

PROJECT MAP NO. 10

SCALE: 1"=1000'

PROJECT AREA NUMBER 10

Priority No. 2

LOCATION: Just east of Snydersburg in Knox and Farmington Townships

This project area consists of 4 strip mines, 3 deep mine openings, 3 springs, and 2 flowing gas wells. Acid mine drainage is discharged into Engle Run and Little Toby Creek.

The area is monitored by weir numbers TY-36 through 39, 41A through 44, 46,47, and 120. The following table represents the water quality recorded at these stations.

| <u>Weir Number</u> | <u>Avg. Flow</u> | <u>Avg. Acid</u> | <u>Max. Acid</u> | <u>Avg. Iron</u> | <u>Max. Iron</u> |
|--------------------|------------------|------------------|------------------|------------------|------------------|
| TY-36 | 14 | 11 | 40 | 0.14 | 0.60 |
| TY-37 | 13 | 13 | 34 | 0.05 | 0.10 |
| TY-38 | 21 | 1.7 | 4.9 | 0.01 | 0.10 |
| TY-39 | 57 | 283 | 926 | 99 | 185 |
| TY-41A | 21 | 41 | 119 | 1.3 | 3.9 |
| TY-41B | 4.5 | 2.2 | 2.7 | 0.002 | 0.01 |
| TY-42A | 12 | 78 | 163 | 3.1 | 5.8 |
| TY-43 | 1.7 | 19 | 22 | 9.7 | 18 |
| TY-44 | 53 | 6.6 | 48 | 0.10 | 0.70 |
| TY-46 | 21 | 24 | 84 | 0.85 | 3.7 |
| TY-47 | 2 | 5.7 | 12 | 1.8 | 4.2 |
| TY-120 | <u>6.3</u> | <u>1.0</u> | <u>2.0</u> | <u>0.02</u> | <u>0.1</u> |
| TOTALS | 230 | 486 | 1474 | 117 | 223 |

Strip mine 10A was discharging from the area of a stripped out deep mine along its southern edge. Water from this mine was monitored by TY-46. The southern portion of this strip also contains several highwalls and numerous depressions where water could pool. Revegetation has taken place only in isolated patches. Another small deep mine located along the toe was stripped out but was not discharging.

Strip mine 10B discharging from the toe along the southern edge. This water was monitored by TY-41B. A deep mine was located at the eastern end of this strip mine. Water was flowing from a clay pipe that probably served as a watercourse. The water was monitored by TY-42A.

Strip mine 10C was discharging from the toe in two places along the western side. This water was monitored by TY-42B and 120. Vegetative cover is lacking along the western and southern portions of the mine. Strip mine 10D was not discharging acid mine drainage.

Flowing gas wells were located at TY-39 and 43. All other weirs in the area were located below springs.

It is recommended that strip mine 10A receive minimal regrading at the northern end and complete backfilling at the southern portion. Soil treatment and planting is necessary following the reclamation.

At strip mine 10B, it is recommended that a clay blanket be installed around the stripped out deep mine opening and tied into solid ground. Strip mine 10B should receive strip mine reclamation, soil treatment and planting and diversion ditches with riprap channels.

Recommendations for mine 10C include strip mine reclamation and soil treatment and planting. No work is recommended for strip mine 10D.

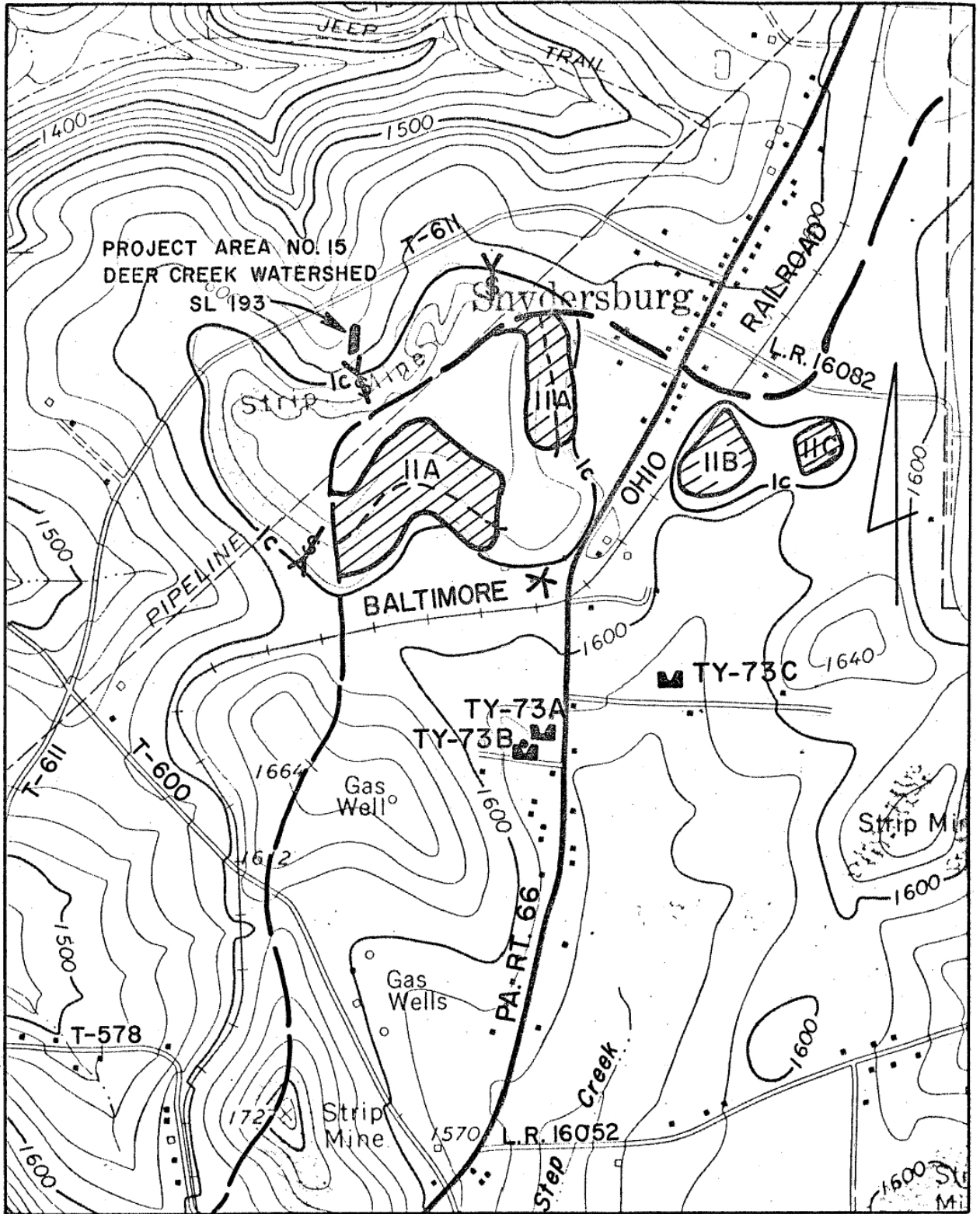
The flowing gas wells at TY39 and 43 should be plugged. The flow from the springs may improve after implementation of the measures are completed.

ESTIMATED ABATEMENT COSTS

| | |
|--------------------------------|------------------|
| 1. Strip Mine Reclamation | |
| Strip Mine 10A | \$120,000 |
| Strip Mine 10B | 245,000 |
| Strip Mine 10C | 75,000 |
| 2. Minimal Regrading | |
| Strip Mine 10A | 46,000 |
| 3. Soil Treatment and Planting | |
| Strip Mine 10A | 46,000 |
| Strip Mine 10B | 49,000 |
| Strip Mine 10C | 15,000 |
| 4. Water Management Facilities | |
| Strip Mine 10A | 20,000 |
| Strip Mine 10B | 50,100 |
| 5. Gas Well Plugging | 30,000 |
| 6. Clay Blanket | 122,500 |
| 7. Contingencies | 82,000 |
| 8. Engineering | 68,000 |
| TOTAL | <u>\$968,600</u> |

Estimated Acid Load Abatement - 70%

Cost per pound of acid load abated \$2,850/lb.



PROJECT MAP NO. II

SCALE: 1" = 1000'

PROJECT AREA NUMBER 11

Priority No. 3

LOCATION: Approximately 1/2 mile south of Snydersburg, Knox Township.

This project area consists of 4 strip mines, 1 deep mine opening and 1 spring. Acid mine drainage discharged from this area forms the headwaters of Step Creek.

The area was monitored by TY-73A, 73B, and 73C. The following table represents the water quality recorded by these stations. (The flow is represented as gallons. per minute and the acid and iron loads in pounds per day.)

| <u>Weir Number</u> | <u>Avg. Flow</u> | <u>Avg. Acid</u> | <u>Max. Acid</u> | <u>Avg. Iron</u> | <u>Max. Iron</u> |
|--------------------|------------------|------------------|------------------|------------------|------------------|
| TY-73A | 28 | 208 | 790 | 30 | 101 |
| TY-73B | 9.4 | 25 | 82 | 4.6 | 13 |
| TY-73C | <u>43</u> | <u>15</u> | <u>46</u> | <u>1.0</u> | <u>5.5</u> |
| TOTALS | 80 | 248 | 918 | 36 | 120 |

Strip mine 11A operated on the outcrop of the old O'Neill No. 4 mine in Snydersburg. It is highly probable that the stripping intersected mine workings during its operation. Most of the affected land has been reclaimed. A deep mine opening of the O'Neill No. 4 mine discharges mine drainage and was monitored by TY-73A.

