

# Meteorological Monitoring Program Overview

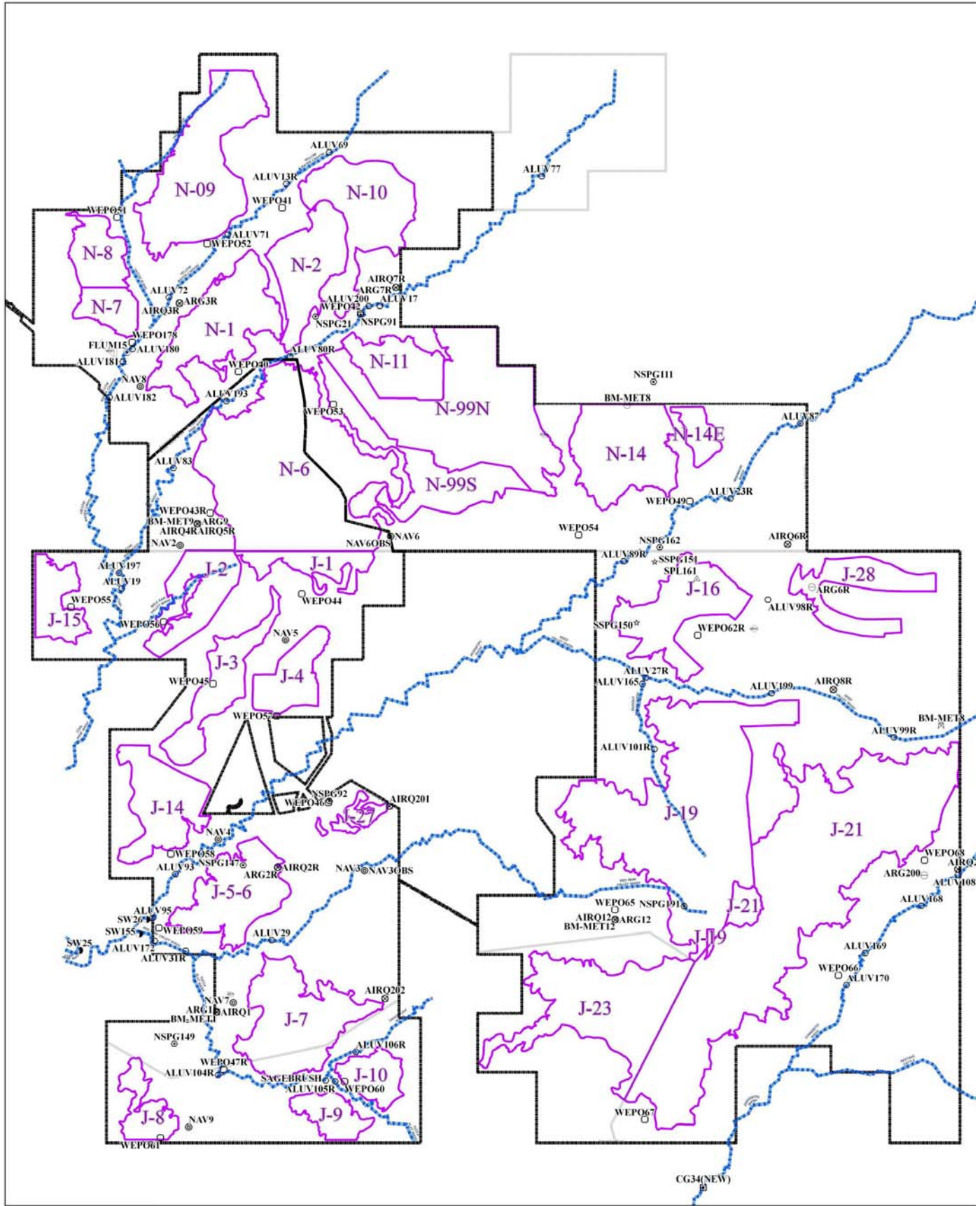
## Peabody Western Coal Company – Black Mesa Complex

- Peabody Western Coal Company (PWCC) has operated the Black Mesa Complex since the early 1970's
- Located in Northeastern Arizona on both the Navajo Nation and Hopi Tribal lands
- PWCC's Meteorological Program began in the Spring of 1980, resulting in the collection of more than 27 years of data
- The Program provides data primarily in support of a comprehensive Air Quality Monitoring Program
- The meteorological data also provides rainfall data required under PWCC's NPDES Permit, and general met data required by the SMCRA mining permit for the Kayenta Mine

# Meteorological Monitoring Program Overview

## Peabody Western Coal Company – Black Mesa Complex

- Meteorological data is collected at 9 locations at the Black Mesa Complex, and is comprised of the following:
  - One 40-Meter Tower (MET9)
  - Three 10-Meter Towers (MET1, MET8R, and MET12)
  - Eight tipping-bucket rain gages (ARG1, ARG2R, ARG3R, ARG6R, ARG7R, ARG9, ARG12, and ARG200)
- Changes to some of the original monitoring sites (1980) have occurred over the years due to regulatory concerns, but were limited to re-location of four rain gages and one of the 10-meter towers.
- The following slide provides a map of the Black Mesa Complex leasehold and the current locations of the met monitoring sites



ENGINEERING/RECLAMATION DEPARTMENT  
 EDWARD HILMAN  
 Black Mesa Complex, Pueblo, Tri-State Coal Company  
 DATE: \_\_\_\_\_  
 PEABODY WESTERN

