for adverse effects. A risk management team evaluation is recommended to determine if a response is required.

Mr. Purdue noted that the contents of the landfill had not been quantified. Mr. Bosche responded that the presumptive remedy approach used for landfills doesn't evaluate the contents but instead concentrates on protective measures. The presumptive remedy is based on the historical record of disposal. Ms. Moutoux added that recommending a cap without further investigation of the contents saves money since the landfill is likely to be capped anyway. Mr. Purdue recommended that the report should make a stronger statement about the presumptive remedy to cap the landfill.

Mr. Rosengard inquired about the origin of the fill used to recontour the landfill site. Mr. Pieper stated that the site was not operated like a traditional landfill noting it is full of construction debris. The fill may have come from an inland area, but apparently it was not capped while in use. Mr. Purdue asked how the depth of the landfill was determined. Mr. Polek responded that soil borings were taken to determine the depth.

V. Environmental Schedule and Suggested Future RAB Topics

Ronald Yee, EFA West, suggested that the members consider the direction of the Restoration Advisory Board, noting it has been in existence for two years. He summarized that remediation had been completed for the four areas in the Litigation Site and that the Tidal Area Site RI was nearing completion. The FS phase will follow; the first FS for Site 1 is to be submitted in September 1997, the second FS for Sites 2, 9, and 11 is to be submitted in March 1998, the third

FS for Site 22 is due in January 1999, and the fourth FS for SWMU Sites 5, 13, and 18 is due in September 2001.

Mr. Yee suggested that the RAB compile a list of outstanding questions and issues they have that could be addressed along with future presentations by PRC. Mr. Purdue asked if RAB members could get regulatory agency comments on issues as they come up. Knowing the regulatory agencies's concerns can help the RAB focus on issues of concern. Mr. Pieper suggested that the Navy could distribute copies of agency comment letters to RAB members.

Mr. Rosengard asked what could be done to more quickly reach the Record of Decision (ROD) phase of the Installation Restoration Program (IRP) process. He expressed the desire to have the Superfund sites receive a clean bill of health as soon as possible. Ms. Moutoux noted that some of the sites may not require the FS phase and may go straight to ROD, thus speeding up the process.

Mr. Rosengard suggested that the comment letter from the RAB and the Tidal Area RI be considered as topics for next month's RAB meeting. He also noted that his term as co-chair of the RAB expires in August and recommended that others consider the position.

VI. Adjournment

There was no public comment. Mr. Rosengard adjourned the meeting at 8:55 pm.

VII. Attachments

A. List of attendees and sign-in sheet from the May 15, 1997 RAB meeting
B. Presentation materials from the May 15, 1997 RAB meeting

The next meeting is scheduled for Thursday, June 19, 1997, Ambrose Community Center, 7:00 p.m.

A copy of these meeting minutes is available for public review at the Information Repository located at the Main Branch of the Contra Costa County Library in Pleasant Hill.

ATTACHMENT A

Attendance List
NWS Concord
Restoration Advisory Board Meeting
Thursday, May 15, 1997

Naval Weapons Station, Concord
Restoration Advisory Board Meeting Attendance
Date: May 15, 1997

RAB MEMBER	*Signature*
Elizabeth Robinson Anello	
Steven Bachofer	Steven Bachofer
Jim Campbell	
George Delacruz	
Scott Etzel	
John Fuery	
Edward Gardner	
James Koeppel	
James Kory	
Sylvia Kotecki	
Clint Mayfield	
Dr. Eugenia McNaughton	
Colleen Monahan	Colleen Monahan
Larry Myers	
Connie Peak	
James Pinasco	
Ricard Purdue	R. L Purdue
Tatiana Roodkowsky	
John Rosengard	John Rosengard
Catie Roy	
Thomas Shirley	
Thomas G. Concannon	Thomas G. Concannon
Janette Concannon	Janette Concannon
Steve Gallo	Steve Gallo

Naval Weapons Station, Concord
Restoration Advisory Board Meeting Attendance
Date: May 15, 1997

NAVY REPRESENTATIVES	*Signature*
Richard Pieper (NWS Concord)	
Ronald Yee (EFA West)	
REGULATORY AGENCIES	
Susan Gladstone (RWQCB)	
Nicole Moutoux (U.S. EPA)	
Phillip Ramsey (U.S. EPA)	
CONSULTANTS	
Kathy Walsh (PRC, EMI)	
John Bosche PRC	
Darlene Brown (GPI)	
Barry Gutierrez (GPI)	

Naval Weapons Station, Concord
Restoration Advisory Board Meeting Attendance
Date: May 15, 1997

PUBLIC/GUESTS - *Name*	*Address and Phone*
Jack Knuff	Knuffock

ATTACHMENT B

Presentation Materials
NWS Concord
Restoration Advisory Board Meeting
Thursday, May 15, 1997

Draft Agenda
Executive Summary, Tidal Area RI Report
Qualitative Ecological Assessment, Tidal Area Sites
Bioassays Being Used for Ecological Assessments at NWS Concord
ToxFAQ on Beryllium

DRAFT AGENDA
NAVAL WEAPONS STATION CONCORD
RESTORATION ADVISORY BOARD MEETING

Thursday, June 19, 1997

7:00 - 9:00 p.m.
Ambrose Community Center
3105 Willow Pass Road
Bay Point, California

7:00 - 7:05	Welcome and Introduction
7:05 - 7:10	Community Co-Chair's Report - John Rosengard
7:10 - 7:15	Approval of April RAB Meeting Minutes
7:15 - 8:00	RAB and Regulatory Agency Comments on the Tidal Area RI Report
8:00 - 8:10	Break
8:10 - 8:30	Continued RAB and Regulatory Agency Comments on the Tidal Area RI Report
8:30 - 8:40	Navy and Contractor Response to Presentations (optional)
8:40 - 8:55	Discussion of RAB Mission and Goals - Ronald Yee (EFA WEST)
8:55 - 9:00	Public Comment
9:00	Adjournment

