Analysis of Boeing's Risk Assessments for the Santa Susana Field Laboratory

by

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Executive Summary

The Draft Program Environmental Impact Report (PEIR) for cleanup of the contaminated Santa Susana Field Laboratory (SSFL) is grossly deficient in that it contains hundreds of pages of material presenting exaggerated claims of purportedly negative impacts of cleaning up the radioactive and toxic chemical contamination, but essentially not a word about the negative impacts from the contamination itself and what would ensue if some or all of it were not cleaned up as promised. The PEIR contains no analysis whatsoever of the risks to public health and the environment from the contamination and from DTSC proposals to breach its longstanding commitments to a full cleanup thereof.

Because of this fundamental flaw in the PEIR, we here put forward data culled from Boeing's own risk assessments that show extreme levels of contamination and associated unacceptable risks to public health and to ecological receptors. It is important to note that Boeing's own analyses show that these risks to the public and to biological features would continue at unacceptable levels *after* the proposed minimal cleanup contemplated, in breach of the full cleanup long promised. Furthermore, the PEIR suggests vast but unspecified exceptions to cleanup, again with no analysis of the ecological or public health impacts of so doing. The data discussed in this report below, however, indicate that to exempt contaminated areas from cleanup could result in concentrations remaining at levels that create risks to public health and the environment far beyond what is acceptable.

In June and July of 2015, the Boeing Company[1] submitted to the Department of Toxic Substances Control (DTSC) 14 Draft[2] RCRA Facility Investigation Data Summary and Findings Reports (RFI)[3] for approval. These reports provided Boeing' own risk assessments for nine contaminated sites at SSFL in Subareas 1A Central and 5/9 South, as well as requests for approval to declare the great majority of the areas for No Further Action (NFA). NFA, in other words, means relief of any cleanup requirement.

Each report varied in length, from sixty to thousands of pages, consisting mostly of graphs, tables, and repetitive methodologies and information. The most important information, however, resided in appendices[4] in the far rear of each report and in tables with tiny print that you must zoom in very closely in order to read. In both cases, the

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[1] The Boeing Company owns much of SSFL, and has been named by DTSC as a Responsible Party for the contamination, along with NASA and the Department of Energy.

[2] Boeing released final versions of these reports in early 2017, but none of them include a Human Health or Ecological Risk Assessments. Instead, in a brief sentence, stated that the Human Health and Ecological Risk Assessments would be published at a later date as separate documents from the RFI reports.

[3] Suspiciously, after public disclosure of the extremely high-risk estimates in these reports, DTSC ordered removal of all risk estimates from RCRA Facility Investigation Reports. See Dec. 9, 2016 DTSC letter to Boeing.

[4]The appendices from each report to which we are referring are:

Appendix E1: Human Health Risk Assessment (HHRA)

Appendix E2: Ecological Risk Assessment (ERA)

Appendix E3: Identification of CMS and NFA Areas Based on Risk Assessments

information was hidden where the general public wouldn't find it easily.[5] We have undertaken an independent analysis of these risk assessment reports, and have reached several astonishing conclusions, summarized below.

Boeing estimates extraordinarily high excess lifetime cancer risks (the risk of getting a cancer from the contaminated sites, beyond one's regular cancer risk) if people were to live on the site. Below are some of Boeing's own risk estimates from their Human Health Risk Assessments (HHRA)[6]:

- An astonishing **96 people out of a 100** exposed, at the Systems Test Lab IV, would get a cancer from the contamination on site.
- **Every third person** exposed at the Environmental Effects Lab would get a cancer from the contamination on site.
- **Every fifth person** exposed at Happy Valley North would get a cancer from the contamination on site.
- **Every tenth person** exposed at Compound A site would get a cancer from the contamination on site.

These are remarkable figures that are far, far above the U.S. Environmental Protection Agency's (USEPA) acceptable risk range[7] of aiming for a one in a million risk and going no higher than one in ten thousand, and far above DTSC's target risk[8] of one in a million. Other high-risk figures found in these reports are presented in a table below (Table ES-1). These values, provided in the HHRA of each report, are current risk values if one were to be exposed at the site. Boeing's own estimates of the risk on their sites are thus orders of magnitude far beyond what would be generally allowable by the federal and state standards.

These reports, however, include requests for approval to designate something on the order of 98% of the soil as NFA, or to not be cleaned up. This is extremely concerning because these reports also provide risk estimates for what the contamination levels would be after the supposed "cleanup," which are still far above the allowable USEPA and DTSC levels if these requests were approved. Furthermore, Boeing proposes to not clean up Happy Valley North at all. The HHRA risk estimate and the post-clean up risk estimate are the exact same number, thus reiterating that Boeing's intention is to not provide the quality cleanup that was promised. Other post-cleanup values can be found in Table ES-2, below.

Additionally, a number of assumptions in the risk assessments underestimate the risks. For example, the reports separately calculate the risk from a suite of PCBs[9], converting the risk into a "Toxicity Equivalent Quotient" (TEQ) tied to the risk of a

[5] DTSC, in September 2016 reviews of the 2015 Boeing risk assessments, directed Boeing to combine the suburban residential garden and direct contact risk estimates and move them to the beginning of the risk assessments, and expressed clearly there, but that has not been done as of this writing.

[6] Three elected officials, concerned about these extremely high risks, raised the matter in a letter to DTSC Director Barbara Lee on December 15, 2015, attached.

[7] U.S. EPA Target Risk Range: 1E-06 to 1E-04 (1×10^{-6} to 1×10^{-4})

[8] Also known as DTSC's "Point of Departure" 1E-06 (1×10^{-6})

[9] PCB: Polychlorinated Biphenyl

standard dioxin congener.[10] However, the PCB TEQs are not included in the estimate of total risk, and because of this intentional separate calculation for PCB TEQs, it gives the illusion of a lower total risk, when in fact the risk is much higher than what it is being claimed, as the total risk should include all PCBs. In some cases, the risks from the estimated PCB-TEQs alone were far above allowable levels for cancer risk or hazard index, and at times with a cancer risk of greater than one in ten.

Similarly, despite USEPA guidance to the contrary, the reports average contaminant concentrations over significant areas, so that an area that is high would not get cleaned up because it has been averaged with soil samples taken in areas where contamination levels are far lower.[11] Furthermore, large areas are declared NFA based on not exceeding soil characterization levels (SCLs), but these SCLs are based neither on the required agricultural exposure scenario, nor the suburban residential scenario supposedly employed, but a far weaker standard, so measurements on which these judgments are based are incapable of detecting and reporting contamination at the levels of concern. The reports divide the suburban residential scenario into exposures from two sources: direct soil contact with contaminated soil and consumption of fruits and vegetables from a backyard garden. The latter is generally two or three orders of magnitude more restrictive than the former, and for proper risk estimates both are to be added together. However, after calculating the backyard garden scenario, the reports do not use it for cleanup decisions or for the establishment of SCLs, resulting in very large estimated risks after cleanup and large areas declared NFA based on SCLs that are orders of magnitude higher than the suburban residential garden risk-based screening level.

Under normal DTSC and USEPA procedures, cleanup is based on the future land use permitted by County zoning and General Plan designations that would produce the greatest exposure. In 2010 DTSC stated:

> "The local government General Plan land designations and local zoning designations are the most reliable expressions of prospective land use…DTSC and USEPA defer to local governments' land use plans and zoning decisions, and base their cleanup level calculations on the assumption that the land will be used as the land use requirements would allow, irrespective of its current use."[12]

In early 2015, Ventura County reaffirmed, in a letter to DTSC, that its General Plan allowed a wide range of agricultural and residential uses. DTSC subsequently said it would adhere to the Ventura County letter and require cleanup sufficient so that any of the land uses allowed by the County could be safely conducted after the cleanup. Thus,

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[10] Congeners are related chemical substances "related to each other by origin, structure, or by function"; IUPAC, *Compendium of Chemical Terminology*, 2nd ed. (the "Gold Book") (1997). http://goldbook.iupac.org/html/C/CT06819.html

[11] See EPA "Radiation Risk Assessment at CERCLA Sites: Q&A," OSWER 9285.6-20, June 13, 2014, p. 8-9. The Boeing risk assessments also frequently report risk in terms of incremental risk (i.e., the risk above background), which also is contrary to EPA and DTSC policy, requiring total risk to be estimated and compared to risk-based standards. While one doesn't clean up below background, when there is contamination (i.e., total contaminant concentration exceeds background), it is to total concentration that is to be compared to cleanup levels and risk goals.

[12] Page 12; http://www.dtsc-ssfl.com/files/lib_correspond/agreements/64765_AIP_Response_to_Comments_Volume_I.pdf

the most protective cleanup standard is agricultural, then residential (with garden), and lastly recreational, which is orders of magnitude less protective than required by DTSC policy.

The Boeing risk assessments, however, are not based on agricultural exposure scenarios. Instead, Boeing has said it would clean up to a suburban residential standard so that, even if no one were to ever live on the site, people living nearby would be protected. Boeing has also said the sites would be cleaned up so that if people could live on the site, have a backyard garden, and drink from a well. Yet, deep within its own reports, are estimates that demonstrate risks far above the safe threshold levels that the DTSC and USEPA consider acceptable.

Each RFI report also includes hypothetical post-remediation risk values, or "residual" risk values. We've included in each chapter Boeing's own residual risk values to show how much contamination is getting cleaned up and what the risk will be after the supposed cleanup. We've summarized residual risk values for the garden use pathway for each site that was listed in Table ES-2.

Additionally, cleanup should meet the most protective Ecological Risk Based Screening Levels (Low TRV EcoRBSLs and EcoRBSLs for invertebrates and terrestrial plants based on true No Adverse Effects Levels.) It is clear, however, that what is proposed would leave contamination at concentrations far above the levels deemed to pose risk to ecological receptors.

To summarize, Boeing's own Human Health Risk and Ecological Risk Assessments have shown risk estimates that are far beyond what is deemed acceptable by USEPA and DTSC standards. Not only that, but it adds insult to injury that Boeing's own calculated post-cleanup risk values are still far above USEPA and DTSC standards, and Boeing had the audacity to request DTSC let them move forward with those risk values.

Furthermore, Boeing released new draft versions of RFI reports in early 2017, none of which included a Human Health Risk Assessment or Ecological Risk Assessment. We can understand the desire to suppress its own damning estimates of risk, but removing them and eventually coming forward with new "massaged" numbers that presumably would claim far lower risks than its own risk estimates from the reports examined here is not appropriate.

The draft PEIR is completely silent on the risk from the contamination and from not cleaning it up. Deferring such estimates to a time after the close of the comment period on the PEIR is an unseemly form of "hiding the ball," contrary to the disclosure and transparency requirements of CEQA and its mandate to thoroughly consider environmental impacts. Were DTSC to include such risk analyses in the final PEIR, after failing to do so in the draft, would be an end-run around the public's right to review and comment. Given the errors in the PEIR and the cloud that hangs over DTSC's conduct at SSFL and statewide, subsequently changing input parameters so as to drive risk estimates down would lack any credibility.

The lack of any analysis about impacts from the contamination and proposals to not clean it up is a major concern because the whole purpose of the cleanup is to protect the health of the residents in the area and the environment, yet there is no analysis in the PEIR about what the health or ecological impacts are if the contamination is left behind in DTSC's document. Boeing's own documents, as we have summarized in this report,

show the health and ecological risks of leaving the contamination behind, and it is beyond unacceptable by USEPA and DTSC standards.

DTSC had promised that it would ensure that Boeing cleans up its portions of SSFL to levels that are safe enough for agriculture and for residences with backyard gardens on site, because the county's then and updated General Plan include agriculture and such residential use for the zoning at SSFL—and in the nearby areas. Whatever the use of site ends up, it needs to be safe for all uses permitted. But more importantly, whatever the end use, people live nearby in residences with gardens and there is agriculture nearby as well. Even assuming some level of dispersion for migrating contaminants, risks as high as these reports estimate if one lived on the site suggests unacceptable risks for people living nearby if the source contamination is not cleaned up. For example, take a site that Boeing estimates would still, after its proposed minimal cleanup, have a cancer risk of 2×10^{-1} (i.e., 2 out of every 10 people exposed would get an excess cancer), as shown in Table ES-2 below. Even if the contamination were to be diluted by a factor of, say, ten or one hundred as it migrates offsite, the resulting risk offsite would still be 2×10^{-3}, about two thousand times higher than the target risk of one in a million.[13]

ES-1: Boeing Risk Estimates in Ranking Order for Current Suburban Residential Garden Pathway*

Site	Risk Value Provided
Systems Test Lab IV	9.6E-01
Environmental Effects Lab	3.0E-01
Happy Valley North	2.0E-01
Compound A	1.0E-01
Advanced Propulsion Test Facility	2.0E-02
Sewage Treatment Plant	1.0E-02
Building 1359	2.0E-03
Unaffiliated Area 5/9 South	3.0E-04
Unaffiliated Area 1A Central	-

"*" Risk Figures taken from Boeing's DSFR's Appendix E1

"-" no value provided

DTSC Point of Departure is 1E-06

USEPA Threshold is 1E-04 to 1E-06

[13] Furthermore, dilution may not always be the case. Over time, concentrations at the source diminish as material migrates, and it can concentrate in the locations to which it migrates, e.g., low-lying areas. For example, the extraordinarily high perchlorate concentrations found in the Dayton Creek bed in Dayton Canyon, offsite, were higher than the remaining perchlorate concentrations in Happy Valley at SSFL, the headwaters of Dayton Creek, where perchlorate was used and soil was contaminated.

ES-2: Boeing Residual Risk Estimates in Ranking Order for Suburban Residentiall Garden Pathway*	
Site	Risk Value Provided
Happy Valley North	2.0E-01
Advanced Propulsion Test Facility	1.0E-02
Environmental Effects Lab	2.0E-03
Systems Test Lab IV	2.0E-03
Building 1359	7.0E-04
Sewage Treatment Plant	3.0E-04
Unaffiliated Area 5/9 South	3.0E-04
Compound A	-
Unaffiliated Area 1A Central	-

"*" Risk Figures taken from Boeing's DSFR's Appendix E3
"-" no value provided
DTSC Standard: 1E-6
USEPA Threshold: 1E-4 to 1E-6
Residual=Post-cleanup values

[Note to the lay reader: The cancer risk figures are given as, for example, 2.0E-01, which mean 2 x 10 to the exponent -1, or 2 x 10^{-1}, or 0.2. In other words, 2 out of every 10 people exposed would get a cancer from the contamination (in addition to the number that would get a cancer otherwise). The risk goal is one in a million, so this risk level would be 200,000 times higher than the target risk.]

The way to protect people nearby is to assure that DTSC's promises (and those of Boeing) that SSFL would be cleaned up such that it would be safe to live on site, eat produce grown on it, and drink from wells are fully carried out. If the source is cleaned up to those safe levels, it is then safe for the people nearby. Failing to do so, however, could result in risks in perpetuity for the people in the area. Additionally, it is imperative that the site be safe enough for ecological resources at the low TRV EcoRBSLs to ensure no effects on animals and plants that reside in the area. The PEIR asserts that vast amounts of contamination should not be cleaned up, supposedly to protect biological receptors, but there is no analysis of the harm to those receptors from the pollution that wouldn't get cleaned up. Our review of the data from the Boeing risk assessments indicates that to breach the commitments to full cleanup and instead exempt large areas would have the opposite effect—exposing biological receptors to contaminants at levels far in excess of the concentrations deemed to pose harm for them.

The draft PEIR is deeply flawed, evidenced by the complete failure to disclose how much contamination, of what types and what concentrations and in what locations, is proposed not be cleaned. It is further entirely inadequate in that it extensively hypes purported impacts from the cleanup while being completely silent regarding the impacts on public health and the environment of radioactive and toxic chemical contamination that would not get cleaned up if the PEIR proposals proceed to breach the cleanup

commitments and instead leave large amounts of contamination not cleaned up. Those flaws are so fundamental that there is no alternative but for the PEIR to be redone and reissued for public review and comment.

Santa Susana Field Laboratory Background

SSFL is a former nuclear reactor and rocket-testing facility located at the boundary between Los Angeles County and Ventura County, just thirty miles from downtown Los Angeles. Founded in the 1940s, it housed ten nuclear reactors, one of which suffered a partial nuclear meltdown in 1959, while three others suffered other accidents. None of the reactors, had containment structures to prevent the radioactivity from being released into the environment. Other facilities on site included a plutonium fuel fabrication facility and a hot lab that reprocessed irradiated nuclear fuel and experienced several radioactive fires. The site also conducted tens of thousands of rocket tests, involving an array of toxic rocket fuels, and two open-air burn pits where radioactive and toxic wastes were burned and that released radioactivity and toxic chemicals into the atmosphere, much of which fell back to earth some distance downwind. Lastly, millions of gallons of TCE were dumped into the ground and much of it percolated into groundwater.

Due to SSFL's history, the site is contaminated with radioactive materials such as cesium-137, strontium-90, and plutonium-239, as well as hazardous chemicals such as perchlorate, PCBs, dioxins, volatile organic compounds, semi-volatile organic compounds, and heavy metals. Federally funded studies found significantly increased rates of cancer among the SSFL workers associated with their exposures, and a more than 60% increase in incidence of key cancers to the public associated with proximity to the site.

The Resource Conservation and Recovery Act (RCRA) Corrective Action program at SSFL began with the RCRA Facility Assessment (RFA) in 1989. The RFA was completed in 1994 and was followed by the RCRA Facility Investigation (RFI), which commenced in 1996 under oversight of the California Environmental Protection Agency (CalEPA) and DTSC. In 2007, DTSC issued a Consent Order for Corrective Action that identified the RCRA Corrective Action requirements for the SSFL to be implemented by the Responsible Parties (RP): Boeing, the United States Department of Energy (DOE), and the National Aeronautics and Space Administration (NASA). In 2010, DOE and NASA signed Administrative Orders of Consent for Remedial Action (AOCs) in agreement with DTSC. The AOCs govern characterization and remedial action activities for soil in portions of SSFL in which those RPs' operations respectively occurred. The portions of land that are not subject to the DOE or NASA AOCs were reorganized in 2013 into nine Boeing subareas for RFI reporting to complete the RFI in accordance with the 2007 Consent Order and DTSC's 2010 commitments for a cleanup of the Boeing portion to agricultural standards associated with Ventura County land use designations.

This report is based on the Data Summary and Findings Reports (DSFRs) that were submitted to DTSC for RFI sites within Boeing's jurisdiction. Each DSFR summarizes the identified sources of contamination, characterization data, and applicable migration pathways for each site within the subareas. The DSFRs also summarize the findings of the human health and ecological risk assessments, and recommendations for corrective measure areas for each site based on the RFI characterization and risk

assessment findings in accordance with Sections 3.4.2[14] and 3.4.3[15] of the 2007 Consent Order.

Risk Assessment Summaries

As a part of each RFI report, the Risk Assessment Summary sections are supposed to present the summary of the HHRA and Ecological Risk Assessment (ERA) findings for each RFI site, but that is not the case with these summaries. Most of these summaries leave out key data that shows high level of risk in the HHRA.

For example, the Exposure Assessment[16] description in this summary states that the only "potential exposure scenarios considered" in these reports are:

- Hypothetical Suburban Resident-Soil Contact
- Hypothetical Suburban Resident-Indoor Air
- Future Recreator-Soil Contract
- Future Recreator-Surface Water Contact
- Garden Use

However, when we look at the "Estimated Risks and Hazards" section[17] of the summary, no description, data, or conclusions were presented for the garden use scenario, when Appendix E1 clearly presents data, calculations, and a summary. The same can be said about the Groundwater Pathway. These summaries do not mention a Groundwater pathway, but there are data tables present in Appendix E. This gives the impression that Boeing is intending to leave out the garden risk estimates to lower the level of cleanup requirements, which is the case in several of these reports.

