

GPS-BASED SCANNING FOR SITE SOIL CHARACTERIZATION AND VERIFICATION

NMA/NRC Uranium Recovery
Workshop

May 24-25, 2005




consulting
scientists and
engineers

Millsite Soil Characterization

Summer - 2004

- Dawn Mining Company – Stevens County, Washington
- Washington Department of Health
- MFG, Inc.




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Dawn Mining Company Background Information

- DMC operated a uranium mill from 1957 to 1982 to process ore from the Midnite Mine
- The mill processed water treatment sludge from the mine to recover uranium from 1992 to 2001
- The mill was permanently shut down in 2001
- The mill building was demolished in 2003
- Site soil characterization took place in 2004
- Soil cleanup is scheduled for summer 2005
- Water treatment plant sludge will continue to be direct disposed to TDA4 for several more years.

Dawn Mining Company Millsite



Elements of the Soil Characterization Plan

- Perform a gamma scan of the entire millsite using a shielded NaI detector.
- Select correlation grid locations.
- Sample soils in correlation grids.
- Select, sample, and scan background (reference locations).
- Develop a correlation between the shielded exposure rate and Ra-226 activity concentration and identify a shielded exposure rate that represents 5 pCi/g Ra-226 above background.
- Dig backhoe trenches to sample sub-surface soils.



Gamma Scan

- The gamma scan was intended to provide 100 percent coverage of the millsite and adequate coverage of potentially impacted areas within the millsite boundary excluding the evaporation ponds and tailings disposal areas.
- The millsite covers approximately 460 acres of which 175 acres are evaporation ponds, disposal areas, and borrow areas that were not scanned for the characterization survey.
- Survey of the roadsides leading into the mill
- The total area scanned on the millsite was approximately 285 acres.



Gamma Scan Equipment

- ATV –mounted systems
 - Two Ludlum Model 44-10 detectors (2x2 inch NaI) shielded with approximately $\frac{3}{4}$ inch of lead
 - Two Ludlum Model 2350 Data Loggers
 - Pen top computer
 - Two Garmin GPS Legends
- Backpack-mounted system – approximately 40 lbs
 - Shielded Ludlum Model 44-10 detector (2 x 2 inch NaI crystal)
 - Ludlum Model 2350 Data Logger
 - Garmin iQue
 - Calculator size device functions as GPS and pen top computer

Gamma Scan Equipment

- The 2 inch NaI detector was mounted in a capped PVC pipe housing
- Lead donuts were fitted around the detector to a height of approximately 2 inches.
- The detectors were padded to prevent damage and keep them rigid in the housing
- For the ATV-mounted system
 - the data loggers and pen top computer were held in a single pack on the ATV.
 - A GPS was mounted on top of each detector housing
- For the backpack-mounted system
 - the data logger was placed in the pack
 - The iQue was carried by the surveyor



ATV- Scanning System



Backpack Scan system



Data Management

- Detector system measures exposure rate every second
- GPS collects time and location coordinates every second.
- The exposure rate, time, and location were simultaneously recorded and stored in the computer or iQue.
 - Note: The lap top and iQue were programed to “say” OhOh! If any of the connections were lost
- The data were downloaded to a laptop computer at least once a day.
- The output files were emailed to the MFG, Inc. office in Fort Collins daily for processing and graphic representation.

Typical Data File

N 35 28.0501	W115 31.0668	3/9/05 8:48:41	3.05E-05	3D GPS Location
N 35 28.0501	W115 31.0668	3/9/05 8:48:42	3.05E-05	3D GPS Location
N 35 28.0500	W115 31.0668	3/9/05 8:48:43	3.31E-05	3D GPS Location
N 35 28.0500	W115 31.0667	3/9/05 8:48:44	3.36E-05	3D GPS Location
N 35 28.0500	W115 31.0667	3/9/05 8:48:45	3.41E-05	3D GPS Location
N 35 28.0499	W115 31.0667	3/9/05 8:48:46	3.15E-05	3D GPS Location
N 35 28.0499	W115 31.0667	3/9/05 8:48:47	3.24E-05	3D GPS Location
N 35 28.0499	W115 31.0667	3/9/05 8:48:48	3.24E-05	3D GPS Location
N 35 28.0499	W115 31.0666	3/9/05 8:48:49	3.40E-05	3D GPS Location
N 35 28.0498	W115 31.0666	3/9/05 8:48:50	3.68E-05	3D GPS Location
N 35 28.0498	W115 31.0666	3/9/05 8:48:51	3.52E-05	3D GPS Location
N 35 28.0498	W115 31.0666	3/9/05 8:48:52	3.52E-05	3D GPS Location
N 35 28.0498	W115 31.0665	3/9/05 8:48:53	3.31E-05	3D GPS Location
N 35 28.0497	W115 31.0665	3/9/05 8:48:54	3.55E-05	3D GPS Location
N 35 28.0497	W115 31.0665	3/9/05 8:48:55	3.35E-05	3D GPS Location
N 35 28.0497	W115 31.0665	3/9/05 8:48:56	3.35E-05	3D GPS Location
N 35 28.0497	W115 31.0664	3/9/05 8:48:57	3.27E-05	3D GPS Location
N 35 28.0497	W115 31.0664	3/9/05 8:48:58	3.36E-05	3D GPS Location
N 35 28.0498	W115 31.0664	3/9/05 8:48:59	3.56E-05	3D GPS Location