EXECUTIVE SUMMARY

This report presents the results of, and recommendations based on, a remedial investigation (RI) conducted at four Tidal Area sites at Naval Weapons Station (NWS) Concord, California:

- Site 1 - Tidal Area Landfill Site
- Site 2 - R Area Disposal Site
- Site 9 - Froid and Taylor Roads Site
- Site 11 - Wood Hogger Site

The Phase 1A RI was conducted to (1) characterize soil, sediment, and surface water contamination at each site; (2) identify potential contamination migration pathways and receptors associated with each site; (3) estimate the extent, nature, and rates of contaminant migration from each site; (4) complete a screening human health risk assessment and a qualitative ecological risk assessment; and (5) gather data to support future focused feasibility studies (FS).

During the Phase 1A RI, soil, sediment, and surface water were sampled in July 1995 and August 1995, and surface water was sampled again in October 1995, January 1996, and April/May 1996 to evaluate environmental conditions and to assess the need for cleanup actions at the sites. In general, these sites were classified as RI sites because previously collected data showed the presence of chemicals in soil or surface water. As necessary, the data gathered will be used in the focused FS process to evaluate potential remedial technologies and alternatives. The results of the RI are summarized below by site, along with recommendations for each site. Based on the results of the Phase 1A RI, the need for groundwater sampling at the Tidal Area sites will be assessed, and any necessary groundwater sampling will be conducted during the Phase 1B RI.

TIDAL AREA SITES

Site 1 - Tidal Area Landfill Site. The Tidal Area Landfill served as the major disposal area for NWS Concord from approximately 1944 to 1979. The landfill reportedly received solvents, acids, paint cans, creosote-treated timbers, asphalt, concrete, asbestos, and ordnance materials, including inert munitions.

Site 2 - R Area Disposal Site. From the late 1940s until about 1976, the area along the eastern side of Baker Road between the Segregation Areas (R buildings) and the Inert Storage Area (S building) was used for the disposal of materials generated during the segregation of conventional munitions returned from Pacific operations. This disposal area became the R Area Disposal Site. The eastern site boundary was moved to the boundary of the Tidal Area Landfill Site in planning the RI, for a more complete investigation of the area between these two sites.

Site 9 - Froid and Taylor Roads Site. The Froid and Taylor Roads Site is located at the intersection of Froid Road and Taylor Boulevard. A piece of spent ordnance was found near the intersection of these roads, and some scrap metal and other debris was found south of the intersection during a previous investigation. The site was defined as the area from the eastern boundaries of the Tidal Area Landfill and Wood Hogger Sites to the intersection of Froid Road and Taylor Boulevard.

Site 11 - Wood Hogger Site. The Wood Hogger Site was used between 1969 and 1973 for chipping dunnage and wood scrap from Tidal Area operations. An incinerator was formerly used to burn wood scrap. Some of the wood chips were deposited on the ground adjacent to the wood hogger machinery. Some of the wood was likely derived from ordnance crates returned from Vietnam, which were probably treated with pentachlorophenol (PCP), a wood preservative that has been identified as a COPC. The site consists of an area surrounding the wood hogger machinery and potential wood chip disposal areas. The site surrounds solid waste management unit (SWMU) 37 site, so data from the Resource Conservation and Recovery Act (RCRA) facility assessment confirmation study investigation at SWMU 37 are included in the RI at the Wood Hogger Site.

HUMAN HEALTH RISK ASSESSMENT

The objective of the human health risk assessment (HHRA) conducted at the Tidal Area sites was to evaluate the potential carcinogenic risks and noncarcinogenic hazards associated with chemicals of potential concern (COPC) and to identify the chemicals of concern (COC) for each site. COCs, or risk drivers, are constituents for which the carcinogenic risk exceeds 10^{-6} or the hazard index exceeds 1.

The HHRA identified arsenic and beryllium as COCs for soil at the Tidal Area Landfill Site. Soil was the only medium sampled at the Tidal Area Landfill Site because no surface water or sediment is present at the site.

The HHRA identified arsenic, benzo(a)pyrene, and dibenz(a,h)anthracene as COCs for soil and arsenic benzo(a)pyrene as COCs for sediment at the R Area Disposal Site. No COCs were identified for surface water at the site.

The HHRA identified arsenic, benzo(a)pyrene, and lead as COCs for soil at the Froid and Taylor Roads Site. No COCs were identified for surface water and no sediment is present at the site.

The HHRA identified benzo(a)pyrene, dibenz(a,h)anthracene, and HPCDD as COCs for soil and arsenic and beryllium as COCs for sediment at the Wood Hogger Site. No COCs were identified for surface water at the site.

The reasonable maximum exposure (RME) risks for potential future residents and industrial workers at the Tidal Area sites are within the U.S. Environmental Protection Agency's (EPA) target risk range of 10^{-6} to 10^{-4}. The RME hazard indices for all sites are below the threshold value of 1, with the exception of the residential scenario at the Wood Hogger Site. Estimated ambient concentrations of metals, primarily arsenic, are the major contributors to risks and hazards at the Tidal Area sites. (Estimated ambient concentrations of metals are the concentrations believed to be naturally present in the soil and not resulting from site activities). Secondary contributors to risks and hazards at the sites are PAHs present at concentrations comparable to ambient levels in urban and rural soils.

CONTAMINANT FATE AND TRANSPORT

The mobility of polycyclic aromatic hydrocarbons (PAH) is low; PAHs detected at the Tidal Area sites occurred in discrete areas. Therefore, they will most likely remain sorbed to soil, although they may be transported by soil erosion from surface water runoff. No SVOCs were detected in the surface water samples collected from the Tidal Area sites, therefore the PAHs appears to remain sorbed to the soil.

