

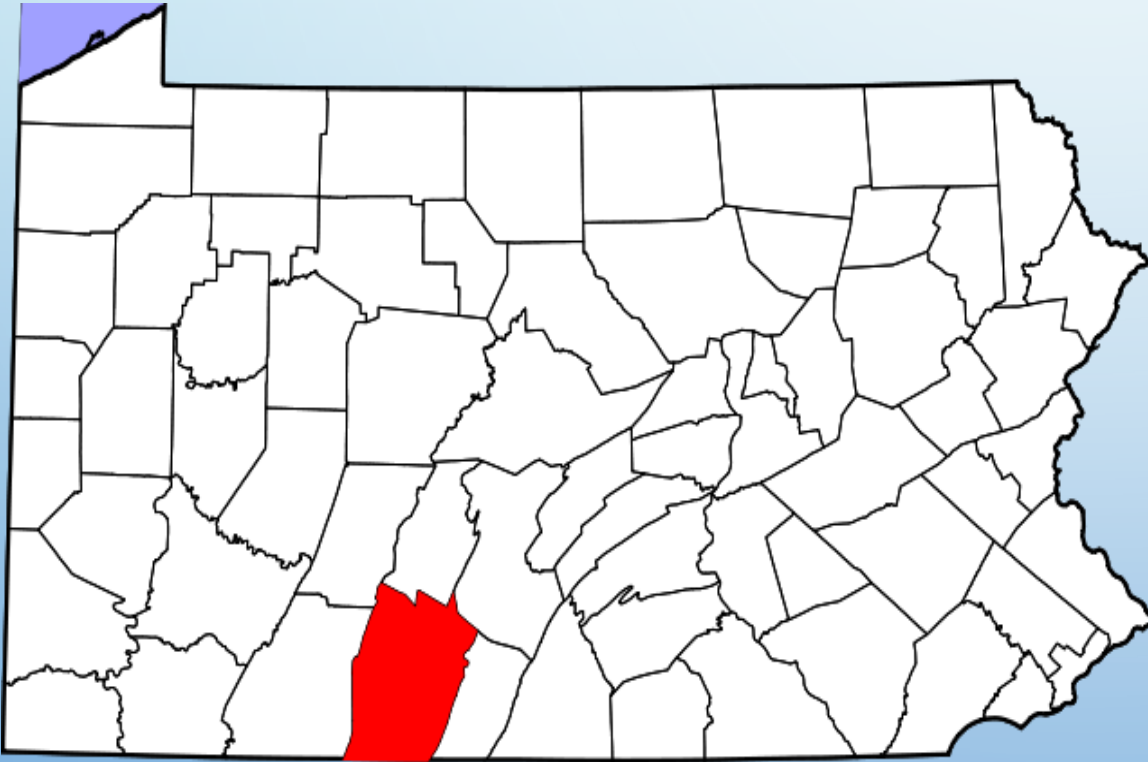
**SUCCESSFUL
ACID MINE
DRAINAGE
ABATEMENT – A
CASE STUDY**

JOE MILLS
SENIOR SCIENTIST

**SKELLY
AND
LOY**

A  **Terracon** Company

**BROAD TOP TOWNSHIP, BEDFORD COUNTY,
PENNSYLVANIA
48.5 SQ. MILES**



1981 WATERSHED STUDY

- PROMPTED BY THE SUCCESS OF A HIGHLY VISIBLE 1979 R.A.M.P. (RURAL ABANDONED MINE PROGRAM) PROJECT
- COMPLETED BY THREE LOCAL CONSERVATION DISTRICTS
- TRASH, SEWAGE & AMD WERE THE LARGEST PROBLEMS OF CONCERN IN THE WATERSHED

ILLEGAL TRASH DUMPING

- BTT SIGNED A HOST MUNICIPALITY AGREEMENT WITH THE LANDFILL OPERATOR
- FREE WEEKLY CURBSIDE GARBAGE PICK-UP
- FREE, SEMI-ANNUAL BULK ITEM PICK-UP
- \$5,000 ANNUAL DONATION TO 3 LOCAL VFD
- \$3.50/TON, \$200,000 (MINIMUM) ANNUALLY TO BTT
- **ILLEGAL TRASH DUMPING HAS BEEN MINIMIZED**

