# 9. CASE STUDY SUMMARIES

This section introduces four case studies that examine the application and comparative findings of incremental sampling methods to discrete sampling methods. Appendix C presents the complete case studies and detailed findings.

## 9.1 Case Study 1. PCB-Contaminated Landfill

Site Name: Green Island Landfill and Reburial Pit, Kure Atoll, Hawaii

Contact Name: Roger Brewer, HDOH

Site Location: Kure Atoll is the northernmost island in the Hawaiian Island chain, located approximately 1400 miles northwest of the island Oahu and 56 miles northwest of Midway atoll. The atoll consists of a lagoon encircled by a reef and a single vegetated island, Green Island. Green Island is just under 1.5 miles long and about 0.35 miles in width and has a maximum elevation of 15 feet.

Background: A U.S. Coast Guard (USCG) station was located on the atoll from the 1960s through the 1990s. A ½-acre area located on the southwest corner of the island was used to dispose of old electrical components and scrap metal. Discreet confirmation soil samples identified concentrations of PCBs as high as 170 mg/kg within the formal landfill footprint. Soil, sediment, and biota samples collected in the surrounding area indicated that PCB contamination was primarily restricted to the landfill site. Debris and approximately 700 $yd^3$ of PCB-contaminated soil were removed from the site in 1993.

A follow-up study of the former landfill area was carried out in 2008. As part of the site investigation, USCG took the opportunity to evaluate the potential advantage and limitations of incremental soil sampling approaches over traditional discrete sampling approaches. The investigation focused on the use of DU and ISM investigation strategies published by HDOH (2008b).

Statistical Evaluation: A statistical evaluation of discrete vs. incremental sample data was conducted by Anita Singh, a contractor to USEPA with Lockheed Martin in Las Vegas and member of the ITRC ISM Team. One objective of the review was to compare estimates of the mean concentration of PCBs in the DU soil based on a specific number of discrete samples vs. one to three incremental samples drawn from the same data set. Another objective of the Kure atoll data set was to determine the equivalent number of discrete samples to a triplicate set of 30–50 point incremental samples. This effort will help to evaluate the cost-effectiveness of collecting incremental samples over discrete samples.

Lessons Learned—ISM Data Collection:

- Isolation of areas of suspected higher contamination is important at a site-wide scale but not at a DU scale.

- Identify and investigate suspected spill areas separately via historical knowledge and/or preliminary sampling.
- Subdivide remaining area into risk-based DUs based on human or ecological health concerns.
- Incorporate an adequate number of increment points within a DU to capture contaminant distribution and heterogeneity.
- A range of 30–50+ increment points is required to adequately characterize a DU—anything less is probably just sampling the mode.
- Use replicate samples to verify that contaminant heterogeneity has been adequately characterized.
- Tight grids of discrete samples can be useful for an initial screening of sites and DU designation, as well as subdivision of "hot" DUs for smaller areas for isolation and characterization of concentrated contamination.

Lessons Learned—ISM Simulation:

- Include at least 30–50 increments per ISM field replicate sample for initial DU characterization.
- Always collect and use replicate sample data (e.g., triplicates) from one or more DUs at a site to evaluate the representativeness of incremental sample data.

Some combination of both discrete and ISM sampling data was ideal for estimating the PCB mean.

- Determining the appropriate number of ISM increments and replicates is critical to ensuring that the ISM sample is representative of the conditions in the field and to assess precision. Between 60 and 90 increment replicate samples are needed to ensure the incorporation of isolated hot spots.
- ISM helped identify the primary spill area, but ISM for the entire core would have yielded the same answer.
- It is not possible to test data representativeness of field data with a small set of discrete samples (e.g., <30 samples), as lognormal outliers would likely be missed.

## 9.2 Case Study 2. Petroleum-Contaminated Soil Stockpile

Site Name: Petroleum Contaminated Soil Stockpile, Prince of Wales Island, Alaska

Contact Name: Earl Crapps, Alaska Department of Environmental Conservation (ADEC)

Site Location: The site is located on the Prince of Wales Island near Craig, Alaska. Craig is on a small island off the west coast of Prince of Wales Island and is connected by a short causeway. It is 56 air miles northwest of Ketchikan and 220 miles south of Juneau.