The most likely transport of metals at the Tidal Area sites would be from erosion of the soil by surface water. The soil beneath ponded water may have a higher metal content than the other site soil. The presence of beryllium in the R Area Disposal and Wood Hogger Sites may result from deposition during ponding and evaporation cycles, rather than an anthropogenic source. Arsenic is indigenous to the soil; it is found throughout the soil in the Tidal Area sites and upland areas.

The petroleum hydrocarbons detected in soil samples from the Froid and Taylor Roads and Wood Hogger Sites will biodegrade with time.

The mobility of dioxins is low. Therefore, they will most likely remain sorbed to soil at the Wood Hogger Site, although they may be transported by soil erosion from surface water runoff. Dioxins may result from the presence of PCP on site or from combustion of wood products in the former incinerator on site.

ECOLOGICAL RISK ASSESSMENT

The objective of the qualitative ecological risk assessment at the Tidal Area at Naval Weapons Station (NWS) Concord, California, was to evaluate whether the contaminants at the Tidal Area sites present a significant risk to ecological receptors. Assessment tools included (1) surveys of plants and animals that use the site; (2) characterization of soil and vegetation; (3) comparison of chemical concentrations in soil, sediment, surface water, and soil extracts (leachate) to screening values; (4) toxicity tests (Microtox and Cytochrome P450); (5) food-chain analysis; and (6) reviews of published literature. Risks to each type of receptor were characterized using a weight-of-evidence approach that incorporated all of the available data. Risks to major groups of receptors based on this approach are summarized below.

Plants and Terrestrial Invertebrates

Soils at the Tidal Area sites appear relatively disturbed as a result of the physical alteration and disruption of habitat from ditches, roads, and buildings, and plant nutrition may be marginal to insufficient in some areas. This condition may be more closely related to land-use practices over the past 60 years than to past chemical releases. Soil concentrations of inorganic contaminants of ecological concern (COEC) may be associated with potential phytotoxicity in plants at some locations in

the Tidal Area sites; however, in general, populations of marsh and upland plants throughout most of the Tidal Area are not considered at great risk from site contaminants.

Although total concentrations of chemicals in environmental media may not be available for uptake by receptors, concentrations of chemicals in leachate samples indicated that invertebrates at the site may be exposed to toxic levels of soluble chemicals.

Aquatic Life

Risk to aquatic invertebrates and fish was evaluated by comparing chemical concentrations in wetland soil, sediment, surface water, and leachate to screening values derived for aquatic taxa, such as wetland cover values set by the California Regional Water Quality Control Board, effects range-low values set by the National Oceanic and Atmospheric Administration, and chronic freshwater or marine ambient water quality criteria set by EPA. Based on this evaluation, risk to aquatic invertebrates at the site was not considered significant.

Terrestrial Vertebrates

Risk to higher trophic level birds and mammals was evaluated by comparing site-specific ingested doses of contaminants to toxicity reference values (TRV) derived from reviews of toxicological literature. Doses were calculated using a food-chain model, with different assumptions for parameters such as body weight, ingestion rate, prey composition, and concentrations of contaminants in prey and soil. The calculated doses were compared to high and low TRVs using the following hazard quotient (HQ) approach:

$$HQ_1 = \text{Dose} / \text{High TRV}, \; HQ_2 = \text{Dose} / \text{Low TRV}$$

Based on these evaluations, none of the higher trophic-level assessment endpoint species were considered subject to significant immediate risk from site contaminants (HQ_1 values are less than 1). When very conservative assumptions were used, individuals from most of these species exposed year-round to maximum concentrations at the site may be subject to some risk (HQ_2 values were sometimes greater than 1); cadmium and lead appear to contribute most significantly to the potential risk.

PRELIMINARY RECOMMENDATIONS

The results of the human health risk assessment indicate that no further action is warranted at the Tidal Area sites to protect human health. For both a potential future industrial worker and a resident, the carcinogenic risks for all the Tidal Area sites are within the EPA target risk range. With the exception of the Wood Hogger Site, the hazard indices are below the threshold value of 1, indicating that there is no potential for noncarcinogenic adverse health effects at the sites. In most cases, site risks and hazards can be attributed primarily to the presence of ambient levels of arsenic at the sites and not to anthropogenic sources.

Results of the ecological risk assessment indicate that no sites in the Tidal Area pose a significant immediate risk that should be addressed by remedial actions. However, there were areas with concentrations of ecological contaminants of concern that may pose a risk to receptors. Any future efforts to enhance tidal action or restore natural hydrologic regimes in the wetland portions of the Tidal Area, and particularly the R Area Disposal Site, should evaluate the potential for migration of contaminants off-site to Suisun Bay. Currently, a feasibility study being conducted at the Tidal Area Landfill Site is considering presumptive remedy options such as capping and "no further action." Based on the results of the ecological risk assessment, the R Area Disposal and Froid and Taylor Roads Sites are proposed for "no further action." The contaminants identified in the southwestern portion of the Wood Hogger Site may pose potential long term risks to ecological receptors that should be evaluated in the context of a risk management decision.