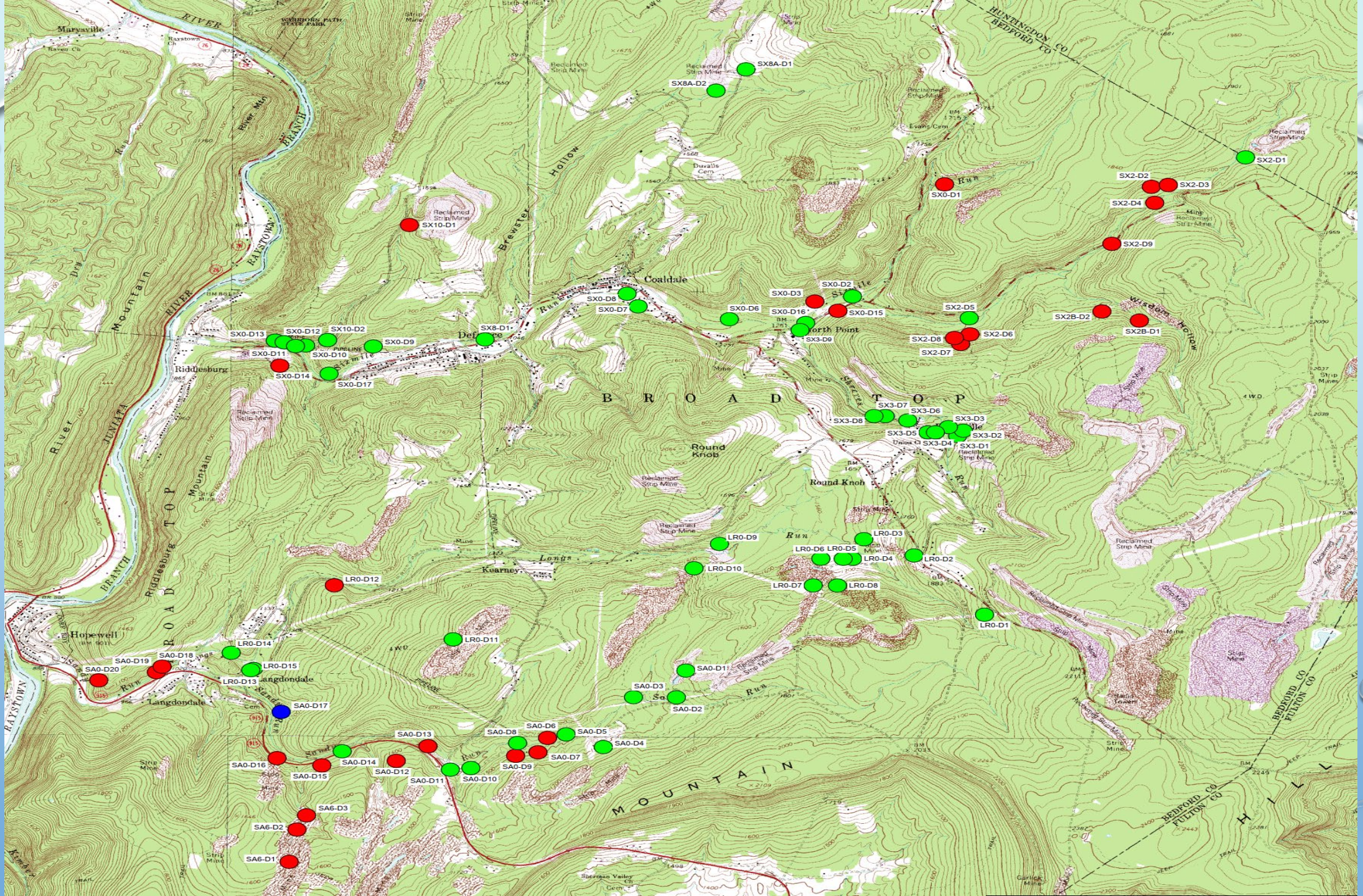
SEWAGE

- 1995 - PA. SEWAGE FACILITIES ACT 537 PLAN COMPLETED, 800 – 850 HOMES
- 4 CLUSTER SYSTEMS TREAT ~600 HOMES / 200 HOMES UTILIZE ON-LOT SYSTEMS, 2-4 HOMES PER SYSTEM
- THE TREATMENT SYSTEMS ARE **OWNED AND MAINTAINED** BY BROAD TOP TOWNSHIP (\$20 MONTHLY MAINTENANCE FEE CHARGED TO EACH HOUSEHOLD)
- US ARMY CORP SECTION 313 PROGRAM MONEY (ENVIRONMENTAL INFRASTRUCTURE) AND OTHER PUBLIC FUNDS WERE UTILIZED
- **NITRATE AND BACTERIOLOGICAL ISSUES HAVE BEEN ELIMINATED**



ACID MINE DRAINAGE (AMD)

- 1977 – SURFACE MINE CONTROL AND RECLAMATION ACT
- 1979 – FIRST RAMP (RURAL ABANDONED MINE PROJECT) COMPLETED IN BTT
- 1990'S – A FEW RAMP AND PA. BUREAU OF ABANDONED MINE RECLAMATION (BAMR) PROJECTS COMPLETED IN BTT
- 1995 - RAMP NO LONGER FUNDED, STATE AML PROGRAMS
- 2005 – WATERSHED IMPROVEMENT PLAN (WIP) COMPLETED
- SINCE COMPLETION OF THE WIP, >\$6.5 MILLION OF CWA SECTION 319 FUNDS AND >\$0.5 MILLION GROWING GREENER GRANT MONEY (SMCRA TITLE IV) SPENT IN THE WATERSHEDS. FORTY-FIVE (45) AMD TREATMENT SYSTEMS CONSTRUCTED.



The background is a light blue gradient. In the top-left and bottom-right corners, there are several realistic-looking water droplets of various sizes, some overlapping. The droplets have highlights and shadows, giving them a three-dimensional appearance.

