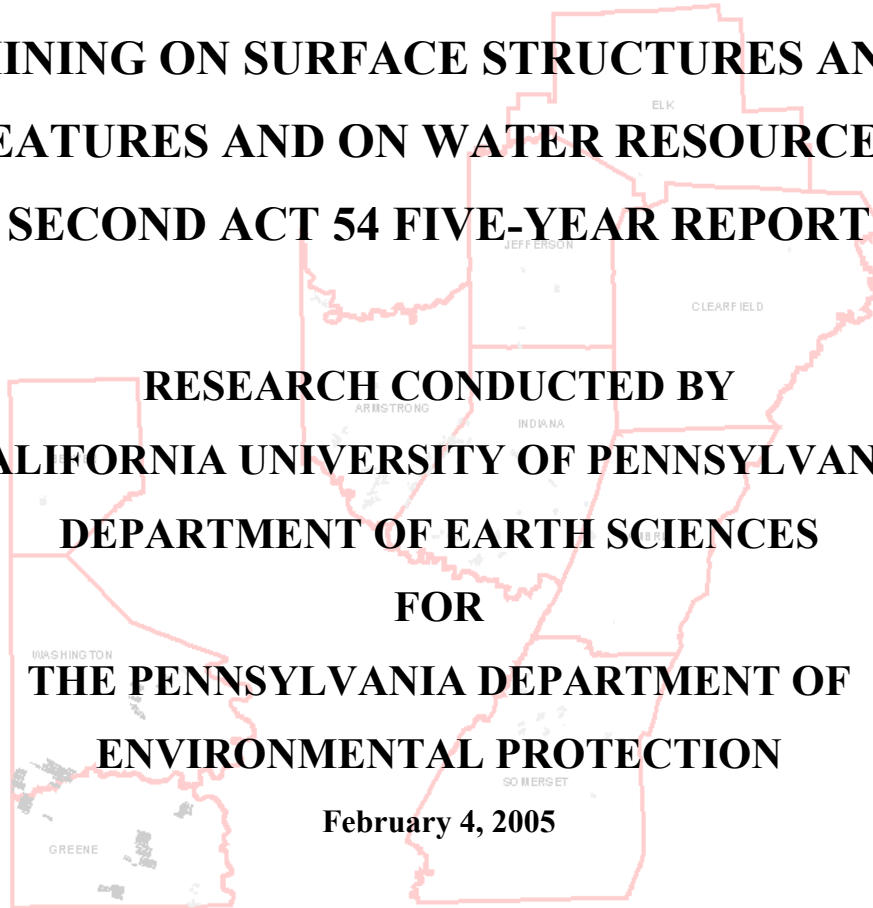


**THE EFFECTS OF SUBSIDENCE RESULTING  
FROM UNDERGROUND BITUMINOUS COAL  
MINING ON SURFACE STRUCTURES AND  
FEATURES AND ON WATER RESOURCES:  
SECOND ACT 54 FIVE-YEAR REPORT**

**RESEARCH CONDUCTED BY  
CALIFORNIA UNIVERSITY OF PENNSYLVANIA  
DEPARTMENT OF EARTH SCIENCES  
FOR  
THE PENNSYLVANIA DEPARTMENT OF  
ENVIRONMENTAL PROTECTION**

**February 4, 2005**



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## **A Guide to Understanding Section IV-Effect of Mining on Water Supplies**

- Individual plates show the water sources for an individual mine.
- For longwall mines, water sources are broken down into *unaffected*, *liability*, and *no liability* categories.
- For room-and-pillar mines, water sources are not categorized.
- Plate 1 shows water sources related to longwall mining.
- Plate 11 shows water sources, with claims, related to room-and-pillar mining.
- High Quality longwall mine, which has public water in the area, had no water source claims.
- High Quality mine only had room-and-pillar development mining started during the study period, longwall panels had not yet been mined as of the assessment period.
- All labeling is accurate *for the time of collection*.

## **Section IV: EFFECT OF MINING ON WATER SUPPLIES**

### **IV.A. Overview and Methodology**

This section reviews and analyzes all data related to water loss problems and claims as reported by property owners and mine operators during the assessment period (see IA). It ties those problems and claims both to the natural ground-water recharge cycle and to the relationship of the problem or claim to the location and type of underground bituminous coal mining. The section also addresses the method of data acquisition, storage, and use.

Other foci of this section are the mechanisms for determining both the liability in water loss claims and the replacement of water supplies that were lost because of mining.

Mining companies appear to view these water supply impacts as relatively minor and manageable, whereas private well owners whose wells have been damaged (impacted) during the period of proximal mining typically view these impacts as cataclysmic and potentially financially ruinous. In many instances observers with independent points of view make qualitative, rather than quantitative, assessments of water loss impacts.

Because individual property owners who suffer water losses experience undeniable inconveniences and even hardships, this section also addresses the time that expired between the date of the water loss report and claim and the date of the final resolution of the problem. The importance of mapping as accurately as possible water sources (springs, wells) through GIS (Geographic Information Systems) software is also discussed.

As mentioned in section III.B, the Pennsylvania Department of Environmental Protection (PA DEP) has developed and maintains an integrated electronic data file known as the Bituminous Underground Mining Information System (BUMIS). A BUMIS record is generated at the California District Mining Office in California, PA either by direct contact between the water supply owner and the PA DEP or by self-reporting by the mine operator when the water supply owner contacts the mine operator. Such self-reporting is required pursuant to Act 54. Because this self-reporting is redundant with the ability of the water supply owner to directly contact the PA DEP, *the number of water loss*

*problems filed is believed to represent all of the water loss problems during the assessment period.*

BUMIS allows for queries that can generate reports for given time frames. At the request of the University's research group (see IA), the PA DEP information technology managers queried this database and provided the researchers with information on all problems reported within the assessment period. The report on this database contains information collected on each water loss claim and problem reported during the period August 21, 1998, through August 20, 2003, the time frame of this report. In addition, the researchers queried the BUMIS files to weed out redundancies (as discussed in section III.J) and to collate reports on various categories of "problems." Some BUMIS records were found to be incomplete. Where possible, PA DEP *water loss reports* (paper files) housed in the California District Mining Office were investigated by the University to find the needed data. In addition, data were provided from the Bureau of Abandoned Mine Reclamation (BAMR).

Water loss **problems** were separated into three categories based upon the cause of the water loss. The majority of the reported problems are directly related to subsidence and related physical effects of underground mining on the overlying surface and overburden. Some water loss problems arose from the flooding of underground mines, and a few water loss problems arose from refuse disposal activities. These three areas are evaluated separately so that the effect of each category can be understood.

#### **IV.B. Direct Mining Water Loss Claims**

During the five-year assessment period, 684 (including one post-mining from Dora 6) wells and springs were reported to the PA DEP as potentially impacted by mining for all of the bituminous coal mines in Pennsylvania. Act 54 provides an opportunity for the mining company and the property owner to reach an agreement regarding the water loss. This agreement could include water supply replacement, repair, recovery, treatment or financial compensation. If the property owner is not satisfied with the mine operator's response, the property owner may file a water loss claim with PA DEP.

Upon receipt of a **claim**, the PA DEP, through the California District Mining Office, is required to make a determination on the validity of the claim. If the water supply is located within the 35-degree angle of presumptive hydrologic influence, then the mine operator is deemed responsible unless the operator can demonstrate that mining was not the cause of the water loss. If the water supply is located outside of the 35-degree angle of presumptive hydrologic influence, then the burden of proof falls to the agency. As each claim progresses from initial reporting to final resolution, its status, including the method of final resolution, is recorded in BUMIS. Based on the BUMIS data and the data obtained from PA DEP files housed in the California District Mining Office the University finds that 54.5 percent of the water losses reported to the PA DEP were resolved without PA DEP involvement. Owners of 45.5 percent of affected water supplies filed water loss claims with the Department.

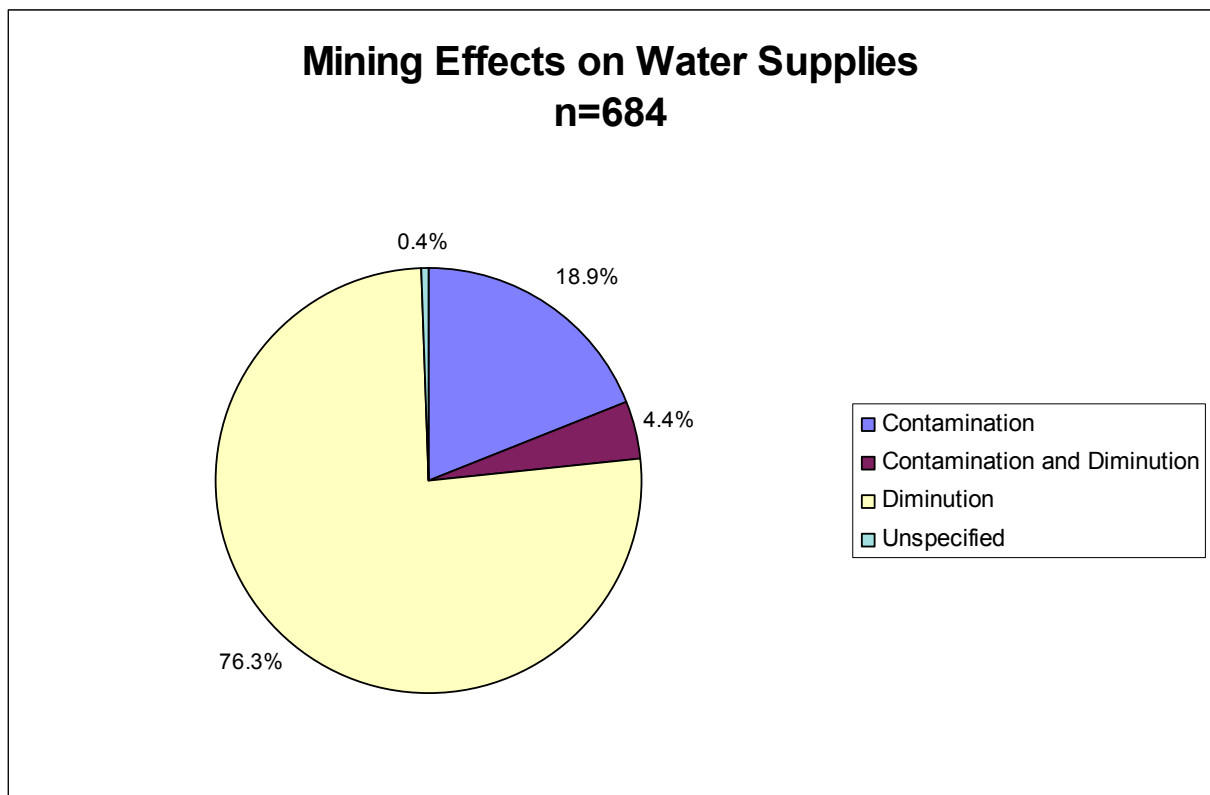


Figure IV.1. Types of problems that were reported during the assessment period.

Figure IV.1 shows the relationship between reported water supply contamination and water supply diminution. Water loss, referred to here as diminution, can be either partial or complete. In those cases where water loss is partial it is possible that water quality can also be affected at the same time. This leads to a dual category of both contamination and diminution. Over 76 percent of reported water supply impacts resulted from insufficient water quantity; almost 19 percent of reported water supply impacts resulted from contamination; and 4.4 percent of reported impacts resulted from combined causes: both diminution and contamination. These data do not reflect any investigation by the PA DEP or the mining company as to the accuracy or validity of the reported water supply impact.

These 684 reported water supply impacts are addressed first by the mining company and then, if necessary, by the PA DEP through the California District Mining Office. The status of the final resolution of these reported impacts, at the end of the assessment period, are presented in table IV.1. The largest percentages of these data, 39.7 percent, are contained in the category “No Liability.” Figure IV.6 and the associated text will evaluate the components of the “no liability” category. Nearly 22 percent of **reported problems** are awaiting final resolution as of this writing. This is followed by “Permanent Supply (Unspecified)” at 19.3 %.

These data, separated as they are into all of these categories, do not allow for a simple understanding of the status of the water loss claims. Therefore, the data have been reduced into six categories. These categories are:

- Resolved Financially
- Permanent Supply
- Repaired / Recovered
- No Problem or Withdrawn
- No Liability
- Resolution Pending

Table IV.1. Resolution Status for 683 Water Claims. The number of problems in this table differs by one from the number in the pie diagram of figure IV.1 because the former includes a water problem associated with Dora 6 (see V.L) that the University later identified as one that is more appropriately included in the 42 post-mining problems that occurred during the assessment period. It also differs from the Scorecard total for water problems because the Scorecard number derives from those water sources *that could be mapped on the basis of accurate locations* contained in the Water Loss files of the California District Mining Office and/or on the “six-month mine maps” submitted by the mine operators. The Scorecard also contains 42 post-mining water claims from Dora 6 (the one included in the assessment period plus 41 others) and two from Mathies Mine (see section IV.E).

