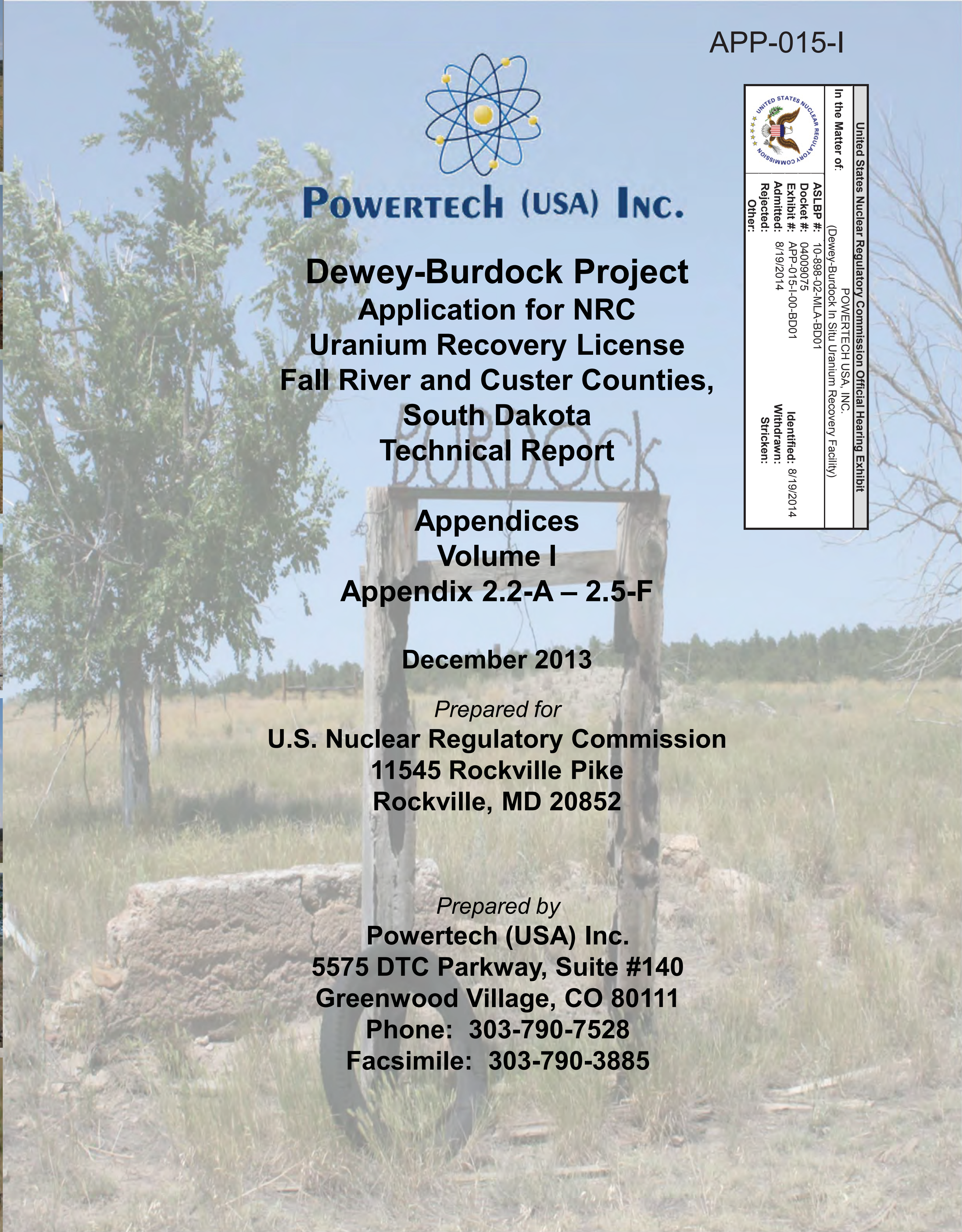
APP-015-I

United States Nuclear Regulatory Commission Official Hearing Exhibit

In the Matter of: POWERTECH USA, INC.
(Dewey-Burdock In Situ Uranium Recovery Facility)

**ASLBP #:** 10-898-02-MLA-BD01
**Docket #:** 04009075
**Exhibit #:** APP-015-I-00-BD01
**Admitted:** 8/19/2014
**Rejected:**
**Other:**
**Identified:** 8/19/2014
**Withdrawn:**
**Stricken:**



POWERTECH (USA) INC.

