

**EMPO-561**  
**Rev. 0**

**Oak Ridge Reservation**  
**Public Warning Siren System**  
**Annual Test Report**

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## ACRONYMS

DOE	Department of Energy
EAS	Emergency Alerting System
EMPO	Emergency Management Program Organization
ETTP	East Tennessee Technology Park
INZ	Immediate Notification Zones
LMES	Lockheed Martin Energy Systems
ORNL	Oak Ridge National Lab
ORR	Oak Ridge Reservation
PWSS	Public Warning Siren System
TEMA	Tennessee Emergency Management Agency

## EXECUTIVE SUMMARY

The full operational test of the Oak Ridge Reservation (ORR) Public Warning Siren System (PWSS) was successfully conducted on September 27, 2000. The annual test is a full-scale sounding of the individual siren systems around each of the three Department of Energy (DOE) sites in Oak Ridge, Tennessee. The purpose of the annual test is to demonstrate and validate the siren systems' ability to alert personnel outdoors in the Immediate Notification Zones (INZ) (approximately two miles) around each site.

The success of this test is based on two critical functions of the siren system. The first function is *system operability*. The system is considered operable if 90% of the sirens are operational. System diagnostics and direct field observations were used to validate the operability of the siren systems. Based on the diagnostic results and field observations, greater than 90% of the sirens were considered operational. The second function is *system audibility*. The system is considered audible if the siren could be heard in the immediate notification zones around each of the three sites. Direct field observations, along with sound level measurements, were used to validate the audibility of the siren system. Based on the direct field observations and sound level measurements, the siren system was considered audible.

The combination of field observations, system diagnostic status reports, and sound level measurements provided a high level of confidence that the system met and would meet operational requirements upon demand.

As part of the overall system test, the Tennessee Emergency Management Agency (TEMA) activated the Emergency Alerting System (EAS), which utilized area radio stations to make announcements regarding the test and to remind residents of what to do in the event of an actual emergency.

# 1. SYSTEM AND TEST BACKGROUND

The Oak Ridge Reservation Public Warning System consists of siren systems around each of the three area facilities and coordinated activation by TEMA of the Emergency Alerting system to inform and, if needed, direct protective actions of the public. The overall utilization and capabilities of the system are specified in *The State of Tennessee Multi-Jurisdictional Emergency Response Plan for the United States Department of Energy Oak Ridge Reservation*.

The siren portion of the system is divided into three distinct groups: East Tennessee Technology Park (ETTP), Y-12 Plant, and Oak Ridge National Lab (ORNL). Each siren group provides coverage for the facility's INZ which is an area within approximately two miles of each facility. All siren systems are managed and maintained by the Y-12 Emergency Management Program Organization (EMPO). This includes the primary and backup radio repeaters at the Y-12 Plant that serve all three facilities, and the control stations at ETTP, Y-12, ORNL, the Oak Ridge 911 center, and the Roane County 911 center. There is a total of 52 sirens in the ORR PWSS: 19 sirens at ETTP, 22 at Y-12 and 11 at ORNL. All ETTP sirens are located in Roane County; all Y-12 sirens are located in Anderson County; and ORNL sirens are located in both Roane and Anderson counties.

The annual test of the ORR PWSS was conducted on September 27, 2000, between 0800 and 1200. In preparation for the test, an intensive coordinated effort to notify the public of the test was conducted by Lockheed Martin Energy Systems (LMES), DOE, TEMA, and city and county officials. The test was used to demonstrate the siren system's readiness to alert personnel outdoors in the INZ around each site in the event of an emergency involving the release of airborne hazardous materials. Personnel were positioned at predetermined locations around each INZ to conduct field observations and sound level measurements. Because the three groups of sirens would normally not be operated together, each siren group was activated independently to obtain sound level measurements.