<b>Category</b>	<b>n</b>	<b>Percent</b>
Agreement (Pre-Mining)	11	1.6%
Agreement (Unspecified in Records)	35	5.1%
Company Purchased Property	8	1.2%
Compensated	3	0.4%
No Actual Problem	9	1.3%
No Liability	271	39.7%
Permanent Supply (Public)	5	0.7%
Permanent Supply (Public & Agreement)	2	0.3%
Permanent Supply (Unspecified)	132	19.3%
Permanent Supply (Unspecified & Agreement)	1	0.2%
Permanent Supply (Well/Spring)	32	4.7%
Permanent Supply (Well/Spring & Agreement)	1	0.2%
Repaired	10	1.5%
Water Supply Recovered	7	1%
Withdrawn	8	1.2%
Resolution Pending	148	21.7%
<b>Total</b>	<b>683</b>	<b>100%</b>

Figure IV.2 shows the distribution of these simplified categories. The category “Repaired or Recovered” should be considered a sub set of the “Permanent Supply” category in that a permanent supply has been reestablished. “Repaired or Recovered” is identified separately in this graph to differentiate the level of intervention required in resolving the water loss.

Because this graph shows the status at the end of the study period it can be somewhat misleading. This is particularly true of the category entitled “Resolution Pending.” This



category contains water supplies that may be waiting for departmental review, but it also contains water supplies where the mining company has been determined to be responsible, but a permanent replacement has not yet been installed, or a permanent supply has been installed, but the operation and maintenance costs are not resolved. A breakdown of “Resolution Pending” for longwall mines is discussed later in this report (section IV.K).

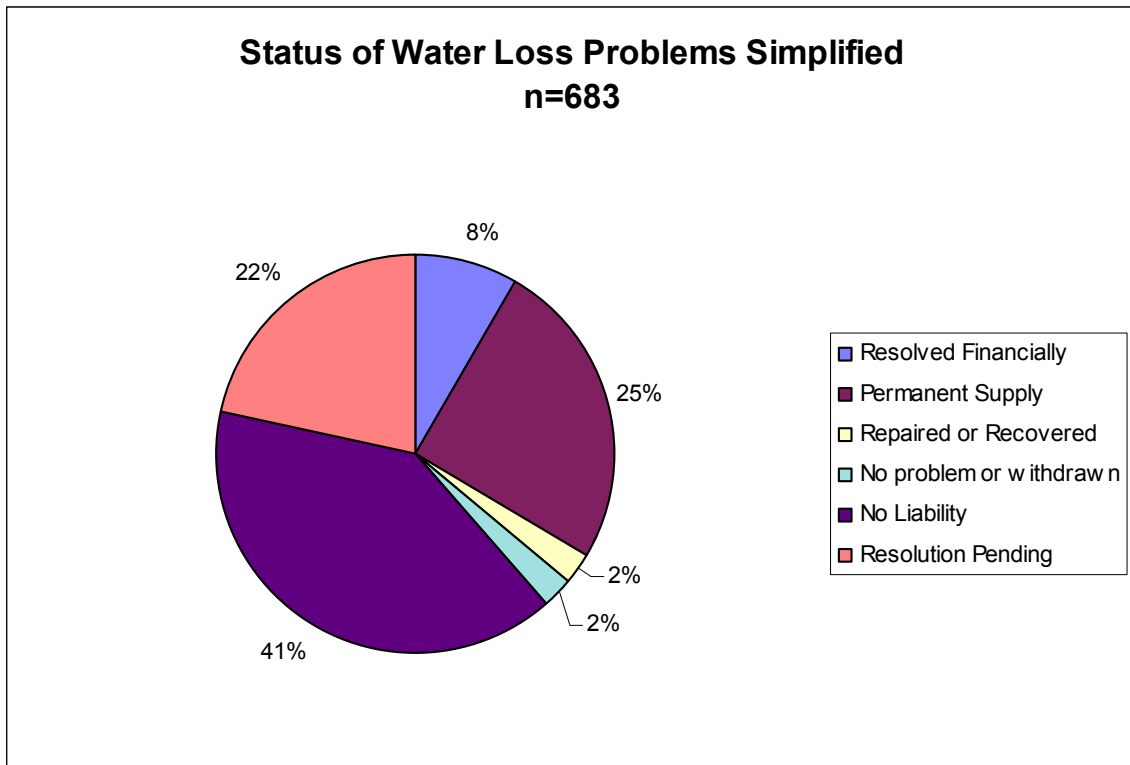


Figure IV.2. Status of reported water loss problems at the end of the assessment period.

It has been previously stated that 54.5 percent of water loss reports are resolved without PA DEP involvement. These are the cases where the mining company is clearly responsible and the mining company accepts that responsibility or where both the water supply owner and the mining company agree that the problem is not the mining company’s responsibility. Those cases that are more problematical fall to the California District Mining Office to investigate and resolve. Of the 683 reported water supply impacts 310 water loss claims were filed. Figure IV.3 shows the resolution of water loss claims filed with the PA DEP during the assessment period. In 63 percent of the water

loss cases the PA DEP found that the mining company was not liable for the reported water supply impact, in over 33 percent of the cases the PA DEP found that the mining company was liable (including resolution pending), and in less than 4 percent of the cases it was determined that no problem existed or the claim was withdrawn.

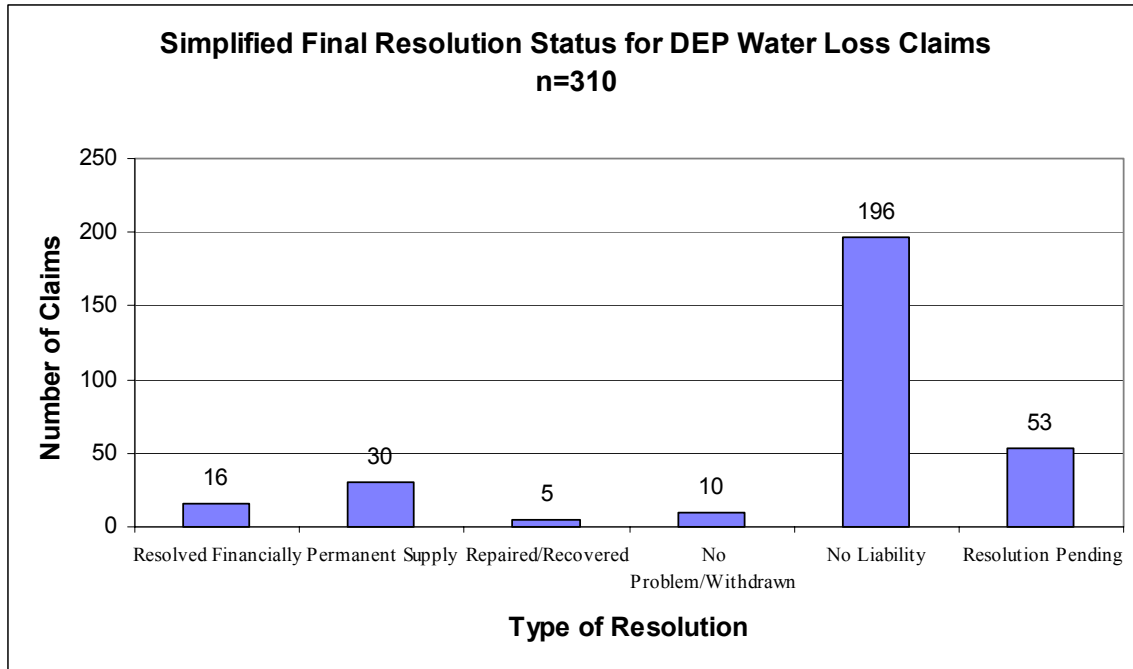


Figure IV.3. Final resolution of water loss claims filed with PA DEP

#### IV.C. Seasonality of Water Loss Claims

Water loss claims do not occur uniformly throughout the year as might be expected from the year-round operation of the mines. Rather, water loss reports are found to be seasonal, and are inversely correlated with precipitation. Within BUMIS, 536 entries contained information on the date that the water loss problem occurred. Figure IV.4 shows the distribution of these water loss reports by month within the study period. It is easy to see the cyclical nature of the water loss reports during the assessment period.

These data were combined so that the number of reports per month could be averaged over the five-year period. This technique clearly shows, in figure IV.5, the seasonal variation in water loss report frequency. Water loss reports in June through December

are 2.25 times higher than in January through May. Since mining is not seasonal, the increased numbers of water loss reports in the June through December time period are indicative of other factors at work. Several possibilities exist to explain this variability. Wet conditions may mask mining's impact until dryer conditions occur. Wet conditions may allow for the rapid filling of near surface voids resulting in "recovery" before a problem is identified. And finally, dry conditions may result in the reporting of water supply impacts as mining impacts even though the water loss is not related to mining.

#### **IV.D. Precipitation and Temperature**

Precipitation data during the five years from 1998 to 2002 are shown in figure IV.6. This time period does not include the last eight months of the assessment period in 2003. These data are presented as departures from normal. If above normal precipitation was observed, then the bar is drawn above the zero line representing greater than normal precipitation. If the bar is drawn below the zero line, then precipitation was less than normal: The larger the individual bar, the greater the departure from normal. These data indicate that between 1998 and 2002 the months between July and December were drier than normal, particularly during 1998 and 1999. In addition to the seasonal trends, it is also interesting to note the large number of water losses reported in November 1998 as shown in figure IV.4 compared to the November 1998 rain precipitation deficit data in figure IV.6.

During the same time period temperature data was also recorded (fig. IV.7); these data are also presented as departures from normal. When these two figures are compared it is easy to see that *not only was precipitation below normal but also monthly average temperatures were above normal*. These weather conditions are not conducive to ground water recharge, and it should be expected that water supplies that are based on shallow ground-water zones or where there is little ground-water recharge area would be subject to seasonal dewatering even without the influence of mining.

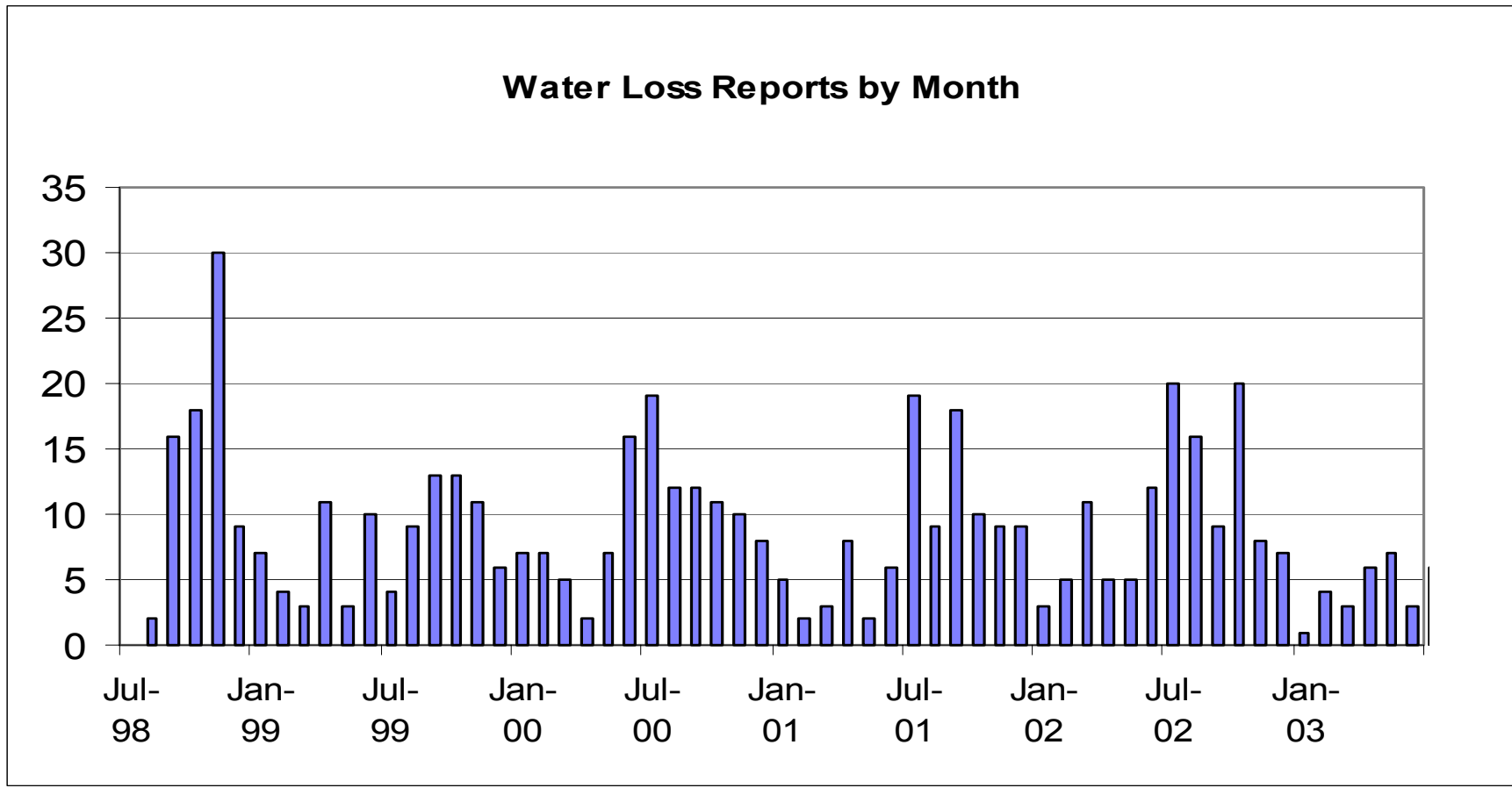


Figure IV.4. Seasonal variation in water loss reports to the California District Mining Office is revealed in the number of reports recorded for each month during the assessment period

