MassDEP Field Assessment and Support Team

After Incident Report	NE-11-6727
Malden High School Mercury Spill Incident	March 2011

BACKGROUND

Reportedly, one or more students brought a residential thermostat into Malden High School on Wednesday, March 16, 2011. The mercury switch ampoule within the thermostat was broken, either by accident or on purpose, in Room B-215, located on the second floor of a building located in the northwest sector of the school complex.

The following day, at 12:32 PM, MassDEP received a request from city officials to assist in the assessment of mercury contamination at the school. Chris Bresnahan of NERO/ER responded to the scene at about 1:30 PM, and was joined by John Fitzgerald (FAST) at 4:30 PM. The Massachusetts Department of Public Health was promptly notified of this situation by DEP staff.

SCOPE OF PROBLEM

Initially, a Model 915+ Lumex Mercury Analyzer ("Lumex Meter") was used to test the shoes of about 12 students who reportedly were most likely to have contacted the spilled mercury beads. The Lumex Meter employs Atomic Absorption Spectroscopy and a high volume pump (20 liters/minute) to quantify extremely low concentrations of mercury vapors. Readings ranged from 200 to 1000 ng/m^3. Based upon these data, shoe contaminant levels were deemed to be relatively low, and a decision was made to release these and other students, who were being detained by school and town officials pending this evaluation.

Subsequently, the air in Room B-215 was tested, and immediately registered between 6000 and 10,000 ng/m^3 of mercury in the breathing zone (4-6 feet above floor level) This reading was verified by using a "Jerome Meter", a less sensitive instrument that utilizes gold film sensors, and which is capable of quantifying mercury levels above 3000 ng/m^3. Concentrations in this range were indicative of the presence of small droplets of mercury in the room.

Next, the surrounding hallways were screened at a 4 to 5 foot level, to ascertain the rough extent of contamination. This was determined to be the hallway area outside of Room B-215, as well as a perpendicular hallway in a southerly direction, including a catwalk that connected two portions of the school (see Figure 1), where readings were initially in the range of 1000 to 2000 ng/m^3. This finding was consistent with the movement of students at the school, and suggests that droplets were spread by persons exiting Room B-215 and traveling to other portions of the complex.

MERCURY

Mercury is a naturally occurring metal which can exist in several different forms. Elemental mercury (notated as Hg^0 and sometimes referred to as metallic mercury or "quicksilver") is a dense, shiny, bead-forming silver-colored liquid. In the past, it was widely used in thermometers and thermostats, as well as in medical and scientific equipment. The average household thermostat contains about 3 to 4 grams of elemental mercury (equivalent to 3000 to 4000 mg).

The use of elemental mercury has been discontinued in recent decades due to its toxicity. Of particular concern is the chronic, long-term exposure to high levels of mercury vapor in air. Unlike most metals, elemental mercury is volatile, and can slowly evaporate into the air over a long period of time (i.e., months or years). This can be especially problematic if a significant amount of this material becomes trapped in cracks in floors and other surfaces.

Mercury is typically measured in air in units of milligrams (mg), micrograms (µg) or nanograms (ng) per cubic meter. The enforceable occupational (OSHA) standard in a work place is 100,000 ng/m^3. The US Agency for Toxic Substances and Disease Registry (ATSDR) recommends that levels of mercury within the breathing zone of schools be less than 1000 ng/m^3, which has also been the recommendation of the Massachusetts DPH.