## 2. TEST RESULTS

Each siren group was activated by the facility using the same procedures that would be used during an emergency activation. Siren system status reports were obtained for each system and examined for evidence of system failure. The system status summaries provide the following indications of siren status:

**Table 1. Siren system status indications**

<b>Status indication</b>	<b>Meaning</b>
Communication - OK	Radio path to Site is OK, no other status at Site
Communication - Fail	No response was received from Site during last poll
Communication - Sync	Too many comm errors occurred at Site (do resync)
Siren Run - OK	The siren sounded without errors
Siren Run - Partial	The siren sounded, but a possible problem may exist
Siren Run - Overrun	The siren sounded, but was on longer than 5 minutes
Door Open	Siren site detected an intruder
Low battery	Site backup battery has dropped below acceptable level
AC Fail	Site has lost AC or Solar Power, SERVICE IMMEDIATELY

Potential problems indicated by the Siren System Status Summaries were reported to the system maintenance contractor for evaluation.



### 3. SUMMARY OF TEST RESULTS

Both system diagnostics and direct field observations were used to validate operability of the siren systems. Based on the diagnostic results and field observations, only one out of 52 sirens failed to operate upon initial activation of the system (98% operability). On an individual group basis, the percent operability was: ETTP-100%, Y-12 - 100%, and ORNL - 91%. As described in the test plan, the siren that failed to operate initially (BCA 206) was re-polled and operated properly following the initial activation. The proper response to this situation in an actual event was discussed with TEMA personnel following the siren test. The TEMA representatives requested that in an actual event, TEMA be notified immediately of any siren failures. This will enable TEMA to begin preparations for manual notifications in the affected areas. The site is then to attempt to re-sound the siren(s) which failed to operate. If the siren(s) sound successfully, TEMA is to be notified so that preparations for manual notifications can be stopped.

Field observations at 27 locations in the three INZs were used to assess system audibility. Sound level measurements and direct observations indicated that the sirens were clearly audible throughout the three INZs. A difference between the average background sound level and the average sound level during siren activation of 3-6 dB indicates an audible siren. Twenty-five of the 27 locations reported clearly audible sirens. Two locations in the ORNL coverage area reported sound levels that were audible but faint. One of these areas is known to be outside the calculated 60 dB coverage area for the ORNL siren group and the other was in an area of high vehicle traffic (Bethel Valley Rd.). Both of these measurement locations will be relocated prior to next year's test.

The following sections provide a summary of the test results for each site.

## 4. ETPP TEST RESULTS

Table 2. Summary of ETPP Test Results

Measurement Location	Background			Sirens Activated			Difference	
	Min	Max	Avg	Min	Max	Avg	Max	Avg
1K	36.0	41.2	37.8	51.0	68.5	61.8	27.3	24.0
2K	42.5	74.1	57.3	54.5	74.6	63.2	0.5	5.9
3K	53.9	71.4	58.8	55.1	86.1	71.3	14.7	12.5
4K	46.9	80.1	63.1	57.5	84.2	69.5	4.1	6.4
5K	46.0	66.7	58.1	52.6	83.1	68.3	16.4	10.2
6K	35.0	44.4	40.0	51.0	76.5	61.5	32.1	21.5
7K	62.6	74.9	66.0	66.8	76.0	71.9	1.1	5.9
8K	41.2	45.6	43.4	53.5	70.0	60.6	24.4	17.2
9K	43.1	50.5	47.1	65.5	77.4	71.6	26.9	24.5

All ETPP sirens ran upon initial system activation. Sound level measurements and direct observations indicated that the system was operating properly.

The siren system status report indicated Siren Run - Partial for two sirens, KCA 006 and KFA 016. This condition was reported to the system maintenance contractor.

## 5. Y-12 TEST RESULTS

**Table 3. Summary of Y-12 Test Results**

Measurement Location	Background			Sirens Activated			Difference	
	Min	Max	Avg	Min	Max	Avg	Max	Avg
1Y	49.8	65.6	57.6	79.0	93.1	85.9	27.5	28.3
2Y	53.9	74.7	63.1	67.8	82.4	75.2	7.7	12.1
3Y	48.7	59.2	53.8	63.2	78.0	71.1	18.8	17.3
4Y	49.1	56.1	56.1	73.3	88.0	79.9	31.9	23.8
5Y	54.2	70.2	58.9	77.0	88.6	82.6	18.4	23.7
6Y	48.6	75.5	57.1	66.4	77.7	72.3	2.2	15.2
7Y	47.1	57.3	52.1	68.2	91.1	80.7	33.8	28.6
8Y	51.7	57.8	54.8	61.2	82.6	69.7	24.8	14.9
9Y	59.5	73.8	66.3	64.5	75.2	69.6	1.4	3.3

All Y-12 sirens ran upon initial system activation. Sound level measurements and direct observations indicated that the system was operating properly.