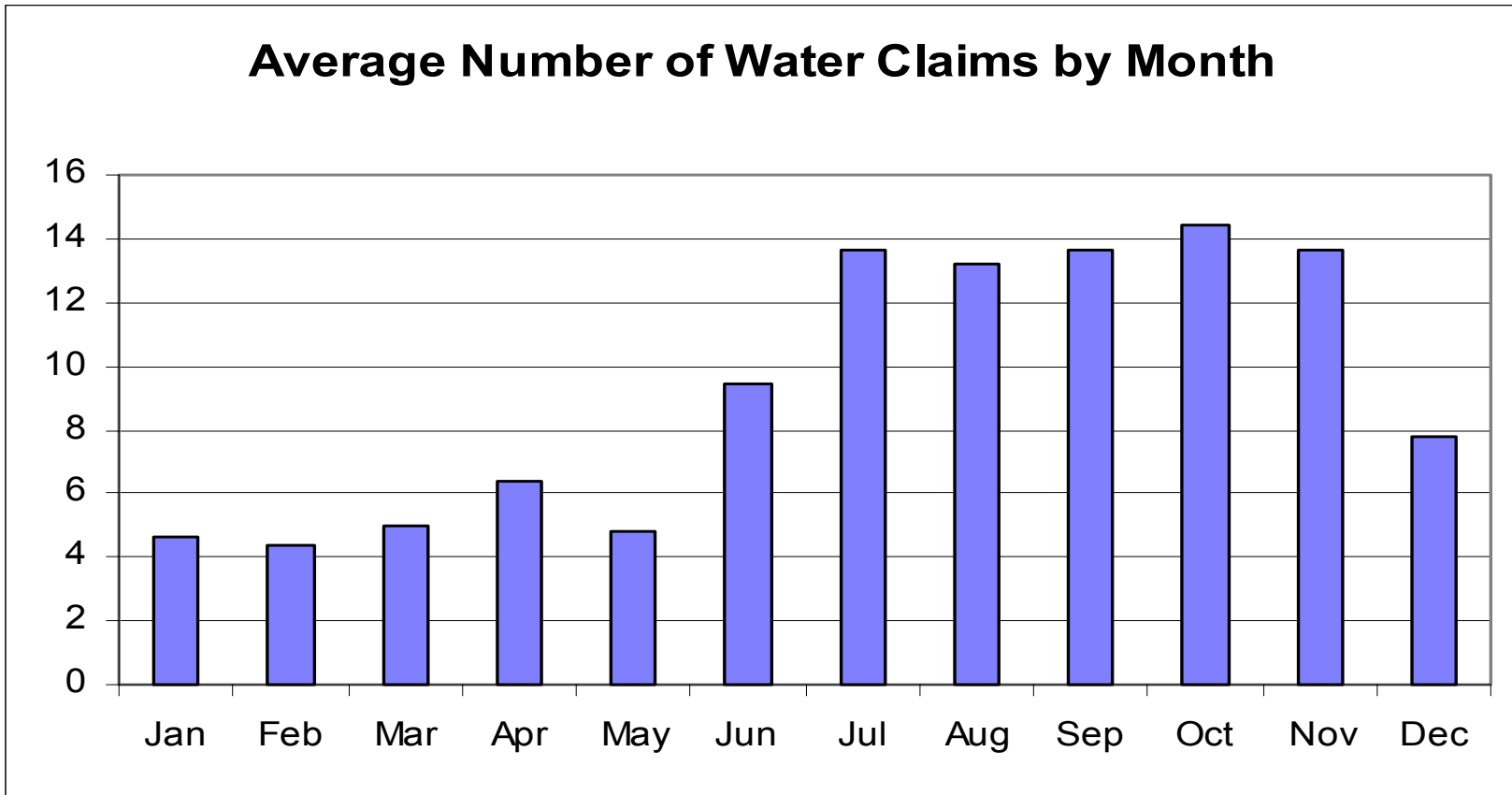


Figure IV.5. Average water loss reports filed per month with the California District Mining Office for the assessment period illustrate a seasonal pattern

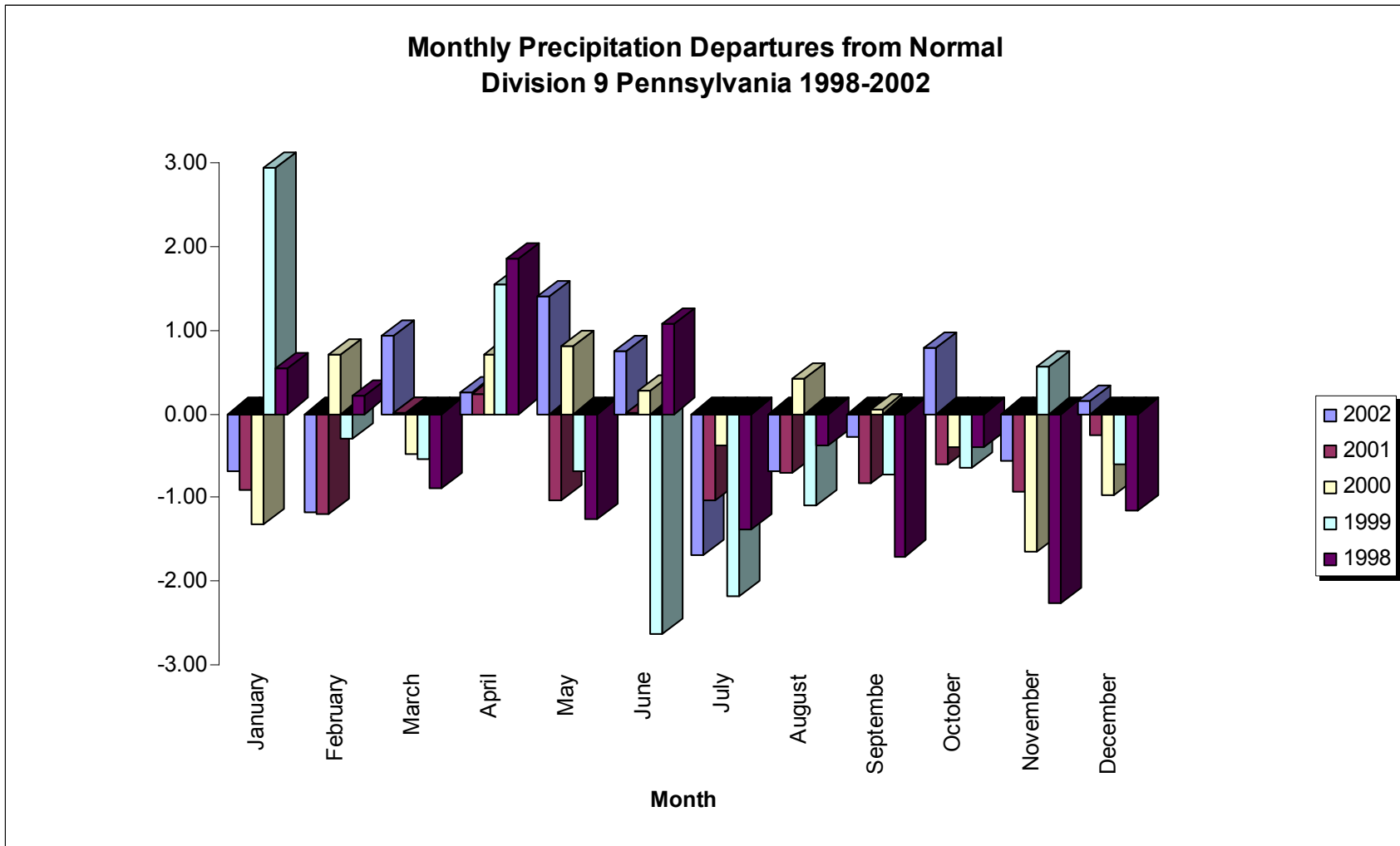


Figure IV.6. Departures from normal precipitation amounts for western Pennsylvania for most of the assessment period. Precipitation for 2003 was not available at the time of this writing

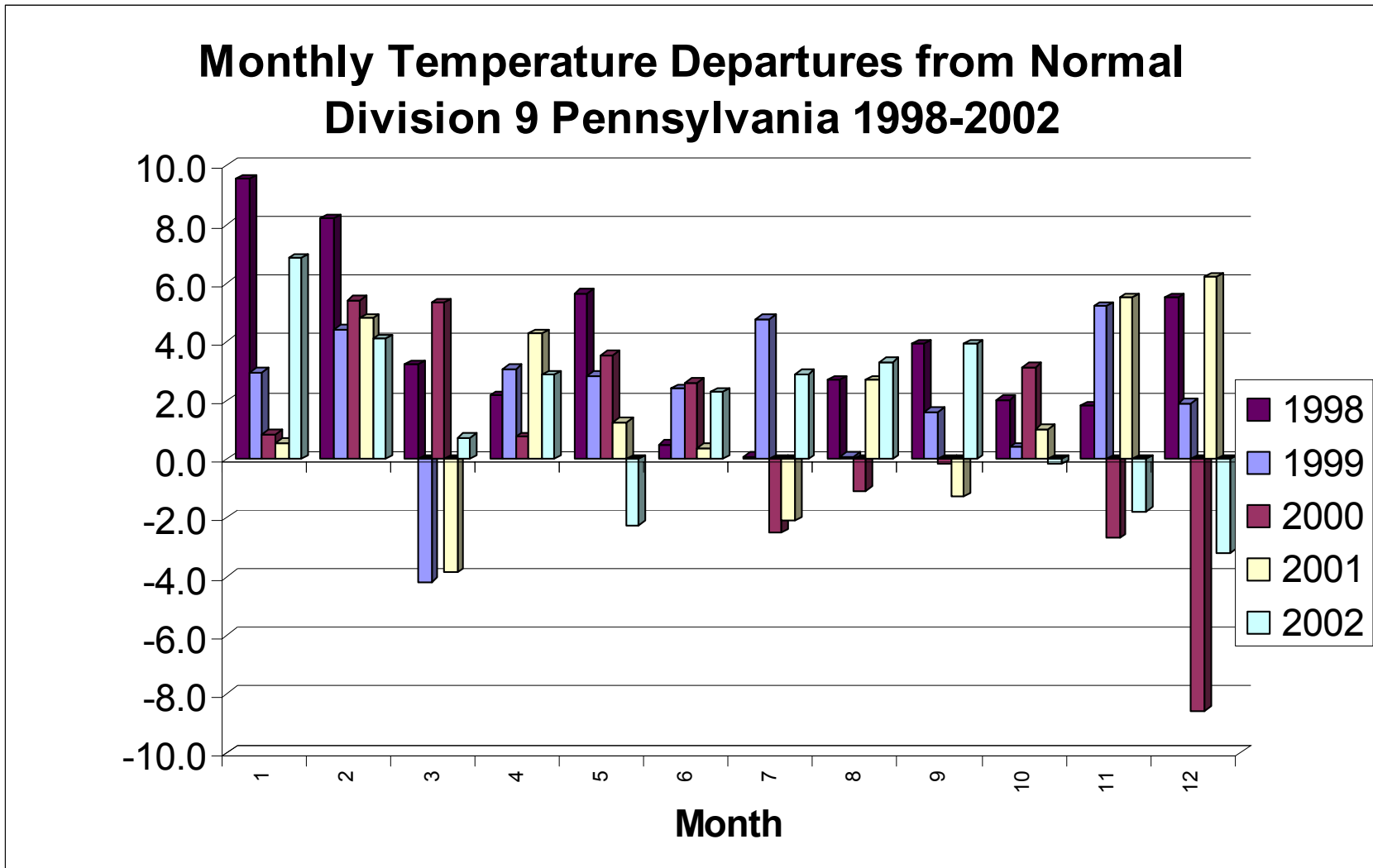


Figure IV.7. Monthly temperature variations as “departures from normal” for western Pennsylvania during the assessment period. Temperatures for 2003 were not available as of this writing

#### **IV.E. No Liability Determination**

The category “no liability” constitutes nearly 40 percent of reported water loss incidents, and as such deserves its own independent analysis. The determination of liability is a difficult and often complicated process. Many factors must be considered in arriving at a conclusion, some of the general factors include determination that a water loss exists. For example, a pump failure might be a mining related water loss but it could also be a water supply maintenance issue; in other cases the water supply owner may not allow a site investigation that would result in a determination by PA DEP that there was no problem. Mining related factors that influence the decision include: distance to mining; timing of the water loss in relationship to mining; overburden thickness, and the type and construction of the water source. Weather related factors such as drought conditions are known to affect water supplies. Finally, legal issues affect the determination of “no liability.” These issues include 1) water losses that occurred prior to the effective date of the Act 54 amendments, 2) losses of water sources that do not meet the definition of a water supply as defined in Act 54, 3) water losses, that upon investigation, are found not to be in the Commonwealth of Pennsylvania, and 4) water losses that are caused by activities other than underground bituminous coal mining.