# Dewey-Burdock Project
## Application for NRC Uranium Recovery License Fall River and Custer Counties, South Dakota Technical Report

## Appendices
## Volume I
## Appendix 2.2-A – 2.5-F

**December 2013**

*Prepared for*
**U.S. Nuclear Regulatory Commission**
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POWERTECH (USA) INC.

# Dewey-Burdock Project
# Application for NRC
# Uranium Recovery License
# Fall River and Custer Counties
# South Dakota
# Technical Report

## LIST OF APPENDICES - VOLUME I

# APPENDIX 2.2-A

# WELL LOCATION DATA

## Table 1: Wells within 2 km of the Project Boundary

| Hydro ID | Township | Range | Section | 1/4 - 1/4 Location | Coordinates East[1] | Coordinates North[1] | Screened Location[2] | Well Use |
|---|---|---|---|---|---|---|---|---|
| 1 | 7 | 1 | 9 | SESE | 1027696 | 429227 | Chilson | Stock |
| 2 | 7 | 1 | 16 | SESE | 1026724 | 423922 | Chilson | Domestic |
| 3 | 7 | 1 | 22 | SWNW | 1028593 | 421104 | Chilson | Stock |
| 4 | 7 | 1 | 15 | SESE | 1032516 | 423080 | Unknown | Stock |
| 5 | 7 | 1 | 14 | NENW | 1035181 | 427284 | Fall River | Stock |
| 6 | 7 | 1 | 14 | NESE | 1037218 | 425012 | Unknown | Stock |
| 7 | 7 | 1 | 23 | NWNW | 1033304 | 422417 | Fall River | Domestic |
| 8 | 7 | 1 | 23 | SWSE | 1036052 | 418515 | Fall River | Domestic |
| 9 | 7 | 1 | 23 | NENE | 1038003 | 421806 | Fall River | Stock |
| 12 | 7 | 1 | 4 | SESE | 1026978 | 434378 | Chilson | Stock |
| 13 | 7 | 1 | 3 | NWNW | 1028360 | 438470 | Chilson | Domestic |
| 14 | 7 | 1 | 2 | NWSW | 1033704 | 434723 | Fall River | Stock |
| 15 | 7 | 1 | 2 | NENW | 1035304 | 438317 | Chilson | Stock |
| 16 | 7 | 1 | 1 | NESW | 1041428 | 434446 | Chilson | Domestic |
| 17 | 7 | 1 | 12 | SENW | 1040223 | 431329 | Fall River | Stock |
| 18 | 7 | 1 | 9 | SWSW | 1022812 | 428960 | Fall River | Domestic |
| 37 | 7 | 2 | 18 | NWSW | 1044183 | 423947 | Unknown | Stock |
| 38 | 6 | 1 | 33 | SWNW | 1024328 | 442289 | Fall River | Stock |
| 40 | 6 | 1 | 30 | SWNW | 1013415 | 447182 | Inyan Kara | Domestic |
| 41 | 6 | 1 | 31 | SWNE | 1015385 | 442081 | Unknown | Stock |
| 42 | 7 | 1 | 5 | SWNE | 1021144 | 436481 | Chilson | Domestic |