Strip mines 11A and 11B were monitored by TY-73C. Both have been reclaimed and are discharging minimal amounts of acid. mine drainage.

Weir number TY-73B. monitored a spring adjacent to PA Route 66.

In order to completely seal the O'Neill Mine, an impervious barrier will be required along the stripped outcrop. A slurry trench is the recommended installation. A deep mine seal will be required for the opening adjacent to the B & O Railroad tracks. The "daylighting" or the hilltop removal of the overburden to recover the remaining coal with subsequent reclamation was also considered; however, the questionable quantity and quality of the remaining coal precluded this possibility.

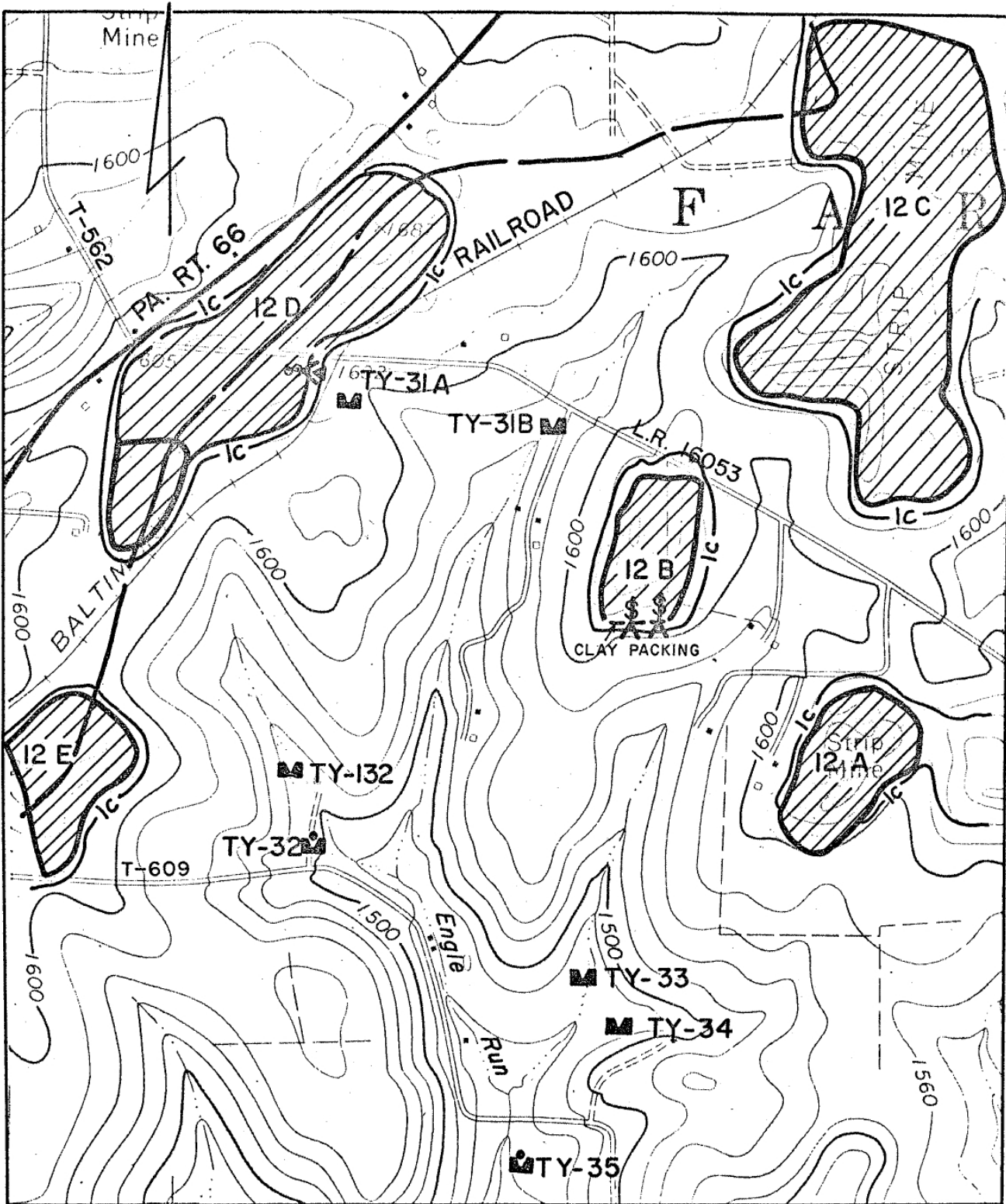
No work is recommended for strip mines 11B and 11C.

ESTIMATED ABATEMENT COSTS

| | |
|-------------------------------|---------------|
| 1. Slurry Trench Installation | \$150,000 |
| 2. Deep Mine Sealing | 25,000 |
| 3. Contingencies | 18,000 |
| 4. Engineering | <u>19,000</u> |
| TOTAL | \$212,000 |

Estimated Acid Load Reduction - 70%

Cost per pound of acid load reduction - \$1,220/lb.



PROJECT MAP NO. 12
 SCALE : 1" = 1000'

LOCATION: Approximately 1½ miles southwest of Leeper, Farmington Township

This project area consists of 5 strip mines, 3 deep mine openings and 2 springs. Acid mine drainage from this area forms the headwaters to Engle Run.

The area was monitored by weir numbers TY-31A, 31B, 32 through 35, and 132. The following table represents the water quality recorded by these stations. (The flow is represented as gallons per minute and the acid and iron loads in pounds per day.)

Strip mine 12A lacks a vegetative cover and contains surface depressions where water can pool. The strip mine was monitored by TY-33 and 34.

| <u>Weir Number</u> | <u>Avg. Flow</u> | <u>Avg. Acid</u> | <u>Max. Acid</u> | <u>Avg. Iron</u> | <u>Max. Iron</u> |
|--------------------|------------------|------------------|------------------|------------------|------------------|
| TY-31A | 2.8 | 3.4 | 5.3 | 0.05 | 0.20 |
| TY-31B | 14 | 8.4 | 13 | 0.02 | 0.03 |
| TY-32 | 32 | 16 | 112 | 0.25 | 0.80 |
| TY-33 | 239 | 106 | 420 | 1.1 | 5.0 |
| TY-34 | 120 | 55 | 233 | 0.30 | 1.4 |
| TY-35 | 11 | 1.5 | 3.7 | 0.21 | 1.8 |
| TY-132 | <u>70</u> | <u>31</u> | <u>88</u> | <u>0.27</u> | <u>1.0</u> |
| TOTAL | 489 | 221 | 875 | 2.2 | 10.2 |

Water is discharging from strip mine 12B at the site of 2 deep mine openings that were removed by the stripping. These mines were located along the southern edge of the strip and water that flowed from them was monitored by TY-33.

Strip mine 12C lacks a vegetative cover and contains surface depressions but was not found to be discharging minimal amounts of acid mine drainage as recorded by TY-31B.

The southern portion of strip mine 12D was not backfilled and contains surface depressions and lacks a vegetative cover. The remainder of 12D has been adequately reclaimed and planted. A deep mine opening (with an air seal) was monitored by TY-31A and had minimal acid production.

Weir number TY-22 monitored flow from a spring and strip mine 12E.