Data in the BUMIS database, including the comments section, were categorized as to the reason given for this determination. Of the 271 determinations of “No Liability” fully 45 percent or 118 water sources could not be categorized from the BUMIS records. In order to understand the reasons for the determination of no liability for these 118 water supplies, the University’s researchers reviewed the water loss claim files housed in the California District Mining Office. These data were combined with the BUMIS data to create Figure IV.8. The categories shown in Figure IV.8 *are unique to this analysis and should not be confused with the categories used in Figure IV.2.* Water supplies shown here as recovered are in addition to the water supplies shown as recovered in Figure IV.2.

Distance to mining was by far the most significant factor cited in the data as the sole or dominant determining factor with 26.9 percent of the total. Often multiple factors were cited as the basis for the determination of “No Liability.” These multiple factors include



1) distance from mining, 2) mining method, 3) time of problem occurrence v. time of mining, 4) depth to mining, 5) recent trends in precipitation, and 6) hydrogeologic considerations such as limited recharge areas and the presence of a ground water divide (a geological barrier) between the mining and the water supply. Multiple factors represent 22.5 percent of the determinations of “No Liability.” The next most significant category included those water supplies where the mining took place prior to Act 54, 11.1 percent of the determinations. In only 8.1 percent of the cases was the mining company able to successfully rebut the presumption of liability that occurs within the 35-degree angle of hydrologic influence. Overburden depth was only a primary factor in 1.5 percent of the “No Liability” determinations.

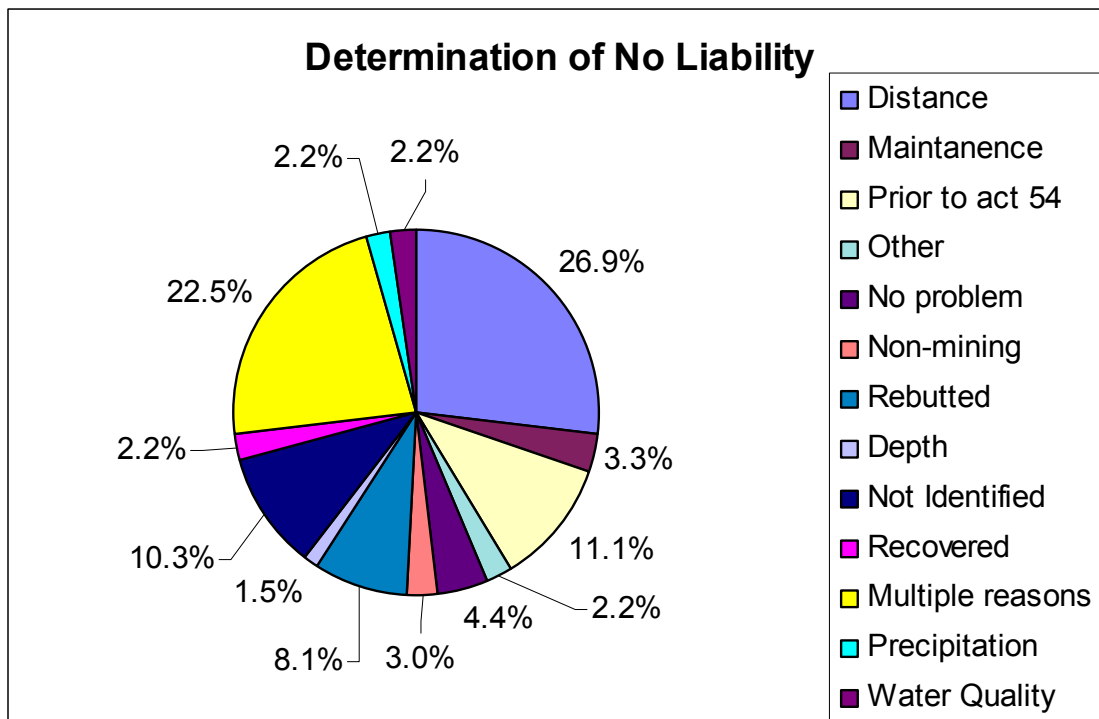


Figure IV.8. “No liability” determinations for water loss claims.

Other reasons that a determination of no liability was reached included 1) the water supply does not lie within Pennsylvania (1 supply); 2) the cause of the water loss was non-mining in origin (8 supplies); 3) the water supply had recovered (6 supplies); 4) upon investigation there was no problem found (12 supplies); and 5) failure to maintain the

water supply was found to be the cause of the problem (9 supplies). Of the primary factors affecting water supplies, drought (precipitation) was specifically cited in only 2.2 percent of the cases as the primary basis for the determination of “no liability” although it was included in 50 percent of the multiple factor determinations. One tenth (10.3 percent) of the “No Liability” determinations could not be categorized because the reasons were *not* recorded in either BUMIS or the water loss investigation files housed in the California District Mining Office.

The category “No Problem” includes those water supplies (12) that were reported as affected by mining but were discovered, upon investigation by the PA DEP (8 cases) or the mining company (4 cases) to be unaffected. The category “Maintenance” (9 supplies) includes three pump failures unrelated to mining, two stuck commode valves that drained the water system, and a plugged water filter.

As a result of the review of the water loss claim files it was determined that two cases that were listed in BUMIS as “No Liability” were, in fact, cases where “Liability” was assigned. One of these water supplies is located over 84 Mine and one is located over Mathies mine. Both of these water cases have been excluded from the “No Liability” category for purposes of analysis (The accompanying “scorecard” includes these two cases).

The BUMIS data were sorted to indicate the distance to mining for all determinations of “no liability” where distance was the determining factor. These data were placed into distance ranges of 0 to 500 feet; 500 to 1,000 feet; 1,000 to 1,500 feet; 1,500 to 2,000 feet; 2,000 to 3,000 feet; 3,000 to 5,000 feet; greater than 5,000 feet; and no distance data provided. The data were further divided into longwall and room-and-pillar categories. Figure IV.9 shows the results of this effort. In 13 cases, distance to mining was identified as the primary reason resulting in a determination of no liability; however, the “distance to mining” data field in BUMIS was blank.

Numerically, very few water loss claims are denied over longwall mines where the distance to mining is less than 1,000 feet. However, distance to mining is cited more frequently as the primary reason for denial of liability for room-and-pillar mines than it is for longwall mines even though longwall mines represent the majority of the water loss claims.

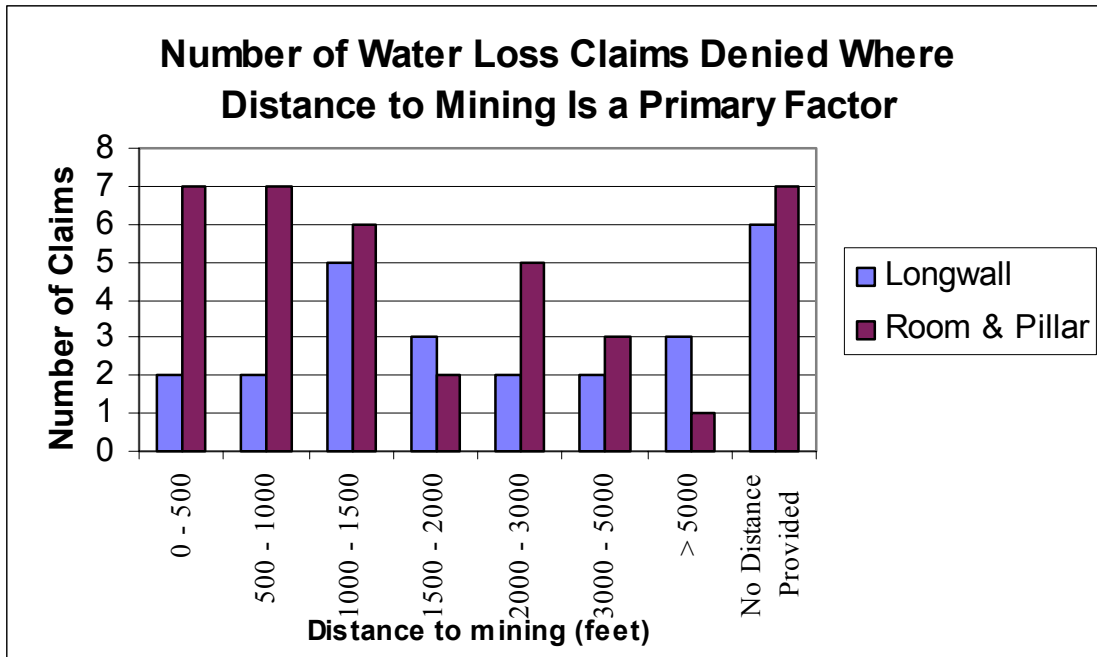


Figure IV.9. Claims denied because of “distance to mining.” As a rule, the 35-degree angle of draw can be interpreted as 26 feet on the surface from the mine boundary for every 100 feet of depth to the bottom of the coal seam.

#### IV.F. Water Loss Claims by Mining Type

All cases of reported water loss in the data set were sorted by mining type (longwall or room & pillar based upon the predominate mining type at each mine). These data were then sorted by water source (well or spring), and finally, they were sorted by type of water supply impact (contamination, diminution, or both). These data are shown in Figure IV.10. This graph allows for the comparison of water loss reports from longwall mines with room and pillar mines. It is clear from this graph that longwall mines had more reports of contamination and diminution than room-and-pillar mines. Reports of both contamination and diminution are about equal between the two mining types.

However, the area mined by each method during the assessment period is significantly different. The total number of acres mined in longwall operations is 27,508 acres, whereas the number of acres undermined by room-and-pillar mines totaled 11,004 acres. This represents 2.5 times as many longwall acres as room-and-pillar acres yet the reports of water loss, while higher in longwall operations, are not 2.5 times higher across the board. Indeed, reports of diminution in longwall wells are only 1.27 times the rate of reports in room-and-pillar mines. Contamination in longwall wells is only 1.09 times the rate of contamination reported in room-and-pillar wells. Diminution in longwall springs vs. room-and-pillar springs is on a par with the mining ratio between the two mining types at 2.51 times, whereas contamination in longwall springs is 10 times more frequent than in room-and-pillar springs. This last finding may be influenced by the low number spring contamination reports in either the longwall or room-and-pillar category. Overall, longwall mining generated 398 water loss reports, and room-and-pillar mining generated 279 reports for a longwall / room-and-pillar ratio of 1.43.

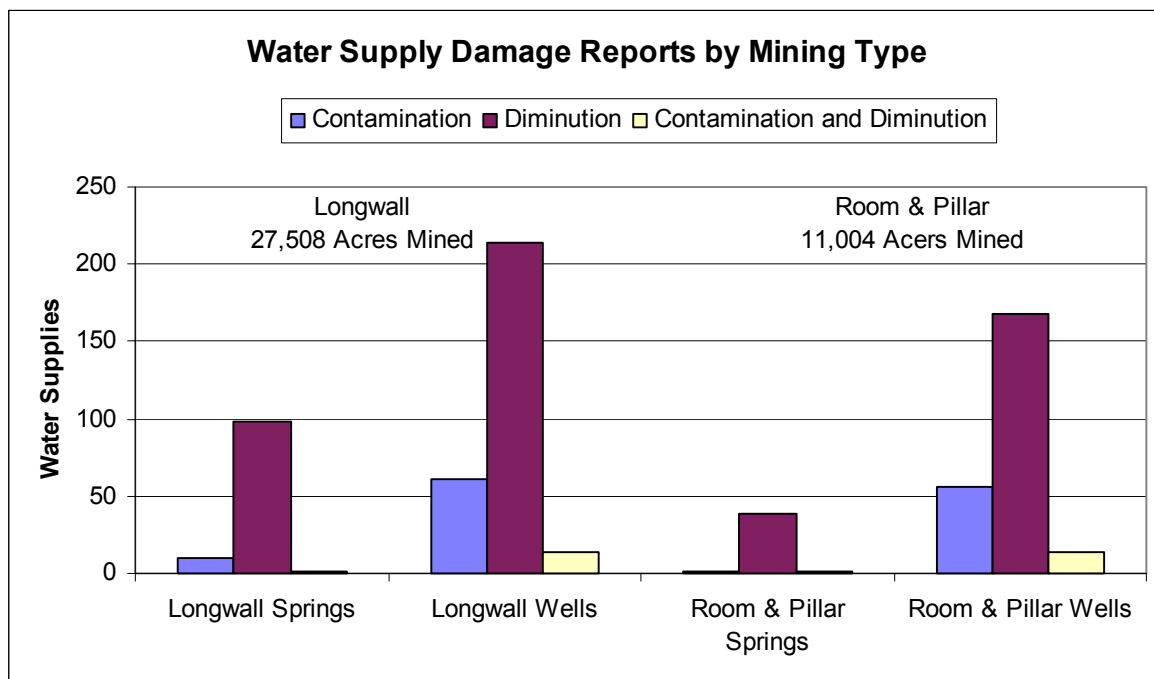


Figure IV.10. Comparison of water supply damage reports by mining type and contamination type.