Human Health Risk Assessments

Each RFI contains within its appendices an HHRA unique to its sub-site. The objective of each HHRA is to determine whether exposure to the environmental media at the site could pose unacceptable risks to human health, thus requiring further evaluation of corrective action as part of a corrective measure study (CMS), or if potential risks to human receptors exposed to current concentrations of chemicals in environmental media area acceptable. If current concentrations of chemicals in environmental media at the site pose unacceptable human health risks and CMS areas are identified, the HHRA asserts that the areas of the site outside of identified CMS areas would be eligible for an NFA designation.

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[14] Section 3.4.2 of DTSC's 2007 Consent Order states that respondents shall submit to DTSC for approval RFI reports for the Surficial Media OU, including Large Home-Range Ecological Risk Assessment Report.
[15] Section 3.4.3 of DTSC's 2007 Consent Order states that the comprehensive Surficial Media OU reports shall summarize the findings from all phases and areas of the SSFL, including all current and historical assessment data collected to date, for the vicinity of the unit being investigated in the RFI program.
[16] Section 5.1.2 "Exposure Assessment", of each DSFR
[17] Section 5.1.3, of each DSFR

Each Boeing RFI report contains an HHRA that is supposed to identify the types of toxic effects a chemical can exert to humans. We have reviewed all of the data tables that are provided in each HHRA, and have created our own tables (below), using the data provided by Boeing, which show only high-risk values that are above USEPA (1E-06 to 1E-04) and DTSC (1E-06) allowable levels. We have also summarized high-non-carcinogenic risk (Hazard Index; HI) values that are above USEPA and DTSC threshold of 1.[18]

The toxicity assessment component of the HHRAs identifies the types of toxic effects a chemical can exert. Chemicals of potential concern are divided into two broad groups based on their effects on human health: carcinogens and non-carcinogens. Health risks are calculated quite differently for carcinogenic and non-carcinogenic effect, and separate toxicity values have been developed for each. Carcinogens are those chemicals suspected of causing cancer following exposure, while non-carcinogenic effects cover a wide variety of systemic effects, such as liver toxicity or developmental effects.

Ecological Risk Assessments

In Boeing's Ecological Risk Assessment (ERA), risk figures were separated into different receptor categories due to the different exposure pathways[19] as listed below.

- **"Terrestrial Plants**: Potential root uptake from soils (0-2 ft bgs[20]).
- **Soil Invertebrates**: Potential ingestion and direct contact with soils (0-2 ft bgs).
- **Birds (*Hermit Thrush*)**: Potential exposure to soil, which includes incidental ingestion of soil (0-2 ft bgs) and food chain uptake (ingestion of food sources that may have bio-accumulated chemicals. Also exposure to surface water by ingestion of surface water containing chemicals.
- **Mammals (*Deer Mice*)**: Potential exposure to soil, which includes incidental ingestion of soil and food chain uptake (ingestion of food sources that may have bio-accumulated chemicals). The soil depth interval with the maximum potential risk is used and can include 0-2 ft bgs, 0-4 ft bgs, or 0-6ft bgs. Exposure from soil vapor through inhalation, and surface water from ingestion.
- **Aquatic Organisms**: Aquatic organisms (plants and water-column invertebrates) may be exposed to chemicals in surface water through root/foliar uptake, dermal/direct contact, or ingestion. Surface water onsite does not support fish."

Risk for some species may be greater as these organisms are more likely to have higher concentrations of chemicals due to greater bioaccumulation as one moves up the food chain. Unlike the HHRA, the ERA does not provide Hazard Indices, so we had to create our own HI calculation. The hazard index we provide for the ERA sections of each RFI report are calculated using only HI's that are above the DTSC and USEPA HI

[18] Two kinds of health effects are considered, carcinogenic and non-carcinogenic. The first is estimated in terms of risk of excess cancer, with a goal of no more than one in a million from all of the contaminants combined. The non-carcinogenic effects (e.g., neurotoxic, impairment of reproduction) are measured in terms of Hazard Index (HI), where the any total HI greater than 1 is supposed to be cleaned up.
[19] Taken from the "Exposure Scenarios" sections of the ERAs provided in each RFI report.
[20] Below ground surface

threshold value of 1. For plants and soil invertebrates, EcoRBSLs for them are "equivalent to their respective medium-specific benchmarks that represent effect levels, values adjusted to a "no effect" level, as well as reported "no effect." As a result, a single set of EcoRBSLs was developed for each group".[21]

For avian and mammal ecological risk, a Hazard Index (HI)/Quotient (HQ) of 1 is used to assess risk. Note, values provided in the "High-HQ" or "High EcoRBSL" columns are meant for further assessment of the site and do not pertain to the cleanup. *Low EcoRBSLs* on the other hand are risk levels where no adverse effects purportedly would occur to any organism, and should be used as cleanup goals. Unlike HHRA, estimated risks for an ERA are only provided as a Hazard Index/Quotient (HI/HQ).

CMS and NFA Areas

Each RFI report contains an "Appendix E3" which is referred to as "Identification of Corrective Measures Study and No Further Action Areas Based on Risk Assessments." The chemicals listed as Chemicals of Concern (COC) or Chemicals of Ecological Concern (COEC) area identified based on the results of the HHRA and Ecological Risk Assessment (ERA), which serve to focus the selection of those media and areas to be evaluated for corrective actions. Once a CMS area is identified, the remaining areas outside the CMS areas are also evaluated to confirm that residual concentrations of COCs result in incremental site risks or hazards below or near the CalEPA and DTSC's limits.

The primary drivers to unacceptable human health risk for the hypothetical suburban resident at an RFI site area identified as COCs, or COECs for ecological risk drivers. The overall objective for identification of CMS areas is to delineate the areas that, if remediated, would result in an acceptable residual risk and hazard. "Residual" in the context of CMS/NFA and Appendix E3, refers to post-remediation risk and hazard estimates.

Unfortunately, Boeing removed a large number of contaminants found in its part of SSFL from the Contaminants of Concern it considers in its analyses.

[21] Section 2.2.3 "Ecological Risk Based Levels" of each ERA.

Subarea 5/9 South

Systems Test Lab-IV[22]

Site Background

The Systems Test Laboratory-IV (STL-4) RFI site is located on the western portion of SSFL. The site is currently inactive, and all previous structures have been demolished. STL-4 was a test site area for small rocket and missile engine testing from the mid-1950s through the early 2000s. Various fuels and oxidizers, including monomethyl hydrazine[23] (MMH), nitrogen tetroxide (NTO), and inhibited red-fuming nitric acid (IRFNA) were used over time at different test stands. After performing an engine test, the engines were flushed and cleaned with trichloroethylene (TCE) and Freon until 1992. Half a million gallons of TCE percolated into the soil and groundwater. The STL-4 site impoundments were used for the collection of engine testing cooling water, aspiration water, area wash down water, and runoff, as well as emergency spill containment and treatment from 1958 through 1985. Other former facilities or former features include 24 buildings, 102 aboveground storage tanks, two underground storage tanks, 1 transformer, the leach field, 4 test stands, 1 pond, 2 explosive storage magazines, and an air stripping tower.

Appendix E1: Human Health Risk Assessment[24]

Garden Use[25]

For the homegrown produce consumption pathway, the total site Estimated Lifetime Cancer Risk (ELCR) is **9.6E-01**, or **96 out of a 100 people**, which is above the USEPA target risk range of 1E-4 to 1E-06 or 1 in 1000 to 1 in 1,000,000 and exceeds DTSC point of departure[26] of 1E-06. The main contributors to the site soil ELCR above USEPA and DTSC thresholds are listed in the Table STL-1. The main contributor, Monomethylhydrazine (MMH) is used as a high-energy fuel in military applications, as a rocket propellant and fuel for thrusters, and as a fuel for small electrical power generating units. Exposure to MMH can cause nasal and respiratory irritation, vomiting, Convulsions, kidney and liver impairment and failure, and can cause convulsions in animals.[27] The epidemiological study of the SSFL workers by the UCLA School of Public Health found significantly elevated cancer death rates among the workers most exposed to MMH.

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[22] http://www.dtsc-ssfl.com/files/lib_rcra_soils/boeingsubarea59south/draft_rfi_rpts/Draft%20RCRA%20Facility%20Investigation%20Data%20Summary%20and%20Findings%20Report%20%E2%80%93%20Systems%20Test%20Laboratory%20IV%20RFI%20Site.pdf

1: https://www.ncbi.nlm.nih.gov/books/NBK222412/

2: https://www.epa.gov/sites/production/files/2015-07/documents/niosh-3510.pdf

[24] PDF pages 2,851-2,899

[25] This pathway evaluates for the hypothetical future suburban resident the consumption of homegrown produce that has accumulated toxic chemicals from the soil.

[26] Point of Departure is another term for cleanup goal.

[27] https://pubchem.ncbi.nlm.nih.gov/compound/methylhydrazine#section=Top

The total site incremental risk[28] is 9E-01, which also exceeds USEPA and DTSC risk standards. The total site HI for this scenario is **727** and with an incremental HI of 453, which exceeds the USEPA and DTSC threshold HI value of 1. Primary contributors above USEPA and DTSC thresholds to the site soil HI are listed below in Table STL-2. The primary contributor, cadmium, is a highly toxic metal known to cause cancer and targets the body's cardiovascular, renal, gastrointestinal, neurological, reproductive, and respiratory systems if one is exposed[29]

Table STL-1: Garden Use Cancer Values*

Analyte	Carcinogenic RBSL (mg/kg)	Cancer Risk	% Contribution to Overall Total
2,3,7,8-TCDD TEQ	7.5E-09	6.0E-04	0.1%
Aroclor 1254	4.9E-04	2.6E-04	0.0%
Aroclor 1260	4.9E-04	6.2E-05	0.0%
Aroclor 1262	4.9E-04	1.2E-05	0.0%
Aroclor 5460	4.9E-04	6.1E-05	0.0%
Arsenic	9.9E-05	7.0E-02	7.3%
Benzo(a)anthracene	8.1E-04	6.1E-04	0.1%
Benzo(a)pyrene	8.1E-05	4.7E-03	0.5%
Benzo(b)fluoranthene	8.1E-04	7.1E-04	0.1%
Benzo(k)fluoranthene	8.1E-04	2.6E-04	0.0%
Chrysene	8.1E-03	7.2E-05	0.0%
Dibenzo(a,h)anthracene	2.4E-04	1.3E-04	0.0%
Dieldrin	6.0E-05	1.0E-05	0.0%
Hexavalent Chromium	1.9E-03	5.3E-04	0.1%
Indeno(1,2,3-cd)pyrene	8.1E-04	1.1E-04	0.0%
Mirex	5.4E-05	3.4E-05	0.0%
Monomethylhydrazine	1.5E-08	8.8E-01	91.6%
n-Nitrosodimethylamine	9.5E-07	1.9E-03	0.2%
Trichloroethene	9.8E-03	2.0E-06	0.0%
Total Risk		**9.6E-01**	
PCB TEQ[a]	7.5E-09	2.0E-02	-

"*" data taken from Table E1-5 in Appendix E1
RBSL=Risk Based Screening Levels
USEPA Target Risk Range of 1E-06 to 1E-04
DTSC Point of Departure Risk Value of 1E-06
PCB-TEQ= Polychlorinated biphenyl-Toxic Equivalent Quotient
"a" PCB TEQ was calculated, but not included in the total risk. If included in the total risk, the correct Risk would be 9.8E-1 or 98/100 people.
The "Total Risk" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

[28] Incremental Risk is defined as that portion of the site risk in excess of that resulting from background/ambient concentrations of chemicals found in soil at the STL-4 RFI Site. Note as previously indicated that risk is supposed to be based on total risk, not incremental.
[29] https://www.osha.gov/SLTC/cadmium/

Table STL-2: Garden Use Non-Cancer Values*			
Analyte	Non-Carcinogenic RBSL (mg/kg)	Hazard Quotient	% Contribution to Overall Total
1,1-Dimethylhydrazine	0.000248	3.23	0.4%
2,3,7,8-TCDD TEQ	0.000000252	17.7	2.4%
Antimony	0.139	2.38	0.3%
Arochlor 1254	0.00721	17.3	2.4%
Aroclor 1260	0.00723	4.2	0.6%
Aroclor 5460	0.00719	4.15	0.6%
Arsenic	0.104	66.7	9.2%
Butyl benzyl phthalate	68.7	0.000216	0.0%
Cadmium	0.00165	547	75.2%
Copper	11.1	1.76	0.2%
Formaldehyde	3.7	1.67	0.2%
MCPA	0.131	9.95	1.4%
Mercury	0.0504	1.02	0.1%
Monomethylhydrazine	0.00298	4.33	0.6%
n-Nitrosodimethylamine	0.0000449	40.1	5.5%
Zinc	53.8	1.68	0.2%
Hazard Index		**727**	
PCB TEQ[a] Hazard Index	0.000000252	467	-

"*" data taken from Table E1-5 of Appendix E1
MCPA= 2-methyl-4-chlorophenoxyacetic acid
RBSL=Risk Based Screening Levels.
USEPA and DTSC Threshold HI is a value of 1.
PCB-TEQ= Polychlorinated biphenyl-Toxicity Equivalent Quotient
"a" PCB TEQ was calculated, but not included in the total. If it was included, the correct HI would be 1194
The "Hazard Index" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Groundwater Use[30]

For groundwater use at Chatsworth Formation well HAR-18, the ELCR is **3E-02**, which is above the USEPA target risk range and exceeds the DTSC point of exposure of 1E-01. The main risk drivers to the groundwater ELCR that are above USEPA and DTSC thresholds are listed in Table STL-3. The primary contributor, vinyl chloride, is used to make a variety of plastics and vinyl products. Acute exposure to vinyl chloride in air can result in central nervous system effects, and chronic exposure (via inhalation and oral) can result in liver damage and cancer.[31]

The HI for this scenario is **426**, which dramatically exceeds the USEPA and DTSC threshold HI value of 1. The primary contributors to the pathway HI above USEPA and DTSC thresholds of 1 are listed below in Table STL-4. The primary contributor, Trichloroethene (TCE), is a nonflammable, colorless liquid, which is mainly used as a solvent to remove grease from metal parts. Exposure to TCE affects reproductive organs and impairs neurological function, as well as kidney cancer, and liver cancer.[32]

Also note that although there are no data provided in the tables of Appendix E1, the RFI report does address lead in water:

> The potential risk from exposure to lead in groundwater is evaluated separately from other carcinogens and noncarcinogens. For this HHRA, potential risk from lead is evaluated by comparing the maximum Exposure Point Concentration (EPC) for lead in Chatsworth Formation groundwater to the USEPA Action

[30] Potential routes of exposure to chemicals in Chatsworth Formation groundwater include ingestion, dermal contact, and inhalation of vapors during assumed hypothetical domestic use.
[31] https://www.epa.gov/sites/production/files/2016-09/documents/vinyl-chloride.pdf
[32] https://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=30

Level in water 15 ug/L. Only one of the well points in Boeing RFI Subarea 5/9 South had an EPC exceeding 15 ug/L, at well point RD-55A where the EPC was 40.5 ug/L." [33]

Table STL-3: Chatsworth Groundwater Cancer Values*			
Analyte	Carinogenic RBC (ug/L)	Cancer Risk	Percent Contribution
1,1-Dichloropropene	2.19E-01	2.79E-05	0.1%
Heptachlor	1.86E-03	2.37E-05	0.1%
n-Nitrosodimethlyamine	1.51E-03	2.38E-03	7.8%
Trichloroethene	4.24E-01	1.53E-03	5.0%
Vinyl chloride	1.36E-02	2.65E-02	86.9%
Total Risk		**3.00E-02**	

"*" data taken from Table E1-12 of Appendix E1
RBC= Risk-based concentration computed using the USEPA's Regional Screening Level online calculator.
ug/L=microgram per liter
The "Total Risk" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.
USEPA Target Risk Range of 1E-06 to 1E-04
DTSC Point of Departure Risk Value of 1E-06

Table STL-4: Chatsworth Groundwater Noncancer Value*			
Analyte	Noncarcinogenic RBC (ug/L)	Hazard Quotient	Percent Contribution
cis-1,2-Dichloroethene	1.04E+01	163	38.30%
n-Nitrosodimethylamine	1.60E-02	22.5	5.30%
Trichloroethene	2.82E+00	230	54.10%
Vinyl chloride	4.44E+01	8.11	1.90%
Hazard Index		**426**	

"*" data taken from Table E1-12 from Appendix E1
RBC= Risk-based concentration computed using the USEPA's Regional Screening Level online calculator.
ug/L=microgram per liter
The "Hazard Index" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.
USEPA and DTSC Threshold HI is a value of 1.

Direct Contact With Soil[34]

For the direct soil contact pathway, the total site ELCR is **1E-04**, which exceeds DTSC's point of departure of 1E-06. Primary contributors above USEPA and DTSC thresholds are listed in Table STL-5 below. The primary contributor, arsenic, is a natural component of the earth's crust, but is highly toxic in its inorganic form, and can be exposed through drinking water, inhalation, and consumption of food that has been exposed to arsenic. Exposure to arsenic can cause, vomiting, abdominal pain, muscle cramping, pigmentation changes, skin lesions, cancer in the lungs, skin, and bladder, pulmonary and cardiovascular diseases.[35] Boeing claims in its HHRA summary "the inclusion of arsenic as a COPC appears to be biasing the incremental risks downward. Arsenic was selected as a soil COPC only because the maximum site detect exceeded two times the background comparison value, even though onsite arsenic levels are not statistically higher than background. If arsenic were excluded as a COPC, the incremental risk for this exposure scenario would be 3E-05" (p. 2856).

The total site HI for soil for this scenario is **0.9**, and the incremental HI is **0.3**, which is below the USEPA and DTSC threshold HI value of 1.

[33] 8.1.1.4 Groundwater Use Pathway (Page 2,857 of pdf)
[34] Potential routes of exposure to chemicals from direct contact with soil include incidental ingestion, dermal contact, and inhalation of fugitive dust and vapors emitted from soil to ambient air.
[35] http://www.who.int/mediacentre/factsheets/fs372/en/

Table STL-5: Direct Soil Contact Cancer Values*			
Analyte	Carcinogenic RBSL (mg/kg)	Cancer Risk	Percent Contribution
Arsenic	6.6E-02	1.1E-04	79.8%
Benzo(a)anthracene	3.9E-01	1.3E-06	1.0%
Benzo(a)pyrene	3.9E-02	9.8E-06	7.4%
Benzo(b)fluoranthene	3.9E-01	1.5E-06	1.1%
Monomethylhydrazine	1.2E-03	1.0E-05	7.8%
Total Risk		**1.0E-04**	
PCB-TEQ[a]	3.6E-06	3.0E-05	-

"*" data take from Table E1-5 from Appendix E1
RBSL=Risk Based Screening Level
DTSC Point of Exposure is 1E-06
PCB-TEQ= Polychlorinated biphenyl-Toxicity Equivalent
"a" PCB TEQ was calculated, but not included in the total. If it was included, the risk would be 1.3E-04.

Indoor Air Pathway[36]

For the indoor air pathway, the total site ELCR is **3E-05**, which exceeds the DTSC point of departure of 1E-06. The primary contributor is to the pathway ELCR is TCE (97%; 3E-04), other contributors are below USEPA and DTSC thresholds. The total site HI is 8 for this scenario, which exceeds the USEPA and DTSC threshold HI value of 1. The primary contributor to the site HI is TCE (98%; HQ=7).