QA/QC

- Daily background checks for all systems in the storage garage
- Daily source checks with all systems
- Daily field checks



ATV Garage



Field Check Strip



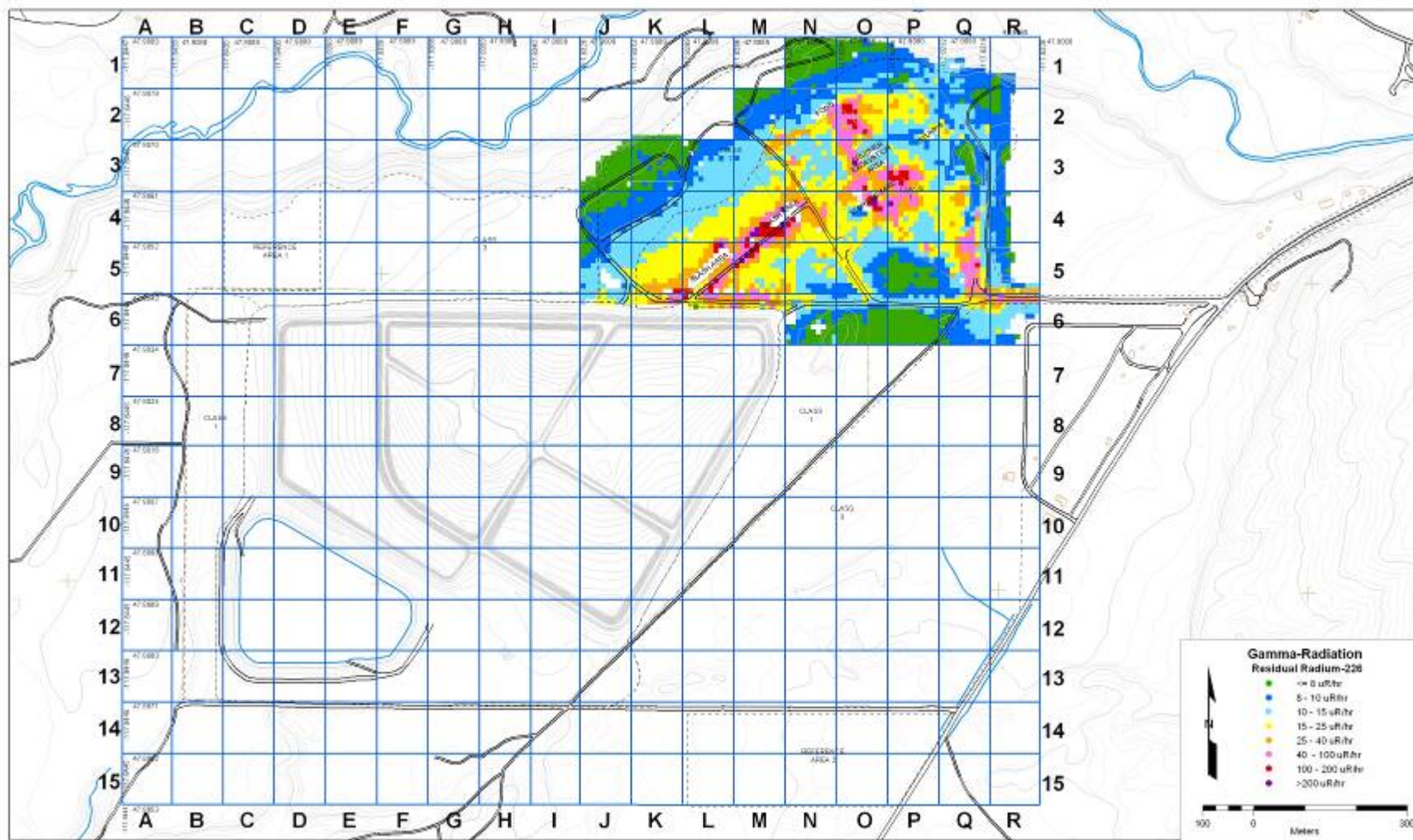
Background (Reference) Areas

- Two reference areas were selected
- Reference areas were scanned using the ATV
 - Average shielded exposure rates
 - Reference area 1 (NW) – 5.38 $\mu\text{R/hr}$
 - Reference area 2 (SE) – 7.56 $\mu\text{R/hr}$