Although these data suggest that longwall mining results in fewer affected water sources per acre, it would be premature to conclude that longwall mining results in less damage

per acre than room-and-pillar mining. The data used in this analysis include all reported water supply impacts including the reports where it was later determined that mining was not responsible. These “No Liability” data were not removed from the data set so that any suggestion of bias would be eliminated. Further, there is no basis for comparing the water supply density between the longwall areas and the room-and-pillar areas. Both of these factors may change the ratio between longwall mining and room-and-pillar mining.

The same source data were then compared with the “No Liability” reports removed. These results are shown in Figure IV.11 on the same vertical scale for comparison.

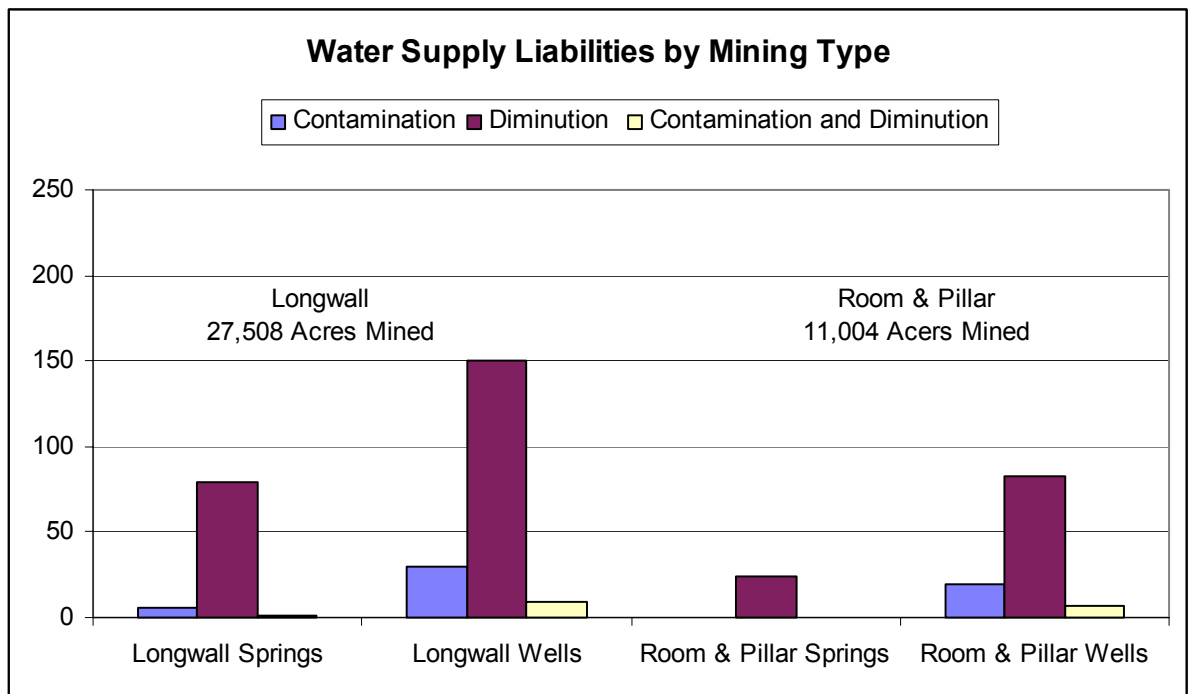


Figure IV.11. Comparison of water supply liabilities by mining type and contamination type.

If a similar comparison of ratios is performed between longwall and room-and-pillar mines, then the diminution in longwall wells rises from 1.27 times the rate of reports in room-and-pillar mines with the “No Liability” data included to 1.81 times with the “No Liability” data excluded. Contamination in longwall wells rises to 1.5 times the rate of contamination reported in room-and-pillar wells from 1.09. Diminution in longwall springs vs. room-and-pillar springs rises from 2.51 to 3. Contamination in longwall

springs cannot be calculated because no springs over room-and-pillar mines were found to be contaminated as a result of mining during the assessment period.

This rise in the ratio between longwall mines and room-and-pillar mines indicates that a greater percentage of reported water losses are ultimately determined to be the result of mining for longwall operations than for room-and-pillar operations. This would suggest that the PA DEP and mine operators find in favor of water supply owner reports when the mining type is longwall vs. room-and-pillar.

Even with this increase, the ratio between longwall liabilities and room-and-pillar liabilities for wells does not come up to the mined area ratio between the two mining types. Conversely, the ratio between longwall spring diminution and room-and-pillar spring diminution increases from being proportional to the acreage mined to being in excess of that ratio.

The University's researchers used the BUMIS data set to identify the number of valid or pending water-loss **reports** by mine. These data were then further sorted into longwall mines and room-and-pillar mines. Figure IV.12 shows the results for the longwall mines. Because of the amount of data available for these mines, the data were further broken down by the method of claim resolution. Figure IV.13 shows the results from the room-and-pillar mines.

For the nine longwall mines, a total of 262 water loss cases were deemed to be valid or are pending final resolution. While Humphrey was a longwall mine, all of the mining in Humphrey during the assessment period was by the room-and-pillar method. Humphrey, Dilworth and Maple Creek mines are now closed. Bailey, Blacksville #2, Cumberland, Emerald, Enlow Fork, and Mine 84 are all still

# Longwall Mine Water Loss Claim Resolution

■ Financial 
 ■ Permanent Supply 
 ■ Repaired / Recovered 
 ■ Pending

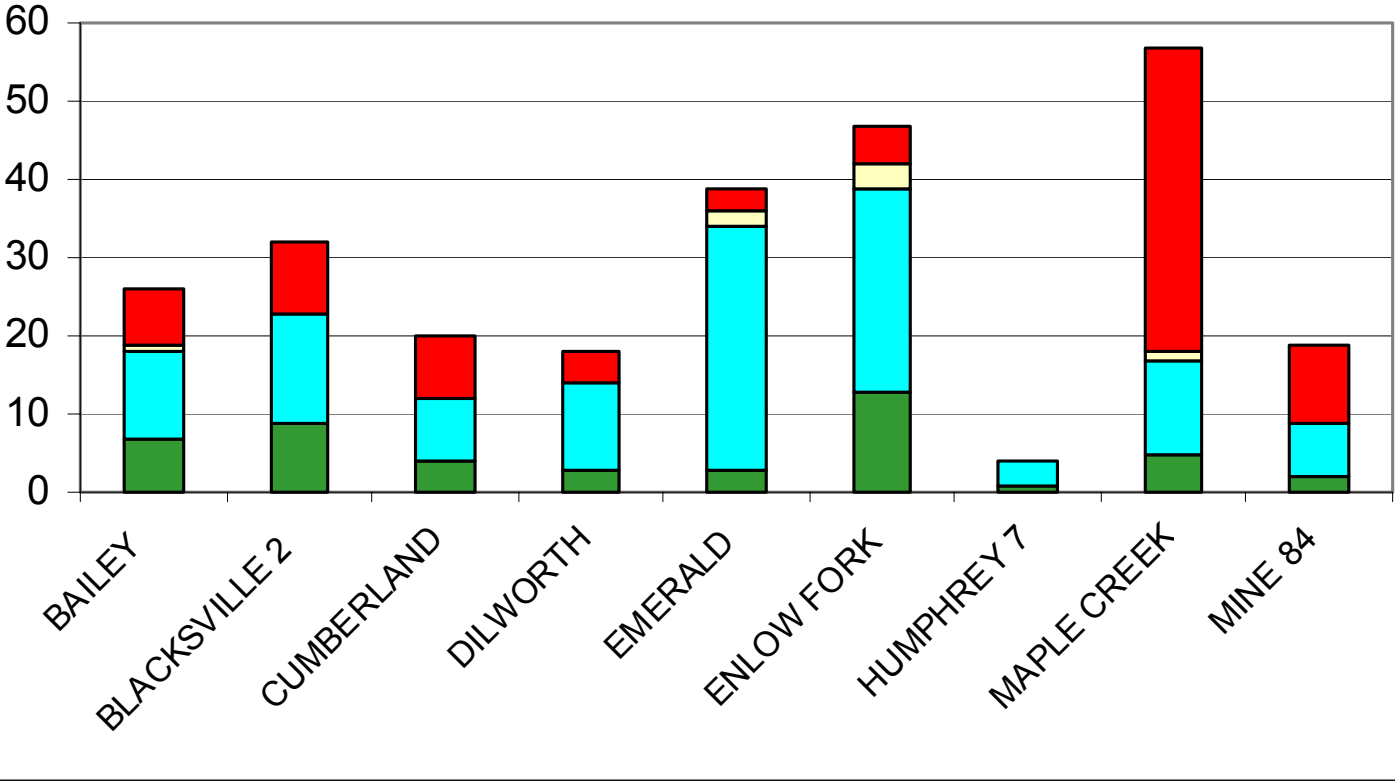


Figure IV.12. Resolutions for water losses over longwall mines

active operations. High Quality mine was active as a room-and-pillar operation during the assessment period but has become a longwall operation since the end of the assessment period. It is evident from figure IV.12 that Maple Creek has far more cases of “Pending” than any other mining operation, representing 46 percent of all pending cases.

The incidence of water supply losses attributed to room-and-pillar mines over the assessment period is significantly less on a per mine basis than for longwall mines with the exception of David Dianne Mine and Mathies Mine. (In section V of this report, water supply loss per mined acre will be investigated)

Figure IV.12 shows the method of resolution of water loss claims for room-and-pillar mines. Mathies and David Dianne Mine (called Dianne Mine at the time of this writing) have the greatest number of pending water loss claims. Future resolutions of the 18 pending water loss cases at Mathies Mine are in doubt since the operator filed a declaration of bankruptcy; however, a public water line extension is anticipated for some or all of these water supplies through BAMR.

#### **IV.G. Water Loss Problems by Water Source**

Of the 683 water-loss problems filed during the study period, 508 reports were for residential wells and 127 were for residential springs. There were eight agricultural springs and two agricultural wells reported to the PA DEP, as well as seven commercial wells and two commercial springs. The uses of the remaining wells and springs were either classified as “unknown,” “other,” or were not classified. Figure IV.14 shows how these problems were resolved. *These data indicate that the PA DEP was more likely to find the mining operation responsible if the water supply was a spring rather than a well.*



