PNNL-23211

# Visual Sample Plan
# Version 7.0 User's Guide

B.D. Matzke          J.E. Wilson
L.L. Newburn       S.T. Dowson
J.E. Hathaway     L.H. Sego
L.M. Bramer        B.A. Pulsipher

March 2014

Pacific Northwest
NATIONAL LABORATORY

UNCLASSIFIED

**DISCLAIMER**

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor Battelle Memorial Institute, nor any of their employees, makes **any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights**. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or Battelle Memorial Institute. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

PACIFIC NORTHWEST NATIONAL LABORATORY
*operated by*
BATTELLE
*for the*
UNITED STATES DEPARTMENT OF ENERGY
*under Contract DE-AC05-76RL01830*

**Printed in the United States of America**

**Available to DOE and DOE contractors from the**
**Office of Scientific and Technical Information,**
**P.O. Box 62, Oak Ridge, TN 37831-0062;**
**ph: (865) 576-8401**
**fax: (865) 576-5728**
**email: reports@adonis.osti.gov**

**Available to the public from the National Technical Information Service,**
**U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161**
**ph: (800) 553-6847**
**fax: (703) 605-6900**
**email: orders@ntis.fedworld.gov**
**online ordering: http://www.ntis.gov/ordering.htm**

UNCLASSIFIED

# Visual Sample Plan
# Version 7.0 User's Guide

B.D. Matzke          J.E. Wilson
L.L. Newburn         S.T. Dowson
J.E. Hathaway        L.H. Sego
L.M. Bramer          B.A. Pulsipher

March 2014

Pacific Northwest National Laboratory
Richland, Washington 99352

# Abstract

This user's guide describes Visual Sample Plan (VSP) Version 7.0 and provides instructions for using the software. VSP selects the appropriate number and location of environmental samples to ensure that the results of statistical tests performed to provide input to risk decisions have the required confidence and performance. VSP Version 7.0 provides sample-size equations or algorithms needed by specific statistical tests appropriate for specific environmental sampling objectives. It also provides data quality assessment and statistical analysis functions to support evaluation of the data and determine whether the data support decisions regarding sites suspected of contamination. The easy-to-use program is highly visual and graphic. VSP runs on personal computers with Microsoft Windows operating systems (XP, Vista, Windows 7, and Windows 8). Designed primarily for project managers and users without expertise in statistics, VSP is applicable to two- and three-dimensional populations to be sampled (e.g., rooms and buildings, surface soil, a defined layer of subsurface soil, water bodies, and other similar applications) for studies of environmental quality. VSP is also applicable for designing sampling plans for assessing chem/rad/bio threat and hazard identification within rooms and buildings, and for designing geophysical surveys for unexploded ordnance (UXO) identification.

# Acronyms

| | |
|---|---|
| ACS | Attribute Compliance Sampling |
| AL | Action Level or Action Limit |
| ANOVA | Analysis of Variance |
| AWE | U.K. Atomic Weapons Establishment |
| CDC | U.S. Center for Disease Control |
| CI | Confidence Interval |
| COG | Course-Over-Ground |
| CS | Collaborative Sampling |
| CSM | Conceptual Site Model |
| DCGLw | Derived Concentration Guideline Level for average concentrations over a wide area |
| DOD | U.S. Department of Defense |
| DOE | U.S. Department of Energy |
| DHS | U.S. Department of Homeland Security |
| DPGD | Decision Performance Goal Diagram |
| DQA | Data Quality Assessment |
| DQO | Data Quality Objectives |
| EPA | U.S. Environmental Protection Agency |
| ESTCP | Environmental Security Technology Certification Program |
| GIGO | Garbage In, Garbage Out |
| GPS | global positioning system |
| LBGR | Lower Bound of the Gray Region |
| MARSSIM | Multi-Agency Radiation Survey and Site Investigation Manual |

| MI | Multiple Increment |
|---|---|
| MK | Mann-Kendall |
| MQO | Measurement Quality Objectives |
| NFA | no-futher-action |
| NIOSH | National Institute for Occupational Safety and Health |
| OSL | Optimum Segment Length |
| PCS | Projected Coordinate System |
| PI | Prediction Interval |
| RCRA | Resource Conservation & Recovery Act of 1976 |
| RTF | rich text format |
| RI | Remedial Investigation |
| RMSE | Root Mean Square Error |
| RSS | Ranked Set Sampling |
| RTF | Rich Text Format |
| SE | Standard Error |
| SERDP | Strategic Environmental Research & Development Program |
| TOI | Targets of Interest |
| UCL | Upper Confidence Limit |
| UBGR | Upper Bound of the Gray Region |
| UTL | Upper Tolerance Limit |
| UTM | Universal Transverse Mercator |
| UXO | Unexploded ordnance |
| VSP | Visual Sample Plan |

WRS          Wilcoxon Rank Sum

WSR          Wilcoxon Signed Rank

# Acknowledgments