TABLE ES-1

SUMMARY OF PRELIMINARY RECOMMENDATIONS AND CONCLUSIONS FOR THE REMEDIAL INVESTIGATION AND QUALITATIVE ECOLOGICAL ASSESSMENT

Site	Human Health Risk Assessment			Qualitative Ecological Risk Assessment Conclusions	Preliminary Recommendations
	Human Health Risk Result (RME)*	**Human Health Risk Drivers**	**Conclusion**		
Site 1, Tidal Area Landfill Site	Residential Risk: 6×10^{-5} HI < 1	**Soil:** Arsenic and beryllium present at ambient levels	Human Health Risk within the EPA's target risk range. HI is less than the threshold value.	The site does not pose an immediate risk to ecological receptors.	Proceed to FS following the presumptive approach, which includes capping and no further action as two alternatives under consideration.
	Industrial Risk: 9×10^{-6} HI < 1	**Soil:** Arsenic present at ambient levels	Human Health Risk within the EPA's target risk range. HI is less than the threshold value.		
Site 2, R Area Disposal Site	Residential Risk: 4×10^{-5} HI < 1	**Soil:** Arsenic present at ambient levels, benzo(a)pyrene and dibenz(a,h)anthracene comparable to ambient levels in urban and rural soils	Human Health Risk within the EPA's target risk range. HI is less than the threshold value.	The site does not pose an immediate risk to ecological receptors. Chemical stressors present no clear signals associated with adverse biological and ecological effects.	No further action.

TABLE ES-1 (Continued)

SUMMARY OF PRELIMINARY RECOMENDATIONS AND CONCLUSIONS
FOR THE REMEDIAL INVESTIGATION AND QUALITATIVE ECOLOGICAL ASSESSMENT

Site	Human Health Risk Assessment			Qualitative Ecological Risk Assessment Conclusions	Preliminary Recommendations
	Human Health Risk Result (RME)[a]	Human Health Risk Drivers	Conclusion		
Site 2, R Area Disposal Site (Continued)	Residential Risk: 5×10^{-5} HI < 1	**Sediment**: Arsenic present at ambient levels, benzo(a)pyrene comparable to ambient levels in urban and rural soils	Human Health Risk within the EPA's target risk range. HI is less than the threshold value.		
	Industrial Risk: 7×10^{-6} HI < 1	**Soil**: Arsenic present at ambient levels	Human Health Risk within the EPA's target risk range. HI is less than the threshold value.		
	Industrial Risk: 9×10^{-6} HI < 1	**Sediment**: Arsenic present at ambient levels	Human Health Risk within the EPA's target risk range. HI is less than the threshold value.		
Site 9, Froid And Taylor Roads Site	Residential Risk: 3×10^{-5} HI < 1	**Soil**: Arsenic present at ambient levels, benzo(a)pyrene, lead exceeds California-modified PRG	Human Health Risk within the EPA's target risk range. HI is less than the threshold value.	The site does not pose an immediate risk to ecological receptors. Habitat is marginal, and potential risks to ecological receptors are predicted to be minimal.	No further action.

TABLE ES-1 (Continued)

SUMMARY OF PRELIMINARY RECOMENDATIONS AND CONCLUSIONS
FOR THE REMEDIAL INVESTIGATION AND QUALITATIVE ECOLOGICAL ASSESSMENT

Site	Human Health Risk Assessment			Qualitative Ecological Risk Assessment Conclusions	Preliminary Recommendations
	Human Health Risk Result (RME)*	Human Health Risk Drivers	Conclusion		
Site 9, Froid And Taylor Roads Site (Continued)	Industrial Risk: 6×10^{-6} HI < 1	**Soil**: Arsenic present at ambient levels	Human Health Risk within the EPA's target risk range. HI is less than the threshold value.		
Site 11, Wood Hogger Site	Residential Risk: 2×10^{-5} HI < 1	**Soil**: Dibenz(a,h)anthracene	Human Health Risk is within the EPA's target risk range. HI is less than the threshold value.	The site does not pose an immediate risk to ecological receptors; however, the concentrations of contaminants suggest some level of risk.	Potential impacts of contamination at the site should be evaluated in the context of a ecological risk management decision.
	Residential Risk: 7×10^{-5} HI < 1.2	**Sediment**: Arsenic and beryllium present at ambient levels	Human Health Risk is within the EPA's target risk range. HI exceeds the threshold value.		
	Industrial Risk: 5×10^{-6} HI < 1	**Soil**: Dibenz(a,h)anthracene and benzo(a)pyrene at ambient concentrations in urban and rural soils, a single detect of HPCDD	Human Health Risk within the EPA's target risk range. HI is less than the threshold value.		

TABLE ES-1 (Continued)

SUMMARY OF PRELIMINARY RECOMENDATIONS AND CONCLUSIONS FOR THE REMEDIAL INVESTIGATION AND QUALITATIVE ECOLOGICAL ASSESSMENT

Site	Human Health Risk Assessment			Qualitative Ecological Risk Assessment Conclusions	Preliminary Recommendations
	Human Health Risk Result (RME)[a]	Human Health Risk Drivers	Conclusion		
Site 11, Wood Hogger Site (Continued)	Industrial Risk: 1×10^{-5} HI < 1	**Sediment**: Arsenic present at ambient levels	Human Health Risk within the EPA's target risk range. HI is less than the threshold value		

Notes:

a Risk assessment results are presented only when the risk exceeds 1E-06. The hazard index is the maximum segregated hazard index.

EPA U.S. Environmental Protection Agency
HI Hazard index
PRG EPA Region IX preliminary remediation goals
RME Reasonable maximum exposure

QUALITATIVE ECOLOGICAL ASSESSMENT TIDAL AREA SITES

Naval Weapons Station Concord

Qualitative Ecological Assessment

- Ecological Risk Assessment: The process that evaluates the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to one or more stressors (U.S. EPA 1992)
- Part of the RI/FS process to evaluate potentially contaminated sites

Framework Approach

- U.S. EPA 1992 Framework for Ecological Risk Assessment
  - Problem formulation
  - Exposure assessment
  - Effects assessment
  - Risk characterization

Data Inputs

- Data from the remedial investigation and the ecological assessment were combined and used to evaluate risk
  - Chemical analysis of environmental media
  - Wildlife surveys
  - Microtox and P450 toxicity screening test
  - Soils characterization

Problem Formulation

- Evaluation of Site Ecology
- Chemistry Data
  - Identify Chemicals of Ecological Concern (ambient and screening values)
- Determination of Assessment Endpoints
  - Marshland Health and Function
  - Plant and Animal Species of Concern

Problem Formulation (cont.)

