Section 5: Water Supply Impacts

5.A - Overview

The University collected data from the PADEP and cross-checked the information with digital versions of the same data provided by some of the mining operators to improve quality assurance (note, mine operators were not required to submit these data). These data are used to perform a full analysis of water supplies undermined and impacted from 21 August 2013 to 20 August 2018. There were 2,353 water supplies recorded in undermined areas during this assessment and 379 had a reported effect. All water supplies undermined during the 5th assessment were analyzed and the reported effects associated with each impacted water supply enumerated. In addition, the liability associated with each reported effect was assessed as well as how long it took to reach a final resolution using the data in BUMIS. The analysis was categorized by the mining type including, longwall, room-and-pillar, and pillar recovery mining. There were 14 inactive mines with reported effects with one categorized as company liable. Finally, the analysis from the 5th assessment was compared to the data from the previous PADEP Act 54 analysis, allowing for a 15-year overview of water supply impacts.

5.B - Data Sources

The University used multiple data sources to locate all water supplies above mining that occurred during the 5th assessment period and within the rebuttable presumption zone (RPZ). All wells, springs, and ponds over 20-acre-ft were mapped using the 6-month mine maps provided by the CDMO and cross-checked with digital data provided by some of the mine operators (note, these digital data were not a requirement, rather a request to improved data quality assurance). All water supplies inside of the RPZ as well as any water supply located outside of the RPZ that had a reported effect were included in this mapping. Characteristics of all water supplies were associated with the ArcGIS locations. The water supplies with reported effects were identified from records provided in BUMIS. The water supplies were organized based on their locations, type, and impact occurrence. Additional information about the location or identification of water supplies was obtained through interactions with the PADEP.

5.B.1 - Water supplies tracked by the PADEP

All water supplies within the permit area must have a pre- and post-mining survey done to test the quantity and quality of the water as per Pennsylvania Code, Title 25, Chapter 89.145a. The pre-mining survey must determine the location and type of water supply as well as its existing and reasonable future use. The following parameters are used to define a baseline water quality and quantity for affected water supplies.

5.B.1.a - Water Quality and Quantity

§89.145a(a) states that water should be tested for both physical and chemical parameters pre- and post-mining to determine if there has been an effect due to mining. These parameters include but are not limited to:

Chemical Properties

- Total dissolved solids
- Specific conductance (corrected to 25 degrees Celsius)
- pH
- Iron
- Total manganese
- Hardness
- Total coliform
- Acidity
- Alkalinity
- Sulfates

Physical Properties

- Flow of water
- Depth and diameter of the well
- Length of casing
- Static water levels
- Yield of water
- Treatment and distribution systems

5.B.1.b - Restoration and Replacement of Water supplies

§89.145a(b) requires that the operators shall promptly restore or replace the affected water supply with a permanent alternative source which adequately serves the pre-mining uses of the water supply and any reasonably foreseeable uses of the water supply.

§89.145a(c) allows the company 24 hours after the operator receives the claim to notify the department of the claim.

5.B.1.c - Temporary Water Supplies

§89.145a(e)(1&2) If an affected water supply is within the RPZ and there is no alternative water supply readily available to the landowner the operator shall provide a temporary water supply within 24 hours of being contacted by the water supply user or the PADEP, whichever occurs first. If a water supply is determined by the state to be affected by underground mining the operator is required to supply a temporary water supply no matter the location of the water supply with respect to the RPZ. The temporary water supply must meet quality standards equal to that of the pre-mining water supply.

5.B.1.d - Permanently Restored and Replaced Water Supplies

§89.145a(f)(1&2) the restored or replaced water supply must at minimum be as reliable, as permanent, and require no extra maintenance as the pre-mining water supply. As well as being able to be controlled and accessed as readily as the pre-mining water supply. The quality of the new water supply must meet the Pennsylvania Safe Drinking Water Act or be comparable to the previous water supply. If the fix is to tie into the public water supply the operator must provide the operation and maintenance cost associated with the public water supply. The restored or repaired water supply must not add additional cost to the user. The landowner and operator can reach a one-time payment to account for the additional cost of the repaired or restored water supply cost.

5.B.2 - University's Process for Tracking Water Supplies

In the scope of work, the University was asked to, "Determine the number of water supplies undermined during the pre-determined period." The University created a process for tracking all water supplies undermined during the 5th assessment period. All mining extents were mapped in ArcGIS using the company supplied AutoCAD files and six-month mining maps. The coal contours and elevation contours were then used to create the overburden raster for each mining extent. Using an ArcGIS script created by the University, the RPZ for each mine was developed. The RPZ covers all areas above a mine plus the surface area along a line at a 35-degree angle from the edge of underground mining to the surface (Figure 5-1). All water supplies within the RPZ that are adversely affected by mining will be compensated or repaired by the mining companies. One exception to this required compensation is when pre-mining data shows the water supply characteristics were not adversely affected as a result of mining.