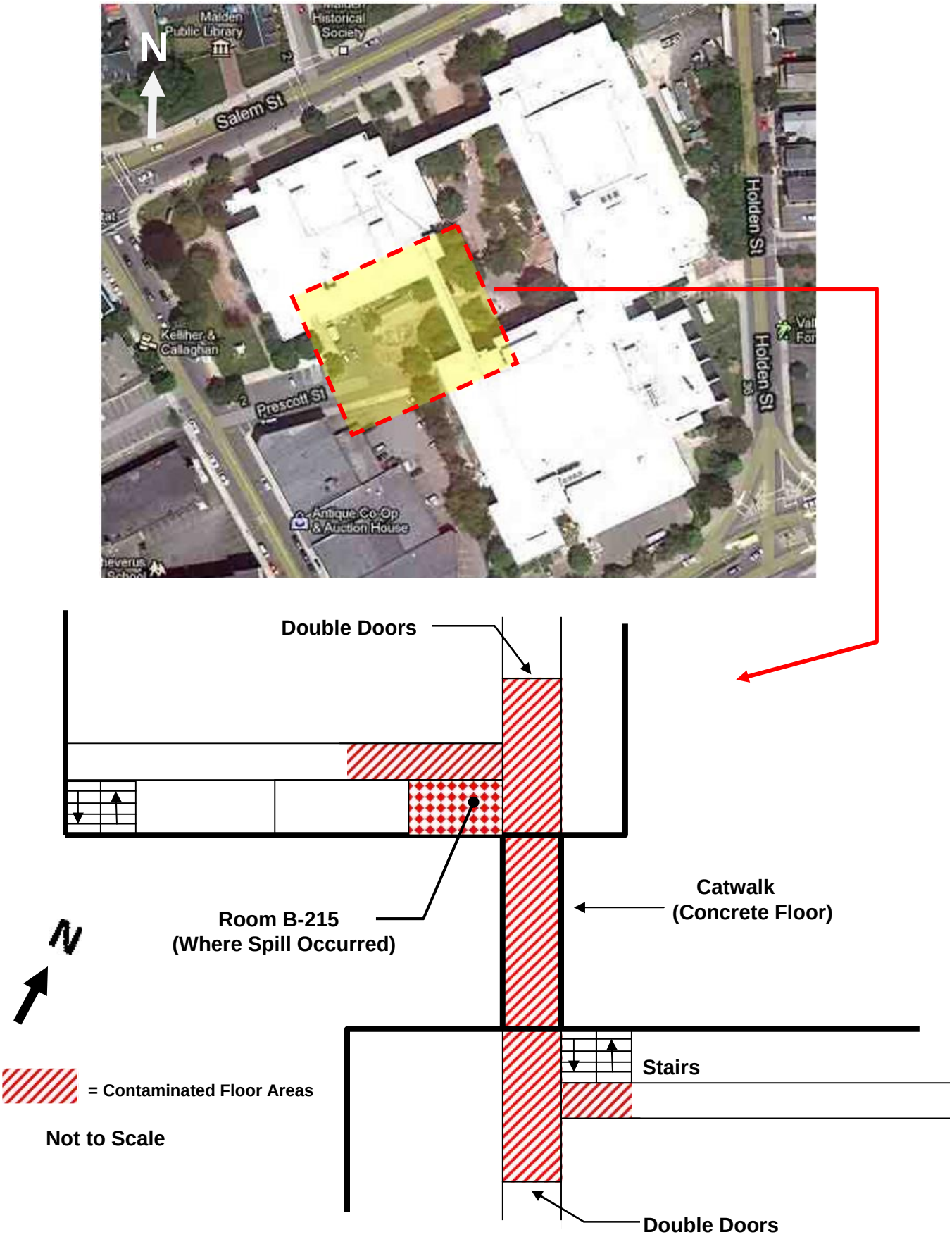

Figure 1 – Spill and Cleanup Location (2nd Floor)

The goal of the effort at Malden High School was to ensure that all "breathing zone" locations were less than 1000 ng/m^3, with the breathing zone being defined as 4 to 6 feet above floor level.

DELINEATION OF AREAS OF CONTAMINATION

Once the approximate extent of breathing-zone contamination was established, the Lumex Meter was used to test floor areas for the presence of tiny mercury droplets. This step is essential to locate areas where removal or treatment measures are desirable, to ensure achievement of breathing zone action levels.

This objective was accomplished by slowly surveying hallway areas in a "Z" pattern with the Lumex Meter, with the sampling probe positioned 1 to 2 inches above the floor. If an area contained a significant amount of merucry droplets, the meter would periodically register "spike" readings of 2000 to 6000 ng/m^3. Particular attention was paid to door openings, where foot traffic tends to be concentrated.

On the basis of this effort, the most significantly contaminated area (outside Room B-215) was the concrete floor in the catwalk the runs perpendicular to and south of Room 215. Lesser amounts were found in the building south of the catwalk, continuing to a stairway to the east of the catwalk/hallway. The boundaries of areas of concern are highlighted in Figure 1.

In addition to testing floor surfaces, door knobs were also evaluated, as were mops and brooms used by the janitorial staff. On this basis, two brooms were identified as being significantly contaminated, and it was recommended that they be disposed. Similarly, the shoes of a janitor who had worked in Room B-215 registered greater than 10,000 ng/m^3 of mercury, and a recommendation was made that these shoes also be disposed.

CLEANUP

The City of Malden elected to retain a hazardous materials response contractor to conduct the cleanup in the school complex. At approximately 7:30 PM, a crew from ENPRO Services of Newburyport arrived at the site.

Staff from MassDEP explained the situation to the ENPRO supervisor, and delineated the areas of contamination. A suggestion was made to apply a mercury immobilization agent in the impacted hallway areas, and to use a Mercury Vacuum in Room B-215, to remove visible droplets, followed by the immobilization agent.

ENPRO chose to use the commercial product *HgX*® as the immobilization agent. This product, a solid powder, is dissolved in water and applied to impacted areas with mops and brushes. It contains proprietary sulfur compounds that chemically react with elemental mercury to form a non-volatile mercuric sulfide salt. After a drying period, the film residue is washed off/removed with water and mops.

POST CLEANUP TESTING

At approximately 5:30 AM on the following morning (Friday, March 18th), Chris Bresnahan of MassDEP returned to the school to determine whether the cleanup had accomplished the stated goal of lowering concentrations of Mercury to less than 1000 ng/m^3. It was noted that breathing zone levels in all impacted hallway areas were approximately 350 ng/m^3 or less. Moreover, there were no discernable levels of mercury vapors "off gassing" from hallway floor areas, suggesting that the immobilization agent had successfully bound-up the elemental mercury droplets.

However, levels of mercury within the breathing zone of Room B-215 remained above 1000 ng/m^3, which necessitated that it be kept closed off to students.

After conducting further cleanup during the day, this room was re-tested by agency staff on Friday afternoon. Unfortunately, levels of mercury in the air continued to exceed the action levels:

- 1800 to 2000 ng/m^3 in the breathing zone in most areas of the room, but as high as 3000 to 5000 ng/m^3 near the exterior wall heating units;

- concentrations in excess of 10,000 ng/m^3 off-gassing from the floor near the exterior wall heating units.

Once again, readings greater than 3000 ng/m^3 were verified by use of a Jerome meter. As such, school officials were advised that access to the room should continue to be restricted.

Late in the day, city and school officials decided to temporarily suspend work in Room B-215, pending an evaluation of financing options.

PHOTOGRAPHS

Hallway outside Room B-215, looking west

Hallway perpendicular/easterly of Room B-215 hallway, looking north

Hallway south of catwalk, looking south

ENPRO personnel applying HgX® to hallway just north of catwalk