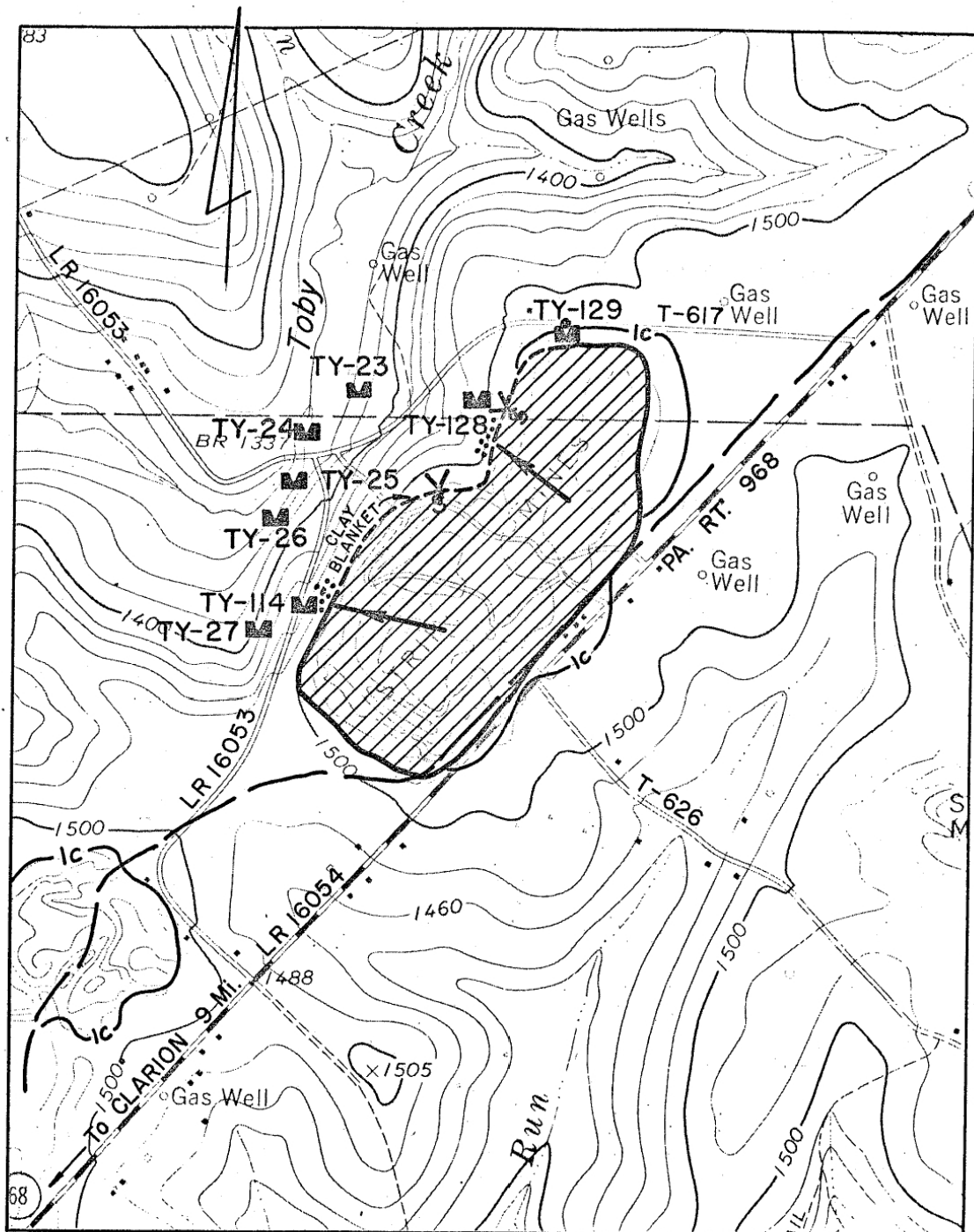
Recommendations for mine 12A include strip mine reclamation and soil treatment and planting. Strip mine 12B should receive the same with clay packing around the southern periphery of the mine. The southwestern portion of strip mine 12D should be backfilled and planted. No work is recommended for areas 12C, 12E, and the remainder of 12D.

ESTIMATED ABATEMENT COSTS

| | |
|--------------------------------|---------------|
| 1. Strip Mine Reclamation | |
| Strip Mine 12A | \$ 85,000 |
| Strip Mine 12B | 75,000 |
| Strip Mine 12D | 55,000 |
| 2. Soil Treatment and Planting | |
| Strip Mine 12A | 17,000 |
| Strip Mine 12B | 15,000 |
| Strip Mine 12D | 11,000 |
| 3. Clay Packing | |
| Strip Mine 12B | 20,000 |
| 4. Contingencies | 28,000 |
| 5. Engineering | <u>26,000</u> |
| TOTAL | \$332,000 |

Estimated Acid Land Abatement - 60%

Cost per pound of Acid load abated - \$2,500/lb.



PROJECT MAP NO. 13

SCALE: 1" = 1000'

PROJECT AREA NUMBER 13

Priority No. 2

LOCATION: Approximately 1-3/4 miles northeast of Helen Furnace, Highland and Farmington Townships

This project area consists of 1 strip mine, 2 deep mine openings and 1 spring. Acid mine drainage is discharged directly into the main stream of Toby Creek from this area.

The area was monitored by TY-23 through 29, 114, 128, and 129. The following table represents the water quality recorded by these stations. (The flow is represented as gallons per minute and the iron and acid loads in pounds per day.)

The Lower Clarion coal was removed by the stripping method of hilltop removal at this site. The

| <u>Weir Number</u> | <u>Avg. Flow</u> | <u>Avg. Acid</u> | <u>Max. Acid</u> | <u>Avg. Iron</u> | <u>Max. Iron</u> |
|--------------------|------------------|------------------|------------------|------------------|------------------|
| TY-23 | 5.2 | 54 | 201 | 4.1 | 11 |
| TY-24 | 6.9 | 81 | 234 | 1.2 | 3.5 |
| TY-25 | 2.8 | 11 | 37 | 0.04 | 0.10 |
| TY-26 | 4.3 | 13 | 29 | 0.005 | 0.03 |
| TY-27 | 17 | 240 | 490 | 68 | 147 |
| TY-28 | 24 | 77 | 193 | 0.49 | 1.5 |
| TY-29 | 6.5 | 20 | 64 | 1.1 | 2.9 |
| TY-114 | 8 | 64 | 89 | 25 | 38 |
| TY-128 | 21 | 297 | 595 | 100 | 699 |
| TY-129 | <u>3.6</u> | <u>31</u> | <u>82</u> | <u>6.9</u> | <u>13</u> |
| TOTALS | 99 | 888 | 2014 | 207 | 915 |

mine is discharging mine drainage along the entire length of the northwestern side. Also discharging, was a stripped out deep mine opening monitored by TY-128. A spring, monitored by TY-129, has been affected by the stripping. The surface of the mine is largely backfilled but is virtually barren of vegetation.

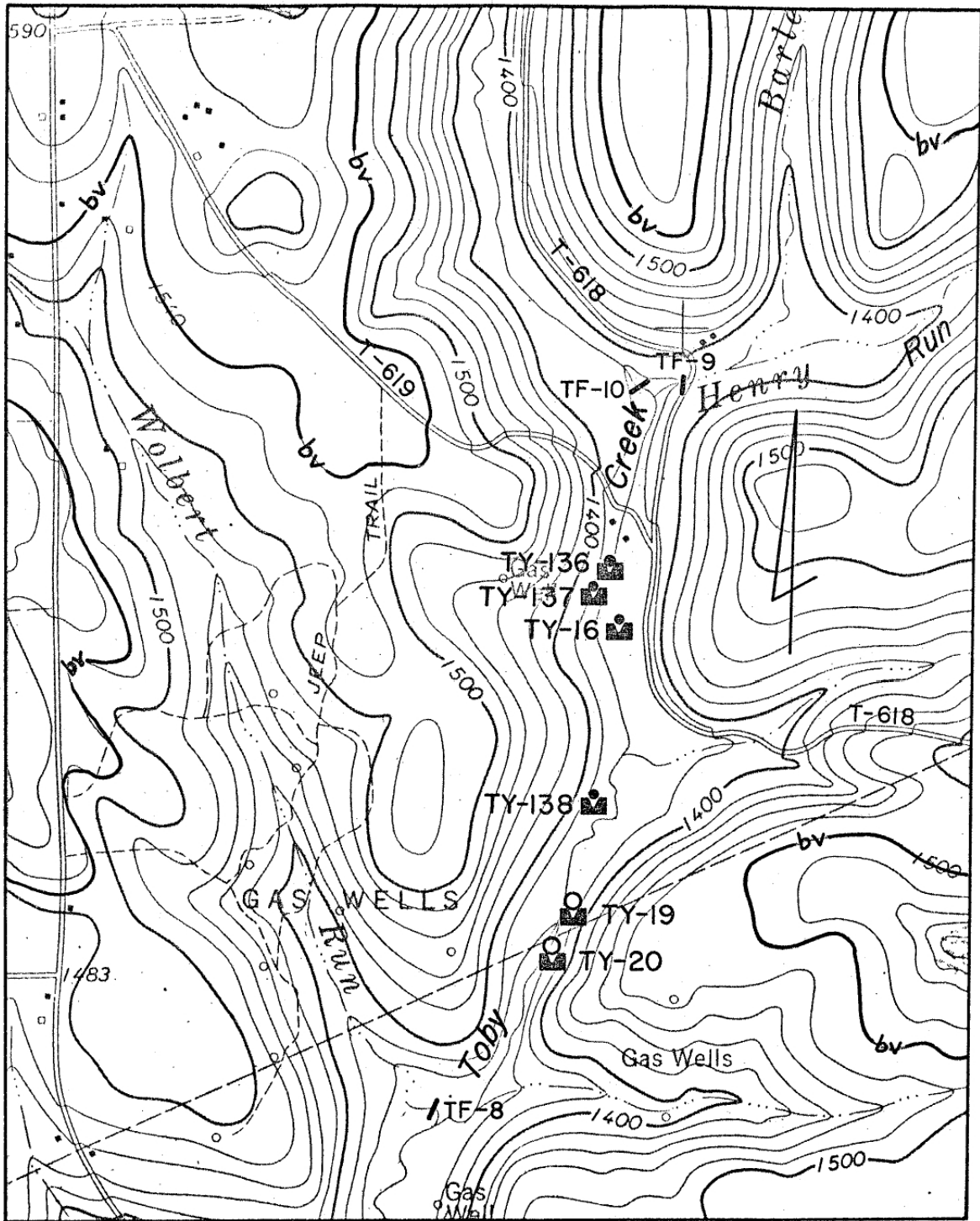
Recommendations for this area include a clay blanket installed over the northwestern end of the strip mine. Strip mine reclamation is recommended over the southwestern portion of the mine, while the remaining area will only required minimal regrading. Soil treatment and planting, diversion ditches and channels will be required to complete the reclamation.