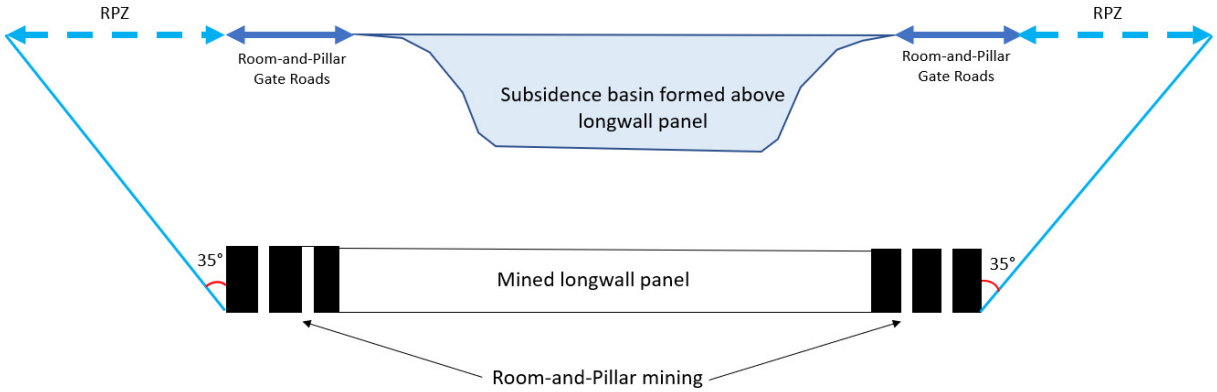

Figure 5-1. The components of the RPZ. Areas over mining plus the RPZ. (Figure not to scale)

Once the RPZ was mapped, all water supplies located outside of the RPZ without a reported effect were eliminated from the ArcGIS database. The remaining water supplies were then divided into categories based on their locations on the maps. Each mining type had unique categories, below is the breakdown of the categories for longwall mining:

- Over the Longwall
- Over Room-and-Pillar
- Within RPZ
- Outside RPZ

Categories for room-and-pillar mining:

- Over Room-and-Pillar
- Within RPZ
- Outside RPZ

And lastly the categories for the pillar recovery mines:

- Over Room-and-Pillar
- Over Pillar Recovery
- Within RPZ
- Outside RPZ

Once all water supplies were mapped, the total number of reported effects were analyzed. Finally, all water supplies located in the RPZ as well as those located outside of the RPZ that had a reported effect were categorized and labeled by type, i.e. spring, well, or pond.

5.C - Summary of Trends in Water Supplies Undermined during the 5th Assessment Period

In the 5th assessment there were 49 active mines that undermined 2,353 water supplies. Three hundred seventy-nine had reported effects. Longwall mining undermined the largest number of water supplies and had the most reported effects (Table 5-1). Fourteen percent (14.1 %) of all longwall and 18.9 % of room-and-pillar water supplies had a reported effect. Company liable effects ranged from 158 for longwall mines to 27 for room-and-pillar mines, and six for pillar recovery mines (Table 5-1).

Table 5-1. Total number of undermined water supplies and water supplies with reported effects by mine. type.

Mining Type	Undermined Water supplies	Reported Effects (% of water supplies undermined)	Company Liable Effects (% of water supplies undermined)
Room-and-Pillar	645	122 (18.9 %)	27 (4.1 %)
Pillar Recovery	57	10 (25 %)	6 (15 %)
Longwall	1,651	233 (14.1 %)	158 (9.6 %)
Mines not active in the 5th assessment	-	14	1
TOTAL	2,353	379	192

Of the 379 water supply reported effects, 192 were determined to be company liable. In the 3rd and 4th assessments there were significantly more reported effects than in the 5th assessment (Iannacchione et al. 2011; Tonsor et al. 2014). There was a 48 % decrease in company liable effects from the 4th to the 5th assessment (Table 5-2).

Table 5-2. Water supply reported effects and company liable effects over the last three assessment periods.

Assessment Period	Reported Effects	Company Liable Effects
5th	379	192
4th	855	371
3rd	683	269

The decrease in total reported effects over the last 15 years can be compared to the acres mined. Table 5-3 shows the number of acres mined per assessment period and the corresponding

company liable impacts. The percent of the total company liable impacts over the last three assessment period has increased, but the number of impacts per acre has decreased. The 4th assessment had the highest company liable impact per acre while the 5th assessment had the lowest.

Table 5-3. Total water supply company liable impacts per acre over the last three assessment periods.