The siren system status report indicated Communication Sync errors for a number of the Y-12 sirens. The system maintenance contractor reported that this was due to a reset/resync operation not being performed prior to the test.

The siren system status report indicated Siren Run - Partial for three sirens (ACC 012, ABB 014, ADG 021), Siren Overrun for three sirens (ABA 009, ADB 016, ADG 021), and Low Battery for one siren (ADA 015). These conditions were reported to the system maintenance contractor.

## 6. ORNL TEST RESULTS

**Table 4. Summary of ORNL Test Results**

Measurement Location	Background			Sirens Activated			Difference	
	Min	Max	Avg	Min	Max	Avg	Max	Avg
1X	59.0	62.0	60.4	64.8	91.1	76.5	29.1	16.1
2X	49.1	55.2	52.5	52.1	59.8	54.9	4.6	2.4
3X	41.9	85.3	62.4	65.1	76.2	70.2	-9.1	7.8
4X	47.9	72.2	56.0	58.5	79.7	66.3	7.5	10.3
5X	41.7	45.8	43.9	43.0	51.2	46.7	5.4	2.8
6X	50.9	58.9	54.4	55.6	75.4	64.7	16.5	10.3
7X	57.2	81.2	66.4	59.2	70.4	63.6	-10.8	-2.8
8X	46.4	59.6	52.4	58.3	91.3	72.9	31.7	20.5
9X	58.2	65.3	61.7	64.4	71.8	68.5	6.5	6.8

Measurement location 2X exhibited low sound level, however, the individual performing measurements at this location reported that the sirens were clearly audible. This is supported by the fact that the sound levels measured while the sirens were activated were approximately 2 - 5 dB above the background sound level measurements. This location was chosen due to the fact that it corresponds to a gap in the calculated 60 dB coverage area for the ORNL siren group as indicated on drawing E2E900031A004. The measurements support the calculated coverage gap. This measurement point will be moved to a different location for next year's test.

Measurement location 5X is located across Chestnut Ridge from any of the ORNL sirens. This location is also outside the calculated 60 dB coverage area for the ORNL siren group. This measurement point will be moved to a point near the construction site for the Spallation Neutron Source for next year's test.

Measurement location 7X was located in an area with heavy vehicle traffic (Bethel Valley Rd.). The individual performing measurements at this location reported that the sirens could be heard, but not very well above the traffic noise. This point is located at the edge of the ORNL INZ.

Siren BCA 206 failed to operate upon initial sounding of the sirens. The nearest measurement location, 9X, recorded sound levels >6 dB above background and reported that the sound was very clear. This indicates good coverage from other sirens (BCB 209 or BCC 210). Following the initial test, siren BCA 206 was polled and ran normally.

During the test, siren BDB 208 ran normally for ~1 minute and then shut down. No alarms or failures were indicated on the siren system status summary report. This condition was reported to the system maintenance contractor.

## 7. LESSONS LEARNED

1. Measurement locations next to high traffic areas produced a higher than normal background sound level reading. It is recommended that some measurement locations be moved away from these areas.
2. Controller radio net problems were experienced due to a problem with the radio repeater and the frequency being used. A better communications check should be performed prior to initiating the test and a back-up communications method (i.e., cell phone) should be provided.
3. Individuals performing the sound level measurements should stay in position following the siren test in case a re-test of any sirens is required. Test control should then release the measurement personnel to move to the next location.
4. At the completion of a siren test, the system should not be reset until after the siren system status summary is printed out.
5. The system software will be reviewed to determine if the resync-reset command can be included in the software command sequence for siren activation.
6. The response sequence to a failed siren that TEMA has concurred with will be transmitted to each of the reservation shift superintendent's offices.

