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DESIGN OF A PARTICULATE-MONITORING NETWORK FOR THE Y-12 PLANT

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Key Words

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ABSTRACT

An Air Quality Monitoring Network Design (AQMND) with multiple objectives is being developed for the Y-12 Plant production facilities. The objectives are: Y-12 facility surveillance; monitoring the transport of Y-12 generated airborne effluents towards either the Oak Ridge National Laboratory or the developed region of the City of Oak Ridge; and monitoring population exposure in residential areas close to the Y-12 Plant.

A two step design process was carried out, using the Air Quality Monitor Network Design Model (AQMND) previously used for the Oak Ridge National Laboratory network. In the first step of the design we used existing air quality monitor locations, subjectively designated locations, and grid intersections as a set of potential monitor sites. The priority sites from the first step (modified to account for terrain and accessibility), and subjectively designated sites, were used as the potential monitor sites for the second step of the process which produced the final design recommendations for the monitor network.

INTRODUCTION

In order to quantify the transport and distribution of certain particulates from the Y-12 manufacturing processes and possible resultant population exposures, the Radiation Safety Group at the Y-12 Plant and the Department of Environmental Management at the Oak Ridge National Laboratory (ORNL) have collaborated in the design of a new

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of a new particulate monitoring network around the Y-12 Plant. This paper summarizes the work to date, including initial design recommendations and discusses possible extensions of the study to further refine the monitoring network design.

The Y-12 Plant is located in Bear Creek Valley, about three kilometers from the central business and population area of Oak Ridge. It is separated from that area by Pine Ridge, with the exception of a small gap in the ridge at the north-east corner of the plant reservation. Figure 1 is a three dimensional representation of the Y-12 and Oak Ridge area showing the complex ridge and valley terrain of the region.

STUDY METHOD

This study was conducted using meteorological and source data provided by the Y-12 Radiation Safety Group and an Air Quality Monitor Network Design Model (AQMND) developed for the design of the ORNL particulate and SO_2 monitoring network. The model has been fully described elsewhere.[1,2,3] The model is used to define a measure of the source to potential monitor site relationship for specified sources and potential monitor sites in the study area. The model is then used to choose a subset of the potential sites which maximizes a measure of the total network's ability to monitor these sources.

A two step procedure was used in the design process. In the first step, an arbitrary grid of 441 potential monitor sites was augmented by eight sites specified by Y-12 personnel. These sites are listed in the following table and are indicated on design plots by the associated acronyms.

TABLE
Monitor Sites

Site	Acronym
Gamble Valley	GV
Tank Farm	TF
Water Plant	WP
SO_2 Monitor - East	SO_2E
- West	SO_2W
South Patrol Road - East	SPRE
- Central	SPRC
- West	SPRW

The Gamble Valley, Tank Farm and Water Plant sites were proposed for the purpose of monitoring transport across Pine Ridge towards the populated areas of Oak Ridge. The existing SO_2 monitors were proposed to monitor transport along the axis of Bear Creek Valley. The South Patrol Road monitors were proposed for the purposes of measuring Y-12 transport in the direction of ORNL and transport of ORNL material into Bear Creek Valley.

RESULTS

The results of the initial design run, labeled in priority order, are shown in Figure 2. The locations of the two major particulate sources considered, Building 9212 and 9206, are shown by the underlined numbers 12 and 06 on the Figure. The recommended design is enumerated in Table 1. While none of the augmentation sites were chosen by the computer model, some of the chosen sites were so close to the augmentation sites that no practical difference would result from using either location. Also, reasons of security and power availability directed that several of the model's assignments be moved, usually to an augmentation site.

In the second phase of the design process, the chosen sites from the first phase computer results, the original eight augmentation sites, and other augmentation sites in suspected transport paths and in populated areas were used as input to the monitor network design model. Thirteen

sites, indicated in Figure 3, were chosen by the model. An eleven site network was recommended. Two recommendations of the model were not chosen. Computer sites 4, 5, and 12 were combined into one recommended monitor location.