Assessment Period	Acres	Company Liable Effects	% Company Liable	Company Liable Effect/acre
5th	28,854	192	51 %	0.006
4th	31,343	371	43 %	0.011
3rd	38,256	269	39 %	0.007

There were 379 water supply reported effects producing 192 company liable and 113 company not liable final resolutions with 73 categorized as interim resolutions at the end of the 5th assessment period. The two most significant company liable resolutions were "Agreement (Unspecified)" (90; Table 5-4) and "Company Purchase Property" (54; Table 5-4). Unspecified agreements took an average of 426 days to resolve and company purchase property averaged 150 days. The two most significant company not liable resolutions were "Not Due to Underground Mining" (76; Table 5-4) and "Withdrawn" (23; Table 5-4). Not due to underground mining took an average of 154 days to resolve and withdrawn claims averaged 303 days.

Table 5-4. Determination of liability based on final resolution category recorded in BUMIS as of 20 August 2018.

Final Resolution		Number	Average Time to Resolution (Days)
Class	**Category**		
Company Not Liable (Unaffected/No Liability)	Resolution Not Returned	1	13
	No Liability	10	24
	Not Due to Underground Mining	80	154
	Referred to Oil and Gas	1	6
	No Current Use	2	0
	Withdrawn	20	303
	Subtotal	114	176
Company Liable (Assigned/Assumed Liable)	Agreement (Pre-mining)	14	52
	Agreement (Unspecified)	90	426
	Closed/Info Appended to Another Case	0	0
	Company Purchase Property	54	150
	Undisclosed Settlement	4	643
	Compensated	4	171
	Permanent Supply	5	590
	Landowner Negotiations	1	202
	Repaired	8	279
	Resolved	12	334
	Subtotal	192	305
Total		306	186

For the remaining 73 impacts that have not reached a final resolution took an average of 329 days to reach an interim resolution (Table 5-5).

Table 5-5. Interim Resolutions in the 5th assessment and average days to reach the interim resolution.

Number of Interim Resolutions	Average days to Interim Resolution
73	329

Figure 5-2 shows the distribution of average days to reach final resolutions based on mine type. The pillar recovery and longwall mines have the highest overall average days to reach a final resolution and room-and-pillar mines the lowest. The outlier in the longwall mines comes from the Harvey Mine. In this case, a spring used for agriculture went dry and it took 1,353 days for a permanent water supply and O&M bond final resolution to be reached.

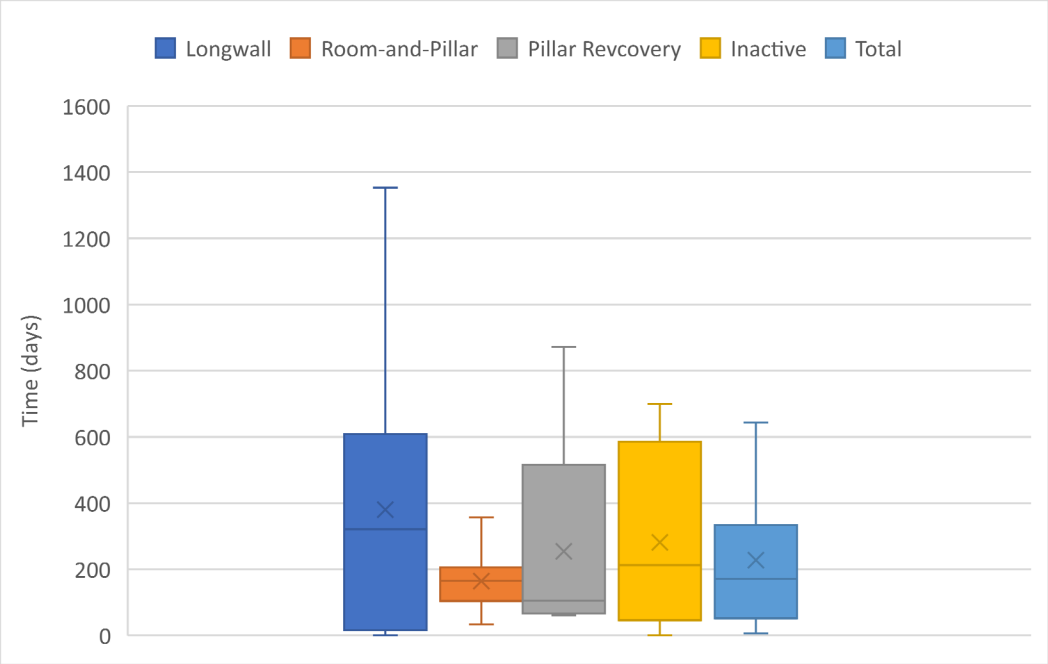

Figure 5-2. Distribution of average days to reach a final resolution based on mining type.