| 43 | 6 | 1 | 34 | SWSE | 1031123 | 439436 | Chilson | Domestic |
| 49 | 6 | 1 | 32 | NWNW | 1018932 | 444022 | Fall River | Stock |
| 51 | 7 | 1 | 9 | SENE | 1027411 | 431487 | Chilson | Stock |
| 61 | 7 | 1 | 11 | NWSE | 1036832 | 429987 | Chilson | Stock |
| 96 | 41N | 60W | 22 | SWSW | 1011630 | 451853 | Chilson | Domestic |
| 102 | 6 | 1 | 18 | SWNE | 1016825 | 458312 | Chilson | Domestic |
| 106 | 6 | 1 | 18 | NENE | 1018099 | 459625 | Unknown | Stock |
| 107 | 6 | 1 | 18 | SWNE | 1017018 | 458158 | Fall River | Domestic |
| 108 | 6 | 1 | 18 | SWNE | 1016478 | 458698 | Fall River | Domestic |
| 109 | 6 | 1 | 17 | NENW | 1020801 | 459625 | Chilson | Domestic |
| 110 | 6 | 1 | 17 | NENE | 1023777 | 459643 | Chilson | Stock |
| 111 | 6 | 1 | 17 | NWNE | 1022074 | 459586 | Fall River | Stock |
| 112 | 6 | 1 | 16 | SESE | 1027864 | 455881 | Fall River | Stock |
| 113 | 7 | 2 | 6 | NESW | 1046437 | 434417 | Unknown | Stock |
| 114 | 7 | 2 | 7 | SESW | 1045410 | 428654 | Unkpapa | Stock |
| 115 | 6 | 1 | 18 | SENE | 1017697 | 457640 | Fall River | Domestic |
| 116 | 6 | 1 | 18 | SENE | 1017992 | 458111 | Fall River | Stock |
| 117 | 6 | 1 | 8 | SWSE | 1022177 | 460796 | Unknown | Stock |
| 138 | 6 | 1 | 18 | NENE | 1017537 | 459030 | Fall River | Domestic |
| 147 | 6 | 1 | 17 | NESW | 1020879 | 456566 | Chilson | Monitor |
| 220 | 6 | 1 | 19 | SENE | 1017872 | 452334 | Unknown | Stock |
| 270 | 6 | 1 | 19 | NWSW | 1014108 | 451942 | Unknown | Stock |
| 436 | 6 | 1 | 20 | NWNE | 1021450 | 454700 | Fall River | Monitor |
| 506 | 7 | 2 | 8 | SWNW | 1050129 | 430704 | Unkpapa | Stock |
| 510 | 7 | 1 | 12 | SESE | 1042933 | 428178 | Chilson | Stock |
| 609 | 6 | 1 | 29 | SWNE | 1021735 | 447808 | Chilson | Monitor |
| 610 | 6 | 1 | 29 | SWNE | 1021599 | 447969 | Fall River | Monitor |
| 611 | 6 | 1 | 20 | NWNE | 1021835 | 453954 | Chilson | Monitor |
| 612 | 6 | 1 | 20 | NWNE | 1021755 | 454128 | Chilson | Monitor |
| 613 | 6 | 1 | 20 | NWNE | 1022125 | 453775 | Fall River | Monitor |
| 614 | 6 | 1 | 20 | NWNE | 1022185 | 453769 | Fuson | Monitor |
| 615 | 6 | 1 | 20 | NWNE | 1022172 | 453708 | Chilson | Monitor |
| 616 | 6 | 1 | 20 | SWNE | 1022132 | 453134 | Chilson | Monitor |