Appendix E2: Ecological Risk Assessment[37]

For avian species, the risk estimation from the site is an HI of **344**, which is far above the threshold of 1. The primary contributor to the ecological risk for avian species is lead, which lead poisoning in birds can cause lethargy, progressive weakness causing the inability to fly, and usually accumulates in the liver, kidneys, and blood.[38] As of yet, no data has been provided for the effects of silver in avian species, though it has shown in poultry to affect the liver.[39] Other chemicals above the threshold of 1 are listed in Table STL-6 below.

For mammals, the risk estimation from the site is an HI of **103**, which is well above the threshold on 1. The primary contributor to the ecological risk for mammals is cadmium, which can cause cancer, and targets the animal's cardiovascular, renal, gastrointestinal, neurological, reproductive, and respiratory systems if an animal is exposed[40]. All chemicals above the threshold of 1 are listed in Table STL-7 below.

[36] For the indoor air pathway, the potential route of exposure to volatile COPCs detected in soil vapor is inhalation of chemicals that could migrate from the vadose zone to inside a future residence.
[37] PDF pages 2,949-3,033
[38] https://www.nwhc.usgs.gov/disease_information/lead_poisoning/
[39] http://www.inchem.org/documents/cicads/cicads/cicad44.htm#6.0
[40] https://www.osha.gov/SLTC/cadmium/

Table STL-6: Risk Estimates for Birds (Hermit Thrush)-Food Chain Uptake via Soil*				
Analyte	Low EcoRBSL	High EcoRBSL	HQ-Low	HQ-High
Cadmium	0.2	3	5	0.3
Chromium	2.4	14	10	2
Copper	1.1	24	20	0.8
Lead	0.062	39	300	0.5
Zinc	32	320	3	0.3
Aroclor 1254	0.083	0.83	2	0.2
Di-n-butyl phthalate	0.11	1.1	4	0.4
Hazard Index			**344**	
PCB-TEQ Birds[a]	5.70E-06	0.000057	300	30

* Data taken from Table E2-8 of Appendix E2
PCB-TEQ=Polychlorinated biphenyl-Toxicity Equivalent
"a" PCB TEQ Bird was calculated separately, but not included in the total HI, or explained why. If included in the total, the correct HI would be 644.
HQ/HI=Hazard Quotient/Index
EcoRBSL=Ecological Risk Based Screening Level
Low EcoRBSLs are conservative and are mostly based on no observed adverse levels.
High EcoRBSLs are based on mid-level effects or low observed adverse effect levels.
USEPA and DTSC Threshold HI is 1.
Since no Hazard Index was calculated, we had to calculate it ourselves. Note, the HI we've provided only includes HQs above 1.

Table STL-7: Risk Estimates for Mammals (Deer Mouse)-Food Chain Uptake via soil*				
Analyte	Low EcoRBSL	High Eco RBSL	HQ-Low	HQ-High
Antimony	0.042	2	7	0.1
Arsenic	2.1	31	3	0.2
Cadmium	0.019	0.81	40	0.8
Chromium	1.9	46	10	0.6
Copper	1.5	350	10	0.05
Lead	3.8	910	4	0.02
Molybdenum	0.13	1.3	5	0.5
Selenium	0.1	2.4	3	10
Zinc	19	820	4	0.1
DioxinFuran TEQ Mammal	5.00E-07	0.000005	7	0.7
MCPA	0.12	0.61	10	2
Hazard Index			**103**	
PCB-TEQ Mammal[a]	5.00E-07	0.000005	900	90

* Data taken from Table E2-9 of Appendix E2
PCB-TEQ= Polychlorinated biphyl-Toxicity Equivalent
"a" PCB-TEQ Mammal was calculated separately, but not included in the total HI, or explained why. If included in the total, the correct HI would be 1,003
HQ/HI=Hazard Quotient/Index
EcoRBSL=Ecological RBSL
Low EcoRBSLs are conservative and are mostly based on no observed adverse levels.
High EcoRBSLs are based on mid-level effects or low observed adverse effect levels.
USEPA and DTSC Threshold HI is 1.
Since no Hazard Index was calculated, we had to calculate it ourselves. Note, the HI we've provided only includes HQs above 1.

Appendix E3: Residual[41] Risk[42]

Garden Use

For the Suburban Residential Garden Exposure Scenario, Boeing estimates the total ELCR after remediation would be **2E-03**, which is far above DTSC's point of exposure of 1E-06. Primary contributors above USEPA and DTSC thresholds are listed below in Table STL-8. The primary contributor, 2,3,7,8-TCDD TEQ, is a dioxin that is an unintentional byproduct of some forms of combustion and several industrial chemical processes, thus they are found in the air and are deposited on surfaces. Exposure to dioxins and dioxin-compounds may result in skin lesions, altered liver function, impairment to the immune, nervous, and endocrine systems, and alter reproductive functions.[43]

[41] Post-remediation risk values for human health risk
[42] PDF Pages 3,135-3,153
[43] http://www.who.int/mediacentre/factsheets/fs225/en/

The HI for this scenario is **376**, still several hundreds of times higher than the USEPA and DTSC threshold of 1. Primary contributors above USEPA and DTSC thresholds are listed below in Table STL-9. The primary contributor is cadmium, which if exposed, can cause cancer and targets the body's cardiovascular, renal, gastrointestinal, neurological, reproductive, and respiratory systems if one is exposed[44]

Another key point to make is that monomethylhydrazine (MMH) was a primary contributor in the HHRA, but as we look at the tables in Appendix E3, we noticed that the EPC for MMH was missing from these tables. In other words, MMH was "removed," thus making it difficult to provide a cancer risk, or an HQ. This makes a clear statement that Boeing is once again making another attempt to reduce its cleanup obligations by altering data for their own benefit.

Table STL-8: Residual Human Health Risk-Garden Exposure Scenario*

Analyte	Carcinogenic RBSL[a] (mg/kg)	Cancer Risk	Percent Contribution
2,3,7,8-TCDD TEQ	7.51E-09	5.37E-04	28%
Aroclor 1254	4.88E-04	1.68E-04	8.7%
Aroclor 1260	4.89E-04	7.13E-05	3.7%
Aroclor 1262	4.88E-04	1.21E-05	0.6%
Aroclor 5460	4.86E-04	6.78E-05	3.5%
Benzo(a)anthracene	8.05E-04	1.80E-04	9.4%
Benzo(a)pyrene	8.09E-05	4.00E-04	20.9%
Benzo(b)fluoranthene	8.05E-04	1.71E-04	8.9%
Benzo(k)fluoranthene	8.09E-04	7.35E-05	3.8%
Chrysene	8.06E-03	2.72E-05	1.4%
Dibenzo(a,h)anthracene	2.38E-04	8.57E-05	4.5%
Dieldrin	5.99E-05	1.04E-05	0.5%
Indeno(1,2,3-cd)pyrene	8.13E-04	7.41E-05	3.9%
Mirex	5.42E-05	3.74E-05	2%
Total Risk		**2.00E-03**	

"*" Data taken from Table E3-2 of Appendix E3

"a" RBSL=Risk Based Screening Levels. RBSLs used in this HHRA are for assessing cancer risk and/or noncancer hazard incoporate these toxicity values, which are route specific. RBSL values were obtained from Section 3.3 of Attachment 1 of Appendix B

TEQ=Toxic Equivalent

USEPA Target Risk Range of 1E-06 to 1E-04

DTSC Point of Departure Risk Value of 1E-06

The "Total Risk" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Table STL-9: Residual Human Health Non-Cancer Risk- Garden Exposure Scenario*

Analyte	Non-Carcinogenic RBSL[a] (mg/kg)	Hazard Quotient	Percent Contribution
1,1-Dimethylhydrazine	0.000248	3.23	0.9%
2,3,7,8-TCDD TEQ	0.000000252	16	4.2%
Antimony	0.139	2.05	0.5%
Aroclor 1254	0.00721	11.4	3%
Aroclor 1260	0.00723	4.83	1.3%
Aroclor 5460	0.00719	4.59	1.2%
Cadmium	0.00165	326	86.6%
Copper	11.1	1.48	0.4%
Formaldehyde	3.7	1.77	0.5%
Zinc	53.8	1.67	0.40%
Hazard Index		**376**	

"*" Data taken from Table E3-2 of Appendix E3

"a" RBSL=Risk Based Screening Levels. RBSLs used in this HHRA are for assessing cancer risk and/or noncancer hazard incoporate these toxicity values, which are route specific. RBSL values were obtained from Section 3.3 of Attachment 1 of Appendix B

TEQ=Toxic Equivalent

USEPA and DTSC Threshold HI is a value of 1

The "Hazard Index" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

[44] https://www.osha.gov/SLTC/cadmium/

Groundwater Use Pathway

It is also significant to note that Boeing did not provide post remediation calculations for the Chatsworth Groundwater Pathway (Well HAR-14), this gives us the impression that Boeing is not intending to do anything about the groundwater well.

Chapter Conclusion

Appendix E3 provides residual risk numbers for what the site would be after the "cleanup", and as we have shown above, the risk values are still far above the allowable USEPA and DTSC levels. Furthermore, this Boeing document attempts to argue that the HHRA and ERA (which are summarized in the tables above) "demonstrate that *acceptable* risks and hazards from potential exposure to soil and soil vapor by hypothetical suburban residents and ecological receptors are expected at the STL-4 RFI site" (emphasis added)[45]. However, it is clearly shown in their own tables and data that the risks are *not* acceptable. Therefore DTSC must ensure that a full cleanup is done at this RFI site.

[45] Appendix E3 Section 3.0 "Conclusions"

Environmental Effects Laboratory[46]

Site Background

The Environmental Effects Laboratory (EEL), also known as the Hydrogen Lab, is located on the boundary between Administrative Areas III and IV in the western portion of SSFL. The Site is currently inactive, and all structures have been demolished. Buildings 3268 and 3271 were used for the EEL Cryogenic Laboratory and associated test cells from 1968 through 2008. These buildings were used for testing various materials under high-pressure hydrogen conditions. Other structures associated with the testing operations included an equipment and material storage building, a mechanics workshop, a hazardous materials storage pad, transformers, and over 25 small aboveground storage tanks that were mostly used to store gases and hydraulic oil.

Appendix E1: Human Health Risk Assessment[47]

Direct Contact with Soil[48]

Potential routes of exposure to chemicals from direct contact with soil include incidental ingestion, dermal contact, and inhalation of fugitive dust and vapors emitted from soil to ambient air. For the direct soil contact pathway, the total site ELCR is **4E-04** with an incremental[49] risk of 3E-04, which both exceed DTSC's point of departure of 1E-06. The primary risk drivers above USEPA and DTSC thresholds are listed in Table EEL-1. The primary contributor, arsenic, is a natural component of the earth's crust, but is highly toxic in its inorganic form, and can be exposed through drinking water, inhalation, and consumption of food that has been exposed to arsenic. Exposure to arsenic can cause, vomiting, abdominal pain, muscle cramping, pigmentation changes, skin lesions, cancer in the lungs, skin, and bladder, pulmonary and cardiovascular diseases.[50] Keep in mind, Boeing notes "a statistical comparison of arsenic levels at the EEL RFI site (site EPC of 26.4 milligrams per kilogram and maximum detected value of 110 mg/kg) with background concentrations indicated that onsite arsenic levels are statistically higher than background" (p. 622).

Both the total site HI for soil and the incremental HI for this scenario are 2, which exceeds the USEPA and DTSC threshold HI value of 1. Primary contributors are listed in Table EEL-2.

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[46] http://www.dtsc-ssfl.com/files/lib_rcra_soils/boeingsubarea59south/draft_rfi_rpts/66635_Draft_RCRA_Facility_Investigation_Data_Summary_and_Findings_Report_-_Environmental_Effects_Laboratory.pdf

[47] PDF pages 617-656

[48] Potential routes of exposure to chemicals from direct contact with soil include incidental ingestion, dermal contact, and inhalation of fugitive dust and vapors emitted from soil to ambient air.

[49] Risk from contamination above background levels onsite

[50] http://www.who.int/mediacentre/factsheets/fs372/en/

Table EEL-1: Direct Soil Contact Carcinogenic Risk*			
Analyte	Carcinogenic RBSL	Cancer Risk	Percent Contribution
2,3,7,8-TCDD TEQ	4.81E-06	4.37E-06	1.1%
Arsenic	6.58E-02	4.01E-04	96.8%
Benzo(a)anthracene	3.87E-01	1.12E-06	0.3%
Benzo(a)pyrene	3.87E-02	4.62E-06	1.1%
Total Risk		**4.00E-04**	
PCB TEQ[a]	3.57E-06	2.00E-05	

* Data taken from Table E1-5 of Appendix E1 of EEL RFI Report
TEQ= Toxic Equivalet Quotient
PCB TEQ= Polychlorinated Biphenyl
"a" PCB TEQ was calculated, but not included in the total risk. If included in the total risk, would be 4.2E-4
USEPA Risk Range is 1E-06 to 1E-04
DTSC Point of Departure is 1E-06
RBSL=Risk Based Screening Level
The "Total Risk" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Table EEL-2: Direct Soil Contact Noncarcinogenic Risk*			
Analyte	Noncarcinogenic RBSL	Hazard Quotient	Percent Contribution
2,3,7,8-TCDD TEQ	0.0000505	0.416	23.3%
Antimony	26.4	0.03	1.7%
Aroclor 1254	1.1	0.0429	2.4%
Aroclor 1260	1.1	0.0344	1.9%
Arsenic	21.6	1.22	68.6%
MCPA	34.3	0.0274	1.5%
Hazard Index		**2**	
PCB TEQ	0.0000386	2	

*Data taken from Table E1-5 of Appendix E1 of EEL RFI Report
TEQ= Toxic Equivalet Quotient
PCB TEQ= Polychlorinated Biphenyl
"a" PCB TEQ was calculated, but not included in the total risk. If included in the total risk, would be 4.
USEPA and DTSC threshold HI value is 1.
RBSL=Risk Based Screening Level
The "Hazard Index" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Garden Use[51]

For the homegrown produce consumption pathway, the total ELCR is **3E-01** and the incremental risk is 2E-01, which is far above DTSC point of departure of 1E-06. Primary contributors above USEPA and DTSC threshold are listed in Table EEL-3. The primary contributor is arsenic, which if exposed can cause vomiting, abdominal pain, muscle cramping, pigmentation changes, skin lesions, cancer in the lungs, skin, and bladder, pulmonary and cardiovascular diseases.[52]

The total site HI for this scenario is **486**, and the incremental HI of **377**, which both *greatly exceed* USEPA and DTSC threshold HI value of 1. The primary contributor is arsenic, and other contributors for this HI are listed in Table EEL-4. Notably, in the HHRA summary, it lists the HI for this scenario as 486, but Table E1-5 of the HHRA

[51] Another pathway evaluated for the hypothetical future suburban resident is the consumption of homegrown produce that has accumulated chemicals from soil.
[52] http://www.who.int/mediacentre/factsheets/fs372/en/

lists the HI as 363. For the sake of our table (EEL-4), we will use the lower value (363) since the chemicals listed are associated with that HI.

Table EEL-3: Garden Use Carcinogenic Risk*			
Analyte	Carcinogenic RBSL	Cancer Risk	Percent Contribution
2,3,7,8-TCDD TEQ	7.51E-09	2.80E-03	1%
Aroclor 1254	4.88E-04	9.70E-05	0.0%
Aroclor 1260	4.89E-04	7.75E-05	0.0%
Arsenic	9.92E-05	2.66E-01	97.3%
Benzo(a)anthracene	8.05E-04	5.39E-04	0.2%
Benzo(a)pyrene	8.09E-05	2.21E-03	0.8%
Benzo(b)fluoranthene	8.05E-04	4.47E-04	0.2%
Benzo(k)fluoranthene	8.09E-04	2.71E-04	0.1%
Chrysene	8.06E-03	6.68E-05	0.0%
Dibenzo(a,h)anthracene	2.38E-04	4.41E-05	0.0%
Hexavalent Chromium	1.94E-03	5.81E-04	0.2%
Indeno(1,2,3-cd)pyrene	8.13E-04	8.31E-05	0.0%
Mirex	5.42E-05	3.39E-05	0.0%
Total Risk		**3.00E-01**	
PCB TEQ[a]	7.50E-09	8.00E-03	

* Data taken from Table E1-5 of Appendix E1 of EEL RFI Report
TEQ= Toxic Equivalet Quotient
PCB TEQ= Polychlorinated Biphenyl
"a" PCB TEQ was calculated, but not included in the total risk. If included in the total risk, the correct risk would be 3.08E-1
RBSL=Risk Based Screening Level
USEPA Risk Range is 1E-06 to 1E-04
DTSC Point of Departure is 1E-06
The "Total Risk" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Table EEL-4: Garden Use Noncarcinogeic Risk*			
Analyte	Noncarcinogenic RBSL	Hazard Quotient	Percent Contribution
2,3,7,8-TCDD TEQ	0.00000025	0.0028	1%
Antimony	0.139	5.68	1.6%
Aroclor 1254	0.00721	6.56	1.8%
Aroclor 1260	0.00723	5.24	1.4%
Arsenic	0.104	253	69.6%
Hexavalent Chromium	1.08	1.05	0.3%
MCPA	0.131	7.2	2%
Hazard Index		**363**	
PCB TEQ[a]	2.52E-07	247	

* Data taken from Table E1-5 of Appendix E1 of EEL RFI Report
TEQ= Toxic Equivalet Quotient
PCB TEQ= Polychlorinated Biphenyl
"a" PCB TEQ was calculated, but not included in the total risk. If included in the total risk, would be 610.
USEPA and DTSC threshold HI value is 1.
RBSL=Risk Based Screening Level
The "Hazard Index" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Indoor Air Pathway[53]

[53] For the indoor air pathway, the potential route of exposure to volatile chemicals detected in soil vapor is inhalation of volatile chemicals that could migrate from the vadose zone to inside a future residence.

For the indoor air pathway, the total site ELCR is **3E-05**, which exceeds the DTSC point of departure of 1E-06 by a factor of 30. The primary risk drivers are trichloroethene (TCE; 94%; 3E-05), and benzene (6%; 2E-06). The total site HI is 7 for this scenario, which exceeds the USEPA ad DTSC threshold value of 1. The primary contributor to the site HI is TCE (>99%; HQ=7). As mentioned in the previous chapter, exposure to TCE can affect reproductive organs and impairs neurological function, as well as kidney cancer, and liver cancer.[54]

Groundwater Use Pathway[55]

For groundwater use at Chatsworth Formation well HAR-18, the ELCR is **3E-02**, which is above both the USEPA target risk range of 1E-06 to 1E-04 *and* exceeds the DTSC point of departure of 1E-06.The primary contributor, vinyl chloride, is used to make a variety of plastics and vinyl products. Acute exposure to vinyl chloride in air can result in central nervous system effects, and chronic exposure (via inhalation and oral) can result in liver damage and cancer.[56] Other primary risk drivers above USEPA and DTSC thresholds are listed below in Table EEL-5.

The HI for this scenario is **426**, which greatly exceeds the USEPA and DTSC threshold HI value of 1. The primary contributors are TCE and cis-1,2-dichloroethene. To elaborate, cis-1,2-dichloroethene is a highly flammable, colorless liquid and is used to produce solvents and in chemical mixtures, which if inhaled or direct contact can have toxic effects, such as irritation of the lungs, skin, and eyes.[57] Other contributors are listed in Table EEL-6.