- Twenty soil samples were taken from each reference area
 - Average Ra-226 concentrations
 - Reference area 1 - 0.95 pCi/g =
 - Reference area 2 - 1.35 pCi/g =



Gamma Scan Results

- Approximately 600,000 individual data points collected
- Exposure rates were mapped and color-coded
- Each dot on the map indicated the coverage for the individual measurement (assumed to be a circle with a 1 m radius)



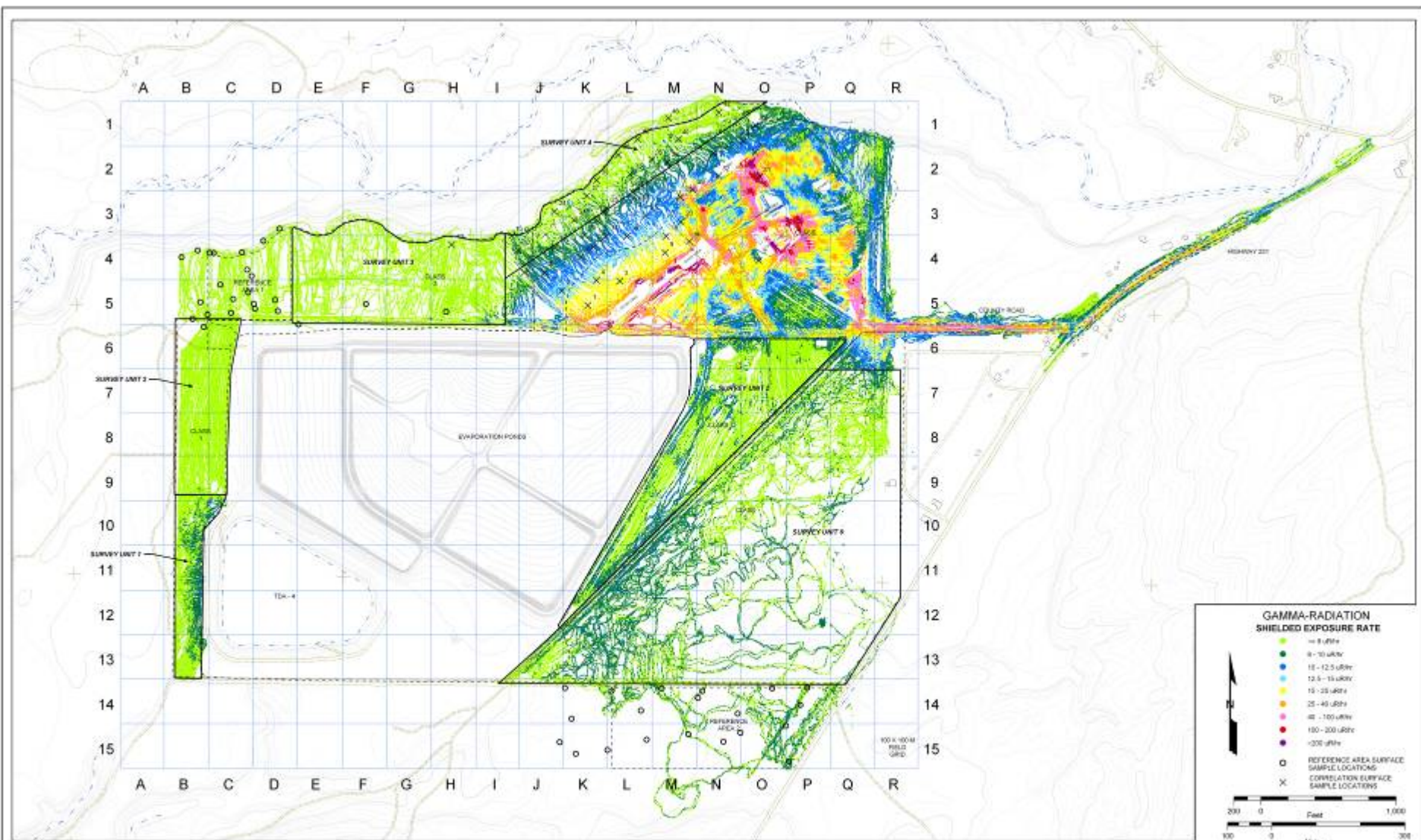
MFG, Inc.
consulting scientists and engineers