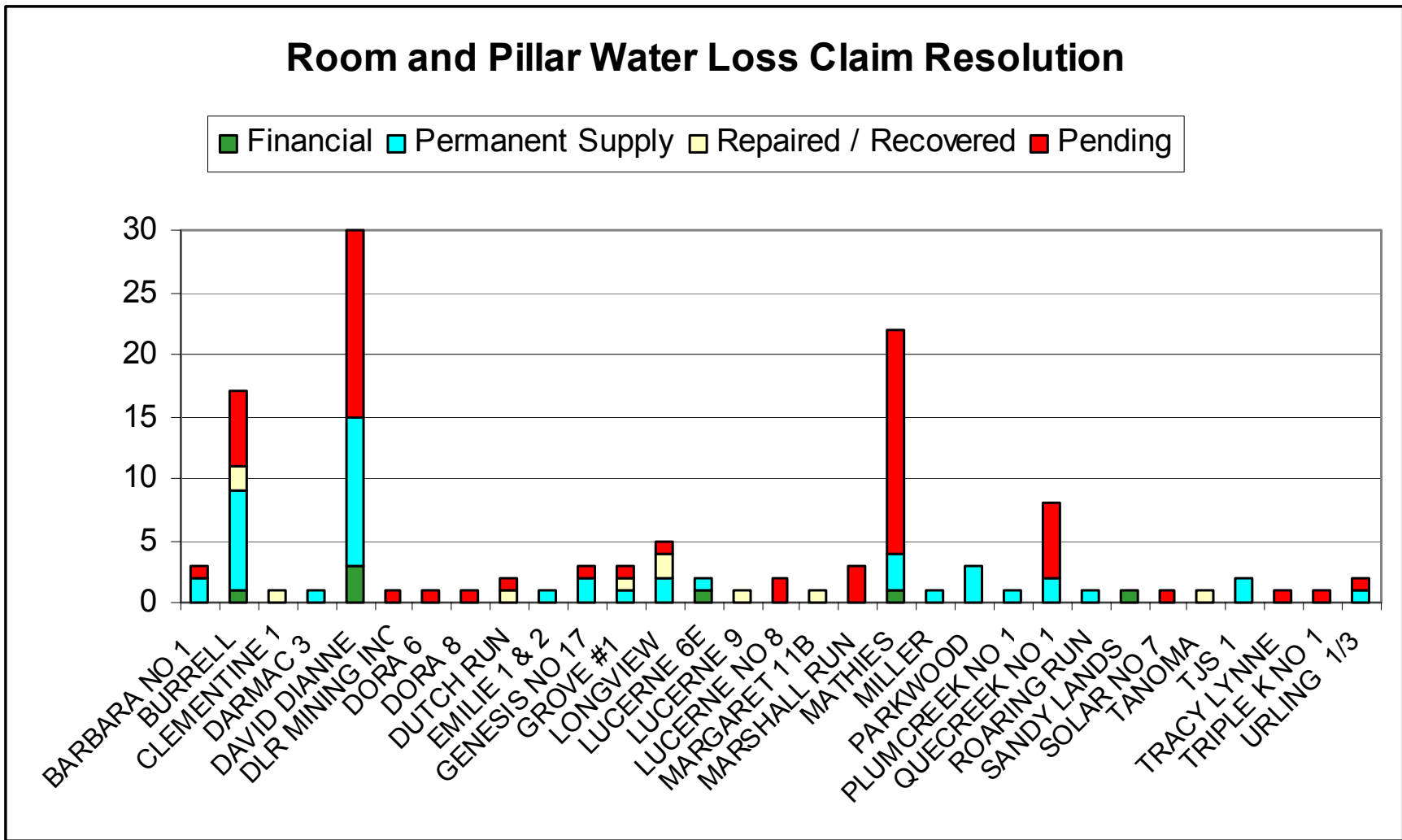


Figure IV.13. Resolutions for water losses over room-and-pillar mines.

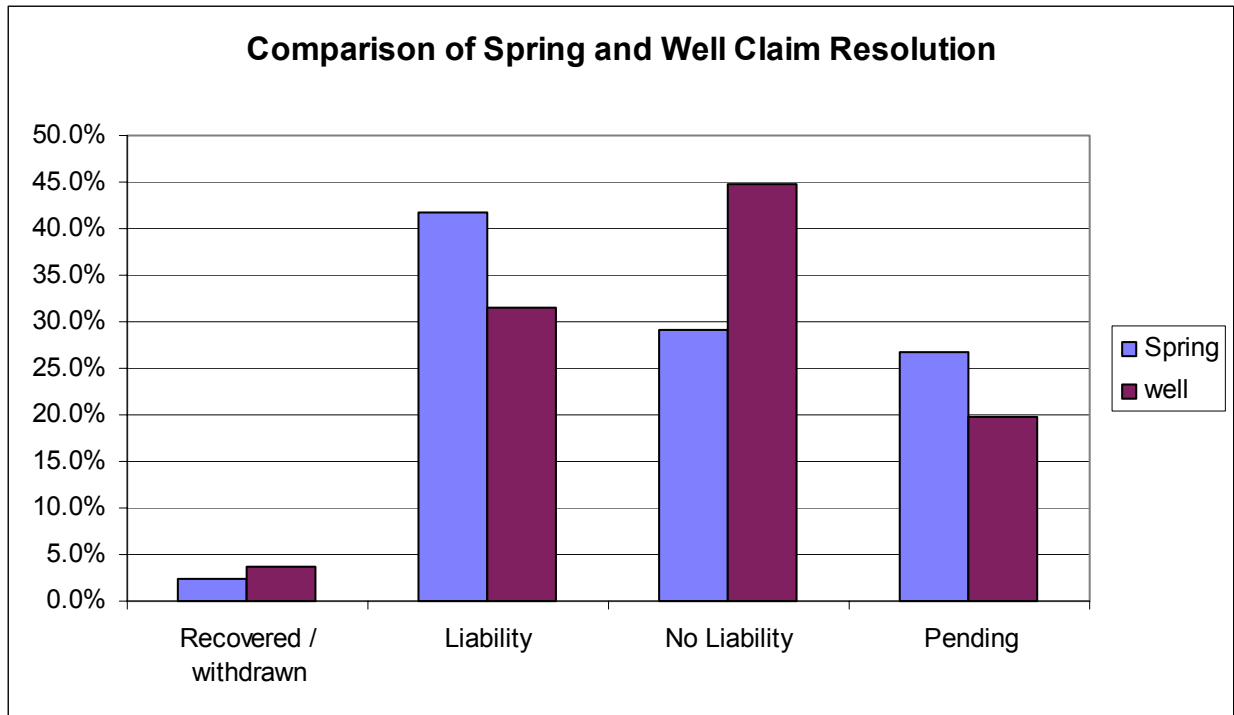


Figure IV.14. Resolutions of claims involving springs and wells.

In most cases a PA DEP classification of “resolution pending” means that the Department and (or) the mine operator have (has) determined that mining is responsible for the reported water loss. In order to determine the frequency with which the Department makes a determination in favor of the water supply owner, the University’s researchers combined the number of resolution pending supplies with the number of liability determinations for the purpose of calculating a percentage. Using this method, 68.5 percent of the 127 residential springs impacts were determined by the PA DEP to be caused by mining, while 51.4 percent of the residential wells impacts were attributed to mining.

The Department and (or) the mine operator are (is) finding in favor of the water supply owner 68.5 percent of the time. This percentage appears to be significant in contrast to the percentage of losses of wells and springs that have been documented in section V.K of this report. Based on pre-mine survey data, only 27 percent of all undermined wells and 18 percent of all undermined springs suffered impacts during the assessment period. This difference in percentages might be attributable to the degree to which a water source

was affected and/or the significance of the water source to the owner. Water loss claims coming before the Department would then generally represent the more difficult problems, with the less difficult “problems” (all water loss problems are “claims”) being resolved either without the Department’s official intervention (see IV.B, above).

#### **IV.H. Water Supply Density / Acres Mined**

Simply comparing the number of water supplies affected at each mine can create a misleading picture of that mine’s overall impact. Two factors can affect this comparison: water supply density and acres that are longwall mined. For example, two mines may have the same number of water supplies impacted; yet, one of those mines could have mined three times the area. Similarly, two mines with the same number of water losses could have a water supply density that varies by a factor of two.

In order to compare the longwall mines in Washington and Greene Counties, the University’s researchers normalized the water loss data through the following process. Longwall mines in the Pittsburgh Coal seam were digitized into the Geographic Information System (GIS) ArcMap 8.3 (see accompanying plates). The locations of water loss claims were combined with the location of water supplies from the pre-mine surveys and these points were also digitized into the GIS database. ArcMap 8.3 was then used to calculate the acreage that was longwall mined during the study period for each mine. At the same time, ArcMap 8.3 was used to count both the number of water supplies within 1,640 feet (500 meters) of the longwall panels, and the number of affected water supplies within the same distance (a greater distance would include un-impacted wells). In all cases, water supplies where the final resolution was pending were counted as “impacted.” Figure IV.13 shows this relationship. It is clear from this figure that Maple Creek had the greatest density of water supplies per acre, with 34 percent of those supplies being affected by mining. By contrast, Blacksville #2 had the lowest density of water supplies; yet, over half of those supplies, 52 percent, were affected. Shoemaker mined a very small area in Pennsylvania; there were only three water supplies within 1,640 feet and none of these supplies were affected. The three mines, of

substantial size, with the lowest percentage of water supplies affected per longwall acre are Mine 84, Bailey, and Cumberland with 6.1, 8.9, and 9.9 percent respectively.

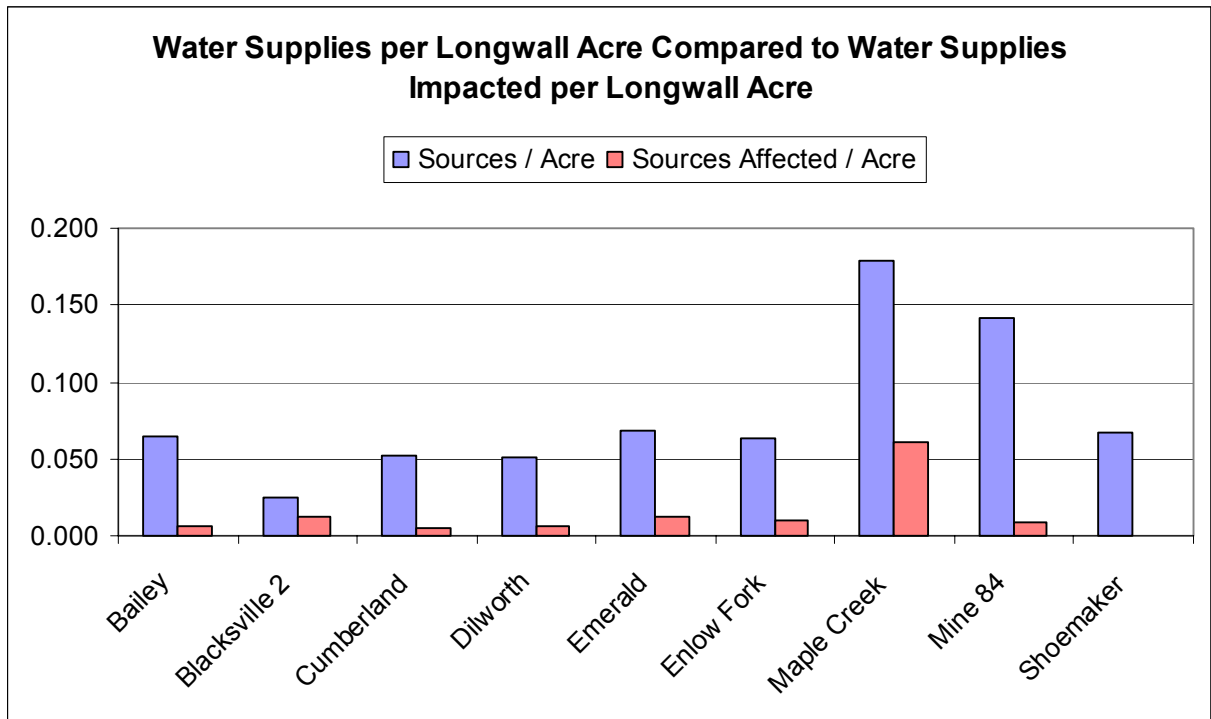


Figure IV.15. A comparison between average number of water supplies present on longwall acreage and average number of water supplies impacted per acre.

#### IV.I. Water Supply Replacement

Of the 412 claims recorded during the study period where mining is liable for the water supply impact, 171 water supplies have been replaced.

BUMIS uses the category “unspecified” as a catchall description that provides no quantifiable information. For example, one comment section includes the following statement:

“Owner reported to company a reduction of flow into his well. Operator investigated and removed pump from well. It was determined that he had sediment at bottom of well and large amount of bacteria growth on pump discharge. Reduction was due to maintenance.”

Yet this water supply is categorized as a permanent supply replacement as opposed to a maintenance problem. Similarly, another water supply listed as Permanent Water Supply Replacement Unspecified has this comment:

“Recd [sic] fax from opr [sic.] 10/21/03- water well and system installed.”

Clearly, this should be listed as a new well or spring, not as unspecified.

Because of these problems, the University’s researchers used the PA DEP water loss claim files housed in the file room of the California District Mining Office to augment and clarify the data. As a result, the University found that new wells or springs replaced 49 percent of water supplies requiring replacement. The use of public water as a replacement source appears to be used preferentially in those areas where public water is readily available, whereas ground water sources dominate in areas that are more distant from the public water distribution system.