Ground reconnaissance of the potential sites has confirmed the suitability of the recommended sites and provided specific siting instructions based upon physical obstructions to air flow such as buildings, terrain and trees. Terrain features such as ridge gaps, which would channelize pollutant transport under stable inversion conditions at the ridge top, were also noted. The deletions of computer-recommended sites numbers 10, 11, and 17 of the first run for being inside the "street-canyon" of the Y-12 plant or being too distant and in the lee of a ridge were also confirmed.

DISCUSSION

Extensions to this design effort hinge on the following question: Will the design be sufficiently improved by the time it must be implemented to make the effort worthwhile? Refinements can be made in the source data, meteorological data and in the atmospheric/diffusion model used in the network design process.

Each building, 9212 and 9206, was treated as an individual point source of equal strength with no appreciable plume rise. In fact, each building has multiple short stacks on its roof, some with the potential for plume rise due to air flow velocities. Treatment of individual stacks is possible at some increase in computer execution time.

Possible improvements in meteorological data and in diffusion model(s) used are related. The meteorological data used was a condensation of seasonal frequencies of wind speed, direction and "lapse" or "inversion" conditions into annual frequencies of stable (Pasquill "E") and unstable (Pasquill "C") categories for each wind speed and direction class. This was sufficient for the gaussian diffusion models used, but would not be satisfactory for a more sophisticated model of the type needed to simulate air flow in near calm, stable conditions of

the type that would lead to transport through the gap to the north-east of the Y-12 Plant or across Chestnut Ridge towards ORNL. Discussions with Y-12 personnel have also revealed the low frequency of fog, an indicator of stable atmospheric conditions, even when fog is present in most other valleys in the Oak Ridge area. This raises the possibility that the Y-12 Plant is creating a "Heat Island" effect, further complicating the modeling of diffusion of particulates in the region.

CONCLUSIONS

A monitor network design has been developed for the Y-12 Plant which provides immediate guidance for the fullfillment of the monitoring requirement. Extensions to the design process to improve the design have been suggested herein. The decision of what further action to take is pending.

The two phase process with human participation is a vivid illustration of the way the computer model is intended to aid the human decision maker, not direct his actions.

TABLE 1
Monitor Network Design Recommendations: Phase One

Site Number	Computer Priority	Comments
1	1	Inside plant boundary
2	2	"
3	(3, 5, 7)	Install close to (5-7)line
4	4	Inside plant boundary
5	6	"
6	8	SPRW probably equally good
7	9	Along Bear Creek Road
8	12	Effectively coincident with SO_2E
9	(13-14)	Effectively coincident with TF
10	(15-19)	Same area as SPRC
11	(16-20)	Gamble Valley area
12	18	Off ridge line, use SPRE
13	-	Use SO_2N for completness
-	10	NOT RECOMMENDED
-	11	In Lee of Ridge Inside Y-12 Plant
-	17	Too distant

TABLE 2

Monitor Network Design Recommendations: Phase Two

Site Number	Computer Priority	Comments
1	1	Inside plant boundary
2	2	North of Bear Creek Road
3	3	"
4	(4, 5, 12)	Just North of Bear Creek Road
5	6	Effectively coincident with SO_2W
6	7	SPRW 300 meters away
7	8	Between SPRC and SPRE
8	9	TF site
9	10	Effectively coincident with SO_2E
10	11	On ridge top between SPRW and SPRC
11	13	Gam[illegible]alley

REFERENCES

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[2]Hougland, E. S. and Oakes, T. W., "Design of the Oak Ridge National Laboratory Steam Plant Air Quality Monitor Network in Complex Terrain," Presented at the 1981 Environmental Protection Seminar, Union Carbide Corporation, Nuclear Division, (April 22, 1981).

[3]Hougland, E. S. and Oakes, T. W., (updated version of the previous paper), "Design of the Oak Ridge National Laboratory Steam Plant Air Quality Monitor Network in Complex Terrain," Presented at the Annual Meeting of the Air Pollution Control Association, Philadelphia, Pennsylvania, June 22, 1981.