Background: The purpose of this project was to test the protocols in the ADEC draft MULTI INCREMENT® sampling guidance (ADEC 2009). The test site was a petroleum-contaminated soil stockpile located in a rock quarry on Prince of Wales Island, Alaska.

During the 2006 excavation and removal of an underground heating oil tank, discrete samples were collected that documented diesel range organics (DROs) at 300–900 mg/kg. Stockpile

tilling and fertilizing were conducted by the responsible party several times after the soil was moved from its original location in May 2006.

Lessons Learned:

- Although the stockpile was shallow, it was compacted and difficult to excavate by hand.
- Field sampling was labor-intensive, requiring approximately 15 person hours to complete. Data quality may have been affected.
- It is recommended that ISM sample processing occurs in a controlled laboratory setting.

### 9.3 Case Study 3. Former Golf Course Field Demonstration of ISM

Site Name: Former Golf Course

Contacts Names: Kelly Black, Neptune and Company, Inc.; Deana Crumbling, USEPA; Ligia Mora-Applegate, Florida Department of Environmental Protection; Mark Malinowski, California Department of Toxic Substance Control; Phil Goodrum, ERM; Keith Tolson, Geosyntec Consultants; Ed Corl, NAVFAC Laboratory Quality and Accreditation Office; Hugh Rieck, USACE; Steve Roberts, University of Florida; Leah Stuchal, University of Florida; Richard Lewis, Conestoga-Rovers & Associates, Inc.; Chris Saranko, Environmental Planning Specialists, Inc.

Site Location: Florida

Background: The ITRC ISM Team identified this site for a field demonstration of ISM. The site was a former golf course where both fertilizers and herbicides containing arsenic had been applied. This former golf course will become a residential development. While it was an active golf course, arsenic was applied in two ways. Monosodium methanearsonate (MSMA) was used as a herbicide to stunt the growth of unwanted plant life, mostly on the fairways. Also, arsenic-rich fertilizer was used frequently on the course. Fertilizer was used more heavily on the tee boxes and greens than on the fairways. Arsenic in soils was the media and COC. Preliminary characterization showed that arsenic is the only COC and that it ranges from 0 to nearly 100 mg/kg in some areas, with significant contamination limited to the top 6 inches of soil.

Lessons Learned:

- Only in cases with strongly skewed or variable data was there much value in collecting more than 30 increments per sample.
- Discrete samples spanned a much wider concentration range and were more variable than the ISM results.
- The data collected via discrete samples and the data collected via incremental sampling methods lead to different results and potentially different decisions.
- Partitioning DUs into subareas may provide an opportunity to discern spatial differences that would not be apparent if incremental samples were collected from the entire DU as a whole.

## 9.4 Case Study 4. Hawaiian Homelands Development

Site Name: Hawaiian Homelands Development, Kapolei, Oahu, Hawaii

Contact Name: Roger Brewer, HDOH

Site Location: The East Kapolei Affordable Housing Project property is located in East Kapolei, Kapolei, Oahu, Hawaii.

Background: This case study summarizes the investigation of the 401-acre former sugarcane field and a ½-acre pesticide-mixing area located within the field which is being developed for residential and commercial use. The primary COCs were arsenic, pentachlorophenol (PCP), dioxins (associated with past use of PCP), and triazine herbicides, each used in the past for weed control. A detailed discussion of the sugarcane field investigation is provided in the report *East Kapolei Affordable Housing Project Kapolei, Oahu, Hawaii, Final Site Assessment Report* (TTEMI 2007). A summary of the pesticide mixing area investigation is provided in the report *Site Investigation Report and Environmental Hazard Evaluation, East Kapolei II Pesticide Mixing and Loading Site* (ESTC 2007, 2010).

Lessons Learned:

- There are no elevated concentrations of COPCs in the soil that suggest conditions are not suitable for residential reuse or that any additional sampling or evaluation is necessary.
- The investigations confirm that ISM samples, essentially very good composite samples with additional lab requirements, are better able to capture small hot spots and overall contaminant heterogeneity within a targeted area.