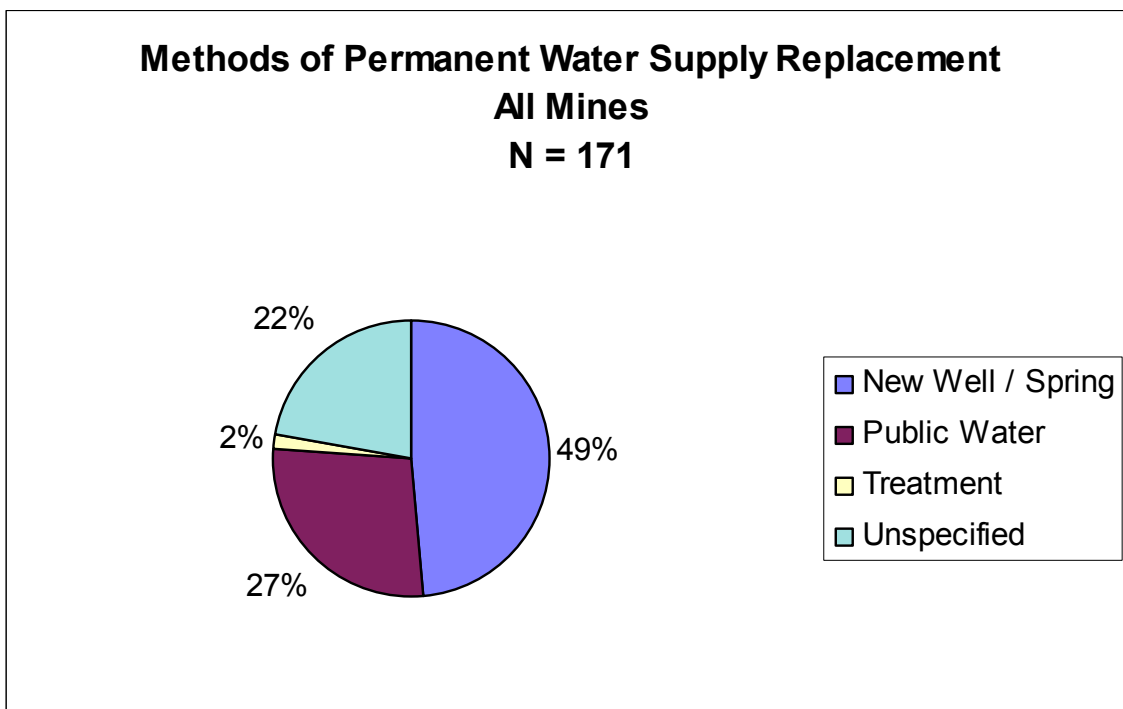


Figure IV.16. Water Supply Replacement Types.

A breakdown of these data by mining type results in the finding that *ground-water sources are used as replacement water supplies 59 percent of the time in room-and-pillar operations. Longwall operations rely on ground-water sources 46 percent of the time. Similarly, public water was used 16 percent of the time in room-and-pillar mines and 31*

*percent of the time in longwall mines.* These data might reflect the generally greater availability of public water in the longwall mining area as well as the ability of large companies to extend public water supplies.

Public water is used for 31 percent of water supply replacements in longwall mines. In order to accomplish this, mine operators are extending public water supply distribution systems. Although the University does not have any specific data on the length of public water lines extended at mining company's expense, it assumes that water line extension is occurring. Consequently, as a result of public water supply replacement, *the area of Washington and Greene counties served by public water has increased more rapidly than it would have without mining.* (Questions about regional ground water will be addressed in a later section)

#### **IV.J. Time to Final Resolution**

One possible measure of the effectiveness of Act 54 is the amount of time that passes from the time a problem is reported and a claim is filed on that problem until it is finally resolved. The BUMIS data set was sorted first by mining type, and then by "Final Resolution Description." For each entry where data were present, the Date Claim Filed was subtracted from the Final Resolution Date. These days were averaged for each Final Resolution Description. This process resulted in some questionable results. Specifically, for the longwall data set, 21 water supplies had negative values, whereas in the room-and-pillar data set there were 2 water supplies with negative values. Some of these negative values might be legitimate if an agreement pre-dated the water loss. Eleven of the negative values were associated with agreements. On the other hand, these negative results may be the result of poor data entry. Lacking any method for differentiating these results, the University included all values. The results for all longwall mines are shown in figure IV.17, and the results for all Room and Pillar mines are shown in figure IV.18.

The determination of "No Liability" is the only category that is entirely within the PA DEP's control. All of the other categories require an action on the part of the mining company, and an agreement of the water supply owner. For longwall mines, the PA DEP

through the California District Mining Office averaged 58 days to make the determination of liability; for room-and-pillar mines the agency averaged 91 days.

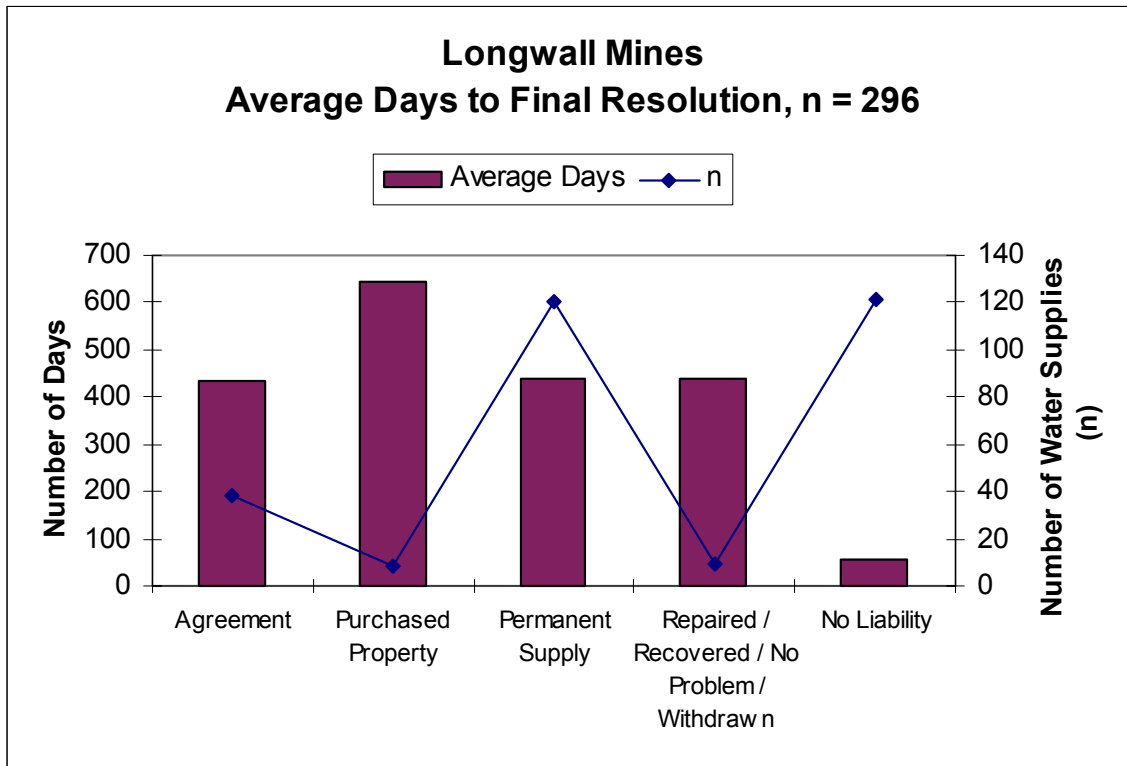


Figure IV.17. Average number of days to final resolution for longwall mines.

In both the room-and-pillar and the longwall cases, purchasing the property appears to be the last resort. This conclusion is based on the very low number of occurrences (n) and the longest amount of time that elapsed between the water loss and the final resolution date. It should be noted that *water loss might not be the sole reason for the purchase of the property*. Damage to buildings is expected to have more bearing on the decision to purchase the property than does water supply replacement based on the relative cost of a house versus a well. Permanent supplies were established on average in 206 days for room-and-pillar mines and 441 days for longwall mines. These time periods include the amount of time needed to install the permanent water supply and, in addition, to negotiate any long-term maintenance cost. Frequently, the agreement on long-term maintenance costs extends the final resolution date.

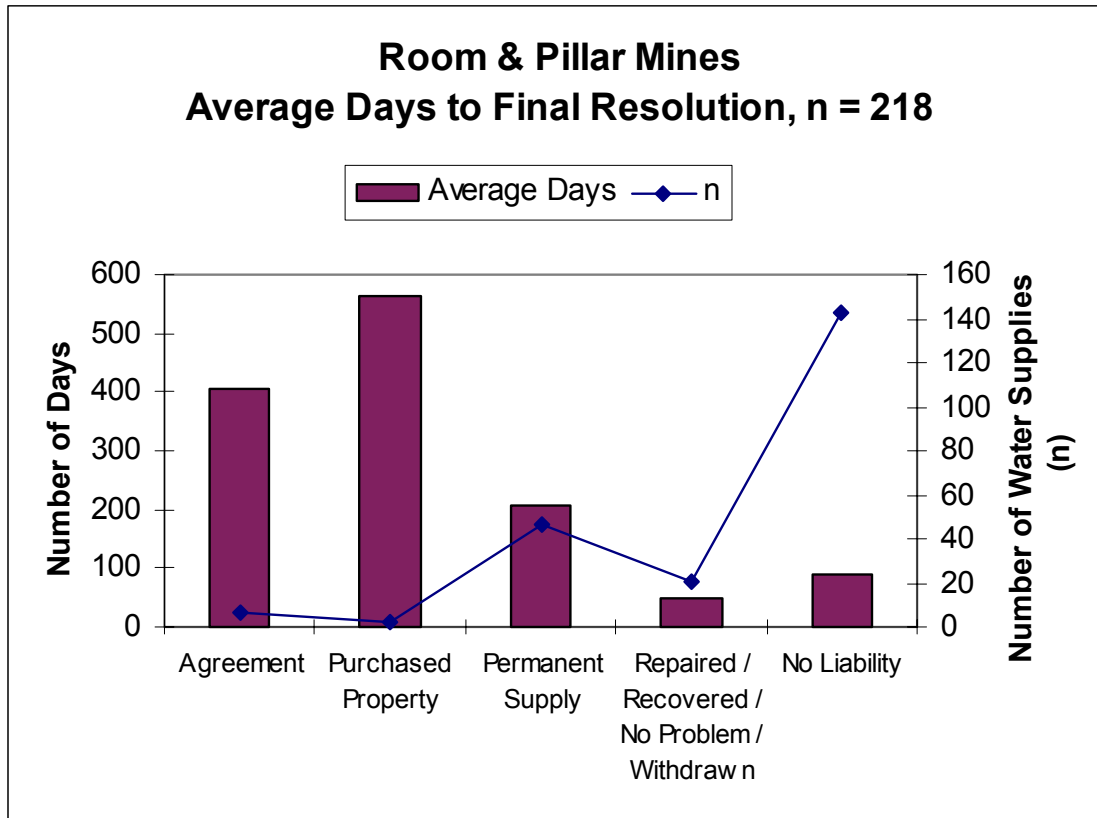


Figure IV.18. Average number of days to final resolution for room-and-pillar mines.

#### IV.K. Resolution Pending

Resolution Pending is a transitory category between an initial report of water loss and a final resolution. The category can be broken down into its various components. These components generally follow the decision-making process. Once a water loss is reported, the water user is placed on a temporary water supply. If the mine operator and the water supply owner come to an agreement, the problem is resolved. If the problem is not resolved at this level, then the PA DEP conducts an investigation to determine whether or not the water loss is the result of mining. If mining is determined to be the cause of the water loss, then the burden falls to the mine operator to provide a permanent water supply. The length of time for this stage of the process will vary on a case-by-case basis, depending on a number of parameters, such as the availability of public water, the location of the water supply in relation to future mining, and the determination of whether or not a ground water supply is to be established, requiring a period for the original water supply to recover, and a period to let the ground stabilize so that the



replacement supply is not transient. In addition, it is often necessary for the mine operator to provide financial compensation to the water supply owner if the operation cost of the water supply exceeds the operation cost of the original supply by 15 percent or more. Any negotiation on financial compensation can also add time to the final resolution.

Any data in BUMIS that did not have a final resolution was categorized as resolution pending. This subset of the data was then classified according to their status in the process. It is possible that water supplies that have been classified as “Temporary Water Supply” may be further along in the process; however, no data were available to justify an alternate classification. Figure VI.19 shows the status of the final resolution pending classification for longwall mines, and figure VI.20 shows the same information for the room-and-pillar mines.

It is clear from this graph that Maple Creek mine has by far the greatest number of water loss claims pending. Many of these claims (14) have a permanent water supply, but the operation and maintenance (O&M) cost is in dispute. Seven water supplies were awaiting construction of a public water distribution system at the end of the study period (August 20, 2003).

It is also clear that the bulk of the water loss claims in the pending category are in fact a liability of mining. As a result, any analysis in this report that evaluated mining’s liability in water loss issues *includes the “final resolution pending” category as though it were a liability.*

Figure IV.20 shows that the same four room-and-pillar mines that had the greatest number of water loss claims also have the greatest number of claims that are pending final resolution. Even though Mathies is in bankruptcy, its distribution of claims was left intact to show the status of those claims in the process. Another important feature of this graph is the lack of any public water supply connections that are pending for the room-and-pillar group.