- Screening chemistry data
  - Tidal Area Ambient Values
  - Wetlands Cover Values
  - Effects Range-Low, Effects Range-Median
  - Ambient Water Quality Criteria

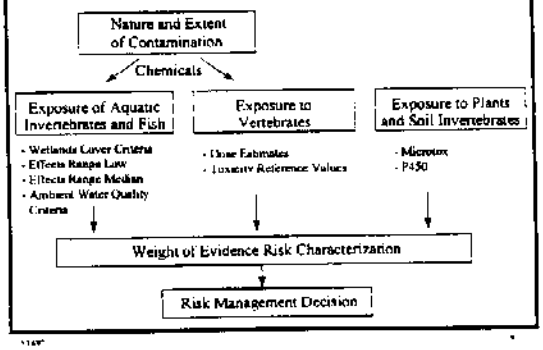
Exposure and Effects Assessment

- Site Soil, Sediment, and Surface Water Evaluation
- Bioassays (laboratory toxicity tests)
  - Microtox
    - No effects observed
  - P 450
    - Higher activity at Wood Hogger Site

Exposure and Effects Assessment (cont.)

- Food Chain Modeling
  - Dose estimates compared to Toxicity Reference Values (TRV) in a Hazard Quotient approach:
    - HQ_1 = Dose / High TRV (less conservative)
    - HQ_2 = Dose / Low TRV (very conservative)

How do the Pieces Fit Together?



Risk Characterization: Weight of Evidence

Lines of Evidence	Receptors of Concern										
	Plants	Benthic Invertebrates	Terrestrial Invertebrates	Fish	Reptiles and Amphibians	California Vole	Salt Marsh Harvest Mouse	Gray Fox	Western Meadowlark	Mallard Duck	Northern Harrier
Inorganic COCs											
Soil/Sediment Exceeds Screening Values?	YES	YES	YES	NA	NA	NA	NA	NA	NA	NA	NA
WET Extraction Exceeds AWQC?	YES	YES	YES	YES	NA	NA	NA	NA	NA	NA	NA
Surface Water Exceeds AWQC?	YES	YES	YES	YES	NA	NA	NA	NA	NA	NA	NA
Food Chain Analysis Conducted?	NO	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES
HQ_1 (Dose/High TRV) >1? (Yes = Risk)	NA	NA	NA	X	X	NO	NO	NO	NO	NO	NO
HQ_2 (Dose/Low TRV) < 1? (Yes = No Risk)	NA	NA	NA	X	X	NO	NO	NO	NO	NO	NO
HQ_2 (Dose/Low TRV) > 1? (Yes = Maybe Risk)	NA	NA	NA	X	X	YES	YES	YES	YES	YES	YES
Organic COCs											
Soil/Sediment Exceed Screening Values?	YES	YES	YES	YES	NA	NA	NA	NA	NA	NA	NA
Surface Water Exceeds AWQC?	YES	YES	YES	YES	NA	NA	NA	NA	NA	NA	NA
Food Chain Analysis Conducted?	NO	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES
HQ_1 (Dose/High TRV) >1? (Yes = Risk)	NA	NA	NA	X	X	NO	NO	NO	NO	NO	NO
HQ_2 (Dose/Low TRV) < 1? (Yes = No Risk)	NA	NA	NA	X	X	YES	YES	YES	YES	YES	YES
HQ_2 (Dose/Low TRV) > 1? (Yes = Maybe Risk)	NA	NA	NA	X	X	NO	NO	NO	NO	NO	NO
Other Information:											
Estimates of Bioavailability High?	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Microtox Toxicity Tests Indicate Effects?	NO	NA	NO	NA	NA	NA	NA	NA	NA	NA	NA
Cytochrome P450 Tests Indicate Effects?	YES	NA	YES	NA	NA	NA	NA	NA	NA	NA	NA
Literature Reviews Indicate Effects?	YES	X	YES	YES	?	X	X	X	X	X	X
Conclusion: Immediate Risk?	NO	NO	NO	NO	?	NO	NO	NO	NO	NO	NO
Conclusion: Potential Risk at Highest Concentrations?	YES	YES	YES	YES	?	YES	YES	YES	YES	YES	YES

Notes: NA = Not applicable, ? = Not enough information to assess, X = Not measured

This is a general summary table based on maximum concentrations and does not necessarily reflect conditions at each site. Please refer to section 13 0 for more details

Risk Characterization

- Plants:
  - Soils are physically disturbed
  - Locations with maximum metals concentrations (lead, chromium, and zinc) may be adversely affected.
  - Organic contaminants are not likely to pose a risk.
- Invertebrates and Soil Biota:
  - Potential for biological effects to invertebrates and other aquatic life at the Wood Hogger Site.

Risk Characterization (cont.)

- Birds and Mammals:
  - No immediate concern for birds and mammals
  - Very conservative models using maximum detected concentrations at specific locations indicate a potential for adverse effects to higher level receptors, especially those that are less mobile.