CONSTRUCTION CONSTRAINTS









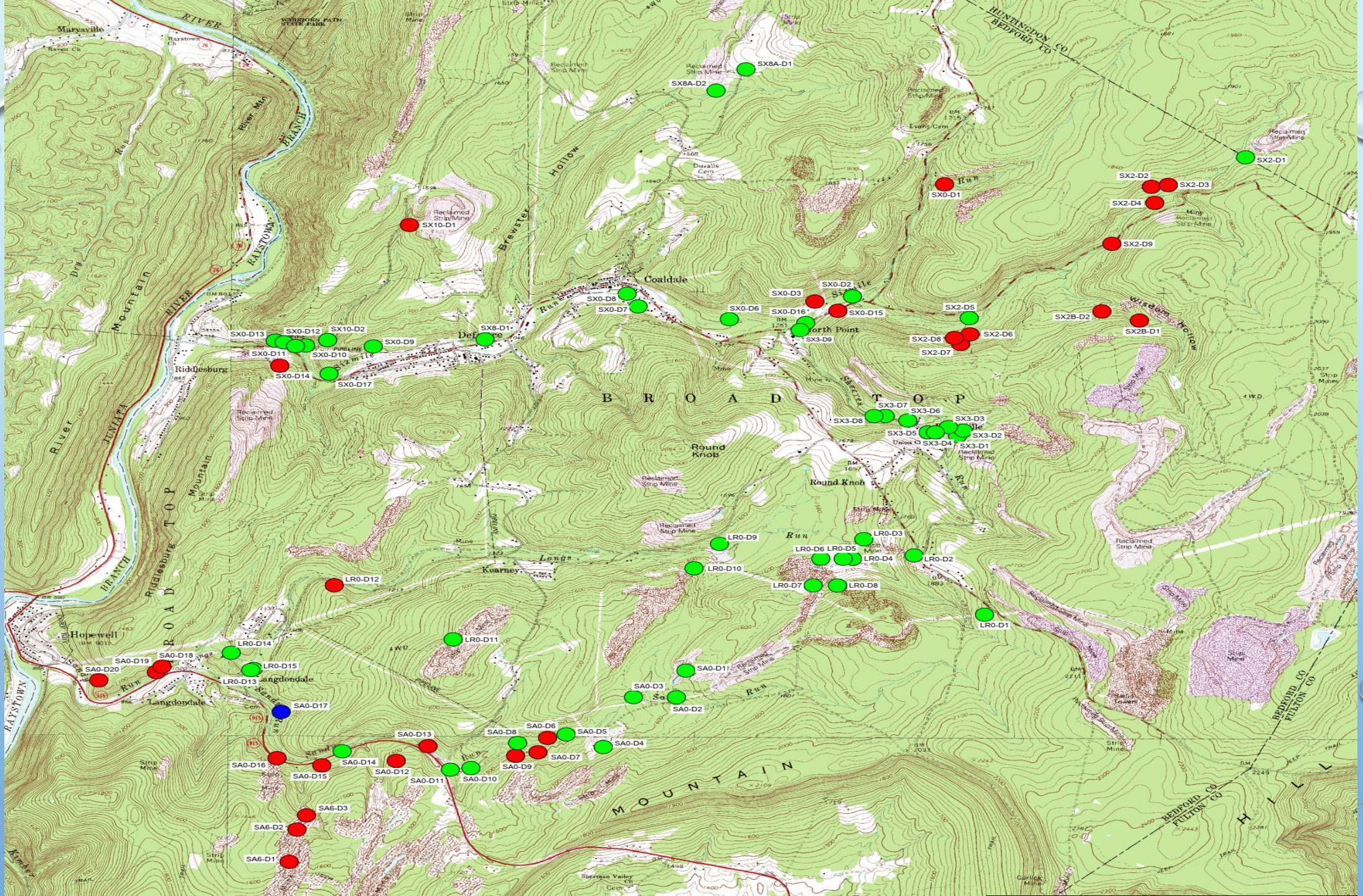


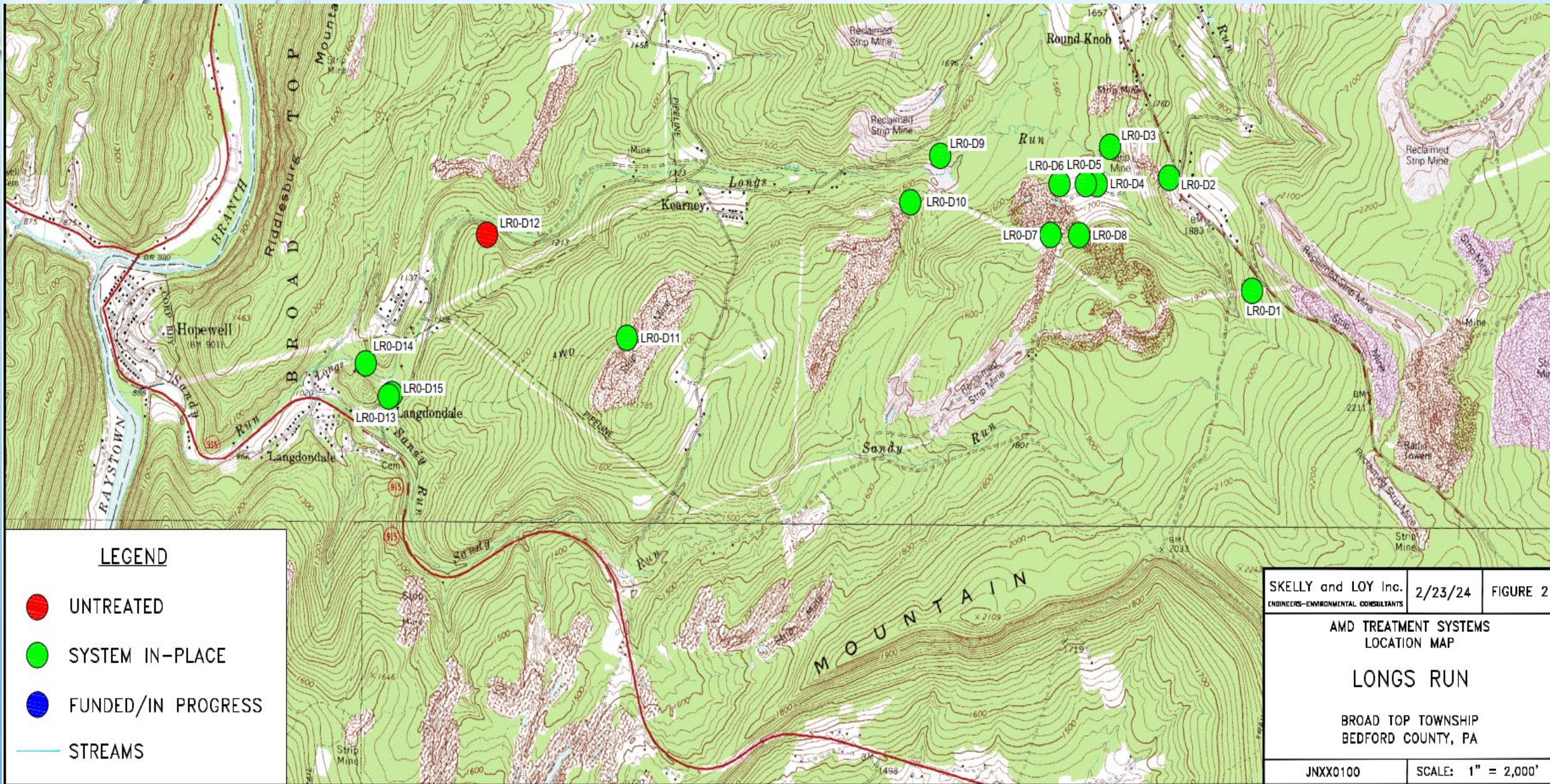




LONGS RUN

- 5.25-MILE TRIBUTARY TO SANDY RUN
- 13 AMD TREATMENT SYSTEMS, LAST SYSTEM COMPLETED IN THE EARLY 2000'S
- 2007 FIRST DOCUMENTED FISH
- 2014 DELISTED IN THE PA INTEGRATED WATER QUALITY MONITORING AND ASSESSMENT REPORT (INTEGRATED REPORT) – THINK CWA SECTION 303(D)
- FREESTONE INDEX OF BIOLOGIC INTEGRITY (IBI) SCORE OF 78.3. IBI = 60 IS CONSIDERED TO HAVE ATTAINED COLD WATER FISHERIES STATUS