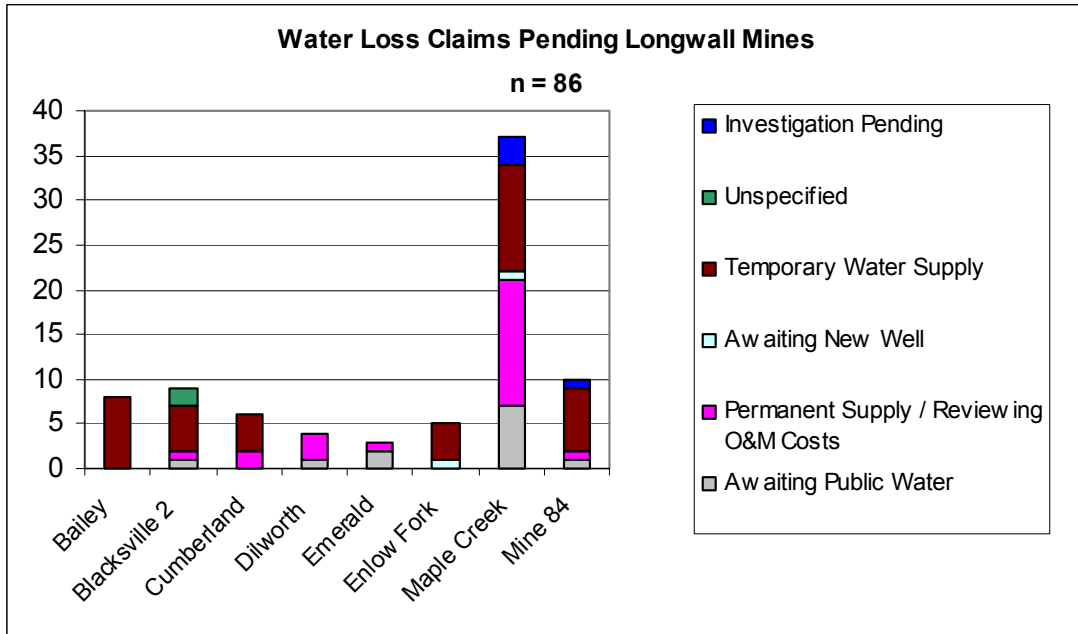


Figure IV.19. Water loss claims that are “pending” for longwall mines.

The PA DEP policy is that a water supply must be promptly restored.<sup>1</sup> This has been applied in a way that water users should not be on temporary water from more than three years. In order to evaluate the compliance with this policy, the University’s researchers evaluated the final resolution pending data set to determine the number of days between the date the water loss occurred and the end of the assessment period. Of the 144 “final resolution pending” cases, 49 cases were found where the three-year time period was exceeded (“aged cases”). Of these, 15 permanent water supplies had been installed and were awaiting the resolution of operation and maintenance (usually, O&M) costs. Nine of the 49 cases were awaiting the installation of public water. Thirteen mines have aged cases; however, three mines are responsible for 67 percent of the cases. The mines with the greatest number of aged claims are Maple Creek with 17, Mathies with 10, and David Dianne with 6. Two public water supply projects, one currently underway and another planned for 2004, are expected to relieve many of the problems at Maple Creek (23 supplies) and Mathies (7 supplies).

<sup>1</sup> “In 2003, the Department modified its water supply replacement policy to promptly provide a permanent water supply and not allow delays up to three years. Promptness is defined by the pertinent facts of each claim and how fast a permanent supply can be installed”

#### **IV.L. Water Loss Due to Mine Flooding**

Water supply impacts due to mine flooding are being handled separately from subsidence related impacts so that the nature of the two impacts can be more fully understood.

Upon mine closure the mine dewatering pumps are removed and the mine is sealed pursuant to PA DEP regulations. This allows the mine to fill with water that might or might not be contaminated with acid mine drainage. As the mine fills with water, less water flows into the mine from barrier leakage and from vertical infiltration. The water level in the mine will continue to rise until a dynamic equilibrium is achieved in which the amount of water flowing into the mine is equal to the amount of water flowing out of the mine. Generally, this flooding process is environmentally desirable because flooded mines do not produce any new acid mine drainage. In addition, mine flooding results in some decrease in vertical infiltration; this helps to return the water table toward its pre-mining water level.

However, there are situations where these attributes of mine flooding can be deleterious to water supplies. This condition exists in the area where the level of water in the mine is the same level as the ground water discharge zone of the mine. Normally this is not a problem unless ground water users are also located in the same area. This condition occurred at the Dora 6 mine in the Community of Hamilton, Perry Township, Jefferson County, Pennsylvania.

The Dora 6 mine was a room-and-pillar mine in the Lower Kittanning coal seam. It has been in operation since 1978. In 1984 the company submitted to the PA DEP the last permit application that contained a hydrogeology analysis of the entire mine.

## Water Loss Claims Pending Room and Pillar Mines n=62

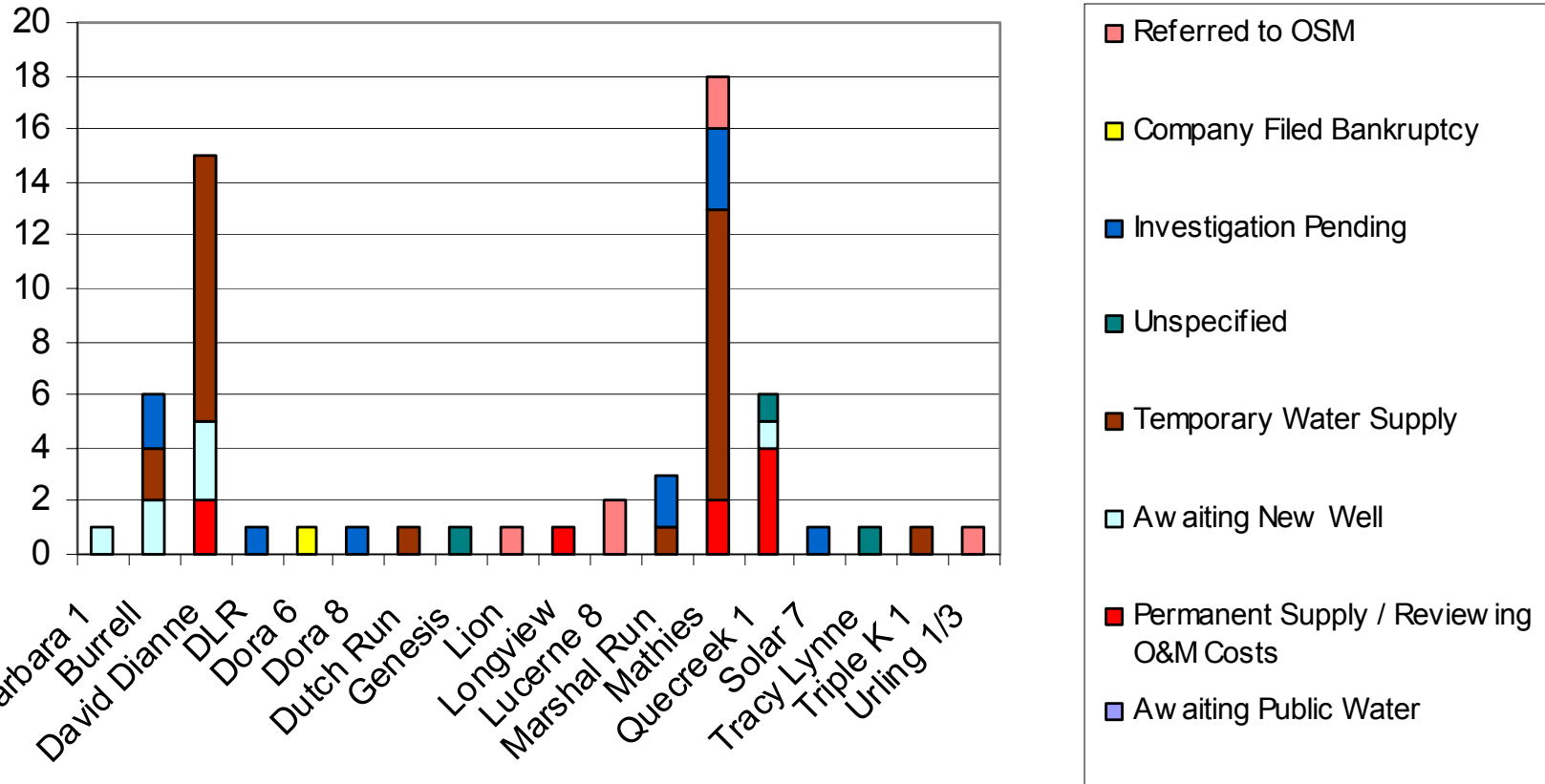


Figure IV.20. Water loss claims that are “pending” for room-and-pillar mines.

All subsequent applications have either been for permit renewals or for the addition of specific facilities and did not address the hydrology of the entire mine. Mining in the vicinity of the community of Hamilton was completed prior to 1984.

The coal seam, near Hamilton is located at approximately 1180 feet above mean sea level (msl), and the elevation of Hamilton varies from 1180 to 1220 ft msl. Coal mining did not extend under Hamilton but stopped at least 700 feet northwest of the nearest water supply. The coal seam rises to the northwest with the highest point in the mine at elevation 1350 msl. In April 1999 approval was granted for final sealing of the mine. When the mine was fully flooded, the water level reached 1260 msl, which placed the water level in the mine above ground surface in the community of Hamilton. Plate 14 shows the extent of the Dora 6 mining, the projected level of current flooding, and the location of the affected and unaffected wells in and around Hamilton.

Forty-seven complaints were received from Hamilton residents due to this situation. Of these 47 complaints three were found to be above the elevation of the water level in Dora 6 and therefore could not be caused by Dora 6. Of the remaining 44 complaints 11 were found to have low sulfate concentrations in 2001. Sulfate concentrations below 50 mg/l are within the range of normal ground-water quality. Concentrations above 50 mg/l are typically influenced by acid mine drainage formation due to mining. However, re-sampling of five water supplies in 2002 and 2003 that were unaffected by mining in 2001 showed that three of the five water supplies had elevated sulfate levels indicating mining impact. In all, 39 water supplies have developed elevated sulfate levels due to the flooding of Dora 6.

Although the well contamination problems did not begin to occur until after mine closure in 2000, all of the necessary elements except the flooding of the mine were in place prior to 1984. Permit review prior to 1984 did not identify the potential problem, and any permit review after 1984 would not have prevented the problem. Sufficient outcrop barrier was left in place to prevent catastrophic release of mine water and to allow the mine to flood to the discharge elevation at the mine portal.

PA DEP requirements and mining company permit applications in the 1978 to 1984 time period were not as comprehensive as they are today or even during the assessment period of this study. Discussions with PADEP hydrogeologists indicate that the conditions at Dora 6 would not be approved under existing knowledge and regulations, and that no similar conditions are known to exist at any currently permitted mines. As a result, the Dora 6 experience is not expected to reoccur.

**IV.M. Spirit of Act 54.** One of the goals of Act 54 was to make the mine operator responsible for any damage caused by a mining operation. The Mathies bankruptcy has forced the Department to intervene with the insurance company on behalf of the water users who will hopefully be made whole in the end. The Department's experience with the Mathies bankruptcy shows that *a large number of unresolved water losses establishes a condition that is not "in the spirit" of Act 54.*

#### **IV.N. Findings**

*Although springs and wells are not inherently more susceptible to the impacts of mining under dry conditions as opposed to wet conditions, mining impacts on springs and wells are more prevalent in droughty weather than during weather with normal or above normal precipitation. Some mining impacts are tolerated and healed under wet conditions, but the lack of excess water under dry conditions results in water loss or diminution.*

*The rationale used by the California District Mining Office in determining liability for water loss or diminution is insufficiently documented within Bituminous Underground Mining Information System. Forty-five percent of the 268 determination of "No Liability" could not be associated with a basis for the decision.*

*Terminology entered into Bituminous Underground Mining Information System is not standardized.*

*Distance to mining is frequently not included in the Bituminous Underground Mining Information System dataset, but “distance-to-mining” was by far the most significant factor cited in the determination of “no liability.”*

*Most mines have a small number of water supplies that are pending final resolution. Three mines, Maple Creek, Mathies, and David Dianne have an exceptionally large number of water supplies pending final resolution at the close of the assessment period, and many of these are long standing problems.*

*Of the 144 “final resolution pending” cases, 49 cases were found where the three-year time period was exceeded (“aged cases”).*

#### **IV.O. Recommendations**

*The PA DEP should take immediate action to reduce the large number of aged water loss claims (those that have exceeded a three-year period).*

*The PA DEP should review the process of data entry into the Bituminous Underground Mining Information System to increase the coverage of data under all entry categories.*

*The PA DEP should either establish a set of standardized terms or commission a standardization of terms that would enhance the quantification of data recorded in the Bituminous Underground Mining Information System.*

*The PA DEP should record the “distance to mining” for every water loss problem and claim.*

*The PA DEP should determine either through its own effort or through the effort of the mine operator the exact coordinates via a GPS unit for every water source that is scheduled to be undermined.*

*during the course of the third five-year Act 54 period (August 21, 2003, to August 20, 2008) the California District Mining Office should determine the exact locations via GPS units of all water sources undermined and reported as losses, contaminations, or diminutions, and it should record in the Bituminous Underground Mining Information System both the locations and the distances to the nearest mine. If possible, the location should indicate the relationship of the sources to the gates and longitudinal panel sections (two outer 25% sections of panels, inner 50%) and the depth to mining (the overburden thickness).*