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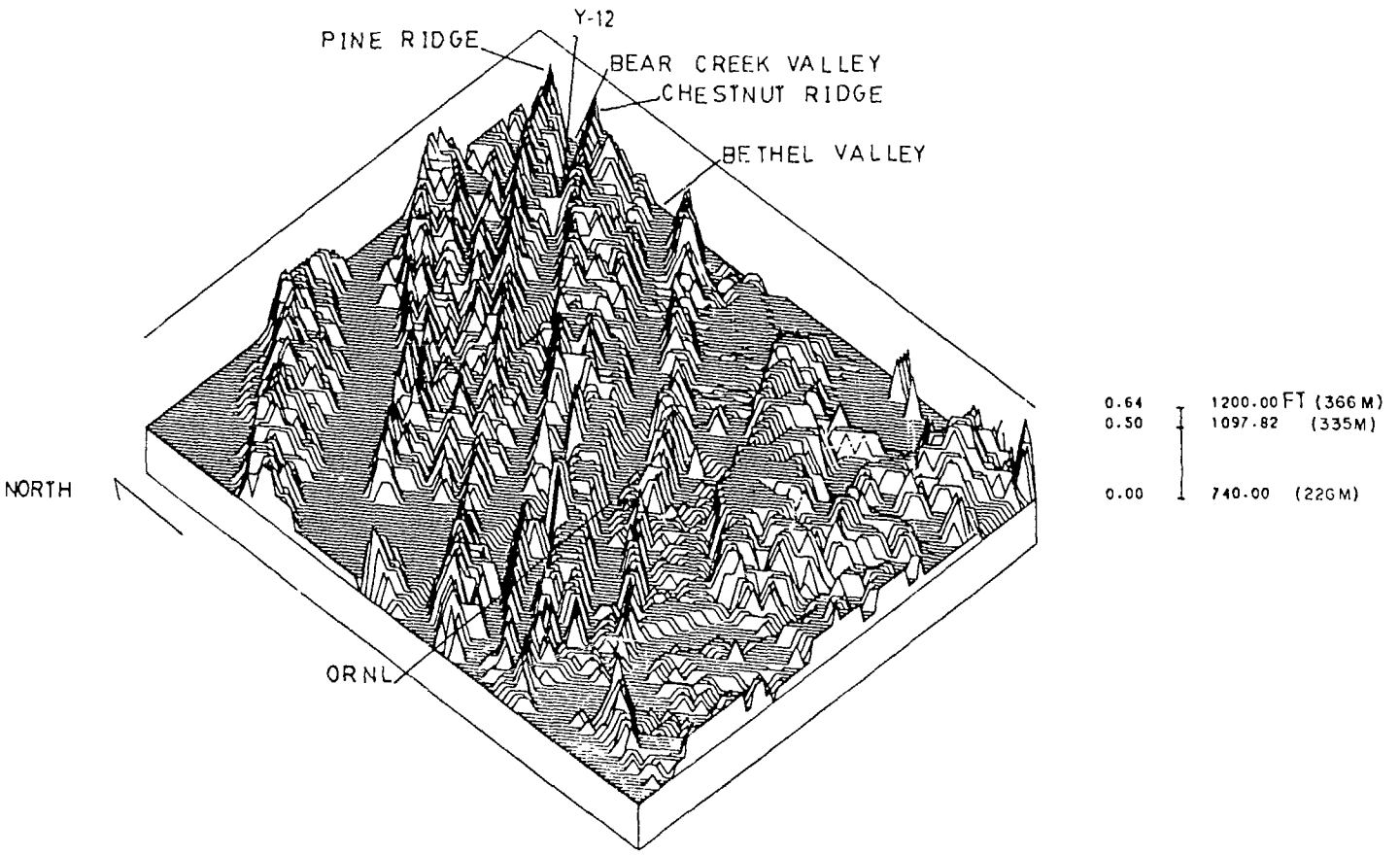