Note, the risk estimates for radionuclides of potential concern identified for Chatsworth Formation groundwater (at HAR-18) were calculated separately from those associated with chemicals of potential concern. The risk calculation table provided in Boeing's HHRA (Table E1-11) indicates that the ELCR is 2E-05, which exceeds DTSC's point of departure, with the primary contributor being Uranium-233/234 (94%; 1E-05). This calculated risk adds on to the total risk of groundwater well HAR-18.

[54] https://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=30
[55] Potential routes of exposure to chemicals in Chatsworth Formation groundwater include ingestion, dermal contact, and inhalation of vapors during assumed hypothetical domestic use.
[56] https://www.epa.gov/sites/production/files/2016-09/documents/vinyl-chloride.pdf
[57] https://pubchem.ncbi.nlm.nih.gov/compound/_Z_-1_2-Dichloroethylene#section=GHS-Classification

Table EEL-5: Groundwater Use Carcinogenic Risk*			
Analyte	Carcinogenic RBC (ug/L)	Cancer Risk	Percet Contribution
1,1-Dichloroethane	2.51E+00	2.07E-06	0.0%
1,1-Dichloropropene	2.19E-01	2.79E-05	0.1%
1,4-Dioxane	2.47E+00	5.67E-06	0.0%
Aldrin	3.94E-03	3.05E-06	0.0%
gamma-BHC	3.49E-02	3.72E-06	0.0%
Heptachlor	1.86E-03	2.37E-05	0.1%
n-Nitrosodimethylamine	1.51E-03	2.38E-03	7.8%
Trichloroethene	4.24E-01	1.53E-03	5%
Vinyl Chloride	1.36E-02	2.65E-02	86.9%
Total Risk		**3.00E-02**	
* Data taken from Table E1-10 of Appendix E1			

RBC= Risk-based concentration
ug/L= Microgram per liter
USEPA Target Risk Range is 1E-06 to 1E-04
DTSC Point of Departure is 1E-06
The "Total Risk" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Table EEL-6: Groundwater Use Noncarcinogenic Risk*			
Analyte	Noncarcinogenic RBC (ug/L)	Hazard Quotient	Percent Contribution
cis-1,2-Dichloroethene	1.04E+01	163	38.3%
Manganese	4.33E+02	0.346	0.1%
n-Nitrosodimethylamine	1.60E-01	22.5	5.3%
Thalium	2.00E-01	0.24	0.1%
Trichloroethene	2.82E+00	230	54.1%
Vinyl Chloride	4.44E+01	8.11	1.9%
Hazard Index		**426**	
* Data taken from Table E1-10 of Appendix E1			

RBC= Risk-based concentration
ug/L= Microgram per liter
USEPA and DTSC threhold HI value is 1.
The "Hazard Index" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Appendix E2: Ecological Risk Assessment[58]

For avian species, the risk estimation from the site is an HI of >**4**[59] (move footnote to end of sentence), which is above the threshold of 1. All chemicals with a low HQ above the USEPA and DTSC threshold of 1 are listed in Table EEL-7 below. For mammals, the risk estimation from the site is an HI of **>61**, which is well above the threshold on 1. All chemicals above the USEPA and DTSC threshold of 1 are listed in Table EEL-8 below.

[58] PDF Pages 699-763
[59] Since the HI was not calculated for this table, we had to calculate our own, but we focused on Hazard Quotients that were above and HQ of 1, therefore HQ's below 1 were not included in our calculation, but we are acknowledging the fact that the HI is higher than what we have calculated.

Table EEL-7: Risk Estimates for Birds (Hermit Thrush)-Food Chain Uptake via Soil*					
Analyte	RME EPC	Low EcoRBSL	High EcoRBSL	HQ Low	HQ High
DioxinFuran TEQ Bird	1.17E-05	5.70E-06	0.000057	2	0.2
4,4'-DDT	0.00637	0.0035	0.58	2	0.01
Hazard Index				**>4**	
PCB TEQ Bird[a]	0.000145	5.70E-06	5.70E+05	30	3

* Data take from Table E2-7 of Appendix E2
PCB=Polychlorinated Biphenyl
TEQ=Toxic Equivalent Quotient
"a" PCB TEQ Birdwas calculated separately from the total HI. If added, the correct Hi would be >34.

Table EEL-8: Risk Estimates for Mammals (Deer Mice)-Food Chain Uptake via Soil*					
Analyte	RME EPC	Low EcoRBSL	High EcoRBSL	HQ Low	HQ High
Antimony	0.546	0.042	2	11	0.3
Arsenic	16.1	2.1	31	8	0.5
DioxinFuran TEQ Mammal	1.57E-05	5.00E-07	0.000005	30	3
MCPA	0.94	0.12	0.61	8	2
Aroclor 1248	0.0233	0.0064	0.064	4	0.4
Hazard Index				**>61**	
PCB TEQ Mammal[a]	3.27E-05	5.00E-07	5.00E-06	70	7

* Data taken from Table E2-8 of Appendix E2
PCB=Polychlorinated Biphenyl
TEQ=Toxic Equivalent Quotient
"a" PCB TEQ mammal was calculated separately from the total HI. If added, the correct Hi would be >131
Note, no actual Hazard Index was provided, we had to calculate our own.

Appendix E3: Residual Risk[60]

Direct Soil Contact (0-2ft below ground surface (bgs))

For this scenario, the residual risk is **2E-06**, which is above DTSC's point of departure. Primary contributor is 2,3,7,8-TCDD TEQ (41.1%; 1.02E-06), which if exposed, it may result in skin lesions, altered liver function, impairment to the immune, nervous, and endocrine systems, and alter reproductive functions.[61] Other main contributors include Aroclor 1254 (10.1%; 2.51E-07), and Hexavalent Chromium (38.8%; 9.66E-07).

Direct Soil Contact (0-10ft bgs)

The residual risk estimates for the 0-10 ft bgs interval are higher and therefore used for computation of incremental risk. For this scenario, the ELCR was **2E-04**, which is both above USEPA's target risk range and exceeds DTSC's point of departure. The primary contributor was arsenic (98.8%; 1.64E-04), which if exposed can cause vomiting, abdominal pain, muscle cramping, pigmentation changes, skin lesions, cancer in the lungs, skin, and bladder, pulmonary and cardiovascular diseases.[62]

Garden Use

[60] PDF Pages 837-855
[61] http://www.who.int/mediacentre/factsheets/fs225/en/
[62] http://www.who.int/mediacentre/factsheets/fs372/en/

For this scenario, the residual risk estimate is **2E-03**, which exceeds USEPA's target risk range of 1E-06 to 1E-04, and DTSC's point of departure of 1E-06. This is a major concern because Boeing claims that the risk after the cleanup would still be very high. The primary contributor to the risk is 2,3,7,8-TCDD TEQ, which if exposed could cause skin lesions, altered liver function, impairment to the immune, nervous, and endocrine systems, and alter reproductive functions.[63] Other contributors are listed in Table EEL-9 below.

The HI for this scenario is 33, which is also above USEPA and DTSC's threshold HI value of 1. The primary contributor is once again, 2,3,7,8-TCDD TEQ, and other contributors are listed in Table EEL-10.

Table EEL-9: Garden Use Residual Carcinogenic Risk*			
Analyte	Carcinogenic	Cancer Risk	Percent Contribution
2,3,7,8-TCDD TEQ	7.51E-09	6.55E-04	42.2%
4,4'-DDT	2.87E-03	4.63E-06	0.3%
Aroclor 1254	4.88E-04	1.19E-04	7.7%
Benzo(a)anthracene	8.05E-04	3.49E-06	0.2%
Benzo(a)pyrene	8.09E-05	3.46E-05	2.2%
Benzo(b)fluoranthene	8.05E-04	6.20E-06	0.4%
Dibenzo(a,h)anthracene	2.38E-04	9.83E-06	0.6%
Heptachlor epoxide	1.71E-04	2.74E-06	0.2%
Hexavalent Chromium	1.94E-03	6.43E-04	41.4%
Indeno(1,2,3-cd)pyrene	8.13E-04	3.10E-06	0.2%
Mirex	5.42E-05	7.03E-05	4.5%
Total Risk		**2.00E-03**	

*Data taken from Table E3-2 of Appendix E3
USEPA Risk Range is 1E-06 to 1E-04
DTSC Point of Departure is 1E-06
RBSL=Risk Based Screening Level
The "Total Risk" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Table EEL-10: Garden Use Residual Noncarcinogeic Risk*			
Analyte	Noncarcinog	Hazard Quotier	Percent Contribution
2,3,7,8-TCDD TEQ	2.52E-07	19.5	59.2%
Antimony	1.39E-01	2.33	7.1%
Aroclor 1254	7.21E-03	8.07	24.5%
Hexvalent Chromium	1.08E+00	1.16	3.5%
Perchlorate	1.58E-02	1.11	3.4%
Hazard Index		**33**	

*Data taken from Table E3-2 of Appendix E3
RBSL=Risk Based Screening Level
USEPA and DTSC Threshold HI value is 1.
The "Hazard Index" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

[63] http://www.who.int/mediacentre/factsheets/fs225/en/

Groundwater

Boeing did not provide post remediation calculations for the Chatsworth Groundwater Pathway (Well HAR-18), giving the impression that Boeing is not intending to do anything about the groundwater well.

Chapter Conclusion

Appendix E3 provides residual risk numbers for what the site would be after the "cleanup", and as we have shown above, the risk values are still above the allowable USEPA and DTSC levels. Furthermore, this Boeing document attempts to argue that the HHRA and ERA (our summaries of which are discussed above) "demonstrate that acceptable risks and hazards from potential exposure to soil and soil vapor by hypothetical suburban residents and ecological receptors are expected at the EEL RFI site if the CMS areas presented are included in site cleanup activities"[64]. But as evidenced in these tables, the risks are not protective of human and ecological health. Therefore, DTSC must ensure that a full cleanup is done at this RFI site.

[64] Appendix E3 Section 3.0 "Conclusions"

Area III Sewage Treatment Plant[65]

Background

The Area III Sewage Treatment Plant (STP-3) RFI site is located in the west-central portion of Administrative Area III at SSFL. The RFI site is currently inactive and all structures have been demolished. Facilities at the STP-3 RFI site identified during the RFA include Building 3600 (the sewage treatment plant); Buildings 3251, 3252, and 3267 (known collectively as the former Ranch House, where a metallurgical laboratory is believed to have been operated); the STP-3 RFI Site Pond; and the STP-3 RFI Site Clarifier period of operation of the suspected metallurgical laboratory are not available from historical documentation, although the ranch house buildings were demolished in the late 1980s.

Appendix E1: Human Health Risk Assessment[66]

Direct Soil Contact

For the direct soil contact pathway, the total site ELCR is **3E-05**, and the incremental risk is also 3E-05, which exceeds DTSC's point of departure of 1E-06. The primary contributors are listed in Table STP-1. The total site HI for soil for this scenario is **4**, which exceeds the USEPA and DTSC threshold HI value of 1. Primary contributors are listed in Table STP-2 below.

Also, the PCB-TEQ risk and HI for this scenario is higher than the calculated total risk and HI, but Boeing is not including the PCB-TEQs because it claims that there are "uncertainties" in the numbers.

Table STP-1: Direct Soil Contact Carcinogenic Risk*

Analyte	Carcinogenic RBSL	Cancer Risk	Percent Contribution
2,3,7,8-TCDD TEQ	4.81E-06	5.50E-06	21.6%
Aroclor 1254	2.32E-01	4.60E-06	18%
Benzo(a)anthracene	3.87E-01	1.40E-06	5.5%
Benzo(a)pyrene	3.87E-02	1.10E-05	43.2%
Benzo(b)fluoranthene	3.87E-01	1.60E-06	6%
Total Risk		**3.00E-05**	
PCB-TEQ[a]	3.57E-06	2.00E-04	-

*Data taken from Table E1-5 of Appendix E1
PCB=Polychlorinated Biphenyl
TEQ=Toxic Equivalent Quotient
"a" PCB TEQ was calculated, but not included in the total risk. If included in the total risk, would be 2.3E-04
DTSC Point of Departure 1E-06
The "Total Risk" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

[65] http://www.dtsc-ssfl.com/files/lib_rcra_soils/boeingsubarea59south/draft_rfi_rpts/66620_Draft_RCRA_Facility_Investigation_Data_Summary_and_Findings_Report_-_Area_III_Sewage_Treatment_Plant_RFI_Site.pdf

[66] PDF Pages 408-452

Table STP-2: Direct Soil Contact Noncarcinogenic Risk*			
Analyte	NonCarcinogenic RBSL	Hazard Quotient	Percent Contribution
2,3,7,8-TCDD TEQ	5.05E-05	0.527	11.7%
Aroclor 1254	1.10E+00	0.971	21.6%
Cadmium	4.60E+00	0.35	7.8%
Mercury	1.68E+01	0.997	22.2%
Silver	2.30E+02	0.83	18.5%
Thallium	7.61E-01	0.674	15%
Hazard Index		**4**	
PCB-TEQ[a]	3.86E+00	22	

*Data taken from Table E1-5 of Appendix E1
PCB=Polychlorinated Biphenyl
TEQ=Toxic Equivalent Quotient
"a" PCB TEQ was calculated, but not included in the total risk. If included in the total HI, would be 26
USEPA and DTSC threshold HI value is 1
The "Hazard Index" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Garden Use

For the homegrown produce consumption pathway, the total site ELCR is **1E-02** and the incremental risk is also 1E-02, which exceeds the DTSC point of departure of 1E-06. The primary risk driver is benzo(a)pyrene, which is an adhesive and sealant, as well as a fuel and fuel additive. Exposure to benzo(a)pyrene has carcinogenic effects and can cause chronic bronchitis, dermatitis, keratosis, damage to the reproductive system and leukemia[67]. Other main risk drivers are listed in Table STP-3.

The HI is **1,838**, and the incremental HI is 1,599, which are almost two thousand of times greater than the USEPA and DTSC threshold HI. The primary risk driver is cadmium, which if exposed, can cause cancer and targets the body's cardiovascular, renal, gastrointestinal, neurological, reproductive, and respiratory systems if one is exposed[68]. Primary risk drivers are listed in Table STP-4. Note also that the PCB-TEQs for both risk and HI are not included in the totals because Boeing claims there are "uncertainties" in the numbers, which is convenient for Boeing because then it gives the illusion that a lesser quality cleanup is then needed when the risk is **1E-01**, and the HI is about **3,304**.

[67] https://pubchem.ncbi.nlm.nih.gov/compound/benzo_a_pyrene#section=Health-Hazard
[68] https://www.osha.gov/SLTC/cadmium/

Table STP-3: Garden Use Carcinogenic Risk*			
Analyte	Carcinogenic RBSL	Cancer Risk	Percent Contribution
2,3,7,8-TCDD TEQ	7.51E-09	3.54E-03	26.9%
Aroclor 1254	4.88E-04	2.19E-03	16.7%
Aroclor 1262	4.88E-04	2.25E-05	0.2%
Benzo(a)anthracene	8.05E-04	6.75E-04	5.1%
Benzo(a)pyrene	8.09E-05	5.30E-03	40.3%
benzo(b)fluoranthene	8.05E-04	7.45E-04	5.7%
benzo(k)fluoranthene	8.09E-04	3.98E-04	3.0%
Chrysene	8.06E-03	1.21E-04	0.9%
dibenzo(a,h)anthracene	2.38E-04	8.57E-04	0.7%
Indeno(1,2,3-cd)pyrene	8.13E-04	6.61E-05	0.5%
Total Risk		**1.00E-02**	
PCB TEQ	7.50E-09	1.00E-01	-

*Data taken from Table E1-5 of Appendix E1
PCB=Polychlorinated Biphenyl
TEQ=Toxic Equivalent Quotient
"a" PCB TEQ was calculated, but not included in the total risk. If included, the total risk would be 1.1E-01
USEPA Target Risk Range 1E-06 to 1E-04
DTSC Point of Departure 1E-06
RBSL=Risk Based Screening Level
The "Total Risk" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Table STP-4: Garden Use Noncarcinogenic Risk*			
Analyte	NonCarcinogenic RBSL	Hazard Quotient	Percent Contribution
2,3,7,8-TCDD TEQ	2.52E-07	105	5.7%
Antimony	1.39E-01	7.9	0.4%
Aroclor 1254	7.21E-03	148	8.1%
Aroclor 1262	7.21E-03	1.53	0.1%
Cadmium	1.65E-03	976	53.1%
Copper	1.11E+01	5.29	0.3%
Mercury	5.04E-02	332	18.0%
Nickel	6.07E+00	8.92	0.5%
Silver	1.81E+00	1.06	5.7%
Thallium	3.60E-03	142	7.7%
Zinc	5.38E+01	4.38	0.2%
Hazard Index		**1,838**	
PCB-TEQ[a]	2.52E-07	3,304	

*Data taken from Table E1-5 of Appendix E1
PCB=Polychlorinated Biphenyl
TEQ=Toxic Equivalent Quotient
"a" PCB TEQ was calculated, but not included in the total risk. If included in the total HI, would be 5,142
USEPA and DTSC threshold HI value is 1
The "Hazard Index" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Groundwater Use

For groundwater use at Chatsworth Formation well HAR-18, the ELCR is **3E-02**, which exceeds the DTSC point of departure of 1E-06. The primary risk driver is vinyl chloride, which if exposed can result in central nervous system effects, and liver damage

and cancer. Other risk drivers are listed in Table STP-5. The HI for this scenario is **426**, which exceeds both the USEPA and DTSC threshold HI value of 1. The primary contributor is TCE, other contributors are listed in Table STP-6.

Boeing states "the potential risk from exposure to lead in groundwater is evaluated separately from other carcinogens and noncarcinogens. For this HHRA, potential risk from lead is evaluated by comparing the maximum EPC for lead in Chatsworth Formation groundwater to the USEPA Action Level in water 15 ug/L. Only one of the 10 well points in Boeing RFI Subareas 5/9 South had an EPC exceeding 15 ug/L at well point RD-55A where the EPC was 40.1 ug/L".

Table STP-5: Groundwater Use Carcinogenic Risk*			
Analyte	Carcinogenic RBC	Cancer Risk	Percent Contribution
1,1-Dichloroethane	2.5E+00	2.1E-06	0.0%
1,1-Dichloropropene	2.2E-01	2.8E-05	0.1%
1,4-Dioxane	2.5E+00	5.7E-06	0.0%
Aldrin	3.9E-03	3.1E-06	0.0%
Heptachlor	1.9E-03	2.4E-05	0.1%
N-Nitrosodimethylamine	1.5E-03	2.4E-03	7.8%
Trichloroethene	4.2E-01	1.5E-03	5.0%
Vinyl Chloride	1.4E-02	2.7E-02	86.9%
Total Risk		**3.0E-02**	

*Data taken from Table E1-12 of Appendix E1
USEPA Target Risk Range 1E-06 to 1E-04
DTSC Point of Departure 1E-06
RBSL=Risk Based Concentration
The "Total Risk" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Table STP-6: Groundwater Use NonCarcinogenic Risk*			
Analyte	NonCarcinogenic RBC	Hazard Quotient	Percent Contribution
1,1-Dichloroethene	1.3E+02	0.19	0.0%
1,1-Dichloropropene	3.9E+01	0.157	0.0%
cis-1,2-Dichloroethene	1.0E+01	163	38.3%
Manganese	4.3E+02	0.346	0.1%
N-Nitrosodimethylamine	1.6E-01	22.5	5.3%
Thallium	2.0E-01	0.24	0.1%
trans-1,2-Dichloroethene	9.3E+01	0.495	0.1%
Trichloroethene	2.8E+00	230	54.1%
Vinyl Chloride	4.4E+01	8.11	1.9%
Hazard Index		**426**	

*Data taken from Table E1-12 of Appendix E1
RBSL=Risk Based Concentration
USEPA and DTSC threshold HI value is 1
The "Hazard Index" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Appendix E2: Ecological Risk Assessment[69]

For plant species, we've calculated an HI of **130**, which is more than a 100 times above the USEPA and DTSC HI threshold value of 1. The two main contributors above an HI of 1 are chromium (HQ=70), and mercury (HQ=60)[70]. Chromium is highly toxic for biota, and accumulation of chromium in plants causes high toxicity in terms of reduction in growth and biomass accumulation, induces structural alterations, interferes with photosynthetic and respiration process, and water and minerals uptake mechanisms, and lastly, death of the plant species.[71] Mercury on the other hand can cause serious damage to plants and wildlife. Mercury concentrations in an ecological setting can cause death of biota, reduced reproduction, slower growth and development, and abnormal behavior.[72]

For invertebrates, we've calculated and HI of at least **202**, with the main contributors being Mercury and Zinc. The effects of mercury have been explained above. Exposure to excessive amounts of zinc can have serious effects in the digestive system.[73] Also take into consideration that invertebrates tend to be a primary food source for other animals in the food chain, and bioaccumulation of zinc can be even more harmful as you go up the trophic levels. Other primary risk drivers above the threshold HI value of 1 are listed in Table STP-7.