5.C.1 - Water Supplies Undermined

All water supplies located within the RPZ as well as those with reported effects outside of the RPZ were identified by type. Figure 5-3 shows that the most commonly undermined water supply type was a well, followed by springs. All active mines except for Horning, Lowery, Crawdad, and Stafford undermined a water supply.

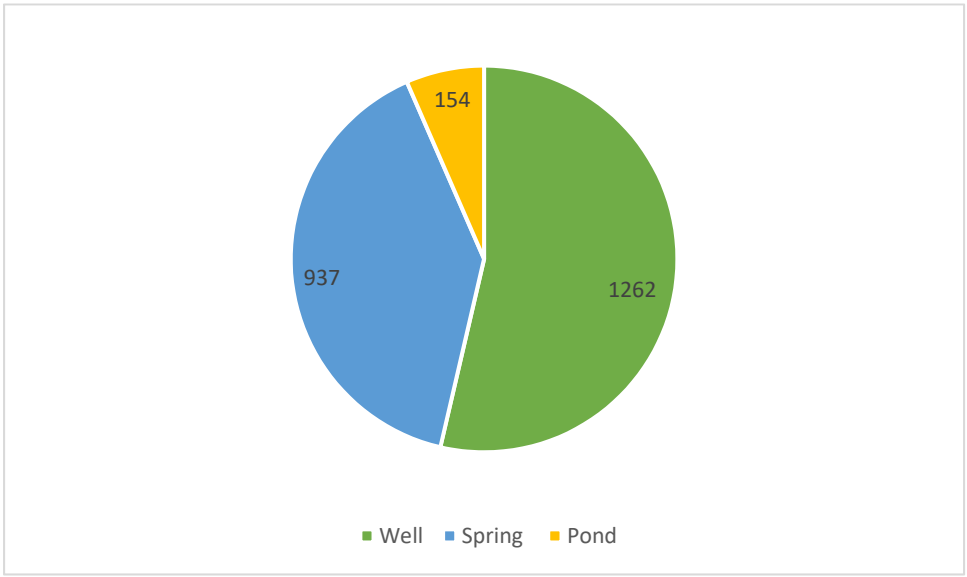

Figure 5-3. Undermined water supply by type of water supply.

5.D - Water Supplies and Mining Methods

The University was tasked with the analysis of water supply impacts by mine type. There are differences in the way longwall, room-and-pillar, and pillar recovery mines identify and implement protection or repair to water supplies affected by mining. Water supply impacts associated with longwall subsidence can more easily be forecast then room-and-pillar mines where subsidence is not expected. Pillar recovery mining can also generate subsidence, although these basins are much smaller in area and magnitude than basins formed by longwall mining. It is also common for pillar recovery mining to avoid undermining water supplies. Experience has shown that water supplies above longwall panels have significantly more impacts than any other mining method. For room-and-pillar mines, impacts can occur when groundwater flowing to wells and springs is disrupted by small cracks and fissures. In some cases, ground movement due to mining (Figure 5-4) can disrupt groundwater flow.

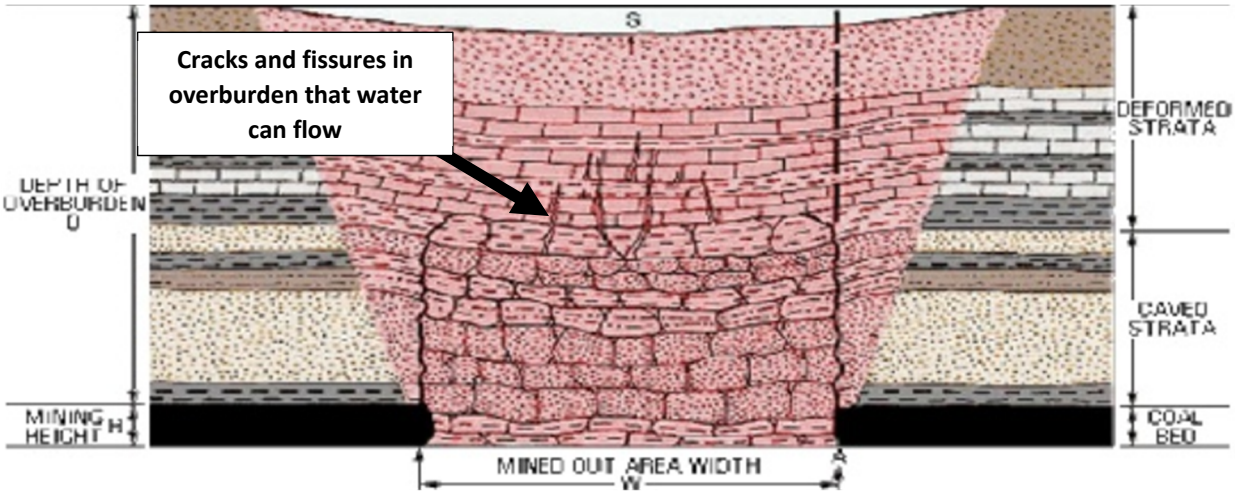

Figure 5-4. Cracks and Fissures occurring from ground movement (Singhal, 2014, slide 2).