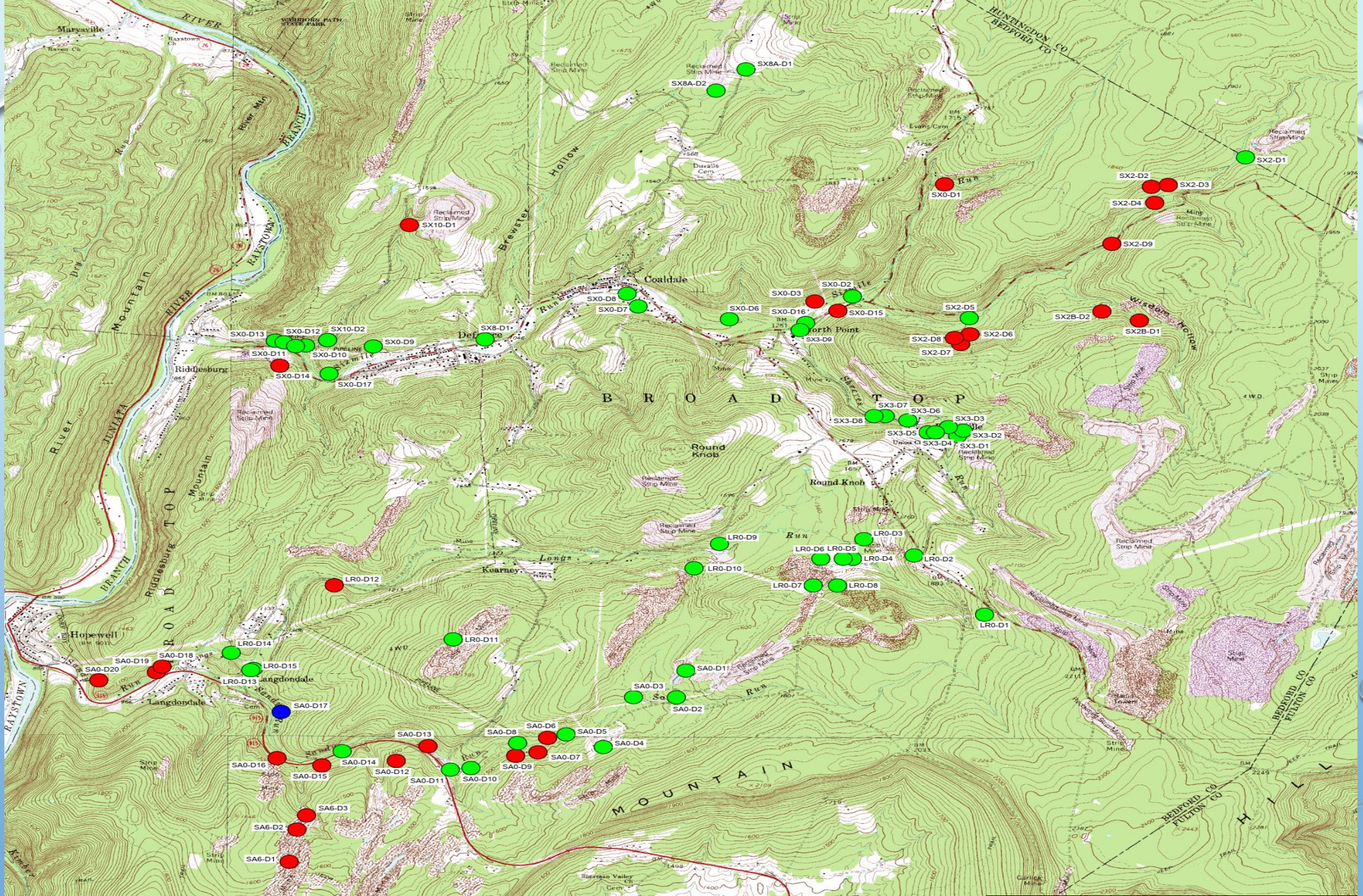
LEGEND

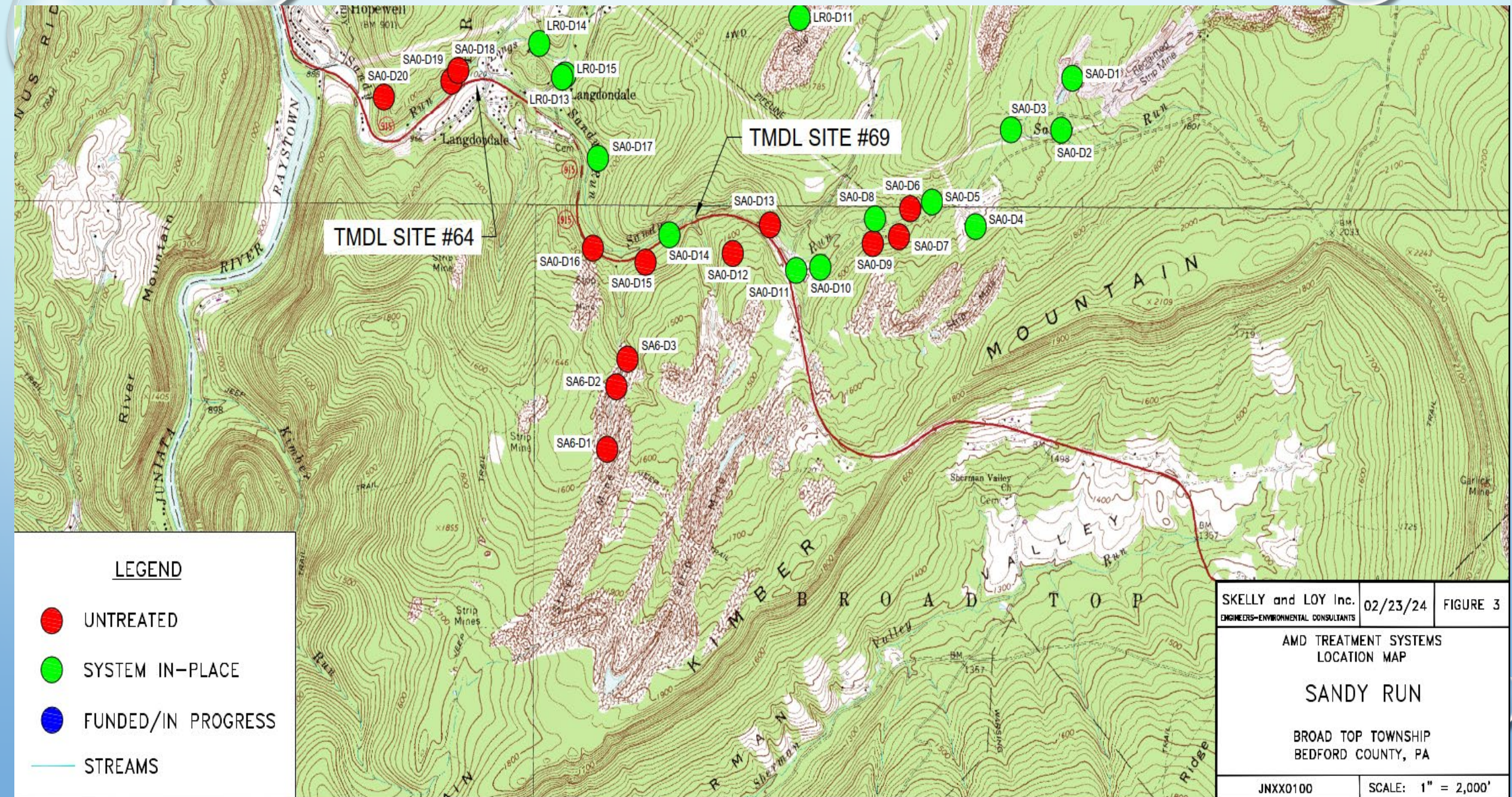
- UNTREATED
- SYSTEM IN-PLACE
- FUNDED/IN PROGRESS
- STREAMS

| | | |
|--|--------------------|----------|
| SKELLY and LOY Inc. ENGINEERS-ENVIRONMENTAL CONSULTANTS | 2/23/24 | FIGURE 2 |
| AMD TREATMENT SYSTEMS LOCATION MAP | | |
| LONGS RUN | | |
| BROAD TOP TOWNSHIP BEDFORD COUNTY, PA | | |
| JNXX0100 | SCALE: 1" = 2,000' | |

SANDY RUN

- 5.25-MILES
- FLOWS INTO THE RAYSTOWN BRANCH OF THE JUNIATA RIVER, AT HOPEWELL, PA
- 9 AMD TREATMENT SYSTEMS, 1 SYSTEM UNDER CONSTRUCTION
- 1 UNTREATED, HIGHLY IMPACTED TRIBUTARY, 3 AMD SOURCES
- HEADWATERS: LANDFILL AND COUNTY (DIRT) ROAD = SEDIMENT IMPAIRMENT AND 3 BAMR TREATMENT SYSTEMS IN NEED OF SOME TLC
- BIOLOGICALLY DEPRESSED BASED ON TU STUDIES





LEGEND

- UNTREATED
- SYSTEM IN-PLACE
- FUNDED/IN PROGRESS
- STREAMS

| | | |
|--|--------------------|----------|
| SKELLY and LOY Inc. ENGINEERS-ENVIRONMENTAL CONSULTANTS | 02/23/24 | FIGURE 3 |
| AMD TREATMENT SYSTEMS LOCATION MAP | | |
| SANDY RUN | | |
| BROAD TOP TOWNSHIP BEDFORD COUNTY, PA | | |
| JNXX0100 | SCALE: 1" = 2,000' | |