ESTIMATED ABATEMENT COSTS

| | |
|--------------------------------|---------------|
| 1. Strip Mine Reclamation | \$ 200,000 |
| 2. Minimal Regrading | 128,000 |
| 3. Clay Blanket | 440,000 |
| 4. Soil Treatment and Planting | 104,000 |
| 5. Water Management Facilities | 58,000 |
| 6. Contingencies | 93,000 |
| 7. Engineering | <u>77,000</u> |
| TOTAL | \$1,100,000 |

Estimated Acid Load Abatement - 75%

Cost per pound of acid load abated - \$1,650/lb.



PROJECT MAP NO. 14

SCALE: 1" = 1000'

PROJECT AREA NUMBER 14

Priority No. 3

LOCATION: Approximately 2 miles southwest of Cooks Corners, Farmington Township.

This project area consists of 2 flowing wells and 4 springs. Acid mine drainage is discharged directly into Toby Creek along its main stream.

The area was monitored by weir numbers TY-16, 19, 20, and 136 through 138. The following table represents the water quality recorded by these stations. (The flow is presented in gallons per minute and the iron and acid loads are in pounds per day.)

| <u>Weir Number</u> | <u>Avg. Flow</u> | <u>Avg. Acid</u> | <u>Max. Acid</u> | <u>Avg. Iron</u> | <u>Max. Iron</u> |
|--------------------|------------------|------------------|------------------|------------------|------------------|
| TY-16 | 40 | 25 | 50 | 4.3 | 9.2 |
| TY-19 | 27 | 77 | 101 | 40 | 67 |
| TY-20 | 17 | 65 | 122 | 33 | 80 |
| TY-136 | 11 | 1.8 | 5.3 | 0.001 | 0.007 |
| TY-137 | 2.2 | 6.4 | 14 | 1.2 | 1.6 |
| TY-138 | <u>8</u> | <u>0.72</u> | <u>1.6</u> | <u>0.01</u> | <u>0.02</u> |
| TOTAL | 105 | 176 | 294 | 79 | 158 |

Flowing gas wells were monitored by TY-19 and 20. All other weirs were located below springs. The source of these springs may be upslope strip mines located between Cooks Corners and Scotch Hill of Project Area No. 15.

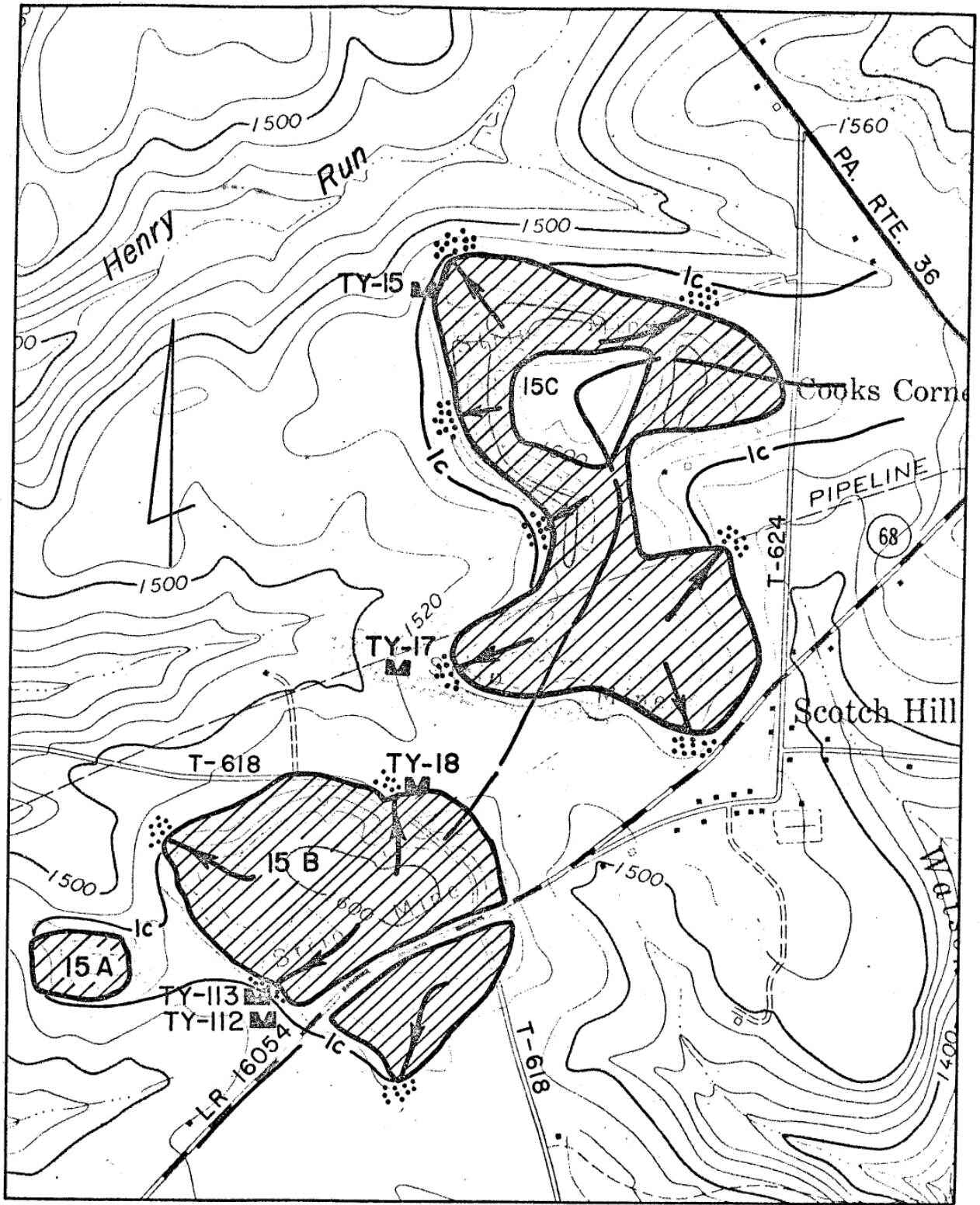
It is recommended that the gas wells at TY-19 and 20 be plugged. The flooded area above TY-16 should be drained to ascertain the presence of other flowing wells. The flow from the springs may be reduced and/or improved when measures on the upslope strip mines are implemented.

ESTIMATED ABATEMENT COSTS

| | |
|--------------------------------------|--------------|
| 1. Gas Well Plugging and Exploration | \$35,000 |
| 2. Contingencies | 3,500 |
| 3. Engineering | <u>3,700</u> |
| TOTAL | \$42,200 |

Estimated Acid Load Abatement - 70%

Cost per pound of acid load abated - \$342/lb.



PROJECT MAP NO. 15

SCALE: 1" = 1000'

PROTECT NUMBER 15

Priority No. 3

LOCATION: Approximately 3/4 miles southwest of Cooks Corners, Farmington Township.

This project area consists of 3 strip mines. The area is located on the eastern perimeter of the watershed with portions of the strip mines draining directly into the Clarion River. In the watershed, acid mine drainage is discharged into Henry Run and an unnamed tributary to Toby Creek.

The area was monitored by weir numbers TY-15, 17, 18, 112, and 113. The following table represents the water quality recorded at these stations. (The flow is shown in gallons per minute and the iron and acid loads in pounds per day.)

| <u>Weir Number</u> | <u>Avg. Flow</u> | <u>Avg. Acid</u> | <u>Max. Acid</u> | <u>Avg. Iron</u> | <u>Max. Iron</u> |
|--------------------|------------------|------------------|------------------|------------------|------------------|
| TY-15 | 17 | 51 | 158 | 3.4 | 11 |
| TY-17 | 8.2 | 49 | 110 | 1.5 | 2.7 |
| TY-18 | 2.9 | 22 | 61 | 0.32 | 0.40 |
| TY-112 | 1.5 | 11 | 14 | 0.78 | 1.0 |
| TY-113 | <u>18</u> | <u>125</u> | <u>245</u> | <u>20</u> | <u>32</u> |
| TOTAL | 48 | 258 | 588 | 26 | 47 |

Strip mine 15A was poorly backfilled leaving many surface depressions. Discharges from the strip mine appear along the toe of spoil at several places.