In some cases, ground water can be released and allowed to move downward along fractures and laterally along bedding planes until it gets redirected, appearing further down the hillsides from a spring that no longer flows. Figure 5-5 shows the emergence of a spring in the hillside after the Bailey Mine undermined the area.

Figure 5- 5. Emergence of a spring in a hillside after longwall mining (Photograph taken from PADEP files).

Water supply impacts can range from the loss of flow to excessive flow and may include water chemistry changes. Most of the cases discussed in this section are water loss cases. However, pooling can result in water saturated soil and increase the potential for slope instabilities, especially on embankments. In some cases, the pooling will render fields unusable or even flood nearby structures. Pooling typically occurs in topographic lows and most often above the mined longwall panels where the subsidence basin causes lower elevations. Figure 5-6 shows an example of pooling located over the Enlow Fork Mine.

Figure 5- 6. Pooling impacts over Enlow Fork (Photographs taken from PADEP files).

5.D.1 - Active Longwall Mines

There were seven active longwall mines in the 5th assessment period that undermined 70.1 % of all water supplies during the 5th assessment period. Longwall mines undermined the largest number of acres in the 5th assessment period, approximately 17,875-acres. Table 5-6 shows the seven active longwall operations and the impacts that they had on the local water supplies. Enlow Fork undermined the most water supplies (680; Table 5-6) and had the most reported effects (135; Table 5-6) and company liable effects (100; Table 5-6). Conversely, the Monongalia County Mine had significantly lower reported effects and company liable impacts than Enlow Fork but the latter mined 3.5 time more acreage than the former and was located in a more populated area.

Table 5-6. Total number of water supplies undermined by operation and number of reported effects.

Mine Name	Total Number of Water Supplies	Reported Effects*	Company Liable	Company Not Liable	Interim Resolution
Bailey	186	22	16	3	3
Cumberland	281	22	14	1	7
Emerald	123	10	5	3	2
Enlow Fork	680	135	100	8	27
Harvey	281	24	13	0	11
Monongalia County	46	6	1	3	2
Tunnel Ridge	54	14	9	1	4
TOTAL	1,651	233	158	19	56

* - Reported effects = company liable + company not liable + interim resolution

All longwall mines have longwall panel mining as well as development gate roads that use room-and-pillar mining. The extraction ratio over the room-and-pillar mining ranges from 0.4 to 0.6 so subsidence, even adjacent to longwall panel is typically measured in inches as compared to feet over the panels. However, even without significant vertical subsidence, water supply effects can occur anywhere within the RPZ (Refer to Figure 5-1 to see the extent of the RPZ). Table 5-7 shows the placement of water supply reported effects for each of the seven active longwall operations based on their location. For all longwall mines active during the 5th assessment, 66.1 % of water supply reported effects occurred directly over longwall panels.

Table 5-7. Location of reported effects over longwall mines.

Mine Name	Reported Effects*	Location of Reported Effects			
		Over Room-and-Pillar	Over Longwall	Within RPZ	Outside RPZ With Reported Effects
Bailey	22	2	15	3	2
Cumberland	22	1	14	7	0
Emerald	10	0	1	7	2
Enlow Fork	135	16	99	5	15
Harvey	24	1	17	5	1
Monongalia County	6	0	1	0	5
Tunnel Ridge	14	3	7	2	2
TOTAL	233	23	154	29	27

* - Reported effects = total over room-and-pillar + total over longwall + total within RPZ + reported effects outside RPZ

There were 177 reported effects from longwall mining that have reached a final resolution. The most common company liable effect was an “Unspecified Agreement” (72; Table 5-8), which took an average of 492 days (Table 5-8). The most common company not liable effect was “Not Due to Underground Mining”, taking 148 days on average to achieve a final resolution. There was also a large amount of company purchased properties for water supplies in the 5th assessment (54; Table 5-8).

Table 5-8. Determination of longwall mining liability based on final resolution category recorded in BUMIS as of 20 August 2018.