For avian species, we've calculated with Boeing's data an HI of **1,367**, which is far above USEPA and DTSC's HI threshold value of 1. The primary contributors are lead and silver. Lead poisoning in birds can cause lethargy, progressive weakness causing the inability to fly, and usually accumulates in the liver, kidneys, and blood.[74] As of yet, no data has been provided for the effects of silver in avian species, though it has shown in poultry to affect the liver.[75] Other contributors can be found in Table STP-7.

Lastly, for mammals, we've calculated an HI of **638**, which is far above USEPA and DTSC's HI threshold value of 1. The primary contributor is nickel, which if exposed, an animal would affect the kidneys and have serious developmental and reproductive effects.

[69] PDF pages 454-505
[70] Table E2-5, PDF page 484
[71] https://link.springer.com/article/10.1007/s10311-013-0407-5
[72] https://www.epa.gov/mercury/basic-information-about-mercury#ecological
[73] https://www.merckvetmanual.com/toxicology/zinc-toxicosis/overview-of-zinc-toxicosis
[74] https://www.nwhc.usgs.gov/disease_information/lead_poisoning/
[75] http://www.inchem.org/documents/cicads/cicads/cicad44.htm#6.0

Table STP-7: Risk Estimates for Birds (Hermit Thrush)-Exposure in Soil*					
Analyte	RME EPC	Low Eco RBSL	High EcoRBSL	HQ-Low	HQ-High
Cadmium	1.61	0.2	3	8.0	0.5
Chromium	73.6	2.4	14	30.0	5.0
Copper	58.5	1.1	24	50.0	2.0
Lead	59	0.062	39	1000.0	2.0
Mercury	16.7	0.87	1.7	20.0	10.0
Nickel	54.1	1.5	60	40.0	0.9
Silver	191	0.99	29	200.0	7.0
Zinc	236	32	320	7.0	0.7
Aroclor 1254	1.07	0.083	0.83	10.0	1.0
DioxinFuran_TEQ_Bird	1.42E-05	5.70E-06	0.000057	2.0	0.2
Hazard Index				**1367**	
PCB TEQ Bird	0.001951	5.70E-06	5.70E-05	300.0	30.0

*Data taken from Table E2-7 from Appendix E2
RME-Reasonable Maximum Exposure
USEPA and DTSC threshold HI value is 1
EcoRBSL=Ecological Risk Based Screening Level
Note, no actual Hazard Index was provided, we had to calculate our own.
The Hazard Index provided in this table only includes HI values above 1, other contrinutors were not included.
"a" PCB TEQ Bird was calculated separately, but not included in the total HI, or explained why. If included in the total, the correct HI would be 1667

Table STP-8: Risk Estimates for mammals (Deer Mice)-Exposure in Soil*					
Analyte	RME EPC	Low Eco RBSL	High EcoRBSL	HQ-Low	HQ-High
Antimony	0.748	0.042	2	20.0	0.4
Cadmium	1.05E+00	0.019	0.81	60.0	1.0
Chromium	50.9	1.9	46	30.0	1.0
Copper	43.9	1.5	350	30.0	0.1
Lead	40	3.8	910	10.0	0.4
Mercury	11.5	2.2	-	5.0	-
Nickel	53.6	0.13	30	400.0	2.0
Silver	75.9	3.5	2.00E+01	1.0	
Zinc	177	19	820	9.0	0.2
Aroclor 1248	2.00E-02	6.40E-03	0.064	3.0	0.3
Aroclor 1254	5.62E-01	3.90E-02	0.39	10.0	1.0
DioxinFuran_TEQ_Mammal	2.64E-05	5.00E-07	0.000005	50.0	5.0
Aroclor 1260	3.41E-01	2.50E-02	0.25	10.0	1.0
Hazard Index				**638**	
PCB TEQ Mammal	0.000437	5.00E-07	5.00E-06	900.0	90.0

*Data taken from Table E2-8 from Appendix E2
RME-Reasonable Maximum Exposure
USEPA and DTSC threshold HI value is 1
EcoRBSL=Ecological Risk Based Screening Level
Note, no actual Hazard Index was provided, we had to calculate our own.
The Hazard Index provided in this table only includes HI values above 1, other contrinutors were not included.
"a" PCB TEQ Bird was calculated separately, but not included in the total HI, or explained why. If included in the total, the correct HI would be 1538

Appendix E3: Residual Risk[76]

Garden Use

The post remediation risk value that Boeing predicts for this scenario is **3E-04**, which is still above the USEPA target risk range, and DTSC's Point of Departure. The primary contributors are listed below in Table STP-9. The main contributor to the post remediation risk is 2,3,7,8-TCDD TEQ, 2,3,7,8-TCDD TEQ (41.1%; 1.02E-06), which if

[76] PDF Pages 557-566

exposed, it may result in skin lesions, altered liver function, impairment to the immune, nervous, and endocrine systems, and alter reproductive functions.[77]

The post remediation HI that Boeing predicts for this scenario is 553, still far above the USEPA and DTSC threshold HI value of 1. The primary contributors are listed below in Table STP-10. The primary contributor is cadmium, which can cause cancer and targets the body's cardiovascular, renal, gastrointestinal, neurological, reproductive, and respiratory systems if one is exposed[78]

Table STP-9: Garden Use Residual Carcinogenic Risk*			
Analyte	Carcinogenic RBSL	Cancer Risk	Percent Contribution
2,3,7,8-TCDD TEQ	7.51E-09	2.28E-04	74.9%
Aroclor 1254	4.88E-04	1.23E-05	4%
Aroclor 1262	4.88E-04	2.25E-05	7.4%
benzo(a)pyrene	8.09E-05	3.58E-05	11.8%
Benzo(b)fluoranthene	8.05E-04	4.61E-06	1.5%
Total Risk		**3.00E-04**	

*Data taken from Table E3-2 of Appendix E3
USEPA Target Risk Range 1E-06 to 1E-04
DTSC Point of Departure 1E-06
The "Total Risk" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Table STP-10: Garden Use Noncarcinogenic Risk*			
Analyte	NonCarcinogenic RBSL	Hazard Quotient	Percent Contribution
2,3,7,8-TCDD TEQ	2.52E-07	6.78	1.2%
Antimony	1.39E-01	9.33	1.7%
Aroclor 1262	7.21E-03	1.53	0.3%
Cadmium	1.65E-03	391	70.7%
Mercury	5.04E-02	1.46	0.3%
Nickel	6.07E+00	7.52	1.4%
Thallium	3.60E-03	1.32	24%
Hazard Index		**553**	

*Data taken from Table E3-2 of Appendix E3
USEPA and DTSC threshold HI value is 1
RBSL=Risk Based Concentration
The "Hazard Index" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Groundwater Use

Boeing did not provide post remediation calculations for the Chatsworth Groundwater Pathway (Well HAR-18), giving the impression that Boeing is not intending to do anything about the groundwater well.

[77] http://www.who.int/mediacentre/factsheets/fs225/en/
[78] https://www.osha.gov/SLTC/cadmium/

Chapter Conclusion

Appendix E3 provides residual risk numbers for what the site would be after the "cleanup", and the tables make clear, the risk values are still often above the allowable USEPA and DTSC levels. Furthermore, this Boeing document attempts to argue that the HHRA and ERA "demonstrate that acceptable risks and hazards from potential exposure to soil and soil vapor by hypothetical suburban residents and ecological receptors are expected at the STP-3 RFI site if the CMS areas presented are included in site cleanup activities"[79]. But as we see in the provided evidence above, the risks are *not* acceptable. Therefore, DTSC must ensure that a full cleanup is done at this RFI site.

[79] Appendix E3 Section 3.0 "Conclusions"

Compound A[80]

Background

The Compound A Facility RFI site is in the northeastern portion of Boeing RFI Subarea 5/9 South, located north of the STL-4 RFI site and south and east of the EEL and STP-3 RFI sites. The site is currently inactive, and all structures have been demolished. The Compound A Facility site was used in support of Rocketdyne Propulsion and Power operations. The Compound A Facility RFI site contains one solid waste management unit (SWMU)-Building 3418 (SWMU 6.4) that was identified in the RFA. Building 3418 was used for manufacturing chlorine pentafluoride (this chemical is referred to as "Compound A") and for manufacturing laser chemicals (nitrogen, fluoride, and antimony compounds) from 1967 through 1969. The Compound A Facility RFI Site boundary was defined to include operations associated with Building 3418. In addition, facilities or features near this SWMU were included in the Compound A Facility RFI site boundary. These include Buildings 3430 and 3768, the STL-4 air-stripping towers and transformer demolished in 2011, two forming pits, and explosive storage bunker, the Compound A on the east side of Building 3418, one suspect pond, and a debris area southwest of Building 3418.

Appendix E1: Human Health Risk Assessment[81]

Direct Soil Contact

For the direct soil contact pathway, the total site ELCR is **2E-04** and the incremental risk is 8E0-06, which exceeds the DTSC point of departure of 1E-06. The primary risk driver to the incremental soil ELCR is arsenic (99%; 2E-04). Boeing then states "a statistical comparison of arsenic levels at the Compound A Facility RFI site (site EPC of 11.2 mg/kg) and maximum detected value of 107 mg/kg with background concentrations indicating that onsite arsenic levels are not statistically higher than background. However, arsenic is considered a chemical of potential concern since the maximum detect exceeded two times the background comparison value". The total site HI for soil for this scenario is **2** and the incremental HI is 1, which exceeds the USEPA and DTSC threshold HI value of 1.

Garden Use

For the homegrown produce consumption pathway, the ELCR is **1E-01**, which is well above the USEPA target risk range and exceeds DTSC's point of departure of 1E-06. Boeing also states that there is no incremental risk over background. The primary contributor to the site ELCR is arsenic (99.9%; 1.09E-01), which if exposed can cause

[80] http://www.dtsc-ssfl.com/files/lib_rcra_soils/boeingsubarea59south/draft_rfi_rpts/66621_Draft_RCRA_Facility_Investigation_Data_Summary_and_Findings_Report_-_Compound_A_Facility_RFI_Site.pdf
[81] PDF Pages 1,187-1,229

vomiting, abdominal pain, muscle cramping, pigmentation changes, skin lesions, cancer in the lungs, skin, and bladder, pulmonary and cardiovascular diseases.[82]

The total site HI for this scenario is **1,112**, and the incremental HI is 715, which exceed the USEPA and DTSC threshold HI value of 1.[83] The primary contributor is cadmium, which can cause cancer and targets the body's cardiovascular, renal, gastrointestinal, neurological, reproductive, and respiratory systems if one is exposed[84] One thing we would like to address is that in the HHRA, are no tables that show Hazard Indices that would add up to the value above, which is extremely unprofessional, and they aren't even completing a full analysis.

Indoor Air Pathway

For the indoor air pathway, the total site ELCR is **5E-04**, which is above the USEPA target risk range of 1E-06 to 1E-04 and exceeds DTSC's point of departure of 1E-06. The primary risk driver is TCE (>99%; 5E-04). The total site HI is **154** for this scenario, which exceeds the USEPA and DTSC threshold HI value of 1. The primary contributor to the site HI is TCE (>99%; HQ=154). As mentioned in the previous chapter, exposure to TCE can affect reproductive organs and impairs neurological function, as well as kidney cancer, and liver cancer.[85]

Groundwater Use Pathway

For groundwater use at Chatsworth Formation well HAR-18, the ELCR is **3E-02**, which is both above the USEPA target risk range and the DTSC point of departure of 1E-06. Primary contributors are listed in Table CA-1. The primary risk driver is vinyl chloride, which if exposed can result in central nervous system effects, and liver damage and cancer.

The site HI is **426** for this scenario, which exceeds the USEPA and DTSC threshold HI value of 1. The primary contributors are listed in Table CA-2. The main contributor is Cis-1,2-dichloroethene, which if inhaled or direct contact can have toxic effects, such as irritation of the lungs, skin, and eyes.[86] For radionuclides in groundwater, the calculated ELCR is **2E-05**, which exceeds the DTSC point of departure of 1E-06. The primary risk driver is Uranium-233/234 (94%; 1E-05).

[82] http://www.who.int/mediacentre/factsheets/fs372/en/
[83] PDF Page 1,192
[84] https://www.osha.gov/SLTC/cadmium/
[85] https://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=30
[86] https://pubchem.ncbi.nlm.nih.gov/compound/_Z_-1_2-Dichloroethylene#section=GHS-Classification

Table CA-1: Groundwater Use Carcinogenic Risk*			
Analyte	Carcinogenic RBC	Cancer Risk	Percent Contribution
1,1-Dichloroethane	2.51E+00	2.07E-06	0.0%
1,1-Dichloropropene	2.19E-01	2.79E-05	0.1%
1,4-Dioxane	2.47E+00	5.67E-06	0.0%
Aldrin	3.94E-03	3.05E-06	0.0%
Heptachlor	1.86E-03	2.37E-05	0.1%
N-Nitrosodimethylamine	1.51E-03	2.38E-03	7.8%
Trichloroethene	4.24E-01	1.53E-03	5.0%
Vinyl Chloride	1.36E-02	2.65E-02	86.9%
Total Risk		**3.00E-02**	
*Data taken from Table E1-12 of Appendix E1			
USEPA Target Risk Range 1E-06 to 1E-04			
DTSC Point of Departure 1E-06			
RBSL=Risk Based Concentration			

Table CA-2: Groundwater Use NonCarcinogenic Risk*			
Analyte	NonCarcinogenic RBC	Hazard Quotient	Percent Contribution
1,1-Dichloroethene	1.26E+02	0.19	0.0%
1,1-Dichloropropene	3.88E+01	0.157	0.0%
cis-1,2-Dichloroethene	1.04E+01	163	38.3%
Manganese	4.33E+02	0.346	0.1%
N-Nitrosodimethylamine	1.60E-01	22.5	5.3%
Thallium	2.00E-01	0.24	0.1%
trans-1,2-Dichloroethene	9.29E+01	0.495	0.1%
Trichloroethene	2.82E+00	230	54.1%
Vinyl Chloride	4.44E+01	8.11	1.9%
Hazard Index		**426**	
*Data taken from Table E1-12 of Appendix E1			
RBSL=Risk Based Concentration			
USEPA and DTSC threshold HI value is 1			

Appendix E2: Ecological Risk Assessment[87]

For plant species, we've calculated an HI of **35**, which is above USEPA and DTSC threshold HI value of 1. Chromium is the primary contributor at a Hazard Quotient of 30. Chromium is highly toxic for biota, and accumulation of chromium in plants causes high toxicity in terms of reduction in growth and biomass accumulation, induces structural alterations, interferes with photosynthetic and respiration process, and water and minerals uptake mechanisms, and lastly, death of the plant species.[88]

For soil invertebrates, we've calculated an HI of **8**, which is above the USEPA and DTSC threshold HI value of 1. The primary contributor is zinc, with an HQ of 4. For birds, we've calculated an HI of **1,141**, which is more than a thousand times higher than the USEPA and DTSC threshold HI value of 1. The primary contributor is nickel, and can affect the kidneys and have serious developmental and reproductive effects of the bird.

[87] PDF Pages 1,259-1,323
[88] https://link.springer.com/article/10.1007/s10311-013-0407-5

Table CA-3: Risk Estimates for Birds (Hermit Thrush)-Exposure in Soil*					
Analyte	RME EPC	Low Eco RBSL	High EcoRBSL	HQ-Low	HQ-High
Barium	130	44	89	3.0	1.0
Cadmium	1.2	0.2	3	6.0	0.4
Chromium	32.1	2.4	14	10.0	2.0
Copper	37.7	1.1	24	30.0	2.0
Fluoride	72.9	35	140	2.0	0.5
Lead	70.8	0.062	39	1000.0	2.0
Nickel	34	1.5	60	20.0	0.6
Silver	21.5	0.99	29	20.0	0.7
Zinc	463	32	320	10.0	1.0
2-Amino-4,6-Dinitrotoluene	2.55E-01	6.00E-03	0.78	40.0	0.3
Hazard Index				**1141**	
PCB TEQ Bird	0.000205	5.70E-06	5.70E-05	40.0	4.0

*Data taken from Table E2-7 from Appendix E2
RME-Reasonable Maximum Exposure
USEPA and DTSC threshold HI value is 1
EcoRBSL=Ecological Risk Based Screening Level
Note, no actual Hazard Index was provided, we had to calculate our own.
The Hazard Index provided in this table only includes HI values above 1, other contrinutors were not included.
"a" PCB TEQ Bird was calculated separately, but not included in the total HI, or explained why. If included in the total, the correct HI would be 1181

Table CA-4: Risk Estimates for mammals (Deer Mice)-Exposure in Soil*					
Analyte	RME EPC	Low Eco RBSL	High EcoRBSL	HQ-Low	HQ-High
Antimony	2.56	0.042	2	60.0	1.0
Arsenic	1.12E+01	2.1	31	5.0	0.4
Cadmium	0.902	0.019	0.81	50.0	1.0
Chromium	32.2	1.9	46	30.0	0.7
Copper	31.1	1.5	350	20.0	0.1
Lead	55	3.8	910	10.0	0.1
Manganese	485	79	920	6.0	0.5
Molybdenum	0.749	0.13	1.3	6.0	0.6
Nickel	33.9	0.13	30	300.0	1.0
Selenium	3.13E-01	1.00E-01	2.4	3.0	0.1
Silver	1.51E+01	3.50E+00	69	4.0	0.2
Zinc	3.51E+02	1.90E+01	820	20.0	0.4
Aroclor 1254	7.82E-02	3.90E-02	0.39	2.0	0.2
DioxinFuran_TEQ_Mammal	6.85E-06	5.00E-07	0.000005	10.0	1.0
Hazard Index				**526**	
PCB TEQ Mammal	6.92E-05	5.00E-07	5.00E-06	100.0	10.0

*Data taken from Table E2-8 from Appendix E2
RME-Reasonable Maximum Exposure
USEPA and DTSC threshold HI value is 1
EcoRBSL=Ecological Risk Based Screening Level
Note, no actual Hazard Index was provided, we had to calculate our own.
The Hazard Index provided in this table only includes HI values above 1, other contrinutors were not included.
"a" PCB TEQ Bird was calculated separately, but not included in the total HI, or explained why. If included in the total, the correct HI would be 626

Appendix E3: Residual Risk[89]

Direct Soil Contact

For soil contact, Boeing estimates the residual risk (post-cleanup) will be **2E-04**, still above both the USEPA target risk range and DTSC point of departure. The primary risk driver is arsenic (98.1%; 1.55E-04). The estimated residual HI is 2, still above the USEPA and DTSC threshold HI value of 1.