Food Chain Modeling Results

HQ_1<1 throughout and HQ_2 results below

Tidal Area Landfill (Site 1)

COEC	Receptor	HQ_2
Cadmium	California Vole	HQ = 3.37
Lead	**California Vole**	**HQ = 248**
	Western Meadowlark	**HQ = 30.7**

Froid and Taylor Roads (Site 9)

COEC	Receptor	HQ_2
Lead	**California Vole**	**HQ = 818**
	Western Meadowlark	**HQ = 101**

Tidal Area (Sites 1, 2, 9, and 11)

COEC	Receptor	HQ_2
Cadmium	Gray Fox	HQ = 1.33
Lead	Mallard	HQ = 34.2
	Northern Harrier	HQ = 47.2
	Gray Fox	HQ = 1590

R Area Disposal (Site 2)

COEC	Receptor	HQ_2
Cadmium	Salt Marsh Harvest Mouse	HQ = 2.32
	California Vole	HQ = 1.75
Lead	**Salt Marsh Harvest Mouse**	**HQ = 2,230**
	California Vole	**HQ = 1,840**
	Western Meadowlark	**HQ = 228**

Wood Hogger (Site 11)

COEC	Receptor	HQ_2
Cadmium	**California Vole**	**HQ = 12.1**
	Western Meadowlark	HQ = 2.12
Lead	**California Vole**	**HQ = 1,160**
	Western Meadowlark	**HQ = 143**
Mercury	California Vole	HQ = 1.17
	Western Meadowlark	HQ = 2.41
Zinc	California Vole	HQ = 1.77
total DDT	Western Meadowlark	HQ = 2.28

Notes:

HQ_2 Calculated according to the following formula: HQ2 = Dose Estimate / Low TRV.

Shading indicates HQ_2 at least one order of magnitude greater than 1.0

Preliminary Recommendations

- Tidal Area Landfill
  - No immediate risk
  - Site will be capped
- R Area Disposal and Froid and Taylor Sites
  - No immediate risk
  - Some potential for long-term risk
  - Recommended for "no further action"

Preliminary Recommendations (cont.)

- Wood Hogger Site
  - Potential for adverse effects
  - Evaluation required by risk management team to determine if response is required

Summary

- The Wood Hogger Site may pose a risk to ecological receptors and should be considered in a risk management context
- The landfill is being capped under the EPA presumptive remedy. No other sites appear appropriate for remedial action based upon the evaluation of the QEA.

Bioassays Being Used For Ecological Assessments At Naval Weapons Station Concord

INTRODUCTION

Ecological assessments (EA) are currently being conducted by the Navy at the Litigation Area sites, the Tidal Area sites, and the Inland Area sites at Naval Weapons Station (WPNSTA) Concord. As part of the EAs, standard bioassays and other types of toxicity tests are being conducted. Toxicity is a measure of the potential for harmful effects on plants or animals at the site.

Bioassays are tests to determine how plants and/or animals are actually affected by the conditions at a site. Bioassays are frequently used at sites where chemical contamination is suspected or is known to be present. In general, during a bioassay a healthy organism is placed in or on soil, sediment, or water (depending on where the organism normally lives) from the site to see how the plant or animal responds. Examples of responses that may occur in the organisms are chronic effects, such as behavior changes or reproductive failure, and acute effects such as mortality. The response of the plant or animal used in the bioassay is a good indicator of whether the medium (the soil, sediment, or water, and any contaminants it contains) is harmful to organisms. No single bioassay can demonstrate which chemicals are causing toxicity; instead, a series of bioassays is done to test for toxicity to several types of organisms by a range of chemical contaminants.

This summary of the four bioassays being used for the EAs at WPNSTA Concord was written in response to a request by the Restoration Advisory Board (RAB). Detailed information regarding the bioassays will be presented at future meetings, if requested by the RAB.

SOLID-PHASE AMPHIPOD BIOASSAY

Solid-phase bioassays measure the toxicity of sediments to plants and animals. Amphipods are small, shrimp-like animals that will be used as the test organism at the Litigation Area sites. The organism being used for the solid-phase amphipod bioassays is *Eohaustorius estuarius*, a species that burrows directly into the sediment. The solid-phase amphipod bioassay was chosen for several reasons:

- *Eohaustorius estuarius* occurs naturally in a wide range of habitats in the San Francisco Bay estuary.
- Amphipods are an important food source for fish.
- Amphipods are more sensitive to contaminated sediments than other types of animals and are the first to disappear from communities affected by pollution.
- The solid-phase amphipod bioassay is widely used in the San Francisco Bay region to assess toxicity, making comparison among sites possible.

The solid phase amphipod bioassay is a static, whole sediment toxicity test of 10 days in duration. A minimum of 20 test organisms per replicate are placed in a 1-liter glass beaker containing 175 milliliters of sediment and clean overlying water. The percent of amphipods surviving is the measured response. Sample toxicity is statistically evaluated by comparing sample survival in the test beaker with a "control" beaker containing clean sediment.

Toxicity of the sediments will be assessed by measuring the percentage of surviving amphipods after 10 days of exposure to site sediments.

PORE WATER BIOASSAY

Pore water is the water that occurs between grains of sediment. Exposure to pore water can be potentially more toxic to some organisms than exposure to sediments. This is because contaminants in pore water are more easily absorbed by organisms than contaminants attached to particles of sediment.

Pore water bioassays will be conducted at the Litigation and Tidal Area sites using the purple sea urchin (*Strongylocentrotus purpuratus*) as a test organism. The pore water bioassay was chosen for the following reasons:

- Pore water is thought to be the most likely route of exposure of many aquatic organisms to contaminants in sediments.
- The bioassay will serve as a check on the results of the solid-phase amphipod bioassay.
- The purple sea urchin pore water bioassay is widely used in the San Francisco Bay region to assess toxicity, making comparison among sites possible.

A centrifuge, using the principle of centrifugal force, is used to spin the pore water out of the wet sediment. Sea urchin eggs and sperm are placed in the pore water for 48 to 96 hours. In this bioassay, urchin eggs and sperm are placed in the pore water to evaluate fertilization success and percentage of larvae which develop normally. Toxicity is assessed by comparing the organisms fertilization success and larval development in the test pore water with those in a clean water control.