Final Resolution		Number	Average Time to Resolution (Days)
Class	**Category**		
Company Not Liable (Unaffected/No Liability)	Resolution No Returned	1	13
	No Liability	0	0
	Not Due to Underground Mining	11	148
	Referred to Oil and Gas	1	6
	No current use	2	0
	Withdrawn	4	502
Subtotal		19	206
Company Liable (Assigned/Assumed Liable)	Agreement (Pre-mining)	13	1
	Agreement (Unspecified)	72	492
	Closed/Info Appended to Another Case	0	0
	Company Purchase Property	54	150
	Undisclosed Settlement	4	644
	Compensated	4	25
	Landowner Negotiations	0	0
	Repaired	5	496
	Permanent Supply	1	1353
	Resolved	5	733
Subtotal		158	368
Total		177	292

There were 56 reported effects from longwall mining water supply reported effects that have not reached a final resolution and are still in interim resolution. It took an average of 441 days for the 56 reported effects to reach an interim resolution (Table 5-9).

Table 5-9. Reported effects in Interim Resolutions from all longwall mining.

Number of Interim Resolutions	Average time to Interim Resolution
56	441

5.D.2 - Active Room-and-Pillar Mines

There were 37 total active room-and-pillars mines in the 5th assessment period and 122 recorded water supply impacts from room-and-pillar mining. Although room-and-pillar mining is not expected to subside the ground the ground water above the mines can, on occasion, redirect flows and cause impacts to water supplies at the surface. Table 5-10 illustrates the number of water supplies reported effects organized by active room-and-pillar mines. Their location relative

to room-and-pillar developments and the RPZ is included to improve the analysis of claim outcomes.

Table 5-10. Location of water supply reported effects for room-and-pillar mining.

Mine Name	Total Water supplies Undermined	Location of all Reported Effects			Company Liable Effects
		Over Room-and-Pillar	Inside RPZ	Outside RPZ	
Acosta	9	0	0	3	0
Barbara 2	17	0	0	6	3
Beaver Valley	7	0	0	2	0
Brubaker	9	1	1	0	0
Brush Valley	56	0	1	0	0
Cass 1	13	0	0	4	0
Cherry Tree	13	0	0	3	0
Clementine 1	42	0	0	23	8
Darmac 2	12	0	0	3	0
Dutch Run	12	0	3	3	2
Harmony	18	0	0	5	0
Heilwood	52	0	1	3	2
Knob Creek	9	0	1	2	1
Logansport	22	0	0	4	2
Madison	28	0	0	4	0
Maple Springs	13	0	0	6	0
Mine 78	30	2	0	1	1
Ondo	10	0	0	2	0
Parkwood	15	3	1	4	1
Penfield	11	0	0	11	1
Roytown	1	0	0	1	0
Toms Run	107	0	1	5	3
Tracy Lynne	22	0	1	4	2
Twin Rocks	18	0	0	2	0
Kimberly	14	0	0	5	1
TOTAL	560*	6	10	106	27

*- This number reflects the total water supplies with reported effects. Twelve room-and-pillar mines had zero reported effects.

Twenty-seven of the 122 reported effects were company liable. Of these reported effects, 106 occurred outside of the RPZ. One mine, Clementine 1, accounted for 21.7 % of the 106. Twenty, or 18.9 %, of the 106 reported effects outside of the RPZ were determined to be company liable. Six, or 5 %, of the 122 reported effects occurred directly above the room-and-pillar mining and

of these six, only two were company liable. Ten reported effects were in the zone between the edge of room-and-pillar developments and the edge of the RPZ. Five, 50 %, were company liable.

Of the 122 reported effects, 107 have reached a final resolution. Twenty-seven impacts were determined to be company liable and 80 were determined to be company not liable. The remaining 15 reported effects are still in Interim Resolution. Table 5-11 shows the average time that it took to reach a final resolution. The most common final resolution is "Not Due to Underground Mining", with 54 reported effects, and it took an average of 117 days to reach these final resolutions. The final resolution that took on average the longest to reach was the water supplies that were "Compensated." This resolution for water supply impacts could take longer because if a new water supply is installed the water cannot cost more than the landowners previous water supply, and if it does the owner must be compensated the difference. A monitoring process may need to take place before a final compensation amount can be determined for the new water supply. The majority of the company liable final resolutions were an "Unspecified Agreement," so more information is not known about them. The overall time to reach all final solutions for water supply company liable impacts over room-and-pillar mining was 182 days, which is less than the overall time it took to reach final resolution for longwall mining.

Table 5-11. Determination of room-and-pillar mining liability based on final resolution status as of 20 August 2018.