DAWN MINE SITE
SCAN AVERAGES FOR 10 X 10 METER GRID CELLS
IN AREA OF CONCERN

Date: JAN 2005
Project: 180583
File: JAN_05.mxd

Correlation Grids

- Approximately 50 10 x 10 meter grids were selected based on initial gamma exposure rate measurements.
 - The intent was to cover the range of expected Ra-226 concentrations with emphasis on concentrations below 10 pCi/g.
 - Composite soil samples were taken from each grid.
 - Samples were analyzed at ELI for Ra-226.
- Correlation grid locations are shown on the scan map



REV	DESCRIPTION	BY	DATE	APPROVED	DATE
1	ISSUED FOR SITE CONSTRUCTION SURVEY REPORT	PLB	01/01	APR	2008

DATE	DESCRIPTION

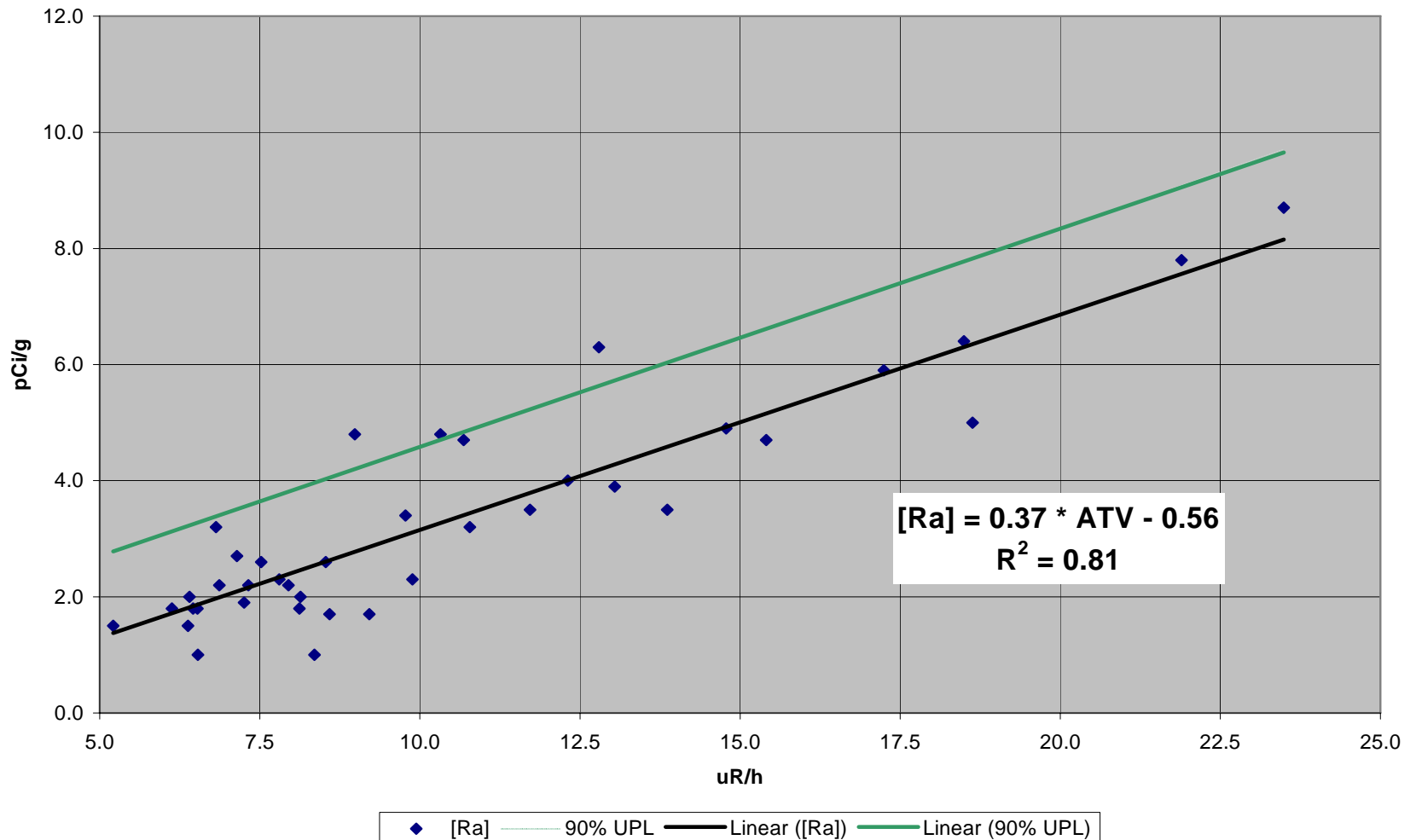
DESCRIPTION	BY	DATE

PREPARED BY	DATE

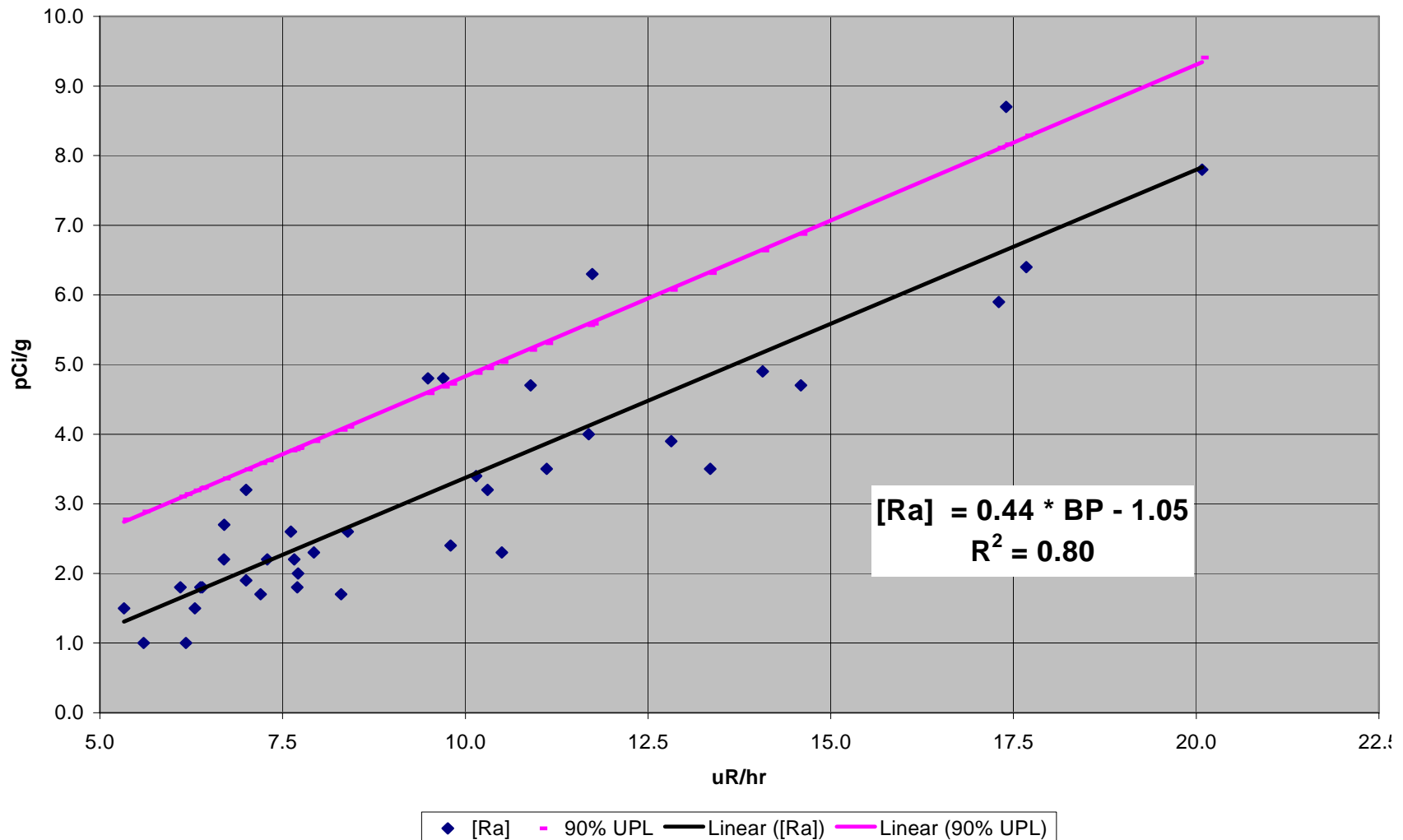
PREPARED FOR	DATE

TITLE	DATE	SCALE
DAWN MILL SITE 2004 SCAN RESULTS AND SURFACE SOIL SAMPLE LOCATIONS	FEBRUARY 2008	1:1

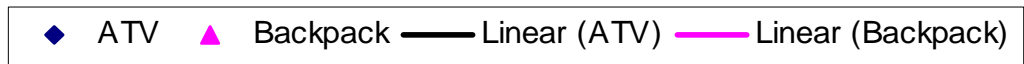
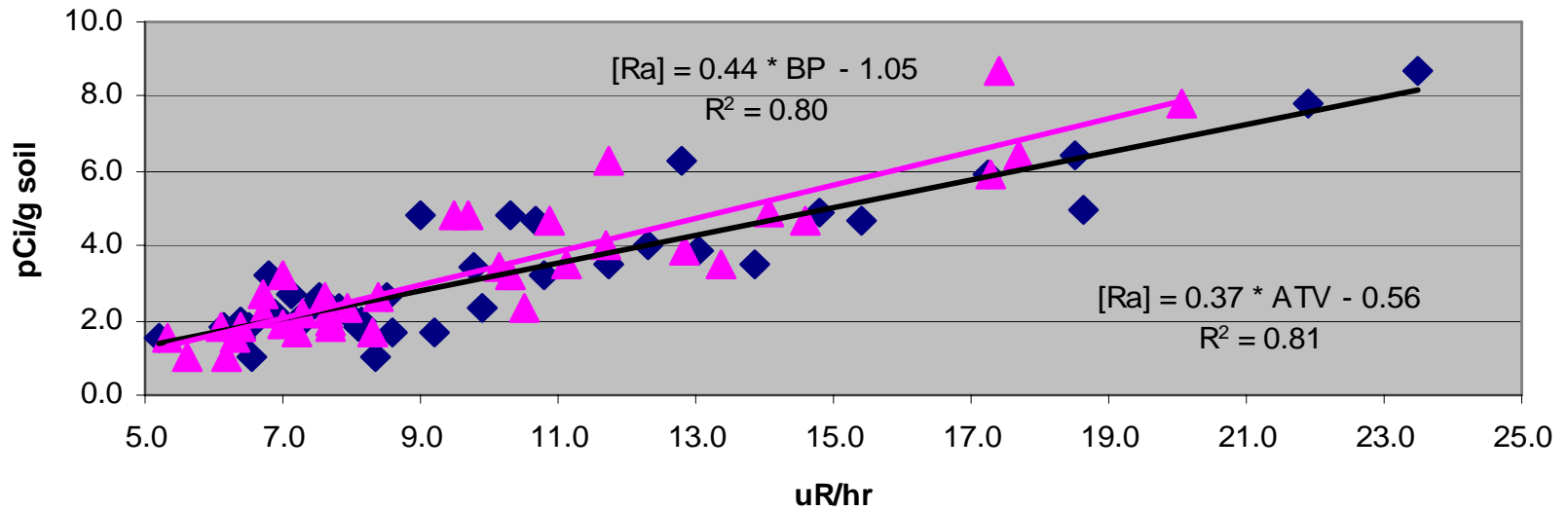
REGRESSION AND UPPER PREDICTION LIMIT FOR RA-226 CONCENTRATION IN SOIL AS A FUNCTION OF ATV GAMMA EXPOSURE



REGRESSION AND UPPER PREDICTION LIMIT FOR RA-226 CONCENTRATION IN SOIL AS A FUNCTION OF BACKPACK (BP) GAMMA EXPOSURE



[Ra] < 15 pCi/g in soil vs. Gamma



System Improvements

- The iQue is the size of a standard GPS so greatly improves the backpack capability
- The pen top computer can be programmed to record and store data from multiple detector/GPS units
 - Truck-mounted systems can carry up to three detectors
- The system is now programmed so that the data can be downloaded to a laptop and displayed on a base map immediately.
 - This allows the surveyor to make sure all areas have been covered.