FIGURE 1. Y12 MONITOR NETWORK DESIGN, REGIONAL TERRAIN

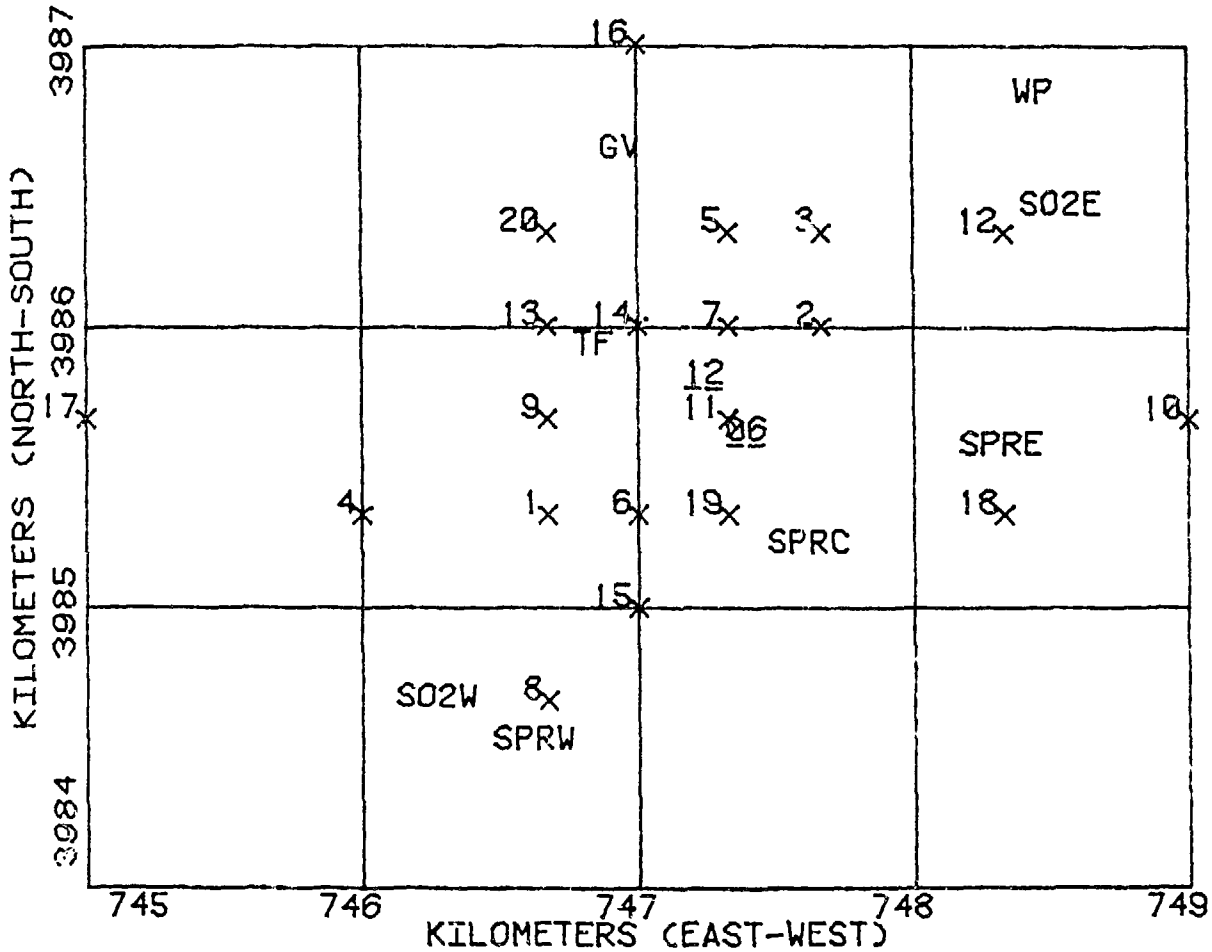

FIGURE 2. Y-12 MONITOR NETWORK DESIGN, RUN ONE, TWENTY