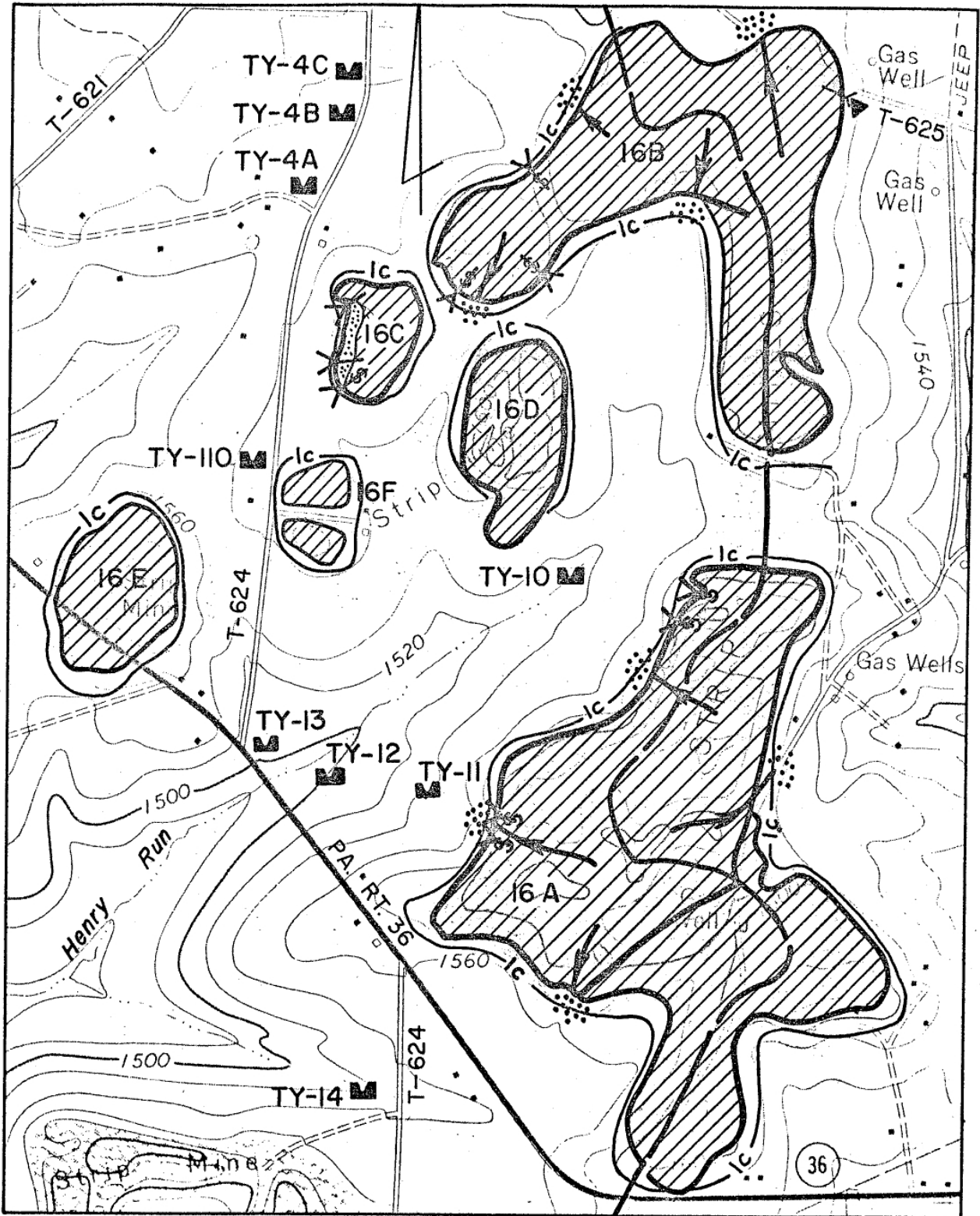
Acid mine drainage flows from strip mine 15B at two open cuts and one drainage ditch. Weir numbers TY-18 and 112 monitored the cuts while TY-112 monitored the ditch. The surface of the mine contains large pools of water and is largely devoid of vegetation.

Strip mine 15C is leaking from two open cuts. Water from these cuts was monitored by TY-15 and 17. The central portion of the mine was recently stripped and was backfilled, graded, and planted.

It is recommended that strip mines 15A, B, and C receive strip mine reclamation, soil treatment and planting and water management facilities (diversion ditches, riprap channels). The strip mines may serve as the recharge area for the springs located along Toby Creek in Project Area No. 14. The implementation of reclamation measures in this area may reduce the acid load at the springs.

ESTIMATED ABATEMENT COSTS

| | |
|--------------------------------------|---------------|
| 1. Strip Mine Reclamation | |
| Strip Mine 15A | \$ 40,000 |
| Strip Mine 15B | 370,000 |
| Strip Mine 15C | 530,000 |
| 2. Soil Treatment and Planting | |
| Strip Mine 15A | 8,000 |
| Strip Mine 15B | 74,000 |
| Strip Mine 15C | 106,000 |
| 3. Water Management Facilities | |
| Strip Mine 15A | 2,000 |
| Strip Mine 15B | 91,000 |
| Strip Mine 15C | 130,000 |
| 4. Contingencies | 135,000 |
| 5. Engineering | <u>91,000</u> |
| TOTAL | \$1,577,000 |
| Estimated Acid load abatement - 85% | |
| Cost per pound of acid load abated - | \$7,190/lb. |



PROJECT MAP NO. 16

SCALE: 1" = 1000'

PROJECT AREA NUMBER 16

Priority No. 1

LOCATION: Immediately north of Cooks Corners, Farmington Township

This project area consists of 6 strip mines and 10 deep mine openings, four of which are small country banks. The area is located along the eastern watershed boundary with two strip mines extending into the Toms Run Watershed. Acid mine drainage from this area forms the headwaters of Henry Run.

The area was monitored by weir numbers TY-4A, 4B, 4C, 10 through 14, and 110. The following table represents the water quality recorded at these stations. (The flow is shown as gallons per minute and the acid and iron loads in pounds per day.)

Strip mine 16A is located on the watershed boundary line. Only the southern third of this mine has been adequately graded and planted. Numerous depressions, where water collects, exist on the

| <u>Weir Number</u> | <u>Avg. Flow</u> | <u>Avg. Acid</u> | <u>Max. Acid</u> | <u>Avg. Iron</u> | <u>Max. Iron</u> |
|--------------------|------------------|------------------|------------------|------------------|------------------|
| TY-4A | 18 | 17 | 50 | 0.22 | 1.0 |
| TY-4B | 13 | 2.2 | 7.2 | 0.04 | 0.06 |
| TY-4C | 86 | 127 | 443 | 2.6 | 12 |
| TY-10 | 1060 | 576 | 3120 | 6 | 33 |
| TY-11 | 13 | 114 | 264 | 11 | 30 |
| TY-12 | 4.2 | 15 | 38 | 0.07 | 0.20 |
| TY-13 | 91 | 147 | 530 | 4.5 | 19 |
| TY-14 | 23 | 24 | 78 | 0.34 | 1.6 |
| TY-110 | <u>4.2</u> | <u>15</u> | <u>28</u> | <u>0.73</u> | <u>1.0</u> |
| TOTAL | 1312 | 1037 | 4558 | 26 | 98 |

northern two-thirds of the strip. Four mine openings have been intercepted by the strip mine. The flow from this area was monitored by TY-11 and 14.

Mine 16B is also located on the boundary line. The western extension of this strip, and the southern end outside the watershed, have numerous surface depressions where water collects. The northeastern portion of this strip has been sufficiently regraded, but needs revegetation. The largest acid load in this project area apparently originates from this strip mine and strip mine 16D. The area was monitored by TY-10.

The surface of strip mine 16D has been extensively replanted, but was poorly regraded, leaving numerous depressions. Mine drainage discharges along the entire southern periphery of this strip.

Strip mine 16C intercepted 3 country banks on its outcrop. The seepages from this site were monitored by TY-110. Strip mines 16E and 16F have been adequately regraded and planted.

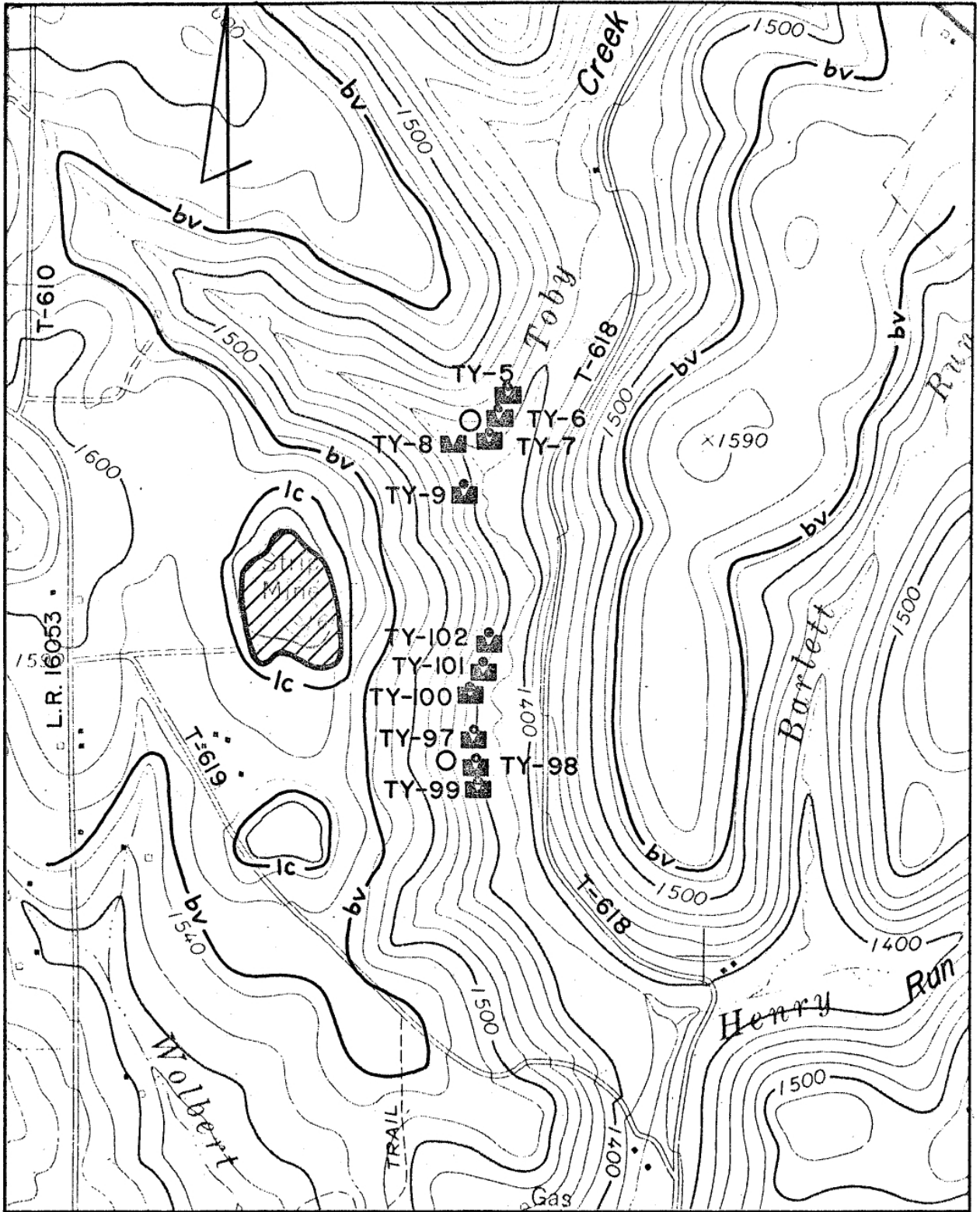
Recommendations for mine 16A include strip mine reclamation and minimal regrading for the northern two-thirds of the area. Strip mine reclamation and minimal regrading is also required for 16B. Diversion ditches and riprap channels are recommended for both areas. Strip mine reclamation with soil treatment and planting is required for 16C and 16D. No work is recommended for 16E and 16F.

