

The Effects of Subsidence Resulting from Underground Bituminous Coal Mining, 2008-2013

**Bituminous Mine Subsidence and Land Conservation Act
Act 54 Amendments
4th Five-Year Report**

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Research was conducted by the University of Pittsburgh for the Pennsylvania Department of Environmental Protection



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Dear Mr. Shuler,

This letter accompanies the University's 4th Act 54 assessment period report entitled "The Effects of Subsidence Resulting from Underground Bituminous Coal Mining, 2008 to 2013". This report is the culmination of work by 24 researchers at the University of Pittsburgh over a two-year period. We believe it to be the most comprehensive Act 54 assessment to date.

Thank you for the opportunity to work with you in providing this information to the citizens of the Commonwealth of Pennsylvania.

Sincerely,

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ACRONYMS AND ABBREVIATIONS

Units of measurement

%	percent
cfs	cubic feet per second
ft	feet
ft ³	cubic feet
GB	gigabytes
gpm	gallons per minute
in	inches
lbs	pounds
m	meters
MA	million years ago
mi	miles

General

Act 54	1994 amendments to BMSLCA
Act54GIS	University of Pittsburgh's Act 54 geographic information system
ArcGIS	geographic information systems software produced by ESRI
AutoCAD	design software produced by Autodesk
BMSLCA	Bituminous Mine Subsidence and Land Conservation Act
BUMIS	Bituminous Underground Mining Information System
CAD	computer-aided design
CDMO	California District Mining Office
DEM	digital elevation model
EIA	United States Energy Information Administration
EHB	Environmental Hearing Board
EPA	United States Environmental Protection Agency
ERRI	Environmental Resources Research Institute
GIS	geographic information system
GPS	global positioning system
MrSID	multi-resolution seamless image database
MSI	Mine Subsidence Insurance
NAD 1983	North American Datum of 1983
NHD	National Hydrography Dataset
NLCD	National Land Cover Database
PADEP	Pennsylvania Department of Environmental Protection
PAGWIS	Pennsylvania Groundwater Information System
PASDA	Pennsylvania Spatial Data Access
PennDOT	Pennsylvania Department of Transportation
PSU	Penn State University
RMSE	root mean squared error
RPZ	rebuttable presumption zone
SE	standard error
SMCRA	Surface Mining Control and Reclamation Act of 1977
SSA	Surface Subsidence Agent

TIF	tagged-image format
USGS	United State Geological Survey
UTM	Universal Transverse Mercator coordinate system
<i>Hydrology</i>	
HMR	Hydrologic Monitoring Report
NWIS	National Water Information System
TGD 563-2000-655	Technical Guidance Document 563-2000-655, “Surface Water Protection – Underground Bituminous Coal Mining Operations”
<i>Streams</i>	
ANOVA	Analysis of variance
EPT	Ephemeroptera, Plecoptera, and Trichoptera taxa
FRAGSTATS	spatial pattern analysis software by the University of Massachusetts
MBII	Macroinvertebrate Biotic Integrity Index
NMDS	Non-metric multi-dimensional scaling
PLS regression	Partial least squares regression
SAS	Statistical Analysis System software produced by SAS Institute
TBS	Total Biological Score
TGD 391-0300-002	Technical Guidance Document 391-0300-002, “Water Quality Antidegradation Implementation Guidance”
TGD 563-2000-655	Technical Guidance Document 563-2000-655, “Surface Water Protection – Underground Bituminous Coal Mining Operations”
UNT	unnamed tributary
WRDS	Water Resources Data System
<i>Wetlands</i>	
NWI	National Wetlands Inventory
PEM	Palustrine emergent wetlands
PEM1	Palustrine emergent wetlands that are dominated by vegetation that remains standing until the following growing season
PEM1B	Palustrine emergent wetlands that are dominated by vegetation that remains standing until the following growing season and that are characterized by a saturated water regime
PFO	Palustrine forested wetlands
PFO1	Palustrine forested wetlands that are dominated by broad-leaved deciduous vegetation
POW	Palustrine open water wetland
PSS	Palustrine scrub/shrub wetlands
PUBHh	Palustrine unconsolidated bottom wetlands that are permanently flooded due to a dike or impoundment
TGD 363-0300-001	Technical Guidance Document 363-0300-001, “Design Criteria – Wetland Replacement and Monitoring”