MICROTOX® (SOLID-PHASE AND ORGANIC EXTRACT)

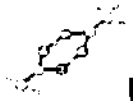
The MICROTOX® test is different from a standard bioassay but is a way to assess the toxicity of sediments at the preliminary screening level.

Two types of MICROTOX® tests will be used at the Tidal and Inland Area sites: (1) the solid-phase MICROTOX® assesses sediment toxicity, and (2) the organic extract MICROTOX® assesses the toxicity of nonionic and chlorinated hydrocarbons extracted from the sediment. From the results of the MICROTOX® test, an Effects Concentration 50 (EC50) value is calculated. The EC50 is the concentration of the sample that results in a 50 percent loss of light. High EC50 values indicate low toxicity, and low EC50 values indicate high toxicity.

MICROTOX® uses light-producing bacteria *(Photobacterium phosphoreum)* as a test organism. When the bacteria are exposed to contaminated sediment, they produce less light--the more toxic the sediments, the less light is produced. The measured response is how much the light is reduced when the bacteria are exposed to contaminated sediments.

The MICROTOX® test was chosen for several reasons:

- The MICROTOX® test is less expensive to perform than standard bioassays, so a larger number of samples can be tested at the preliminary screening level.
- The MICROTOX® test can be performed in the field, which can accelerate cleanup actions. Other bioassays require that the sediment or water be shipped to a laboratory.
- The problems encountered when running the standard bioassays (such as organisms dying because of causes unrelated to contamination) are not experienced with these tests.



P450 BIOMARKER

The P450 reporter gene system (RGS) biomarker is being used at the Tidal Area sites to assess the potential toxicity at the screening level. For this test, a firefly gene is added to a cell so that the cell produces light when exposed to toxic soil or sediment (see Fig. 1). The amount of light produced is a measure of the level of toxicity of the soil or sediment being tested. This test is being used to determine if specific chemical compounds are present at levels that are potentially toxic to organisms.

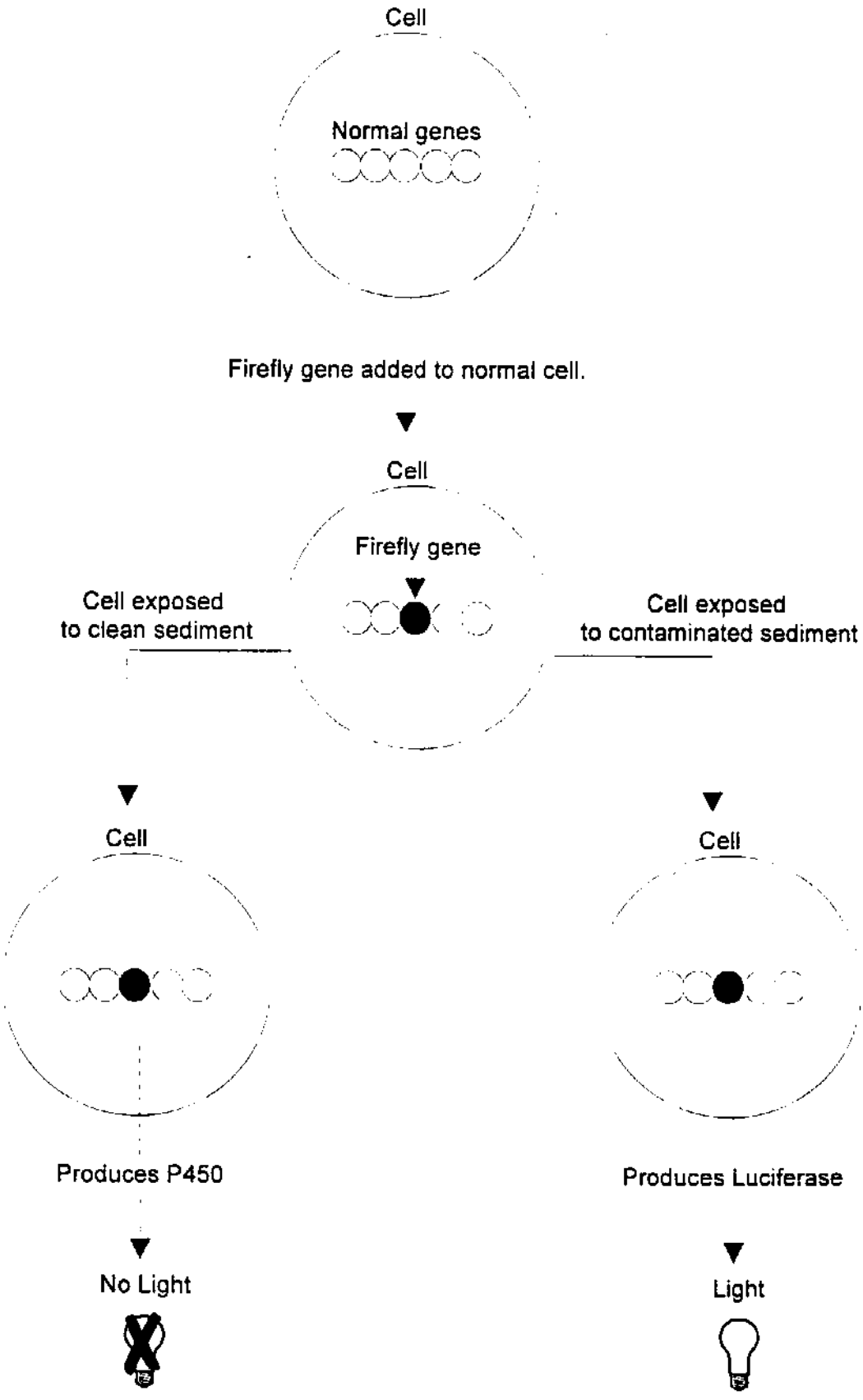
The RGS approach uses a human liver cancer cell line that has been engineered such that a specific gene (the CYP1A1 gene), when activated by certain toxins, will produce luciferase, a light producing enzyme, instead of the normal P450. The toxins that cause production of luciferase are called inducer compounds. Inducer compounds include complex synthetic compounds.