ESTIMATED ABATEMENT COSTS

| | |
|--------------------------------|---------------|
| 1. Strip Mine Reclamation | |
| Strip Mine 16A | \$ 500,000 |
| Strip Mine 16B | 510,000 |
| Strip Mine 16C | 55,000 |
| Strip Mine 16D | 105,000 |
| 2. Minimal Regrading | |
| Strip Mine 16A | 100,000 |
| Strip Mine 16B | 24,000 |
| 3. Soil Treatment and Planting | |
| Strip Mine 16A | 152,000 |
| Strip Mine 16B | 94,000 |
| Strip Mine 16C | 11,000 |
| Strip Mine 16D | 21,000 |
| 3. Water Management Facilities | |
| Strip Mine 16A | 95,000 |
| Strip Mine 16B | 72,500 |
| 4. Contingencies | 150,000 |
| 5. Engineering | <u>97,000</u> |
| TOTAL | \$1,886,500 |

Estimated Acid Load Abatement - 80%

Cost per pound of acid load abatement - \$2,273/lb.



PROJECT MAP NO. 17

SCALE: 1" = 1000'

LOCATION: Approximately 2 miles west of Cooks Corners, Farmington Township

This project area consists of 1 strip mine, 2 flowing gas wells and 4 springs. Acid mine drainage is discharged directly into the main stream of Toby Creek.

The area was monitored by weir numbers TY-S through 9 and 97 through 102. The following table represents the water quality recorded at these stations. (The flow is shown as gallons per minute and iron and acid loads in pounds per day.)

The strip mine discharges water from two open cuts and 1 seepage along the toe of spoil. The flow was monitored by TY-8. The surface is not backfilled, is pervious and has sparse vegetation. The mine is considered to recharge the springs monitored by TY-9, 100, 101, and 102.

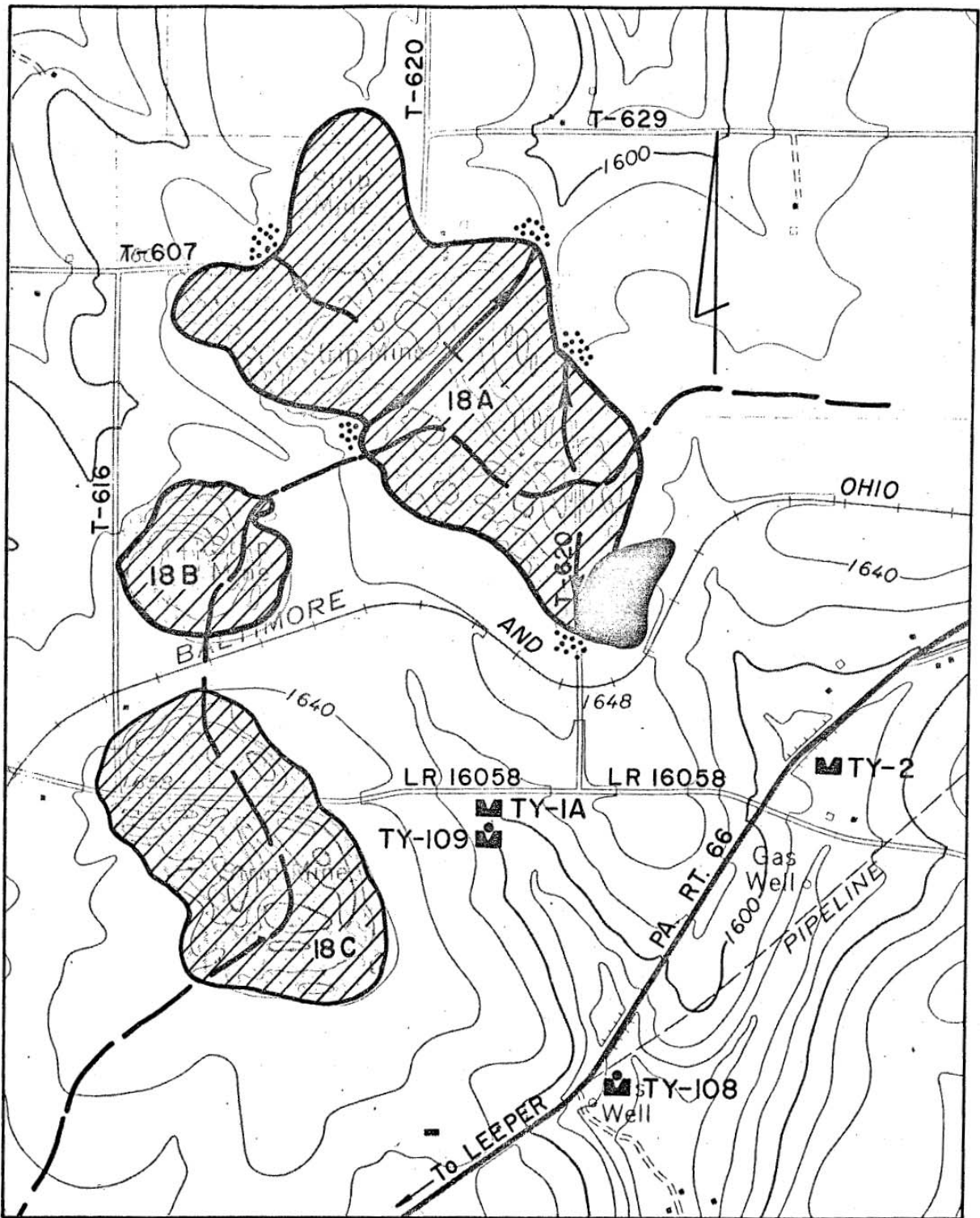
| <u>Weir Number</u> | <u>Avg. Flow</u> | <u>Avg. Acid</u> | <u>Max. Acid</u> | <u>Avg. Iron</u> | <u>Max. Iron</u> |
|--------------------|------------------|------------------|------------------|------------------|------------------|
| TY-5 | 10 | 51 | 148 | 16 | 33 |
| TY-6 | 2 | 10 | 10 | 2.8 | 3.1 |
| TY-7 | 25 | 51 | 108 | 18 | 41 |
| TY-8 | 119 | 141 | 467 | 0.37 | 1.4 |
| TY-9 | 24 | 12 | 22 | 0.06 | 0.10 |
| TY-97 | 13 | 21 | 58 | 3.1 | 17 |
| TY-98 | 34 | 104 | 463 | 54 | 183 |
| TY-99 | 1.8 | 5.5 | 9.6 | 0.95 | 1.7 |
| TY-100 | 7.8 | 10 | 38 | 0.01 | 0.10 |
| TY-101 | 8.6 | 8.4 | 38 | 0.06 | 0.17 |
| TY-102 | <u>4.5</u> | <u>2.2</u> | <u>8.6</u> | <u>0.05</u> | <u>0.02</u> |
| TOTALS | 250 | 416 | 1370 | 95 | 281 |

Two flowing gas wells were monitored by TY-5, 6, 7, 97, 98, and 99.

It is recommended that the strip mine receive strip mine reclamation and soil treatment and planting. The two gas wells should be plugged. The springs discharging acid mine drainage should show improvement after reclamation measures have been completed on the strip mine.

ESTIMATED ABATEMENT COSTS

| | |
|--|---------------|
| 1. Strip Mine Reclamation | \$ 60,000 |
| 2. Soil Treatment and Planting | 12,000 |
| 3. Gas Well Plugging | 30,000 |
| 4. Contingencies | 10,000 |
| 5. Engineering | <u>12,000</u> |
| TOTAL | \$124,000 |
| Estimated Acid Load Abatement - 75% | |
| Cost per pound of acid load abated - \$397/lb. | |



PROJECT MAP NO. 18

SCALE: 1"=1000'

LOCATION: Approximately 14 miles northeast of Leeper, Farmington Township

This project area consists of 3 strip mines and 2 springs. The area is located on the northwestern boundary of the watershed. Acid mine drainage discharged from this area represents the extreme headwaters of Toby Creek.