- ⊗ Air Monitor
- ⊙ Aluvial Well
- ⊙ Crest Gauge
- ⊙ Navajo Well
- ⊙ Precip Gauge
- ⊙ Spoil Well
- ⊙ Spring
- ⊙ Wepo
- ⊙ Meteorological Tower
- ⊙ Idled
- ⊙ Spoil Spring
- Washes (Major)
- Permanent Tract Area
- Coal Area

- Permit Line**
- Mine Permit
  - Black Mesa Mine
  - Kayenta Mine
  - Lease Line

CHG#	DATE	DESCRIPTION
001	11/19/08	ISSUE
002	01/27/09	ISSUE PERMIT
003	02/10/09	ISSUE PERMIT
004	02/10/09	ISSUE PERMIT
005	02/10/09	ISSUE PERMIT
006	02/10/09	ISSUE PERMIT
007	02/10/09	ISSUE PERMIT
008	02/10/09	ISSUE PERMIT
009	02/10/09	ISSUE PERMIT
010	02/10/09	ISSUE PERMIT
011	02/10/09	ISSUE PERMIT
012	02/10/09	ISSUE PERMIT
013	02/10/09	ISSUE PERMIT
014	02/10/09	ISSUE PERMIT
015	02/10/09	ISSUE PERMIT
016	02/10/09	ISSUE PERMIT
017	02/10/09	ISSUE PERMIT
018	02/10/09	ISSUE PERMIT
019	02/10/09	ISSUE PERMIT
020	02/10/09	ISSUE PERMIT

CURRENT ENVIRONMENTAL MONITORING SITE DRAWING # 93500  
 Black Mesa Complex  
 PO Box 650, Kayenta, Arizona 86033  
 Produced For: PCCU - Map It  
 Map Scale: 1 Inch = 2000 Feet - Contour Interval  
 Map Check By: Ben Wilson  
 Plot Date: \_\_\_\_\_

# Meteorological Monitoring Program Overview

## Peabody Western Coal Company – Black Mesa Complex

- Instrumentation – 40 Meter Tower (MET9)
  - Climatronics F460 wind speed and direction sensors (10 and 40 meters)
  - Climatronics TS-10 temperature sensors (10 and 40 meters)
  - LiCor 200X solar radiation sensor (6 meters)
  - Belfort MRI 305 precipitation gage (3 meters)
  - Climatronics barometric pressure sensor (2 meters)
  - Campbell Scientific 21X data logger for data acquisition
- Pan evaporation data was collected at MET9 and the other three 10-meter towers beginning in 1980, but has since been discontinued



# Meteorological Monitoring Program Overview

## Peabody Western Coal Company – Black Mesa Complex

- Instrumentation – 10 Meter Towers (MET1, MET8R, and MET12)
  - Climatronics Wind Mark III wind speed and direction sensors
  - Climatronics 100093 temperature sensors
  - Belfort MRI 305 precipitation gage (3 meters)
  - Campbell Scientific CR10 data loggers for data acquisition
  
- Instrumentation – Precipitation Gages (ARG2R, ARG3R, ARG6R, ARG7R, ARG8)
  - Belfort MRI 305 precipitation gages (3 meters)
  - Campbell Scientific CR10 data loggers for data acquisition



# Meteorological Monitoring Program Overview

## Peabody Western Coal Company – Black Mesa Complex

- Data Reduction and Processing
  - Digital data is stored as 1-hr and 24-hr averages in each CSI data logger
  - Data is downloaded from the data loggers to CSI data storage modules, then transferred to PWCC personal computers and into relational databases
  - Data loggers perform many of the required data processing procedures internally (e.g., Sigma Theta)



# Meteorological Monitoring Program Overview

## Peabody Western Coal Company – Black Mesa Complex

- Data Logger Functions by Data Type
  - Wind Speed – 1-hr scalar mean values averaged from a continuously sampled signal, mph converted to knots
  - Wind Direction – Unit vector processing used to compile hourly averages
  - Sigma Theta – 1-hr values are calculated using four 15-minute values compiled
    - Based on EPA's February 2000 "Meteorological Monitoring Guidance for Regulatory Modeling Applications"

# Meteorological Monitoring Program Overview

## Peabody Western Coal Company – Black Mesa Complex

- Data Logger Functions by Data Type
  - Temperature, Barometric Pressure, and Solar Radiation – 1-hr values are compiled using the continuously sampled signals from each sensor
  - Precipitation – Hourly totals are calculated using the raw data set collected

# Meteorological Monitoring Program Overview

## Peabody Western Coal Company – Black Mesa Complex

- Audits
  - Quality Assurance audits of meteorological sensors are performed semi-annually by an independent contractor to assess accuracy of the measurements
  - Complete system checks are performed for each monitored parameter including sensors and associated outputs
  - QA Audits are performed in accordance with the EPA's March 1995 "Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV, Meteorological Measurements"

# Meteorological Monitoring Program Overview

## Peabody Western Coal Company – Black Mesa Complex

- Relational Databases
  - Meteorological Data is stored in relational databases based on Borland's PARADOX software
  - Lookup tables provide control for data integrity and include site names, coordinates, and other pertinent information such as beginning monitoring dates
  - Data is typically stored as 1-hr or 24-hour averages, including data logger derived calculations such as Sigma Theta
  - Data reporting utilities have been developed and are linked to the databases to provide daily, monthly, and annual data summary reports, wind rose diagrams, and other reporting and analytical features