SANDY RUN, LOW FLOW, AUGUST 2019

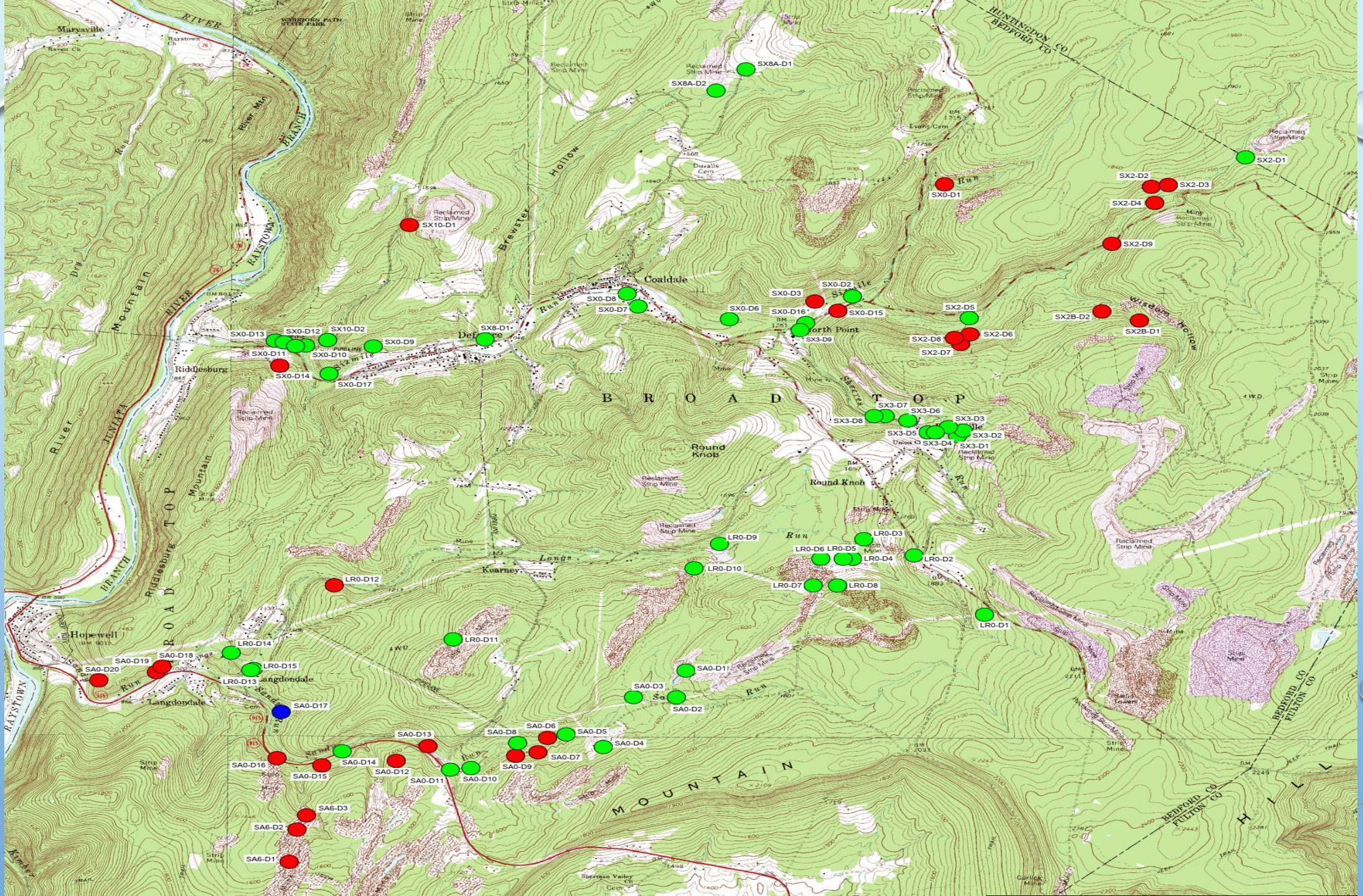
| AMD Site | pH in | pH out | Fe in | Fe out | Al in | Al out | Acidity in | Acidity out |
|----------|-------|---------|-------|---------|-------|---------|------------|-------------|
| SAO-D1 | 2.55 | No Flow | 9.01 | No Flow | 7.67 | No Flow | 98.53 | No Flow |
| SAO-D2 | 2.97 | 6.67 | 14.6 | 0.88 | 1.63 | <0.1 | 58.84 | -56.65 |
| SAO-D3 | 5.14 | 6.27 | | 0.35 | | 0.11 | | -3.61 |
| SAO-D4 | 2.28 | 7.01 | 75.7 | 0.354 | 33.5 | <0.1 | 419.2 | -70.31 |
| SAO-D5 | 2.45 | 7.24 | 6.7 | 0.2 | 11.5 | <0.1 | 146 | -53.46 |
| SAO-D8 | 3.53 | 7.75 | 1.67 | 0.2 | 5.69 | 0.18 | 55.09 | -37.43 |
| SAO-D10 | 2.67 | 7.54 | 10.6 | 0.2 | 10.2 | 0.43 | 159.3 | -51.65 |
| SAO-D11 | 5.88 | 7.54 | 7.79 | 0.2 | <0.1 | <0.1 | 9.91 | -33.37 |
| SAO-D14 | 3.43 | 6.55 | 3.01 | 0.2 | 6.75 | 0.31 | 100.3 | -34.73 |