Garden Use

There are no calculations provided by Boeing for the Garden Use pathway for residual risk. In other reports, the garden use pathway residual risk was provided, so why was it not included in this report? This gives us the impression that Boeing will not attempt to clean up this pathway.

Groundwater Use

Boeing did not provide post remediation calculations for the Chatsworth Groundwater Pathway (Well HAR-18), giving the impression that Boeing is not intending to do anything about the groundwater well either.

Chapter Conclusion

Appendix E3 provides residual risk numbers for what the site would be after the "cleanup", and as our table's demonstrate, the risk values are still often above the allowable USEPA and DTSC levels. Furthermore, this Boeing document attempts to argue that the HHRA and ERA "demonstrate that acceptable risks and hazards from potential exposure to soil and soil vapor by hypothetical suburban residents and ecological receptors are expected at the Compound A RFI site if the CMS areas presented are included in site cleanup activities"[90].Once again, as we see from the data Boeing provided, the risks are *not* acceptable. Therefore, DTSC must ensure that a full cleanup is done at this RFI site.

[89] PDF Pages 1,397-1,413
[90] Appendix E3 Section 3.0 "Conclusions"

Unaffiliated Areas[91]

The Unaffiliated Areas (UA) of 5/9 South was not used for any industrial purposes. No SSFL activities were conducted on this land. The area does include several drainage channels and surface water. Boeing did not do any modeling for this area, arguing that contamination could not be present because no SSFL activities happened in this region.

Boeing has also found that many of the sites that are in close proximity to the UA are incredibly contaminated as shown by the other RFI reports. However, Boeing claims that the UAs are not contaminated whatsoever because no previous activity had ever occurred on that portion of the property. This is an unrealistic assumption, however, as contamination does not stay in one place—on the contrary, it travels via wind and ground and surface water. We argue that these areas must be tested before these areas are deemed for No Further Action.

We'd also like to note that this RFI report was incomplete; for example, Boeing submitted data charts on compact disks instead of including the charts in this RFI report. The data was then uploaded to the DTSC's website upon our request, months after they should have been posted. Furthermore, the data that was posted is quite inadequate and does not include basic summaries for human or ecological risk assessments.

[91] http://www.dtsc-ssfl.com/files/lib_rcra_soils/boeingsubarea59south/draft_rfi_rpts/66636_Draft_RCRA_Facility_Investigation_Data_Summary_and_Findings_Report_-_Unaffiliated_Areas_of_5_9_South.pdf

Subarea 1A Central

Happy Valley North[92]

Background

The Happy Valley Area of Concern identified in the RFA was subdivided into two RFI sites – the Happy Valley North (HVN) RFI site in Boeing Subarea 1A Central, and the Happy Valley South RFI Site in Boeing Subarea 1A South. A ridge separates the two RFI sites, forming a natural divide between the surface water in each area. The HVN RFI comprises an area of approximately 1.3 acres surrounding the former Chemistry Laboratory (Building 1315), the former Tunnel Facility (Building 1773), and various support buildings where energetics and propellants were stored and tested from the early 1950s to the mid-1990s.

In the northern part of the HVN RFI site, experiments utilizing energetics compounds and detonators were conducted at the Building 1315 Chemistry Lab, the adjacent test cells, and the detonation and energetics sups southwest of the building. In the southern portion of the HVN RFI site, the Tunnel Facility and the associated Control Center and its test cells were used to test rocket and gun propellants. Other structures associated with HVN operations included the Instrumentation/Mechanics Shops, an incinerator, a chemistry lab, workshops, the Peroxide Catalyst Production Building, the High Altitude Test Chamber, cooling towers, and several small storage and support buildings.

Two phases of interim measures were conducted at the HVN RFI Site. Between 1999 and 2000, an interim measure was implemented to screen debris and remove suspected energetic and ordnance items. Small piles of sand (approximately 5 cubic yards of material) near the Tunnel Facility, sediment from concrete lined drainages, and sediment within the detonation sump at Building 1315 were excavated, sifted, and disposed of offsite (UXB, 2002). During the Happy Valley Interim Measures (HVIM) conducted from 2003 to 2004, approximately 800 cubic yards of metals-impacted shallow soil at the Building 1316 and Tunnel Facility area were excavated to address elevated arsenic concentrations. Additionally, 30 cubic yards of perchlorate-impacted soil were excavated from the hill-slope east of Building 1316 (MWH, 2004a). Between 2004 and 2006, perchlorate-impacted soils were bio remediated *in situ* (without being moved from where they are onsite) in the Building 1316 area.

Appendix E1: Human Health Risk Assessment[93]

When the HHRA summary lists off the main risk contributors to either the ELCR or HI, the risk values Boeing lists do not match with the risk values listed in the tables throughout the HHRA.

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[92] http://www.dtsc-ssfl.com/files/lib_rcra_soils/boeingsubarea1acntrl/DraftRFIReports/Draft_RCRA_Facility_Investigation_Data_Summary_and_Findings_Report_-_Happy_Valley_North_RFI_Site.PDF

[93] PDF Pages 583-687

Direct Soil Contact

For the direct soil contact pathway, the total site ELCR is **4E-04** and the total incremental risk is 2E-04, which exceeds the USEPA target risk range of 1E-06 to 1E-04 and the DTSC point of departure of 1E-04. The primary risk drivers are arsenic (77%; 1.9E-04) and 1,4-dichlorobenzene (22%; 5.5E-05). Arsenic, being the main contributor can cause vomiting, abdominal pain, muscle cramping, pigmentation changes, skin lesions, cancer in the lungs, skin, and bladder, pulmonary and cardiovascular diseases.[94]

The total site HI for soil for this scenario is **2**, which exceeds the USEPA and DTSC threshold HI value of 1. Boeing also states "the potential risks from exposure to lead in soil at the HVN RFI site were not evaluated since lead was not identified as a chemical of potential concern. A comparison of lead levels with background concentrations indicated that onsite lead levels are lower than background lead levels."

Garden Use

For the homegrown produce consumption pathway, the total site ELCR is **2E-01** and the total incremental ELCR is 1E-01, both of which are above USEPA target risk range of 1E-06 and 1E-04 and exceeds DTSC's point of departure of 1E-06. The main contributor is arsenic (100%; 1.2E-01). The total site HI for this scenario is **700** and the incremental HI is 400, both of which surpass by far the USEPA and DTSC threshold HI value of 1. The primary risk drivers are listed in Table HVN-1.

Table HVN-1: Noncarcinogenic Risk*		
Analyte	NonCarcinogenic RBSL	Hazard Quotient
Arsenic	1.00E-01	220
Cadmium	1.60E-03	410
Mercury	5.00E-02	4.4
2,3,7,8-TCDD TEQ	2.50E-07	7.1
Aroclor 1254	7.20E-03	10
Aroclor 1260	7.20E-03	1.5
Hazard Index		**700**
PCB TEQ	2.50E-07	210
*Data taken from Table E1-5 of Appendix E1		
PCB=Polychlorinated Biphenyl		
TEQ=Toxic Equivalent Quotient		

"a" PCB TEQ was calculated, but not included in the total risk. If included in the total HI, would be 910
USEPA and DTSC threshold HI value is 1
The "Hazard Index" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Indoor Air Pathway

For the indoor air pathway, the total site ELCR is **1E-05**, which is within the USEPA and target risk range of 1E-06 to 1E-04 and above the DTSC point of departure of 1E-06. The risk driver associated with the site ELCR for indoor air is trichloroethene

[94] http://www.who.int/mediacentre/factsheets/fs372/en/

(TCE) (100%; 1.2E-05). The total site HI for this scenario is **4**, which is above the USEPA and DTSC threshold HI value of 1. The risk driver associated with the site HI for indoor air is also TCE (100%; HQ=3.5).

Groundwater Use

For groundwater use at Chatsworth Formation well HAR-16, the ELCR is **2E-02**, which is above the USEPA target risk range of 1E-06 to 1E-04 and exceeds DTSC point of departure of 1E-06. The primary contributors are listed in Table HVN-2, with TCE being the main contributor.

The HI is **2,000** for this scenario, which is above and way beyond the USEPA and DTSC threshold HI value of 1. The risk drivers above the USEPA and DTSC threshold are listed in Table HVN-3.

The potential risk from exposure to lead in groundwater is evaluated separately from other carcinogens and non-carcinogens. For this HHRA, the potential risk from lead is evaluated by comparing the maximum EPC for lead in Chatsworth Formation groundwater to the USEPA Action Level in water of 15ug/L. None of the well points in Boeing RFI Subarea 1A Central had an EPC exceeding 15ug/L.

For radionuclides in groundwater, the risk estimates for radionuclides of potential concern identified for Chatsworth Formation groundwater (at HAR-16) were calculated separately from those associated with chemicals of potential concern. The risk calculation indicates that the ELCR is **6E-04**, which is above the USEPA target risk range of 1E-06 to 1E-04 and exceeds the DTSC point of departure of 1E-06. The only groundwater radionuclide of potential concern in HAR-16 was radium-226 (100%; 6.4E-04).

Table HVN-2: Groundwater Use Carcinogenic Risk*

Analyte	Carcinogenic RBC	Cancer Risk
1,2,3-Trichloropropane	1.80E-04	4.60E-05
Tetrachloroethene	7.10E-02	6.20E-05
Trichloroethene	4.20E-01	1.30E-02
n-Nitrosodimethylamine	1.50E-03	6.50E-03
Total Risk		**2.00E-02**

*Data taken from Table E1-12 of Appendix E1
USEPA Target Risk Range 1E-06 to 1E-04
DTSC Point of Departure 1E-06
RBSL=Risk Based Concentration
The "Total Risk" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Table HVN-3: Groundwater Use NonCarcinogenic Risk*

Analyte	NonCarcinogenic RBC	Hazard Quotient
Perchlorate	1.40E-01	26.0
1,1,2-Trichloroethane	4.20E-01	1.2
cis-1,2-Dichlorothene	1.00E+01	8.1
Trichloroethene	2.80E+00	1900.0
n-Nitrosodimethylamine	1.60E-01	62.0
Hazard Index		**2,000**

Appendix E2: Ecological Risk Assessment[95]

For Avian species, we've calculated an HI of **100**, which is exactly a 100 times above the USEPA and DTSC threshold HI value of 1. The primary contributor is 2-Amino-4,6-dinitrotoluene, other contributors are listed in Table HVN-4. For mammals, we calculated an HI of **276**, which is above USEPA and DTSC threshold HI value of 1.

Table HVN-4: Risk Estimates for Birds (Hermit Thrush)-Exposure in Soil*

Analyte	RME EPC	Low TRV	High TRV	HQ-Low	HQ-High
Cadmium	6.80E-01	2.00E-01	3.00E+00	3.4	0.2
Selenium	8.00E-01	3.90E-01	1.50E+00	2.0	0.5
2,4,6-Trinitrotoluene	3.90E-01	2.30E-01	5.80E+00	1.7	0.1
2-Amino-4,6-dinitrotoluene	3.90E-01	6.00E-03	7.80E-01	66.0	0.5
Pentachlorophenol	8.00E+00	2.80E+00	2.10E+01	2.9	0.4
p-Nitroaniline	8.00E+00	3.40E+00	3.40E+01	2.4	0.2
PCB TEQ Bird (Coplanar PCBs)	1.20E-04	5.70E-06	5.70E-05	22.0	2.2
Hazard Index				**100**	

*Data taken from Table E2-5 from Appendix E2
RME-Reasonable Maximum Exposure
USEPA and DTSC threshold HI value is 1
TRV=Toxicity reference value.
Note, no actual Hazard Index was provided, we had to calculate our own.
The Hazard Index provided in this table only includes HI values above 1, other contrinutors were not included.

Table HVN-5: Risk Estimates for mammals (Deer Mice)-Exposure in Soil*

Analyte	RME EPC	Low Eco TRV	High TRV	HQ-Low	HQ-High
Arsenic	2.40E+01	2.10E+00	3.10E+01	11.0	0.8
Cadmium	4.10E-01	1.90E-02	8.10E-01	21.0	0.5
Selenium	7.50E-01	1.00E-01	2.40E+00	7.5	0.3
2,4,6-Trinitrotoluene	3.90E-01	1.30E-01	6.50E-01	3.0	0.6
2-Amino-4,6-dinitrotoluene	3.90E-01	6.10E-02	4.60E-01	6.5	0.9
1,2-dichlorobenzene	5.80E+02	1.30E+02	1.30E+02	4.5	4.5
1,3-dichlorobenzene	5.40E+01	2.30E+01	1.10E+02	2.3	0.5
1,4-Dichlorobenzene	9.20E+01	5.60E+00	2.80E+01	16.0	3.3
Pentachlorophenol	8.00E+00	3.80E+00	1.00E+01	2.1	0.8
MCPA	9.40E+00	1.20E-01	6.10E-01	78.0	15.0
2,3,7,8-TCDD TEQ Mammal	1.50E-06	5.00E-07	5.00E-06	3.0	0.3
Aroclor 1248	5.30E-02	6.40E-03	6.40E-02	8.3	0.8
Aroclor 1254	7.60E-02	3.90E-02	3.90E-01	1.9	0.2
PCB TEQ Mammal (coplanar PCBs)	5.40E-05	5.00E-07	5.00E-06	110.0	11.0
Hazard Index				**275**	

*Data taken from Table E2-6 from Appendix E2
RME-Reasonable Maximum Exposure
USEPA and DTSC threshold HI value is 1
TRV=Toxicity reference value.
Note, no actual Hazard Index was provided, we had to calculate our own.
The Hazard Index provided in this table only includes HI values above 1, other contrinutors were not included.

Appendix E3: Residual Risk[96]

In researching the residual risk, we were disturbed to find that three chemicals in these residual risk assessments were "taken out." This was evidenced by the fact that the Exposure Point Concentration values have been set to "0", which prevents the ability to

[95] PDF Pages 689-827
[96] PDF Pages 829-849

calculate the cancer risk or HI. These chemicals are: 1,1,1-Trichloroethane; Hexachlorobutadiene; and p-Cymene. We've also seen this with Monomethylhydrazine (MMH) in the Systems Test Lab-IV residual risk values where MMH's (the primary contributor to the human health risk) EPC was also set to "0" in the residual risk assessment tables.

Direct Soil Contact

For this scenario, the site residual ELCR is **3E-04**, which is still above USEPA's target risk range, and DTSC's point of departure. The primary risk driver for this ELCR is arsenic (2.5E-04).

Garden Use

For this pathway, the site residual ELCR is **2E-01,** which is still above USEPA's target risk range and DTSC's point of departure. The primary risk drivers are listed in Table HVN-6. We also want to make another key point that Boeing's estimated residual risk of 2E-01 is the same as the risk level before the cleanup (see Appendix E1 of this chapter, above), this is another clear statement that Boeing is not intending to cleanup this site at all.

For this pathway, Boeing estimates that the residual HI will be **600**, which is still far above USEPA and DTSC's threshold HI value of 1. Primary risk drivers are listed in Table HVN-7.

Table HVN-6: Garden Use Residual Carcinogenic Risk*

Analyte	Carcinogenic RBSL	Cancer Risk
Arsenic	9.90E-05	1.70E-01
Benzo(a)pyrene	8.10E-05	2.40E-04
Benzo(b)fluoranthene	8.10E-04	1.50E-05
Dibenzo(a,h)anthracene	2.40E-04	1.30E-05
2,3,7,8-TCDD TEQ	7.50E-09	1.40E-04
Aroclor 1254	4.90E-04	1.90E-04
Aroclor 1260	4.90E-04	2.20E-05
Total Risk		**2.00E-01**
PCB TEQ[a]	7.50E-09	9.10E-03

*Data taken from Table E3-2 of Appendix E3
USEPA Target Risk Range 1E-06 to 1E-04
DTSC Point of Departure 1E-06
The "Total Risk" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Table HVN-7: Garden Use Noncarcinogenic Risk*		
Analyte	NonCarcinogenic RBSL	Hazard Quotient
Arsenic	1.00E-01	160
Cadmium	1.60E-03	450
Mercury	5.00E-02	4.7
2,3,7,8-TCDD TEQ	2.50E-07	4.2
Aroclor 1254	7.20E-03	13
Aroclor 1260	7.20E-03	1.5
Hazard Index		**553**
PCB TEQ	2.50E-07	270

*Data taken from Table E3-2 of Appendix E3
USEPA and DTSC threshold HI value is 1
RBSL=Risk Based Concentration
The "Hazard Index" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Groundwater Use

Boeing did not provide post remediation calculations for the Chatsworth Groundwater Pathway (Well HAR-16), giving the impression that Boeing is not intending to do anything about the groundwater well either.

Chapter Conclusion

Appendix E3 provides residual risk numbers for what the site would be after the "cleanup", and as we have shown above, the risk values are still above the allowable USEPA and DTSC levels. Furthermore, this Boeing document attempts to argue that the HHRA and ERA (which our summaries are listed above) "demonstrate that acceptable risks and hazards from potential exposure to soil and soil vapor by hypothetical suburban residents and ecological receptors are expected at the Happy Valley North RFI site if the CMS areas presented are included in site cleanup activities"[97]. But as we see from Boeing's own risk numbers, the risks are *not* acceptable. Therefore DTSC must ensure that a full cleanup is done at this RFI site.

[97] Appendix E3 Section 3.0 "Conclusions"

Advanced Propulsion Test Facility[98]

Background

The APTF RFI Site is approximately 3.3 acres located in the northeastern portion of Administrative Area I, generally west of the HVN and B359 RFI Sites. The RFI Site is currently inactive and contains no structures. The APTF test area (SWMU 4.9) has been used for research and development programs, including testing components used in liquid-fueled rocket engines, propellant research, and advanced laser research and testing. The site was activated in 1953 and supported research programs until 2005, when operations ceased (Boeing, 2008). Between 1960 and 1985, operational wastewater at the APTF RFI Site discharged to the APTF-1 surface impoundment (SWMU 4.10); the water was treated with hydrogen peroxide or hypochlorite and transferred to the APTF-2 surface impoundment (SWMU 4.11) where it would receive further treatment and/or be discharged to the Area I Road Drainage leading to R-1 Pond. Between 1985 and 1996, APTF wastewater was treated in a 1,000-gallon ozonator tank (Area I Area of Concern) and discharged to the R-1 Pond (ICF, 1993; SAIC, 1994). In 1985, APTF-1 and APTF- 2 impoundment closure was initiated and conducted under the oversight of the California Department of Health Services. Soils were excavated, gunite liners were removed, and the impoundments were backfilled with soil from an unspecified borrow source in Administrative Area IV. A concrete slab was constructed over APTF-1, and a 6-inch vegetated topsoil layer was placed over APTF-2. Concrete-lined surface water diversion ditches were constructed around former impoundment APTF-2. Closure activities were completed in December 1988 (EMCON, 1989; SAIC, 1994), and the impoundments were certified closed by DTSC in 1995 (DTSC, 1995).