SITES, SCALE = 1:24000

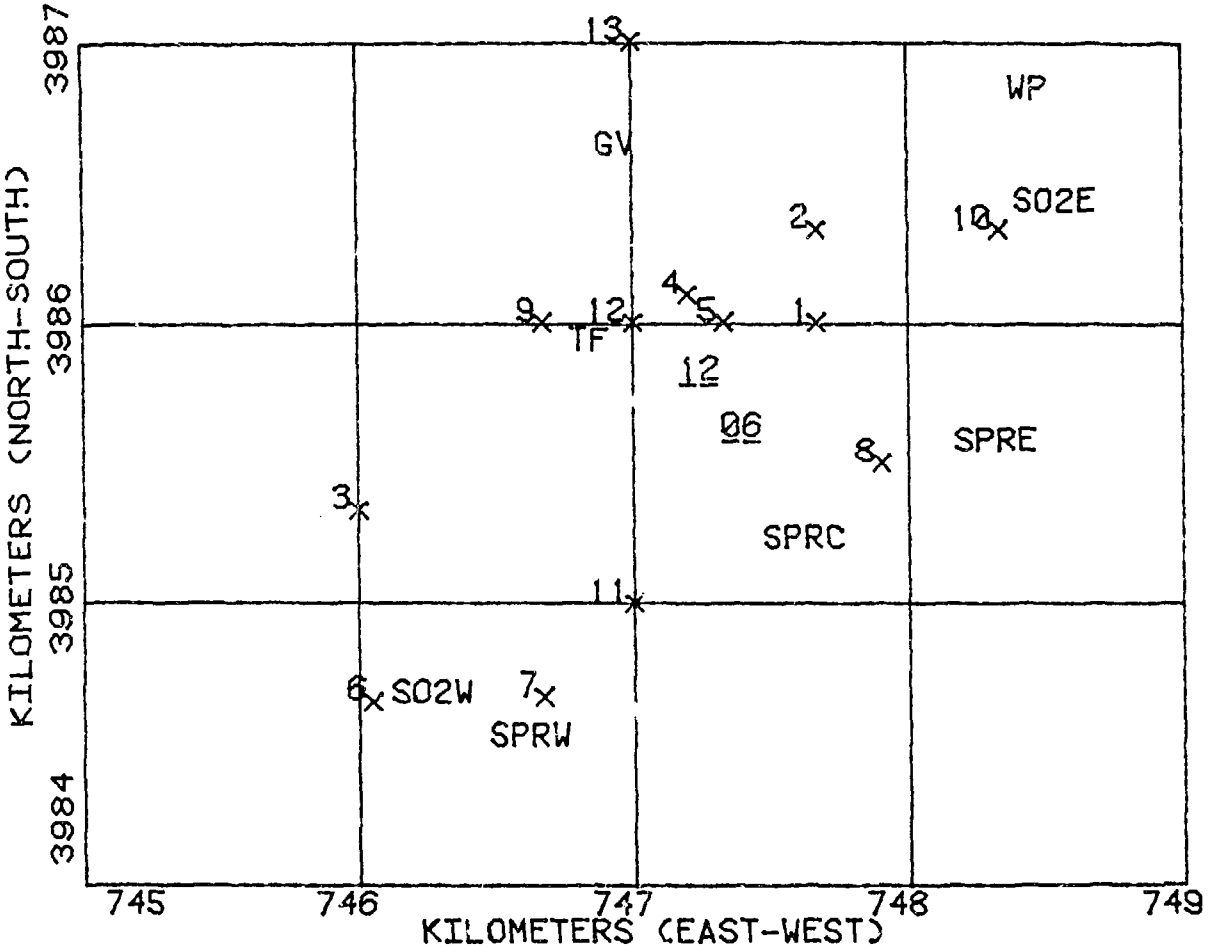

FIGURE 3. Y-12 MONITOR NETWORK DESIGN, RUN TWO, THIRTEEN SITES, SCALE = 1:24000