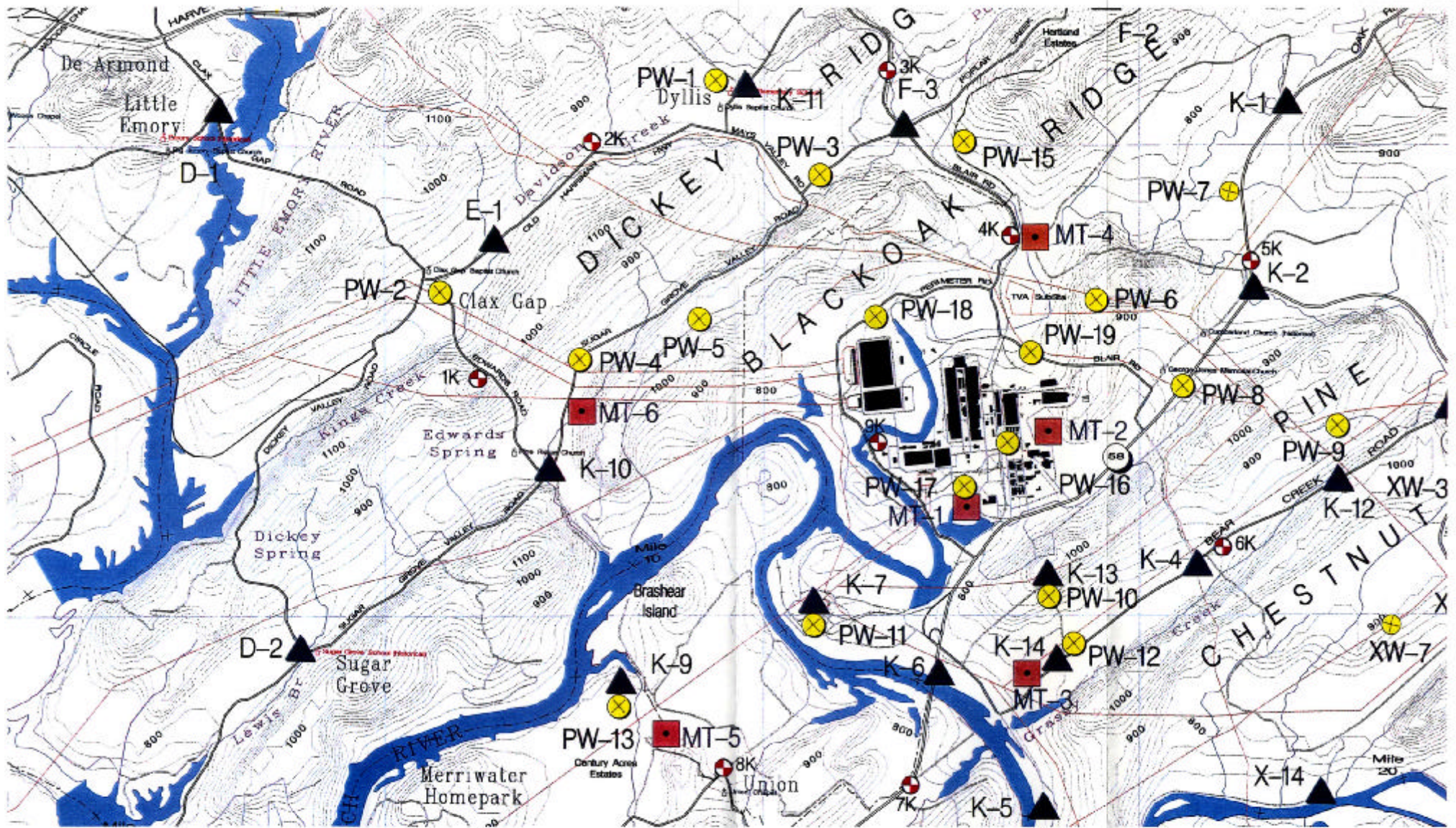


Fig. 1. ETPP measurement locations.