Site operations at the APTF RFI Site were conducted at test stands located in four aboveground test pits (Buildings 1342, 1786, 1764 and 1767). Components tested included injectors, combustors, pulse engines, cryogenic engines, thrust chambers, small turbopumps, bearings, and seals. Tests were monitored and controlled from Building 1314 located in the center of the site. A machine shop (Building 1338) located adjacent to the control center was used to store equipment and tools, and to assemble, disassemble, and clean equipment and components used in testing operations. The administrative office was located in Building 1383. Buildings 1370 and 1446 were constructed in the 1980s to support advanced laser research and testing programs. After the completion of the laser research programs, Building 1446 was used as a workshop and Building 1370 was used for the storage of charts, gauges, and miscellaneous instrumentation (Boeing, 2002). Over 150 ASTs have been documented as being present at the APTF RFI Site. Due to program changes and upgrades to the APTF area, tanks were commonly installed and removed throughout the site operational history. The ASTs contained water, fuels, oxidizers, and other chemicals used in testing operations and were located throughout the operational area of the site.

[98] http://www.dtsc-ssfl.com/files/lib_rcra_soils/boeingsubarea1acntrl/DraftRFIReports/Draft_RCRA_Facility_Investigation_Data_Summary_and_Findings_Report_-_Advanced_Propulsion_Test_Facility_RFI_Site.pdf

Appendix E1: Human Health Risk Assessment[99]

Direct Soil Contact

For the direct soil contact pathway, both the total site and incremental ELCRs are **1E-05**, which are within the USEPA target risk range of 1E-06 to 1E-04 and DTSC point of departure of 1E-06. The total site and incremental His for soil for this scenario are **2**, both of which exceed the USEPA and DTSC threshold HI value of 1. The primary risk drivers associated with the HI are Aroclor 1254 and Aroclor 1260. Aroclors can cause serious liver damage, and can also severely damage the nervous system, as well as irritate the lungs and throat, cancers and birth defects.[100]

Garden Use

For the homegrown produce consumption pathway, both the total site and incremental ELCR are **2E-02**, which are above the USEPA target risk range of 1E-06 and 1E-04 and the DTSC point of departure of 1E-06. The primary risk driver is n-Nitrosodimethylamine, which is used as an antioxidant, as an additive for lubricants, and formerly used in the production of rocket fuels. This chemical targets the liver; kidneys, lungs, and can cause cancer in these organs, as well as tumors in the stomach, and decreased pulmonary function.[101] Other contributors are listed in Table APTF-1.

The total site and incremental His for this scenario are **2,000**, which exceed USEPA and DTSC threshold HI of 1. Primary risk drivers are listed in Table APTF-2, and the primary risk driver is cadmium. Boeing notes "lead was identified as a chemical of potential concern in the 0-2 ft bgs soil interval. The lead EPC (14mg/kg) in the 0-2 ft bgs soil interval exceeds the lead suburban residential garden RBSL of 6.9 mg/kg".

[99] PDF Pages 1,589-1,771
[100] https://toxnet.nlm.nih.gov/cgi-bin/sis/search/a?dbs+hsdb:@term+@DOCNO+6357
[101] https://pubchem.ncbi.nlm.nih.gov/compound/n-nitrosodimethylamine#section=GHS-Classification

Table APTF-1: Garden Use Carcinogenic Risk*		
Analyte	Carcinogenic RBSL	Cancer Risk
Hexavalent Chromium	1.90E-03	5.30E-04
n-Nitrosodimethylamine	9.50E-07	1.10E-02
Benzo(a)anthracene	8.10E-04	1.10E-05
Benzo(a)pyrene	8.10E-05	1.00E-04
Benzo(b)fluoranthene	8.10E-04	1.40E-05
Benzo(k)fluoranthene	8.10E-04	1.10E-05
Dibenzo(a,h)anthracene	2.40E-04	1.80E-05
Heptachlor epoxide	1.70E-04	1.40E-04
2,3,7,8-TCDD TEQ	7.50E-09	2.30E-03
Aroclor 1260	4.90E-04	1.00E-03
Total Risk		**2.00E-02**
PCB TEQ[a]	7.50E-09	1.00E-01

* Data taken from Table E1-4 of Appendix E1 of APTF RFI Report
TEQ= Toxic Equivalet Quotient
PCB TEQ= Polychlorinated Biphenyl
"a" PCB TEQ was calculated, but not included in the total risk. If included in the total risk, would be 1.2E-01
USEPA Risk Range is 1E-06 to 1E-04
DTSC Point of Departure is 1E-06
RBSL=Risk Based Screening Level
The "Total Risk" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Table APTF-2: Garden Use Noncarcinogenic Risk*		
Analyte	NonCarcinogenic RBSL	Hazard Quotient
Antimony	1.40E-01	2.6
Cadmium	1.60E-03	1100
Copper	1.10E+01	37
Mercury	5.00E-02	14
Zinc	5.40E+01	3
Formaldehyde	3.70E+00	1.1
n-Nitrosodimethylamine	4.50E-05	240
Heptachlor epoxide	4.50E-03	5.1
MCPP	2.50E-01	9.6
2,3,7,8-TCDD TEQ	2.50E-07	69
Aroclor 1254	7.20E-03	130
Aroclor 1260	7.20E-03	70
Hazard Index		**2,000**
PCB TEQ	2.50E-07	3,000

* Data taken from Table E1-4 of Appendix E1 of APTF RFI Report
PCB=Polychlorinated Biphenyl
TEQ=Toxic Equivalent Quotient
"a" PCB TEQ was calculated, but not included in the total risk. If included in the total HI, would be 3,000
USEPA and DTSC threshold HI value is 1
The "Hazard Index" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Indoor Air Pathway

For the indoor air pathway, the total site ELCR is **9E-05**, which is above the DTSC point of departure of 1E-06. The risk driver associated with the site ELCR is trichloroethene (TCE) (99%; 9.2E-05). The total site HI for this scenario is **30**, which is above the USEPA and DTSC threshold HI value of 1. The risk driver for the site HI is TCE (99%; HQ=26).

Groundwater Use

For groundwater use at Chatsworth Formation well HAR-16, the ELCR is **2E-02**, which is above the USEPA target risk range of 1E-06 to 1E-04 and exceeds DTSC's point of departure of 1E-06. The primary risk drivers are listed in Table APTF-3. The HI is **2,000** for this scenario, which exceeds the USEPA and DTSC threshold value of 1. Primary contributors are listed in Table APTF-4.

The risk estimates for radionuclides of potential concern identified for Chatsworth Formation groundwater (at HAR-16) were calculated separately from the chemicals of potential concern. The risk calculated for these radionuclides in groundwater is **6E-04**, which is above USEPA's target risk range, and exceeds DTSC's point of departure of 1E-06. The only groundwater radionuclide of potential concern in HAR-16 was radium-226 (6.4E-04; 100%).

Table APTF-3: Groundwater Use Carcinogenic Risk*

Analyte	Carcinogenic RBC	Cancer Risk
1,2,3-Trichloropropane	1.80E-04	4.60E-05
Tetrachloroethene	7.10E-02	6.20E-05
Trichloroethene	4.20E-01	1.30E-02
n-Nitrosodimethylamine	1.50E-03	6.50E-03
Total Risk		**2.00E-02**

*Data taken from Table E1-12 of Appendix E1
USEPA Target Risk Range 1E-06 to 1E-04
DTSC Point of Departure 1E-06
RBSL=Risk Based Concentration
The "Total Risk" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Table APTF-4: Groundwater Use NonCarcinogenic Risk*

Analyte	NonCarcinogenic RBC	Hazard Quotient
Perchlorate	1.40E-01	26
1,1,2-Trichloroethane	4.20E-01	1
cis-1,2-Dichlorothene	1.00E+01	8
Trichloroethene	2.80E+00	1900
n-Nitrosodimethylamine	1.60E-01	62
Hazard Index		**2,000**

*Data taken from Table E1-12 of Appendix E1
RBSL=Risk Based Concentration
USEPA and DTSC threshold HI value is 1
The "Hazard Index" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Appendix E2: Ecological Risk Assessment[102]

For avian species, we've calculated an HI of **1,010**, which is far above the USEPA and DTSC threshold HI value of 1. The primary contributor is copper, which if exposed by oral consumption (such as water with high copper levels) can cause liver damage, hemolytic crisis, and ultimately death.[103] Other contributors are listed in Table APTF-5.

[102] PDF Pages 1,773-1,980
[103] https://www.ncbi.nlm.nih.gov/books/NBK225400/#ddd00077

For mammals, we've calculated an HI of **1,984**, which is far above USEPA and DTSC threshold HI value of 1. The primary contributor is the PCB TEQ Mammal, other contributors are listed in Table APTF-6.

Table APTF-5: Risk Estimates for Birds (Hermit Thrush)-Exposure in Soil*					
Analyte	RME EPC	Low TRV	High TRV	HQ-Low	HQ-High
Cadmium	1.80E+00	2.00E-01	3.00E+00	9.0	0.6
Copper	4.10E+02	1.10E+00	2.40E+01	370.0	17.0
Cyanides	2.10E-01	1.80E-01	1.80E+00	1.1	0.1
Fluoride	4.00E+01	3.50E+01	1.40E+02	1.2	0.3
Lead	1.40E+01	6.20E-02	3.90E+01	220.0	0.4
Zinc	1.60E+02	3.20E+01	3.20E+02	5.0	0.5
2,4,6-Trinitrotoluene	4.00E-01	2.30E-01	5.80E+00	1.7	0.1
2-Amino-4,6-dinitrotoluene	4.00E-01	6.00E-03	7.80E-01	67.0	0.5
bis(2-Ethylhexyl) phthalate	3.80E-01	3.20E-01	-	1.2	-
2,3,7,8-TCDD TEQ Bird	1.10E-05	5.70E-06	5.70E-05	1.9	0.2
Aroclor 1254	9.60E-01	8.30E-02	8.30E-01	12.0	1.2
Aroclor 1260	5.10E-01	5.30E-02	5.30E-01	9.6	1.0
PCB TEQ Bird (coplanar PCBs)	1.80E-03	5.70E-06	5.70E-05	310.0	31.0
Hazard Index				**1010**	

*Data taken from Table E2-5 from Appendix E2
RME-Reasonable Maximum Exposure
USEPA and DTSC threshold HI value is 1
TRV=Toxicity reference value.
Note, no actual Hazard Index was provided, we had to calculate our own.
The Hazard Index provided in this table only includes HI values above 1, other contrinutors were not included.

Table APTF-6: Risk Estimates for mammals (Deer Mice)-Exposure in Soil*					
Analyte	RME EPC	Low Eco TRV	High TRV	HQ-Low	HQ-High
Antimony	3.60E-01	4.20E-02	2.00E+00	8.6	0.2
Cadmium	1.80E+00	1.90E-02	8.10E-01	95.0	2.2
Copper	4.10E+02	1.50E+00	3.50E+02	270.0	1.2
Lead	1.40E+01	3.80E+00	9.10E+02	3.7	0.0
Molybdenum	6.30E-01	1.30E-01	1.30E+00	4.8	0.5
Selenium	3.80E-01	1.00E-01	2.40E+00	3.8	0.2
Zinc	1.60E+02	1.90E+01	8.20E+02	8.5	0.2
2,4,6-Trinitrotoluene	4.00E-01	1.30E-01	6.50E-01	3.1	0.6
2-Amino-4,6-dinitrotoluene	4.00E-01	6.10E-02	4.60E-01	6.6	0.9
2,3,7,8-TCDD TEQ Mammal	1.70E-05	5.00E-07	5.00E-06	35.0	3.5
Aroclor 1254	9.60E-01	3.90E-02	3.90E-01	25.0	2.5
Aroclor 1260	5.10E-01	2.50E-02	2.50E-01	20.0	2.0
PCB TEQ Mammal (coplanar PCBs)	7.50E-04	5.00E-07	5.00E-06	1500.0	150.0
Hazard Index				**1984**	

*Data taken from Table E2-6 from Appendix E2
RME-Reasonable Maximum Exposure
USEPA and DTSC threshold HI value is 1
TRV=Toxicity reference value.
Note, no actual Hazard Index was provided, we had to calculate our own.
The Hazard Index provided in this table only includes HI values above 1, other contrinutors were not included.

Appendix E3: Residual Risk[104]

We found that two chemicals in these residual risk assessments were "taken out". By that we mean the Exposure Point Concentration values have been set to "0", which prevents the ability to calculate the cancer risk or HI. These chemicals are: Heptachlor Epoxide, and MCPP. We've also seen this with Monomethylhydrazine (MMH) in the Systems Test Lab-IV residual risk values where MMH's (the primary contributor to the human health risk) EPC was also set to "0" in the residual risk assessment tables. We've also seen this happen with the Happy Valley North residual risk values.

[104] PDF Pages 1,982-2,005

Direct Soil Contact

For this scenario, the site residual ELCR is **2E-06**, which is above DTSC's point of departure.

Garden Use

For this pathway, the site residual ELCR is **1E-02,** which is still above USEPA's target risk range and DTSC's point of departure. The primary risk drivers are listed in Table APTF-7. To leave this high risk amount of contamination behind even after a said "cleanup" is unacceptable. For this pathway, Boeing estimates that the residual HI will be **700**, which is still far above USEPA and DTSC's threshold HI value of 1. Primary risk drivers are listed in Table APTF-8.

Table APTF-7: Garden Use Residual Carcinogenic Risk*		
Analyte	Carcinogenic RBSL	Cancer Risk
Hexavalent Chroium	1.90E-03	8.60E-05
n-Nitrosodimethylamine	9.50E-07	1.10E-02
Benzo(a)anthracene	8.10E-04	1.10E-05
Benzo(a)pyrene	8.10E-05	1.10E-04
Benzo(b)fluoranthene	8.10E-04	1.50E-05
Benzo(k)fluoranthene	8.10E-04	1.10E-05
Dibenzo(a,h)anthracene	2.40E-04	1.90E-05
2,3,7,8-TCDD TEQ	7.50E-09	2.30E-04
Aroclor 1254	4.90E-04	1.50E-04
Total Risk		**2.00E-01**
PCB TEQ[a]	7.50E-09	1.50E-02

*Data taken from Table E3-2 of Appendix E3
USEPA Target Risk Range 1E-06 to 1E-04
DTSC Point of Departure 1E-06
The "Total Risk" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Table APTF-8: Garden Use Residual Noncarcinogenic Risk*		
Analyte	NonCarcinogenic RBSL	Hazard Quotient
Antimony	1.40E-01	2.5
Cadmium	1.60E-03	370
Copper	1.10E+01	1.1
Mercury	5.00E-02	11
Zinc	5.40E+01	1.6
Formaldehyde	3.70E+00	1.1
n-Nitrosodimethylamine	4.50E-05	240
2,3,7,8-TCDD TEQ	2.50E-07	6.7
Aroclor 1254	7.20E-03	10
Hazard Index		**700**
PCB TEQ	2.50E-07	440

*Data taken from Table E3-2 of Appendix E3
USEPA and DTSC threshold HI value is 1
RBSL=Risk Based Concentration
PCB TEQ was calculated, but not included in the total risk. If included in the total HI, would be 1,140
The "Hazard Index" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Groundwater Use

Boeing did not provide post remediation calculations for the Chatsworth Groundwater Pathway (Well HAR-16), giving the impression that Boeing is not intending to do anything about the groundwater well either.

Chapter Conclusion

Appendix E3 provides residual risk numbers for what the site would be after the "cleanup", and as we have shown above, the risk values are still above the allowable USEPA and DTSC levels. Furthermore, this Boeing document attempts to argue that the HHRA and ERA "demonstrate that acceptable risks and hazards from potential exposure to soil and soil vapor by hypothetical suburban residents and ecological receptors are expected at the Advanced Propulsion Test Facility RFI site if the CMS areas presented are included in site cleanup activities"[105]. But as we've shown above from Boeing's own documents, the risks are *not* acceptable. Therefore DTSC must ensure that a full cleanup is done at this RFI site.

[105] Appendix E3 Section 3.0 "Conclusions"

Building 1359[106]

Background

The B359 RFI Site is located in the central portion of Administrative Area I, generally east of the APTF and HVN RFI Sites. The B359 RFI Site is currently inactive and contains no structures. The B359 RFI Site consists of approximately 3.5 acres. The B359 site was used primarily as an energetics research, testing, and storage area from the early 1950s to the early 1990s and includes the former North American Kindelburger Atwood (NAKA) area (Buildings 1325, 1328, 1741, and 1997), the Neptune Test Area/Potassium Loop Facility (Building 1790), and various support buildings where energetics and propellants were stored and tested. Perchlorate was used at the B359 RFI Site for the preparation and assembly of turbine spinners and igniters during the 1950s and 1960s. At the northwest portion of the facility was the High Energy Solids Lab (Building 1359), where the primary energetic material tests were performed within four test cells positioned along the north side of the building and facing a soil berm. The Propellant Physical Property Testing Building (Building 1325), located in the southwestern portion of the B359 RFI Site, was used for perchlorate milling and mixing with other compounds for rocket propellant development. The northeastern corner of the facility included the Neptune Test Area (also referred to as the Potassium Loop Facility), where saltwater conversion experiments were conducted in the 1960s. Other structures at the B359 RFI Site included the Igniter Curing Building (Building 1328), Lower Research Auxiliary Workshop (Building 1353), Photo Elastic Lab (Building 1354), Oxidizer Preparation Building (Building 1376), Hydrogen Peroxide Storage-Gas Flow Facility (Building 1373), and numerous chemical, igniter, and ordnance storage facilities. The B359 RFI Site also included three leach fields (B359 Areas of Concern): the Northeast Leach Field (associated with Building 1301 in the Instrument and Equipment Laboratory [IEL] RFI Site to the east); the Building 1374 Leach Field (associated with Building 1374 in the APTF RFI Site to the west); and the Building 1315 Leach Field (potentially associated with Building 1315 in the HVN RFI Site to the southwest).

During 2003 and 2004, soils with elevated concentrations of perchlorate from the Happy Valley South (HVS) RFI Site were excavated and transported to the B359 RFI Site as part of the Happy Valley Interim Measures (HVIM) project. These soils were transported to the B359 site for biotreatment of perchlorate. Prior to transportation of these soils from the HVS RFI Site, soils with elevated concentrations of metals within the B359 RFI Site were excavated and disposed offsite. Biotreatment activities then took place between 2004 and 2006 (MWH, 2007).

Appendix E1: Human Health Risk Assessment[107]

[106] http://www.dtsc-ssfl.com/files/lib_rcra_soils/boeingsubarea1acntrl/DraftRFIReports/Draft_RCRA_Facility_Investigation_Data_Summary_and_Findings_Report_-_Building_1359_RFI_Site.pdf

[107] PDF pages 1,308-1,467

Direct Soil Contact

For the direct soil contact pathway, both the total site and incremental ELCR are **1E-05**, which exceed the DTSC point of departure of 1E-06. The total site HI for soil for this scenario is **3** and the total incremental HI is 2, both of which exceed the USEPA and DTSC threshold HI value of 1. The only risk driver to the total incremental soil HI is Aroclor 1254 (HQ = 1.5; 66% contribution). Aroclors can cause serious liver damage, and can also severely damage the nervous system, as well as irritate the lungs and throat, cancers and birth defects.[108]

Garden Use

For the homegrown produce consumption pathway, both the total site and incremental ELCR are **2E-03**, which are above the USEPA target risk range of 1E-06 to 1E-04 and the DTSC point of departure of 1E-06. Primary risk drivers are listed in Table B-1. The total site HI for this scenario is **500** and the incremental HI is 300, both of which exceed the USEPA and DTSC threshold HI value of 1. Main contributors are listed in Table B-2. Lead was identified as a COPC in the 0 to 2 feet bgs soil interval. The lead EPC (27 mg/kg) in the 0 to 2 feet bgs soil interval exceeds the lead suburban residential garden RBSL of 6.9 mg/kg.