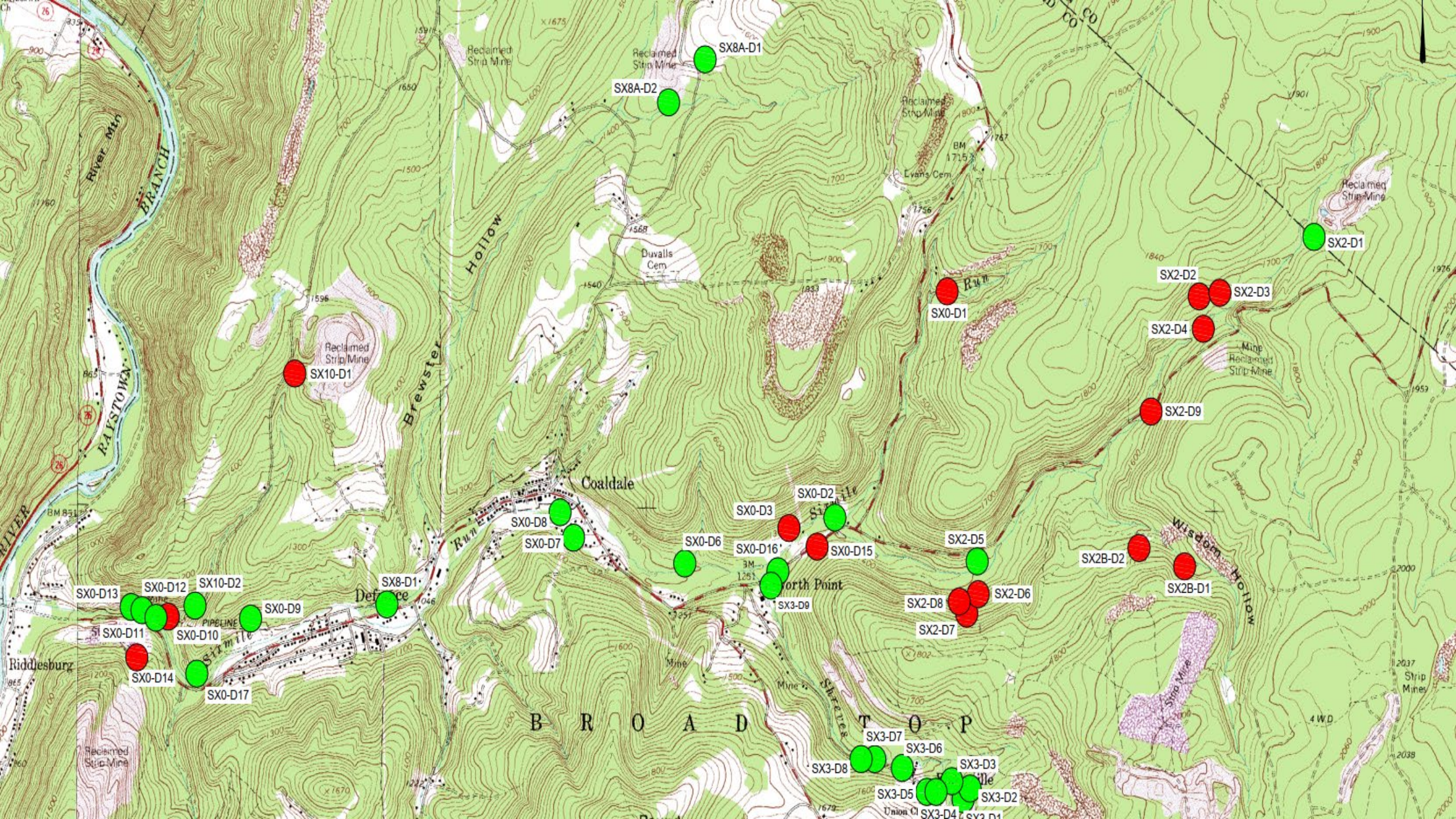
SANDY RUN AMD TREATMENT SYSTEMS DATA COLLECTED MARCH 17, 2019 (HIGH FLOW)

| SITE | FLOW, GPM | FIELD pH IN | FIELD pH OUT | ACIDITY (mg/L) IN * | ACIDITY (mg/L) OUT * | TOTAL Fe IN | TOTAL Fe OUT | TOTAL Al IN | TOTAL Al OUT |
|-------------------------------------|-----------|-------------|--------------|---------------------|--------------------------|-------------|------------------------|-------------|-----------------------------|
| SAO-D1 | 150 | 3.46 | 3.64 | 53.55 | 46.27 | 1.58 | 1.12 | 4.39 | 3.82 |
| pH CHANGE, LOADS (TPY) and % Change | | | 0.2 | 17.62 Tons | 15.22 Tons 14% | 0.52 Tons | 0.37 Tons 29% | 1.44 Tons | 1.26 Tons 18% |
| SAO-D2 | 3 | 3.91 | 5.14 | 34.8 | 12.14 | 1.63 | <0.03 | 3.03 | 1.06 |
| pH CHANGE, LOADS (TPY) and % Change | | | 1.23 | 0.23 Tons | 0.08 Tons 65% | 0.01 Tons | 0.0 Tons 100% | 0.02 Tons | 0.01 Tons 50% |
| SAO-D3 | 300 | 5.14 | 4.4 | 7.61 | 22.42 | 0.3 | 0.53 | 0.19 | 2.29 |
| pH CHANGE, LOADS (TPY) and % Change | | | 0.74 | 5.01 Tons | 14.75 Tons 195% Increase | 0.2 Tons | 0.35 Tons 74% Increase | 0.13 Tons | 1.51 Tons 1,061.5% Increase |
| SAO-D4 | 3 | 2.84 | 8.18 | 365.6 | -37.71 | 50.9 | 0.42 | 30.3 | 0.1 |
| pH CHANGE, LOADS (TPY) and % Change | | | 5.34 | 2.41 Tons | -0.25 Tons 110% | 0.33 Tons | 0.003 Tons 99% | 0.2 Tons | 0.00 Tons 99% |
| SAO-D5 | 300 | 3.1 | 7.19 | 121 | -4.05 | 4.76 | 0.95 | 9.05 | 2.1 |
| pH CHANGE, LOADS (TPY) and % Change | | | 4.09 | 79.63 Tons | -2.67 Tons 103% | 3.13 Tons | 0.63 Tons 80% | 5.96 Tons | 1.31 Tons 76.8% |
| SAO-D8 | 58 | 2.9 | 8.69 | 102.8 | -32.39 | 4.88 | 0.49 | 7.43 | 0.84 |
| pH CHANGE, LOADS (TPY) and % Change | | | 5.79 | 13.08 Tons | -4.12 Tons 131.5% | 0.62 Tons | 0.06 Tons 89.9% | 0.95 Tons | 0.11 Tons 88.75% |
| SAO-D10 | 93 | 3.18 | 8.64 | 199.6 | -36.23 | 18.9 | 0.53 | 12.4 | 0.77 |
| pH CHANGE, LOADS (TPY) and % Change | | | 5.46 | 40.72 Tons | -7.39 Tons 118% | 3.86 Tons | 0.11 Tons 97.2% | 2.53 Tons | 0.16 Tons 94% |
| SAO-D11 | 190 | 6.78 | 7.44 | 8.65 | -22.55 | 7.49 | 0.36 | 0.1 | 0.1 |
| pH CHANGE, LOADS (TPY) and % Change | | | 0.66 | 3.61 Tons | -9.4 Tons 360.4% | 3.12 Tons | 0.15 Tons 95% | 0.04 Tons | 0.04 Tons 0% |
| SAO-D14 | 168 | 3.1 | 7.7 | 114.8 | -35 | 3.3 | <0.03 | 7.2 | 0.36 |
| pH CHANGE, LOADS (TPY) and % Change | | | 4.6 | 42.31 Tons | -12.9 Tons 130% | 1.22 Tons | 0.00 Tons 100% | 2.65 Tons | 0.13 Tons 95% |