Final Resolution		Number	Average Time to Resolution (Days)
Class	**Category**		
Company Not Liable (Unaffected/No Liability)	Resolution No Returned	0	0
	No Liability	9	34
	Not Due to Underground Mining	58	118
	Referred to Oil and Gas	0	0
	No current use	0	0
	Withdrawn	13	215
	Subtotal	80	106
Company Liable (Assigned/Assumed Liable)	Agreement (Pre-mining)	1	203
	Agreement (Unspecified)	13	118
	Closed/Info Appended to Another Case	0	0
	Company Purchase Property	0	0
	Permanent Supply	3	357
	Compensated	0	0
	Landowner Negotiations	1	202
	Repaired	3	134
	Resolved	6	195
	Subtotal	27	107
Total		107	182

5.D.3 - Active Pillar Recovery Mines

The five active pillar recovery mines undermined just 57 water supplies and had ten reported effects with six company liable effects in the 5th assessment period. The location of the water supply impacts is divided into four undermining categories: pillar recovery mining; room-and-pillar, inside the RPZ, and outside of the RPZ (Table 5-12). The areas of pillar recovery can cause damage to the surface not normally seen in room-and-pillar mining. Here, the overburden support is compromised when the pillars are extracted. Water supplies can be adversely impacted. However, the area with the fewest water supplies is over pillar recovery mining. It is likely that mine operators sometimes plan to avoid extracting pillars beneath surface water supplies. The Nolo mine had the largest number of company liable effects (3), while Crawdad and Quecreek had none.

Table 5-12. Total number of water supplies and their location over the pillar recovery mines.

Mine	Total Water supplies Undermined	Location Reported Effects				Company Liable
		Over Room-and-Pillar	Over Pillar Recovery	Inside RPZ	Outside RPZ	
4 West	10	4	1	4	1	1
Crawdad	0	0	0	0	0	0
Nolo	28	7	0	17	4	3
Prime 1	2	0	0	0	2	2
Quecreek	17	8	0	9	0	0
TOTAL	40	11	1	21	7	6

Figure 5-7 shows the distribution of the reported effects and their final resolution over the areas in pillar recovery mines. The one water supply undermined by pillar recovery mining was determined to be company liable. There were only four company not liable final resolutions and zero interim resolutions. It is interesting to note that the area with the five company liable effects, or 83.3 % of the total, occurred outside of the RPZ. It is unlikely that subsidence is occurring outside of the RPZ given the known extents of strata aquifers in the region and the geometry of the RPZ.

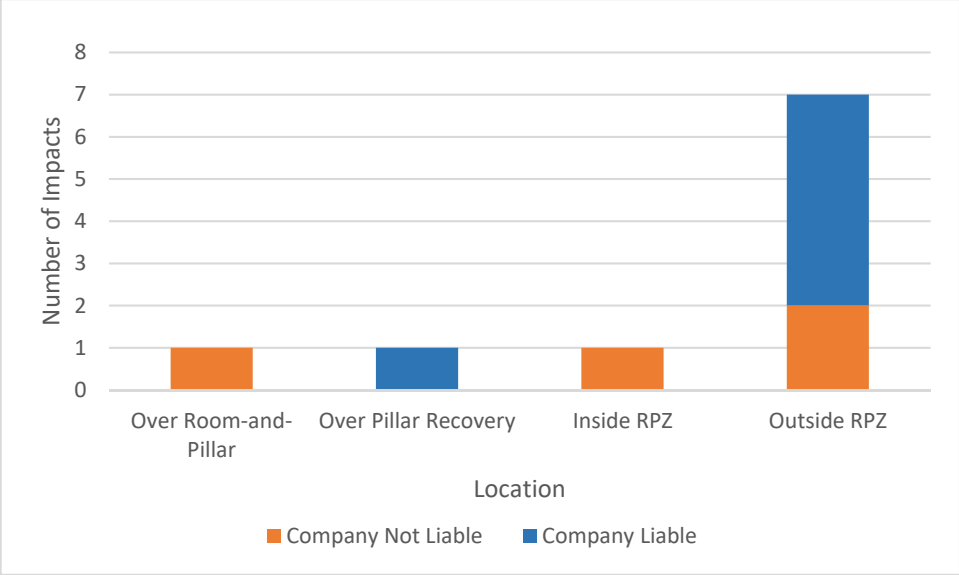

Figure 5-7. Location of reported impacts and their resolution.

Pillar recovery mines extracted the fewest acres of all mine types in the 5th assessment period, approximately 2,494 acres. The impact ratio for pillar recovery is very similar as for room-and-pillar mines. All water supply undermined with reported effects reached a final resolution. Table 5-13 shows ten categories with the number and total average days to reach a final resolution. The average for all ten reported effects was 254 days. The final resolution that took the longest to

occur was an "Unspecified Agreement." One claim at Prime 1 took 1,592 days to achieve a resolution.

Table 5-13. Determination of pillar recovery mining liability based on final resolution category recorded in BUMIS as of 20 August 2018.