- ▲ FMT SAMPLING POINTS
- METEOROLOGICAL TOWERS
- PUBLIC WARNING SYSTEM
- ◆ PUBLIC WARNING SYSTEM

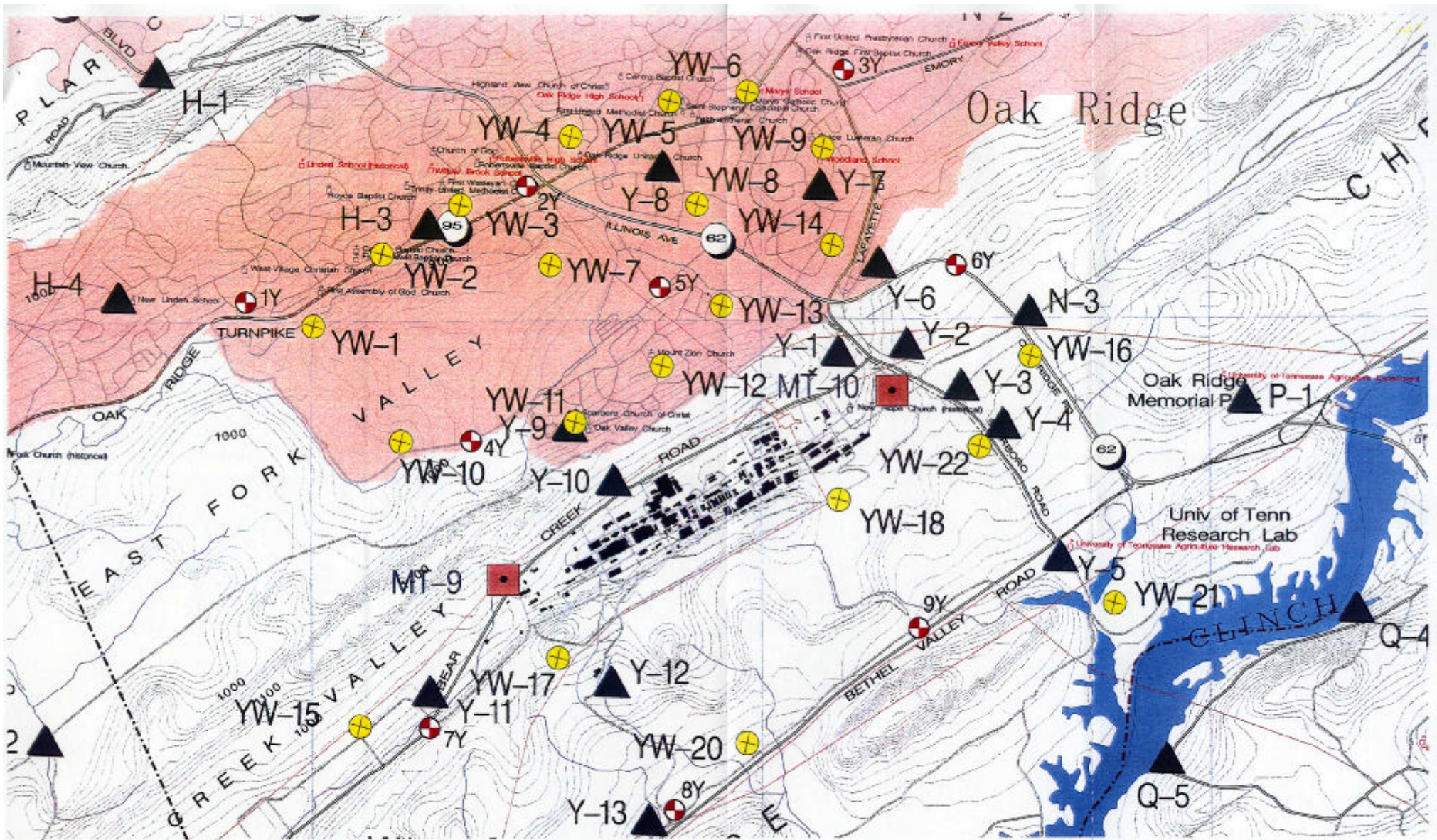


Fig. 2. Y-12 measurement locations.