SIX MILE RUN

- 6-MILES, FLOWS INTO THE RAYSTOWN BRANCH OF THE JUNIATA RIVER NEAR DEFIANCE, PA
- 23 AMD TREATMENT SYSTEMS, 21 SYSTEMS DISCHARGING > 6.0 PH, TWO SYSTEMS DISCHARGING ~ 5.0 DURING HIGH FLOW EVENTS
- MAINSTEM PH BETWEEN 6.0 AND 7.5 PH, HAS MET GOALS ESTABLISHED IN 2005 WIP
- TU STUDIES INDICATE BIOLOGICAL IMPAIRMENT EXISTS, ALTHOUGH (YOY) TROUT ARE PRESENT





SIX MILE RUN, LOW FLOW, AUGUST 2017

| AMD Site | pH in | pH out | Fe in | Fe out | Al in | Al out | Acidity in | Acidity out |
|----------|-------|---------|-------|---------|-------|---------|------------|-------------|
| SX2-D1 | 3.80 | No Flow | <0.04 | No Flow | 8.9 | No Flow | 80.0 | ND |
| SX2-D5 | | 6.7 | | <0.04 | | <0.1 | | -76.6 |
| SXO-D2 | 4.07 | 6.56 | 0.1 | <0.04 | 2.5 | <0.1 | 26.1 | -30.6 |
| SXO-D16 | 3.25 | 6.96 | 0.5 | <0.04 | 6.2 | <0.1 | 59.8 | -35.5 |
| SXO-D4 | 2.48 | 6.87 | 22.7 | <0.04 | 8.0 | <0.1 | 137.2 | -71.0 |
| SXO-D6 | 3.39 | 6.93 | 31.0 | 0.2 | 30.0 | <0.1 | 330.1 | -19.5 |
| SXO-D8 | 3.04 | 7.30 | 7.8 | <0.04 | 6.2 | <0.1 | 88.4 | -42.9 |
| SX8-D1 | 3.39 | 6.93 | 10.8 | <0.04 | 0.75 | <0.1 | 68.7 | -96.0 |
| SXO-D9 | 4.07 | 6.94 | 29.7 | 0.2 | 8.0 | <0.1 | 131.4 | -32.8 |

SIX MILE RUN STREAM DATA AUGUST 2017

*A NEGATIVE NET ACIDITY INDICATES AN ALKALINE DISCHARGE.

**ALL SAMPLES WERE COLLECTED IN MARCH 2017, EXCEPT SX10-D2 WAS COLLECTED APRIL 16, 2019, SXO-D17 WAS COLLECTED JANUARY 11, 2021, SXO-D10, D11, D12, AND D13 WAS COLLECTED AUGUST 9, 2023

| SITE | Field pH | Net Acidity, mg/l CaCO ₃ * | Iron, mg/l | Aluminum, mg/l |
|---|--------------|---------------------------------------|--------------|----------------|
| SX2-D1 | No Discharge | No Discharge | No Discharge | No Discharge |
| Six Mile Downstream of SX2-D1 | 6.71 | | | |
| Six Mile Upstream of SX2-D5 | 6.77 | | | |
| SX2-D5 | 6.7 | -76.6 | <0.04 | <0.1 |
| Six Mile Downstream of SX2-D5 | 6.71 | -15.12 | <0.04 | <0.1 |
| Six Mile Upstream of SXO-D2 | 6.56 | -30.6 | <0.04 | <0.1 |
| SXO-D2 | 6.81 | | | |
| Six Mile Downstream of SXO-D2 and Upstream of SXO-D16 | 6.63 | | | |
| SXO-D16/SXO-D4 | 6.87 | -71.0 | <0.04 | <0.1 |
| Six Mile Downstream of SXO-D16/SXO-D4 and Upstream of SXO-D6 | 5.98 | -13.5 | 0.05 | <0.1 |
| SXO-D6 | 6.93 | -19.5 | 0.2 | 0.1 |
| Six Mile Downstream of SXO-D6 and Upstream of SXO-D8 | 7.02 | | | |
| SXO-D8 | 7.3 | -42.9 | 0.04 | <0.1 |
| Six Mile Downstream of SXO-D8 | 6.98 | | | |
| Six Mile Upstream of SX8-D1 | 7.05 | | | |
| SX8-D1 | 6.93 | -96.0 | <0.04 | <0.1 |
| Six Mile Downstream of SX8-D1 and Upstream of SXO-D9 | 7.03 | -16.46 | <0.04 | <0.1 |
| SXO-D9 | 6.94 | -32.8 | 0.2 | <0.1 |
| Six Mile Downstream of SXO-D9 | 7.03 | -22.22 | 0.34 | <0.1 |
| Six Mile Downstream of SXO-D9 and Upstream of SX10-D2/SXO-D17 | 7.28 | | | |
| SX10-D2/SXO-D17 | 6.50 | -29.00 | 3.79 | 0.54 |
| Six Mile Downstream of SX10-D2/SXO-D17 and Upstream of SXO-D10, D11, D12, and D13 | 7.14 | | | |
| SXO-D10, D11, D12 and D13 | 6.74 | | | |
| Six Mile Downstream of SXO-D10, D11, D12 and D13 | 7.25 | -19.40 | 0.47 | 0.56 |



COLO

ALEC

frogg toggs

DO NOT DRINK HANDLE WITH CARE



CONCLUSIONS

- CITIZEN SURVEY
- WATERSHED APPROACH
- DEDICATED PEOPLE
- MAINTENANCE, MAINTENANCE, MAINTENANCE.....



JOE MILLS
SKELLY & LOY, INC.
SENIOR SCIENTIST
(304)590-4300
JMILLS@SKELLYLOY.COM