Table B-1: Garden Use Carcinogenic Risk*		
Analyte	Carcinogenic RBSL	Cancer Risk
Benzo(a)anthracene	8.10E-04	1.20E-04
Benzo(a)pyrene	8.10E-04	4.40E-04
Benzo(b)fluoranthene	8.10E-04	6.90E-05
Benzo(k)fluoranthene	8.10E-04	1.70E-05
chrysene	8.10E-03	1.20E-05
Dibenzo(a,h)anthracene	2.40E-04	6.10E-05
Indeno(1,2,3-cd)pyrene	8.10E-04	2.60E-05
2,3,7,8-TCDD TEQ	7.50E-09	4.40E-04
Aroclor 1254	4.90E-04	6.50E-04
Aroclor 1260	4.90E-04	1.40E-04
Total Risk		**2.00E-03**
PCB TEQ[a]	7.50E-09	3.30E-02

* Data taken from Table E1-4 of Appendix E1 of APTF RFI Report
TEQ= Toxic Equivalet Quotient
PCB TEQ= Polychlorinated Biphenyl
"a" PCB TEQ was calculated, but not included in the total risk. If included in the total risk, would be 3.5E-02
USEPA Risk Range is 1E-06 to 1E-04
DTSC Point of Departure is 1E-06
RBSL=Risk Based Screening Level
The "Total Risk" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

[108] https://toxnet.nlm.nih.gov/cgi-bin/sis/search/a?dbs+hsdb:@term+@DOCNO+6357

Table B-2: Garden Use Noncarcinogenic Risk*		
Analyte	NonCarcinogenic RBSL	Hazard Quotient
Antimony	1.40E-01	2.9
Barium	7.20E+01	2.8
Cadmium	1.60E-03	330
Copper	1.10E+01	1.3
Mercury	5.00E-02	6.2
Silver	1.80E+00	19
Thallium	3.60E-03	87
Zinc	5.40E+01	4.4
HMX	7.30E-01	1
Perchlorate	1.60E-02	4.1
MCPP	2.50E-01	6.8
2,3,7,8-TCDD TEQ	2.50E-07	13
Aroclor 1254	7.20E-03	44
Aroclor 1260	7.20E-03	9.6
Hazard Index		**500**
PCB TEQ	2.50E-07	970

* Data taken from Table E1-4 of Appendix E1 of Building 1359 RFI Report

PCB=Polychlorinated Biphenyl

TEQ=Toxic Equivalent Quotient

"a" PCB TEQ was calculated, but not included in the total risk. If included in the total HI, would USEPA and DTSC threshold HI value is 1

The "Hazard Index" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Groundwater Use

For the groundwater use at Chatsworth Formation well HAR-16, the ELCR is **2E-02**, which is above the USEPA target risk range of 1E-06 to 1E-06 and exceeds the DTSC point of departure of 1E-06. The primary risk drivers are listed in Table B-3. The HI is **2,000** for this scenario, which exceeds the USEPA and DTSC threshold HI value of 1. The primary contributors are listed in Table B-4.

For the radionuclides in groundwater, the ELCR is **6E-04**, which is above USEPA's target risk range and DTSC's point of departure. The only groundwater chemical of concern in HAR-16 was radium-226 (100%; 6.4E-04).

Table B-3: Groundwater Use Carcinogenic Risk*		
Analyte	Carcinogenic RBC	Cancer Risk
1,2,3-Trichloropropane	1.80E-04	4.60E-05
Tetrachloroethene	7.10E-02	6.20E-05
Trichloroethene	4.20E-01	1.30E-02
n-Nitrosodimethylamine	1.50E-03	6.50E-03
Total Risk		**2.00E-02**
*Data taken from Table E1-12 of Appendix E1		

USEPA Target Risk Range 1E-06 to 1E-04
DTSC Point of Departure 1E-06
RBSL=Risk Based Concentration
The "Total Risk" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Table B-4: Groundwater Use NonCarcinogenic Risk*		
Analyte	NonCarcinogenic RBC	Hazard Quotient
Perchlorate	1.40E-01	2.60E+01
1,1,2-Trichloroethane	4.20E-01	1.20E+00
cis-1,2-Dichlorothene	1.00E+01	8.10E+00
Trichloroethene	2.80E+00	1.90E+03
n-Nitrosodimethylamine	1.60E-01	6.20E+01
Hazard Index		**2,000**
*Data taken from Table E1-12 of Appendix E1		

RBSL=Risk Based Concentration
USEPA and DTSC threshold HI value is 1
The "Hazard Index" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Appendix E2: Ecological Risk Assessment[109]

For avian species, we calculated an HI of **677**, with lead being the main contributor. Lead poisoning in birds can cause lethargy, progressive weakness causing the inability to fly, and usually accumulates in the liver, kidneys, and blood.. Other contributors are listed in Table B-5. For mammals, we calculated and HI of **597**.

[109] PDF Pages 1,470-1,639

Table B-5: Risk Estimates for Birds (Hermit Thrush)-Exposure in Soil*					
Analyte	RME EPC	Low TRV	High TRV	HQ-Low	HQ-High
Antimony	2.00E+02	4.40E+01	8.90E+01	4.6	2.3
Cadmium	5.40E-01	2.00E-01	3.00E+00	2.7	0.2
Copper	1.40E+01	1.10E+00	2.40E+01	13.0	0.6
Lead	2.70E+01	6.20E-02	3.90E+01	440.0	0.7
Silver	3.40E+01	9.90E-01	2.90E+01	35.0	1.2
Zinc	2.40E+02	3.20E+01	3.20E+02	7.4	0.7
2,4,6-Trinitrotoluene	4.00E-01	2.30E-01	5.80E+00	1.7	0.1
2-Amino-4,6-dinitrotoluene	4.00E-01	6.00E-03	7.80E-01	67.0	0.5
Aroclor 1254	3.20E-01	8.30E-02	8.30E-01	3.8	0.4
Aroclor 1260	6.90E-02	5.30E-02	5.30E-01	1.3	0.1
PCB TEQ Bird (coplanar PCBs)	5.80E-04	5.70E-06	5.70E-05	100.0	10.0
Hazard Index				**677**	

*Data taken from Table E2-5 from Appendix E2
RME-Reasonable Maximum Exposure
USEPA and DTSC threshold HI value is 1
TRV=Toxicity reference value.
Note, no actual Hazard Index was provided, we had to calculate our own.
The Hazard Index provided in this table only includes HI values above 1, other contrinutors were not included.

Table B-6: Risk Estimates for mammals (Deer Mice)-Exposure in Soil*					
Analyte	RME EPC	Low Eco TRV	High TRV	HQ-Low	HQ-High
Antimony	4.10E-01	4.20E-02	2.00E+00	9.7	0.2
Barium	2.00E+02	1.20E+02	2.00E+02	1.7	1.0
Cadmium	5.40E-01	1.90E-02	8.10E-01	28.0	0.7
Copper	1.40E+01	1.50E+00	3.50E+02	9.2	0.0
Lead	2.70E+01	3.80E+00	9.10E+02	7.1	0.0
Selenium	2.30E-01	1.00E-01	2.40E+00	2.3	0.1
Silver	3.40E+01	3.50E+00	6.90E+01	9.8	0.5
Zinc	2.40E+02	1.90E+01	8.20E+02	12.0	0.3
2,4,6-Trinitrotoluene	4.00E-01	1.30E-01	6.50E-01	3.1	0.6
2-Amino-4,6-dinitrotoluene	4.00E-01	6.10E-02	4.60E-01	6.6	0.9
2,3,7,8-TCDD TEQ Mammal	3.30E-06	5.00E-07	5.00E-06	6.6	0.7
Aroclor 1254	3.20E-01	3.90E-02	3.90E-01	8.1	0.8
Aroclor 1260	6.90E-02	2.50E-02	2.50E-01	2.8	0.3
PCB TEQ Mammal (Coplanar PCBs)	2.50E-04	5.00E-07	5.00E-06	490.0	49.0
Hazard Index				**597**	

*Data taken from Table E2-6 from Appendix E2
RME-Reasonable Maximum Exposure
USEPA and DTSC threshold HI value is 1
TRV=Toxicity reference value.
Note, no actual Hazard Index was provided, we had to calculate our own.
The Hazard Index provided in this table only includes HI values above 1, other contrinutors were not included.

Appendix E3: Residual Risk[110]

Garden Use

For this pathway, Boeing's residual risk estimates an ELCR of **7E-04**, which is above DTSC's point of departure. Primary risk drivers are listed in Table B-7. A key point we want to make here is that the PCB-TEQ (is calculated separately because Boeing claims there are "uncertainties" in the numbers, therefore Boeing did not include the PCB-TEQ ELCR and HI's in the total risk and HI) shows a higher risk than the total site. For this scenario, the residual ELCR is **1.1E-02**, which is higher than the total residual ELCR that Boeing has calculated.

[110] PDF Pages 1,642-1,665

For this pathway, Boeing's residual HI is **400**, which is still far above USEPA and DTSC's threshold HI value of 1. Primary contributors are listed in Table B-8.

Table B-7: Garden Use Residual Carcinogenic Risk*		
Analyte	Carcinogenic RBSL	Cancer Risk
Benzo(a)anthrcene	8.10E-04	1.40E-05
Benzo(a)pyrene	8.10E-05	1.50E-04
Benzo(b)fluoranthene	8.10E-04	1.60E-05
Benzo(k)fluoranthene	8.10E-04	1.40E-05
Dibenzo(a,h)anthracene	2.40E-04	1.50E-04
Indeno(1,2,3-cd)pyrene	No RBSL listed	2.50E-05
2,3,7,8-TCDD TEQ	7.50E-09	1.70E-04
Aroclor 1254	4.90E-04	1.60E-04
Arocor 1260	4.90E-04	3.40E-05
Total Risk		**7.00E-04**
PCB TEQ[a]	7.50E-09	1.10E-02

*Data taken from Table E3-2 of Appendix E3 of Building 1359 RFI Report
USEPA Target Risk Range 1E-06 to 1E-04
DTSC Point of Departure 1E-06
The "Total Risk" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Table B-8: Garden Use Residual Noncarcinogenic Risk*		
Analyte	NonCarcinogenic RBSL	Hazard Quotient
Antimony	1.40E-01	2.7
Barium	7.20E+01	1.1
Cadmium	1.60E-03	260
Mercury	5.00E-02	4.5
Thallium	3.60E-03	85
Zinc	5.40E+01	1.1
HMX	7.30E-01	1
Perchlorate	1.60E-02	4.4
MCPP	2.50E-01	6.8
2,3,7,8-TCDD TEQ	2.50E-07	5
Aroclor 1254	7.20E-03	11
Aroclor 1260	7.20E-03	2.3
Hazard Index		**400**
PCB TEQ	2.50E-07	330

*Data taken from Table E3-2 of Appendix E3 of Building 1359 RFI Report
USEPA and DTSC threshold HI value is 1
RBSL=Risk Based Concentration
PCB TEQ was calculated, but not included in the total risk. If included in the total HI, would be 730
The "Hazard Index" value in this table includes other chemicals that were not listed in this table. This value was provided By Boeing in the HHRA.

Chapter Conclusion

Appendix E3 provides residual risk numbers for what the site would be after the "cleanup", and as shown above, the risk values are still above the allowable USEPA and DTSC levels. Furthermore, this Boeing document attempts to argue that the HHRA and ERA "demonstrate that acceptable risks and hazards from potential exposure to soil and soil vapor by hypothetical suburban residents and ecological receptors are expected at Building 1359 RFI site if the CMS areas presented are included in site cleanup activities"[111]. However, Boeing's own tables demonstrate that the risks are not acceptable, and DTSC must therefore ensure that a full cleanup is done at this RFI site.

[111] Appendix E3 Section 3.0 "Conclusions"

Unaffiliated Areas[112]

As explained in this report, a total of 14 samples were collected from 8 locations throughout the Subarea 1A Central Unaffiliated Areas (UA). These samples were analyzed for Volatile Organic Compounds (VOCs), dioxins and furans, total petroleum hydrocarbons (TPH), semi-volatile organic compounds (SVOCs), metals, polychlorinated biphenyls (PCBs), and formaldehyde. Utilizing only 8 locations for sampling is not enough to determine how contaminated an area is. The areas could not be topographically arranged so that less chemicals flow there from the surrounding areas. It is not mentioned if these areas were chosen completely at random or chosen intentionally to give results with the least concentrations of chemicals. Boeing states:

> "No SSFL historical operations were conducted in the Subarea 1A Central Unaffiliated Areas. Consequently, groundwater flow and contaminant transport modeling was not completed for these sites. Groundwater flow and contaminant transport modeling was performed for nearby Boeing RFI sites in Subareas 1A Central, 1A North, and 1A South that might contribute to groundwater contamination underlying the Subarea 1AC Unaffiliated Areas; refer to the Boeing RFI Subarea 1A Central, Subarea 1A North, and Subarea 1A South RFI site DSFRs for details on this modeling".

Despite operations not occurring above the ground in these UAs, groundwater systems are intrinsically connected and the groundwater in this area is most certainly contaminated as we have seen in these RFI reports of high-risk levels in groundwater. Chemicals and radionuclides are above characterization levels in these subareas, therefore it is only appropriate that groundwater flow and contaminant transport modeling be done in Subarea 1A Central UAs.

This UA is considered for No Further Action (because "no chemicals were detected at concentrations that exceeded human health or ecological-based characterization levels in the Subarea 1A Central UAs; therefore, human health and ecological risk assessments were not performed for these sites". However, 2 pages later, the reader is presented with information delegitimizing this information. Boeing states "Table 4-1 summarizes the nature and extent evaluations performed for soil at Subarea 1A Central UAs. Tables 4-2 and 4-3, which are provided electronically on the CDs that accompanies this DSFR, present details on the detect and non-detect sample results, respectively, exceeding characterization levels". These two statements are conflicting. Characterization levels are in place so that any chemical or radionuclides found above this concentration are an unacceptable threat to human and ecological life. This document does not even include by how much these levels are exceeded.

[112] http://www.dtsc-ssfl.com/files/lib_rcra_soils/boeingsubarea1acntrl/DraftRFIReports/Draft_RCRA_Facility_Investigation_Data_Summary_and_Findings_Report_-_Unaffiliated_Areas_of_1A_Central.PDF

Conclusion

The Draft Program Environmental Impact Report for cleanup of contamination at the Santa Susana Field Laboratory is fundamentally flawed. It wholly fails to evaluate the most important impacts of all—the impacts on public health and the environment from the radioactive and toxic chemical contamination that would remain under all of the alternatives put forward. Because DTSC in the PEIR has abrogated its longstanding commitments to a full cleanup of all the contamination at SSFL, which barred "leave in place" alternatives, and is instead proposing to leave in place large but unspecified amounts of contamination, the impacts of doing so must be examined. But they are not. Instead, what one gets is essentially a propaganda document, a one-sided attack on the very cleanup commitments DTSC itself had long made, rather than a scientifically defensible environmental impact report.

Boeing's own risk assessments for areas within 1A Central and 5/9 South, however, provide significant information that partially addresses the question of the impacts from the contamination itself. The results are startling—immense risks to public health and extreme exceedances of contaminant levels that pose harm to biological receptors—even after the minimal cleanup proposed. Furthermore, these data make clear that excepting contaminated areas from cleanup, for biological or other reasons, as vaguely proposed without detailed disclosure in the PEIR, would actually result in unacceptable risk to those biological receptors as the levels far exceed acceptable hazardous indices, and would similarly pose great risks to public health.

The entire premise of DTSC's longstanding commitments to a full cleanup of SSFL was that irrespective of the use of the SSFL land in the future, people reside nearby and agriculture is conducted nearby, so one must clean up SSFL to all the land uses allowed by Ventura County's land use designations for SSFL and the surrounding areas. If it is cleaned up so it is safe to live on SSFL or do agriculture there, it would therefore be safe for the people who live nearby or engage in agriculture in the area. Furthermore, claiming to want to protect biological features by not cleaning up the contamination that is polluting them is illusory. The data analyzed here demonstrate that what DTSC is now proposing, breaking its long commitments, would place at risk public health as well as those very biological receptors.

There are few acceptable remedies to such a fundamental set of flaws in the PEIR. Were DTSC to attempt to purportedly address in the final PEIR the risks to public health and ecological receptors from the contamination proposed to not be cleaned up pursuant to the various alternatives (including the No Action Alternative), this essential element of the PEIR would have been shielded entirely from public review and comment, in violation of CEQA. However, to finalize the PEIR without addressing the risks to public health and ecological receptors from the contamination that would remain under the various alternatives proposed would nullify the PEIR as a valid CEQA document.

Furthermore, DTSC has so severely lost public credibility, at SSFL and statewide, and the job done on the PEIR is so flawed, so much an effort to help the Responsible

Parties get out of their cleanup obligations, that any risk assessment that might be now included would have little authority or plausibility. (Indeed, since it appears DTSC allowed the EIR contractor to actually be a contractor of one of the RPs rather than contracted to DTSC, and because DTSC allowed the RPs to write and edit much of the PEIR, that conflict of interest further eliminates any credibility were there to be at this late stage such an assessment.

If the pattern seen to date continues, and DTSC attempt to arrange (probably through one or more of the RPs) preparation of evaluation of risks to public health and ecological receptors from the contamination, one would expect DTSC to throw out its own official risk based screening levels (RBSLs) from the approved Standardized Risk Assessment Methodology (SRAM) and selectively change the inputs (e.g., alter the Mass loading Factor but not the root uptake factors and produce ingestions rates) so as to dramatically drive down risk estimates. DTSC has already attempted such manipulation of the approved SRAM RBSLs by falsely claiming in the PEIR that the suburban residential SRAM-based garden RBSLs were based on assuming 100% of one's produce comes from a backyard garden and thus attempting to reject, based on misrepresentation, its own officially approved RBSLs. Elsewhere in the PEIR the SRAM is ignored entirely and cherry-picked changed inputs, not officially approved in the SRAM, are used to try to dramatically further drive down cleanup goals. We note that there is only one officially approved SRAM, that DTSC did direct Boeing to propose revisions to the residential risk levels but Boeing refused, submitting a proposed SRAM that simply removed the residential scenario entirely. DTSC is thus stuck. The official SRAM is the official DTSC-approved risk assessment methodology, and must be used. (We note that it was approved by DTSC without formal opportunity for public input or any CEQA coverage, and is absolutely critical to the cleanup.)

There really is only one approach that would meet CEQA requirements. A fundamentally redone PEIR needs to be prepared, one that includes an honest disclosure of the amounts of contamination, of what kind and what concentrations, proposed to be left in place, and an evaluation of how those levels exceed the SRAM-based suburban residential garden RBSLs (and rural residential RBSLs, revised to fix the grossly erroneous produce ingestion rates), and Low-TRV EcoRBSLs. This needs to be performed by a contractor who is not contracted to the Responsible Parties and be prepared independently, rather than just repeat claims made by the RPs. The revised draft PEIR would then need to be recirculated for public comment.

It is deeply unfortunate that DTSC has dragged its feet for so many years that the promised 2017 date for completion of cleanup has passed without that long-sought completion; indeed, the cleanup hasn't commenced. By producing such a grossly deficient draft PEIR, DTSC has now created a situation where one either is faced with a terribly weak cleanup, in violation of past commitments and the need to protect public health and the environment, or the need to essentially start over again, this time doing it right. It is tragic that DTSC has failed so thoroughly in its obligation to protect public health and the environment, that it has demonstrated such a complete capture by the

polluting interests it is to regulate. But a great deal is stake, and the only option is for DTSC to prepare a valid PEIR and recirculate it for public review and comment.