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- ▲ FMT SAMPLING POINTS
- PUBLIC WARNING SYSTEM
- METEOROLOGICAL TOWERS
- ⊕ 100' ALUM. ROAD LEV. FIELD IDENTIFICAL POINT

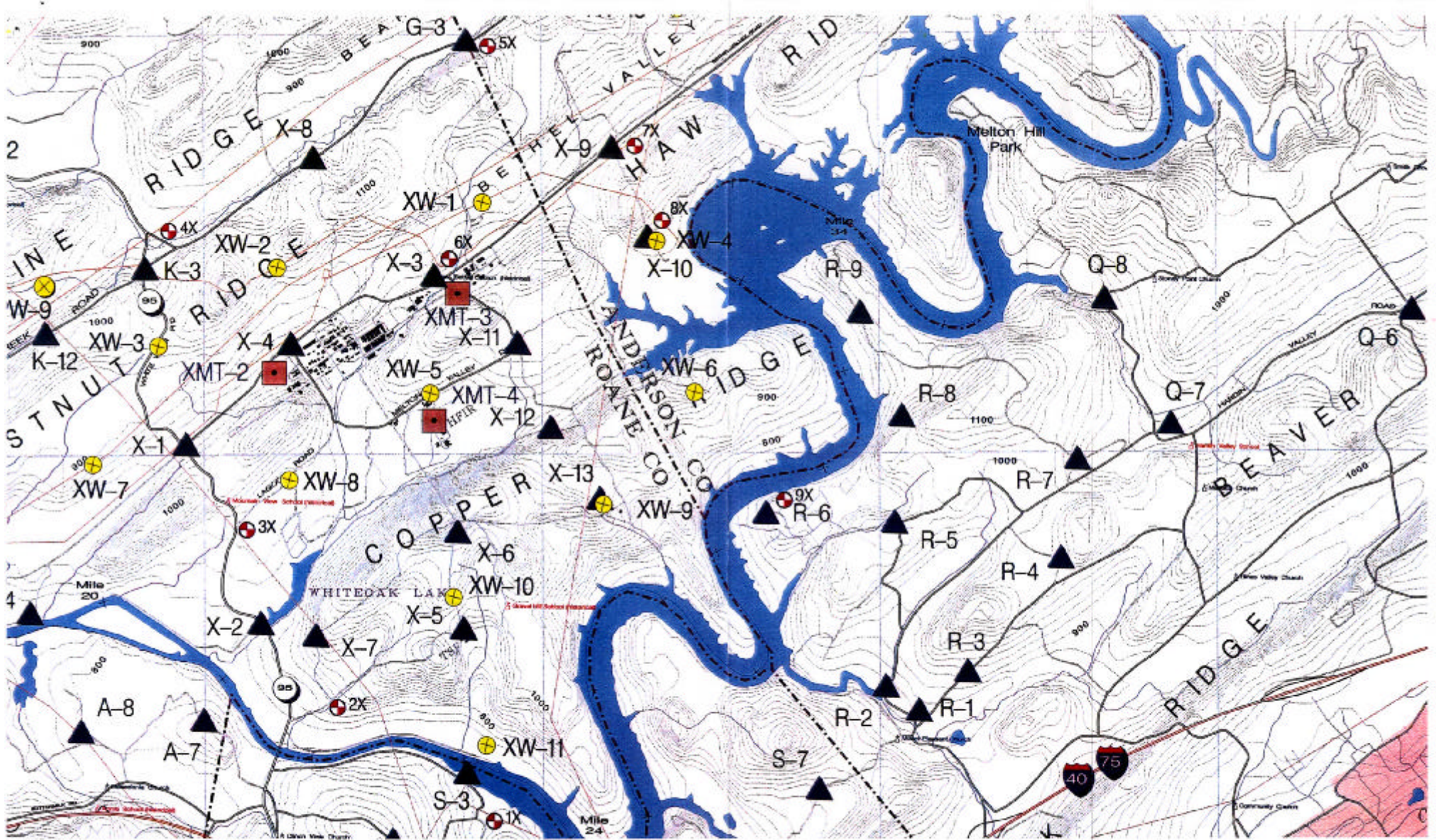


Fig. 3. ORNL measurement locations.

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- ▲ FMT SAMPLING POINTS
- METEOROLOGICAL TOWERS
- PUBLIC WARNING SYSTEM
- ⊕ RELAY STATION (SEE FIG. 4C FOR DETAILS)