The area was monitored by weir numbers TY-1A, 2, 108 and 109. The following table represents the water quality as recorded at these stations. (The flow is shown as gallons per minute and the iron and acid loads in pounds per day.)

Strip mine 18A contains many surface depressions and lacks vegetative cover in many places. The strip is seeping along its northern boundary into the

Coon Creek Watershed. A large portion of the southern boundary of 18A is covered with

| <u>Weir Number</u> | <u>Avg. Flow</u> | <u>Avg. Acid</u> | <u>Max. Acid</u> | <u>Avg. Iron</u> | <u>Max. Iron</u> |
|--------------------|------------------|------------------|------------------|------------------|------------------|
| TY-1A | 131 | 87 | 384 | 4 | 22 |
| TY-2 | 248 | 442 | 1864 | 34 | 159 |
| TY-108 | 6.6 | 4.7 | 16 | 0.04 | 0.10 |
| TY-109 | <u>5.4</u> | <u>6.6</u> | <u>13</u> | <u>0.003</u> | <u>0.01</u> |
| TOTALS | 391 | 540 | 2277 | 38 | 181 |

coal refuse from an abandoned coal tipple. The flow from this area is monitored by TY-2.

Strip mine 18B has been backfilled but lacks a vegetative cover. Acid mine drainage originating at the toe of spoil along the eastern side was monitored by TY-1A. Mine drainage also flowed from the western side of the strip into the Coon Creek Watershed.

The only water discharged from strip mine 18C was along its northwestern boundary which flowed into the Coon Creek Watershed.

Weir numbers TY-108 and 109 monitored flows from springs adjacent to mine 18C.

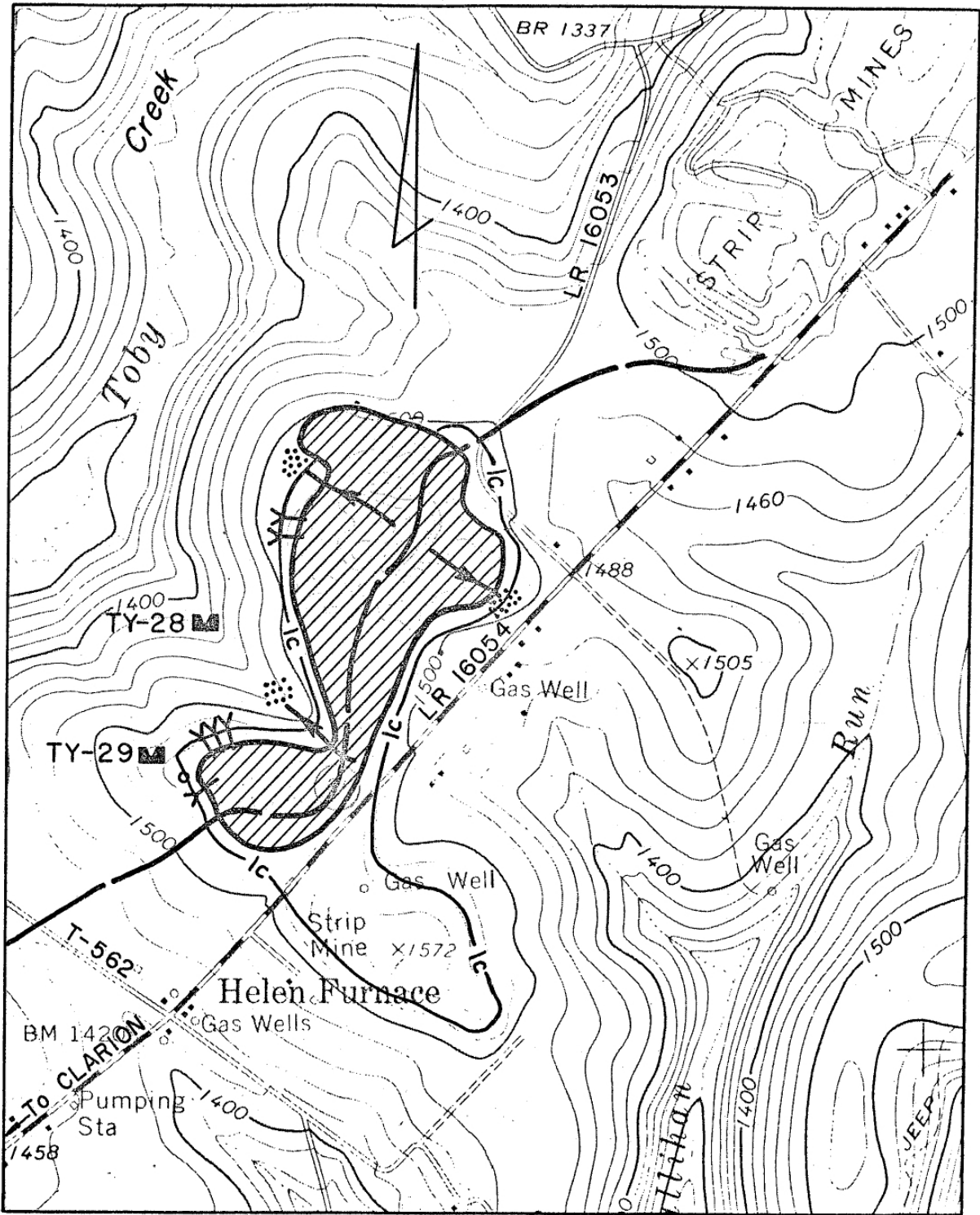
Recommendations for mine 18A include strip mine reclamation and soil treatment and planting. Diversion ditches and riprap channels are also required. The coal refuse should be excavated, transported and buried at the reclamation area. The surface of mine 18B should receive minimal regrading and soil treatment and planting. No work is recommended for strip mine 18C.

ESTIMATED ABATEMENT COSTS

| | |
|--------------------------------------|---------------|
| 1. Strip Mine Reclamation | |
| Strip Mine 18A | \$ 650,000 |
| 2. Minimal Regrading | |
| Strip Mine 18B | 40,000 |
| 3. Soil Treatment and Planting | |
| Strip Mine 18A | 132,000 |
| Strip Mine 18B | 20,000 |
| 4. Coal Refuse Disposal | 60,000 |
| 5. Water Management Facilities (18A) | 130,000 |
| 6. Contingencies | 103,000 |
| 7. Engineering | <u>80,000</u> |
| TOTAL | \$1,215,000 |

Estimated Acid Load Abatement - 80%

Cost per pound of acid load abated - \$2,810/lb.



PROJECT MAP NO. 19

SCALE: 1" = 1000'

LOCATION: Just north of Helen Furnace, Highland Township

This project area consists of 1 strip mine and 6 deep mine openings. Acid mine drainage is discharged directly into the main stream of Toby Creek.

The area was monitored by weir numbers TY-28 and 29. The following table represents the water quality recorded at these stations. (The flow is represented as gallons per minute and the iron and acid loads in pounds per day.)

| <u>Weir Number</u> | <u>Avg. Flow</u> | <u>Avg. Acid</u> | <u>Max. Acid</u> | <u>Avg. Iron</u> | <u>Max.</u> |
|--------------------|------------------|------------------|------------------|------------------|-------------|
| TY-28 | 24 | 77 | 193 | 0.49 | 1 |
| TY-29 | <u>6.5</u> | <u>20</u> | <u>64</u> | <u>1.1</u> | <u>2</u> |
| TOTAL | 31 | 97 | 257 | 1.6 | 4 |

The strip mine is discharging from old deep mine openings and below the toe of spoil in the southwestern corner. This flow was monitored by TY-29. Water from an open drainage ditch, located along the western side of the mine, was joined by seepage from the toe of spoil further south. This flow was monitored by TY-28. Large portions of the mine lack vegetative cover and it contains surface depressions where water can pool.