The P450 RGS biomarker is being used for several reasons:

- The P450 RGS biomarker test is relatively inexpensive.
- The P450 RGS biomarker is a good screening level test to indicate the toxicity of certain contaminants.

Figure 1

How The P450 Biomarker Works



ToxFAQs

Beryllium

April 1993

Agency for Toxic Substances and Disease Registry

This fact sheet answers the most frequently asked health questions about beryllium. For more information, you may call 404-639-6000. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

SUMMARY: Exposure to beryllium happens mostly in the workplace, near some hazardous waste sites, and from breathing tobacco smoke. Lung damage has been observed in some people who have breathed contaminated air. Some people become highly sensitive to beryllium exposure. Beryllium has been found in at least 349 of 1,300 National Priorities List sites identified by the Environmental Protection Agency.

What is beryllium?
(Pronounced ber-il' le-um)

Pure beryllium is a hard, grayish metal. In nature, beryllium can be found in compounds in mineral rocks, coal, soil, and volcanic dust. Beryllium compounds are commercially mined, and the beryllium purified for use in electrical parts, machine parts, ceramics, aircraft parts, nuclear weapons, and mirrors.

Beryllium compounds have no particular smell.

What happens to beryllium when it enters the environment?

- Beryllium dust gets into air from burning coal and oil.
- Beryllium dusts settles from air to the soil and water.
- It enters water from rocks and soil, and from industrial waste.
- Some beryllium compounds dissolve in water, but most settle to the bottom as particles.
- Beryllium particles in ocean water may take a few hundred years to settle to the bottom.
- Most beryllium in soil doesn't move up to the surface or into the groundwater.
- Fish do not build up beryllium in their bodies from the surrounding water to any great extent.

How might I be exposed to beryllium?

- Background levels in air, food, and water are low.
- Breathing contaminated workplace air (e.g., mining or processing ores, alloy and chemical manufacturing with beryllium, machining or recycling metals containing beryllium).
- Breathing tobacco smoke from leaf high in beryllium.
- Breathing contaminated air or ingesting water or food near industry or hazardous waste sites.

How can beryllium affect my health?

Beryllium can be harmful if you breathe it. The effects depend on how much you are exposed to and for how long.

High levels of beryllium in air cause lung damage and a disease that resembles pneumonia. If you stop breathing beryllium dust, the lung damage may heal.

Some people become sensitive to beryllium. This is called a hypersensitivity or allergy. These individuals develop an inflammatory reaction to **low levels** of beryllium. This condition is called chronic beryllium disease, and can occur long after exposure to small amounts of beryllium. This disease can make you feel weak and tired, and can cause difficulty in breathing.

Both the short-term, pneumonia-like disease and the chronic beryllium disease can cause death.

Swallowing beryllium has not been reported to cause effects in humans because very little beryllium can move from the stomach and intestines into the bloodstream.

Beryllium contact with scraped or cut skin can cause rashes or ulcers.

How likely is beryllium to cause cancer?

The Department of Health and Human Services (DHHS) has determined that beryllium and certain beryllium compounds may reasonably be anticipated to be carcinogens. This determination is based on animal studies and studies in workers. None of the studies provide conclusive evidence, but when taken as a whole, they indicate that long-term exposure to beryllium in the air results in an increase in lung cancer.

Is there a medical test to show whether I've been exposed to beryllium?

Tests can measure beryllium in the urine and blood. The amount of beryllium in blood or urine may not indicate how much or how recently you were exposed. Small amounts of human lung and skin can also be removed from the body and examined for beryllium. These tests can be done in a doctor's office or in a hospital.

One test uses blood cells washed out of the lung. If these cells start growing in the presence

of beryllium, you are probably sensitive to beryllium and may have chronic beryllium disease.

Has the federal government made recommendations to protect human health?

The Environmental Protection Agency (EPA) restricts the amount of beryllium that industries may emit into the environment to 10 grams (g) in a 24-hour period, or to an amount that would result in atmospheric levels of 0.01 micrograms of beryllium per cubic meter of air (0.01 $\mu g/m^3$), averaged over a 30-day period.

The National Institute for Occupational Safety and Health (NIOSH) recommends a standard for occupational exposure of 0.5 $\mu g/m^3$ of beryllium in workroom air during an 8-hour shift to protect workers from potential cancer.

The Occupational Safety and Health Administration (OSHA) sets a limit of 2 $\mu g/m^3$ of beryllium in workroom air for an 8-hour work shift.

Glossary

Carcinogen:
Substance that can cause cancer.
Ingesting:
Taking food or drink into your body.
Hypersensitivity:
A greater than normal bodily response to a foreign agent.
Microgram (µg):
One millionth of a gram.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1993. Toxicological profile for beryllium Atlanta: U.S. Department of Health and Human Services, Public Health Service.

Agency for Toxic Substances and Disease Registry (ATSDR). 1993. Case studies in environmental medicine: Beryllium toxicity. Atlanta: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns. For more information, contact:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE, Mailstop E-29
Atlanta, GA 30333
Phone: 404-639-6000

U.S. Department of Health and Human Services
Public Health Service
Agency for Toxic Substances and Disease Registry

Link to ATSDR Science Corner

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Charlie Xintaras / chx1@cdc.gov