Final Resolution		**Number**	**Average Time to Resolution (Days)**
Class	**Category**		
Company Not Liable (Unaffected/No Liability)	Resolution No Returned	0	0
	No Liability	0	0
	Not Due to Underground Mining	3	73.7
	Referred to Oil and Gas	0	0
	No current use	0	0
	Withdrawn	1	105
	Subtotal	4	89
Company Liable (Assigned/Assumed Liable)	Agreement (Pre-mining)	0	0
	Agreement (Unspecified)	4	872
	Closed/Info Appended to Another Case	0	0
	Company Purchase Property	0	0
	Permanent Supply	1	60
	Compensated	0	0
	Landowner Negotiations	0	0
	Repaired	0	0
	Resolved	1	160
	Subtotal	6	567
Total		10	254

The previous assessments had significantly higher numbers of reported effects (384; Table 5-14) and company liable effects (152; Table 5-14) over room-and-pillar mines. This is approximately three times the number during the 5th assessment period. The 3rd assessment period had 83 company liable water supplies. Likewise, pillar recovery had more company liable effects in the 3rd and 4th assessments periods than in the 5th. This is partly due to a decreased number of pillar recovery mines (Table 5-14).

Table 5-14. Room-and-pillar and pillar recovery mines categorized by their reported effects and company liable impacts over the last three assessment periods.

Assessment Period	Room-and-Pillar			Pillar Recovery		
	Number of Mines	Reported Effects	Company Liable Effects	Number of Mines	Reported Effects	Company Liable Effects
5th	38	122	27	4	10	6
4th	34	384	152	5	24	13
3rd	35	238	83	6	20	10

5.D.4 - Inactive Mines

There were ten inactive mines with water supply reported effects during the 5th assessment period. Impacts to water supplies after mining ceases and the operation closes can occur for several reasons. Determination of those reasons is beyond the scope of this report. All the inactive mines with water supply reported effects were room-and-pillar mines. There was a total of 14 reported effects. Table 5-15 shows the mines that had a reported effect and their resolution. There was only one of the impacts that was company liable and that occurred over the David Dianne Mine. Two claims had not reached a final resolution.

Table 5-15. Water supply reported effects resolutions per inactive mime.

Mine Name	Company Liable	Company Not Liable	Interim Resolution
Augustus	0	1	0
David Dianne	1	0	0
Emilie 1 & 2	0	0	1
Geronimo	0	1	0
Mine 84	0	2	1
No 3 Deep	0	1	0
Ridge	0	1	0
Rossmoyne	0	1	0
Stonycreek	0	3	0
Urling 1/3 Deep	0	1	0
TOTAL	1	11	2

There were 12 impacts that have reached a final resolution (Table 5-16), with the most common final resolution being “Not Due to Underground Mining.” The one company liable agreement had an “Unspecified Agreement,” so information about this claim was limited.

Table 5-6. Determination of inactive mine liability based on final resolution category recorded in BUMIS as of 20 August 2018.

Final Resolution		Number	Average Time to Resolution (Days)
Class	**Category**		
Company Not Liable (Unaffected/No Liability)	Resolution No Returned	0	0
	No Liability	1	1
	Not Due to Underground Mining	8	244
	Referred to Oil and Gas	0	0
	No current use	0	0
	Withdrawn	2	699
	Subtotal	11	378
Company Liable (Assigned/Assumed Liable)	Agreement (Pre-mining)	0	0
	Agreement (Unspecified)	1	181
	Closed/Info Appended to Another Case	0	0
	Company Purchase Property	0	0
	Permanent Supply	0	0
	Compensated	0	0
	Landowner Negotiations	0	0
	Repaired	0	0
	Resolved	0	0
	Subtotal	1	181
Total		12	281

5.E - Summary

The longwall mines undermined the most water supplies of all mine types (1,651, 70.1 % of all water supplies) in the 5th assessment period. They also had the highest number of reported effects (233, 61.4 % of all reported effects) and company liable impacts (158, 82.3 % of all company liable effects). This is expected over longwall mines because of the areal extent of longwall mining and occurrence of cracks and fissures within the overburden subjected to subsidence. The overall impacts from room-and-pillar mining decreased from the 3rd and 4th assessments and the company liable per acre mined was 75 % less than longwall mines. This shows the importance of ground support by the coal pillars. Pillar recovery was the mining type with the fewest total impacts as well as company liable impacts. Although pillar recovery has expected subsidence in the areas that the pillars are extracted, it is important to note that there are usually no water supplies located over these areas. Because longwall extracts a large area of coal over a relatively short period of time, these operations cannot as easily avoid areas with high water supply densities.

Evaluation of subsidence impact data on an ongoing basis is central to the tasks specified in Act 54. The total number of water supply reported effects in the 5th assessment decreased compared to the 3rd and 4th assessment period, i.e. 683 (former) and 855 (latter). While the percent of total company liable effects were highest in the 5th assessment the number of company liable effects per acre mined was the lowest among these assessment periods. A decline in acres mined has resulted in a decreased number of company liable water supply effects.

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