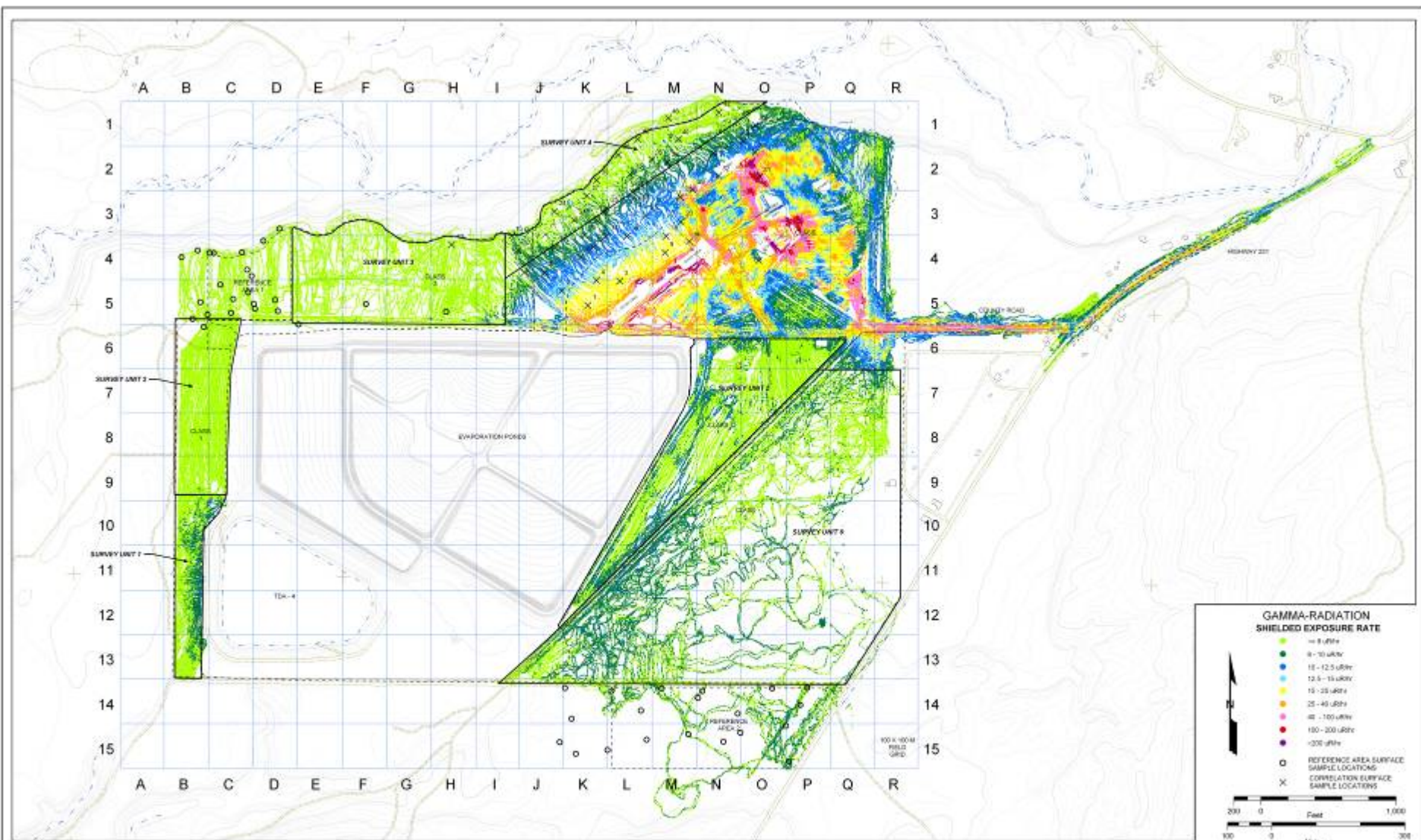
Truck Mounted Systems



Where do we go from here at DMC?

- Verification of areas that need no further cleanup based on the gamma scan.
- Site soil cleanup driven by the gamma scan and backhoe trench results.
- Final Status Survey at the time of site closure:
 - Gamma scan
 - Soil Sampling





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Project Manager