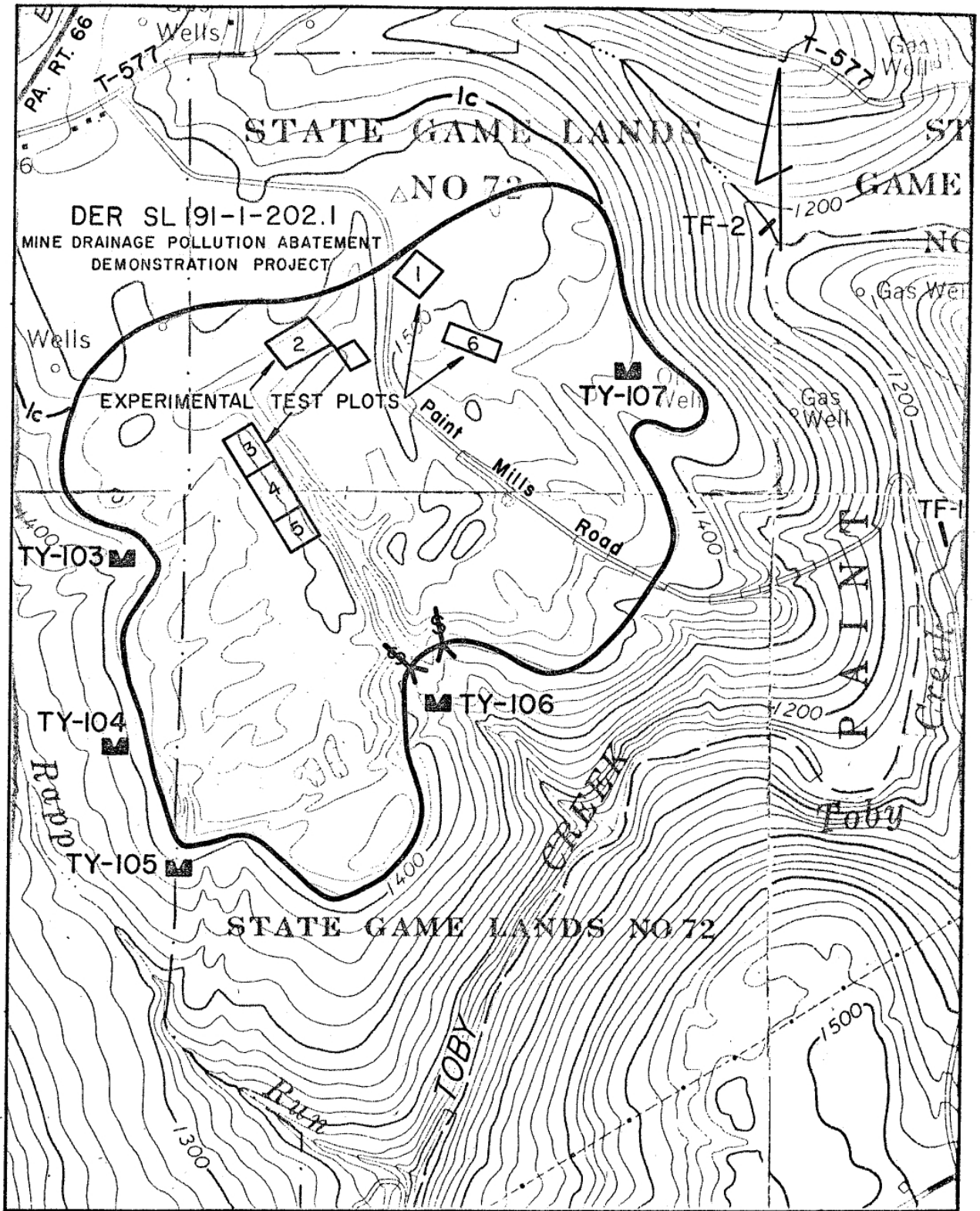
Recommendations for this area include strip mine reclamation of the entire strip mine and soil treatment and planting. Also required are diversion ditches and riprap channels for the expedition of surface runoff.

ESTIMATED ABATEMENT COSTS

| | |
|--------------------------------|---------------|
| 1. Strip Mine Reclamation | \$345,000 |
| 2. Soil Treatment and Planting | 69,000 |
| 3. Water Management Facilities | 75,000 |
| 4. Contingencies | 49,000 |
| 5. Engineering | <u>43,000</u> |
| TOTAL | \$581,000 |

Estimated Acid Load Abatement - 75%

Cost per pound of acid load abated - \$7,960/lb.



PROJECT MAP NO. 20

SCALE: 1"=1000'

LOCATION: Approximately 2 miles north of Clarion Borough

This project area consists of one large strip mine (230 acres). Acid mine drainage is discharged into Rapp Run and into the main stream of Toby Creek near the mouth. Flows monitored from this site represent the largest discharges of acid mine drainage into the Toby Creek Watershed.

The area was monitored by weir numbers TY-103, 104, 105, 106 and 107. The following table represents the water quality recorded at these stations.

(The flow is shown as gallons per minute and the iron and acid loads in pounds per day.)

The area was first stripped in 1953 by the G.A. Stiles Company. Approximately 20 acres of Lower Kittanning and Upper Clarion coal were removed. In 1956, the Zacherl Coal Company stripped 30 acres at the southern outcrop. The remainder of the area stripped the Upper Clarion coal seam in

| <u>Weir Number</u> | <u>Avg. Flow</u> | <u>Avg. Acid</u> | <u>Max. Acid</u> | <u>Avg. Iron</u> | <u>Max. Iron</u> |
|--------------------|------------------|------------------|------------------|------------------|------------------|
| TY-103 | 19 | 192 | 874 | 8.6 | 36 |
| TY-104 | 39 | 687 | 2,779 | 47 | 163 |
| TY-105 | 8.7 | 154 | 449 | 8.5 | 26 |
| TY-106 | 195 | 6,807 | 11,088 | 749 | 1,161 |
| TY-107 | <u>5.8</u> | <u>64</u> | <u>238</u> | <u>2.2</u> | <u>1.9</u> |
| TOTALS | 268 | 7,904 | 15,428 | 815 | 1,388 |

a northwest progression from the outcrop by the G.A. Stiles Company to 1965. In the process, three deep mine openings were stripped out and a large drainage ditch was opened for the conveyance of surface runoff. The majority of the pollution from the site originates at a highwall and is conveyed by the ditch as monitored by TY-106. Additional flows were monitored on the perimeter of the strip mine by TY-103, 104, 105, and 107. The composition of the surface of the mine is coarse sandstone. The material has poor compactability and high permeability. Therefore, it is subject to considerable infiltration of surface water into the highly acidic Clarion overburden. The strip mine may be the recharge area of the springs located downslope of the area in Project Area number 3 of the proposed abatement plan.

This area was the subject of a site evaluation performed by Gwin, Dobson, Foreman, Inc. in 1973. The work involved determining the extent and nature of work required to abate the acid mine drainage from the strip mine. The mining

history, geology (through an exploratory drilling program), extent of pollution, and recommended abatement measures with cost estimates were developed for the area. Recommendations for the area included backfilling, regrading, installation of water management facilities, impervious covering and soil treatment and planting.

Plans and bid documents were prepared in 1975 by Gwin, Dobson & Foreman, Inc. Work to be accomplished was that as outlined in the site, evaluation report. Bids were opened for the job but were found to be excessive. The project was suspended temporarily pending a review of the abatement measures for the site.

The Department of Environmental Resources prepared plans and bid documents for a demonstration project (DER SL 191-1-201.1) on the strip mine in 1978. The purpose of the project is to prepare test plots for an evaluation of the most suitable and effective means of reclaiming the strip mine areas in State Game Lands No. 72. The work involves grading test plots, performing various methods of compacting test plots, placing of impervious covering material, revegetation, installation of drainage facilities around plots and construction of flow measurement structures to record runoff from each plot. The strip mine is similar to many in the area where the surface is quite permeable, devoid of vegetation and situated on a hilltop. Mines of this type are thought to pollute local groundwater systems. After an evaluation of the reclamation measures of the demonstration project, the results will be applicable not only to the strip mine of State Game Lands No. 72 but to surface mines in the surrounding area.

PROJECT COST SUMMARY

| | <u>Project Area No.</u> | <u>Acid Load (ppd)</u> | <u>Acid Reduction (ppd)</u> | <u>Cost/lb.</u> | <u>Total Cost</u> |
|----------------|-----------------------------|--------------------------------|-------------------------------------|-----------------|-------------------|
| PRIORITY NO. 1 | 3 | 6,655 | 5,324 | \$ 475 | \$ 2,529,000 |
| | 4 | 1,481 | 666 | 55 | 36,300 |
| | 5 | 3,944 | 2,958 | 165 | 488,000 |
| | 6 | 1,163 | 581 | 1,436 | 835,000 |
| | 16 | <u>1,037</u> | <u>830</u> | 2,273 | <u>1,886,500</u> |
| Sub-Total | | 14,280 | 10,359 | | \$ 5,774,800 |
| PRIORITY NO. 2 | 1 | 735 | 439 | 1,336 | \$ 589,000 |
| | 2 | 408 | 347 | 378 | 131,000 |
| | 7 | 473 | 355 | 3,600 | 1,276,000 |
| | 8 | 496 | 347 | 1,454 | 505,000 |
| | 10 | 486 | 340 | 2,850 | 968,600 |
| | 13 | 888 | 666 | 1,650 | 1,100,000 |
| | 17 | 416 | 312 | 397 | 124,000 |
| | 18 | <u>540</u> | <u>432</u> | 2,810 | <u>1,215,000</u> |
| | Sub-Total | | 4,442 | 3,238 | |
| PRIORITY NO. 3 | 9 | 146 | 117 | 7,936 | \$ 927,000 |
| | 11 | 248 | 174 | 1,220 | 212,000 |
| | 12 | 221 | 133 | 2,500 | 332,000 |
| | 14 | 176 | 123 | 342 | 42,200 |
| | 15 | 258 | 219 | 7,190 | 1,577,000 |
| | 19 | <u>97</u> | <u>73</u> | 7,960 | <u>581,000</u> |
| Sub-Total | | 1,146 | 839 | | \$ 3,671,200 |
| TOTAL | | 19,868 | 14,436 | | \$15,354,600 |

AVERAGE ACID LOAD REDUCTION - 73%

AVERAGE COST PER POUND OF ACID LOAD REDUCTION - \$1,064/lb.