## Table 1: Wells within 2 km of the Project Boundary (Continued)

| Hydro ID | Township | Range | Section | 1/4 - 1/4 Location | Coordinates East[1] | Coordinates North[1] | Screened Location[2] | Well Use |
|---|---|---|---|---|---|---|---|---|
| 617 | 6 | 1 | 20 | NENW | 1021026 | 453582 | Chilson | Monitor |
| 618 | 7 | 1 | 2 | SENE | 1038074 | 435906 | Unknown | Stock |
| 619 | 7 | 1 | 2 | SENW | 1034866 | 436729 | Chilson | Stock |
| 620 | 6 | 1 | 35 | NWNW | 1033951 | 443209 | Chilson | Stock |
| 622 | 6 | 1 | 20 | NENE | 1022776 | 454033 | Chilson | Monitor |
| 623 | 6 | 1 | 20 | NENE | 1022686 | 454311 | Fall River | Monitor |
| 628 | 6 | 1 | 20 | SESE | 1022496 | 449718 | Fall River | Stock |
| 631 | 6 | 1 | 23 | SWSW | 1034177 | 449309 | Fall River | Stock |
| 635 | 7 | 1 | 14 | NENW | 1004085 | 427131 | Not a Well[3] | NA |
| 637 | 7 | 1 | 11 | NESE | 1038075 | 430320 | Unknown | Monitor |
| 638 | 7 | 1 | 2 | NENE | 1038269 | 437976 | Fall River | Monitor |
| 639 | 7 | 2 | 7 | SENW | 1045704 | 430722 | Unknown | Stock |
| 640 | 7 | 1 | 12 | SESE | 1043010 | 427965 | Unknown | Stock |
| 642 | 7 | 1 | 12 | SESE | 1042926 | 428042 | Unknown | Stock |
| 645 | 7 | 1 | 16 | NENE | 1027681 | 427998 | Unknown | Stock |
| 650 | 7 | 1 | 1 | SESE | 1043781 | 433331 | Chilson | Stock |
| 656 | 6 | 1 | 31 | SENW | 1014230 | 442000 | Unknown | Stock |
| 657 | 6 | 1 | 20 | NWNE | 1021483 | 454729 | Chilson | Monitor |
| 662 | 7 | 1 | 11 | SESW | 1035381 | 428928 | Unknown | Monitor |
| 668 | 7 | 1 | 15 | NWNE | 1031029 | 427450 | Inyan Kara | Stock |
| 676 | 6 | 1 | 34 | SESW | 1030846 | 439891 | Alluvial | Monitor |
| 677 | 7 | 1 | 4 | SWSW | 1023527 | 434077 | Alluvial | Monitor |
| 678 | 7 | 1 | 9 | SWNE | 1026522 | 431925 | Alluvial | Monitor |
| 679 | 6 | 1 | 27 | NWSE | 1032294 | 446245 | Alluvial | Monitor |
| 680 | 7 | 1 | 11 | NESW | 1035078 | 429969 | Chilson | Monitor |
| 681 | 6 | 1 | 32 | NENW | 1020330 | 443725 | Fall River | Monitor |
| 682 | 7 | 1 | 11 | SENW | 1035139 | 431257 | Chilson | Monitor |
| 683 | 6 | 1 | 29 | NESW | 1020212 | 446104 | Fall River | Monitor |
| 684 | 7 | 1 | 11 | NESW | 1035191 | 429744 | Chilson | Monitor |
| 685 | 6 | 1 | 32 | NWNE | 1020690 | 443409 | Fall River | Monitor |
| 686 | 7 | 1 | 11 | NESW | 1034970 | 429749 | Chilson | Monitor |
| 687 | 6 | 1 | 32 | NENW | 1020081 | 443724 | Fall River | Monitor |
| 688 | 7 | 1 | 11 | NESW | 1035027 | 429974 | Fall River | Monitor |
| 689 | 6 | 1 | 32 | NENW | 1020316 | 443789 | Chilson | Monitor |
| 690 | 7 | 1 | 11 | NESW | 1035114 | 429970 | Unkpapa | Monitor |
| 691 | 6 | 1 | 32 | NENW | 1020364 | 443698 | Fall River | Monitor |
| 692 | 7 | 1 | 11 | NESW | 1035075 | 430014 | Chilson | Monitor |
| 693 | 6 | 1 | 32 | NENW | 1020327 | 443661 | Unkpapa | Monitor |
| 694 | 7 | 1 | 15 | NWNW | 1028717 | 426836 | Fall River | Monitor |
| 695 | 6 | 1 | 32 | SESE | 1022385 | 439312 | Fall River | Monitor |
| 696 | 7 | 1 | 15 | NWNW | 1028538 | 427141 | Chilson | Monitor |
| 697 | 6 | 1 | 32 | SESE | 1022350 | 439347 | Chilson | Monitor |
| 698 | 7 | 1 | 2 | NESW | 1035909 | 435651 | Fall River | Monitor |
| 703 | 7 | 1 | 1 | SWSE | 1041621 | 434334 | Unkpapa | Domestic |
| 704[4] | 7 | 1 | 5 | SWNE | 1020966 | 436647 | Chilson (Beginning 2/4/2009) | Domestic |
| 704[4] | 7 | 1 | 5 | SWNE | 1020966 | 436647 | Unkpapa (Cemented to Chilson 1/28/2009) | Domestic |

## Table 1: Wells within 2 km of the Project Boundary (Continued)

| Hydro ID | Township | Range | Section | 1/4 - 1/4 Location | Coordinates East[1] | Coordinates North[1] | Screened Location[2] | Well Use |
|---|---|---|---|---|---|---|---|---|
| 705 | 6 | 1 | 21 | NENE | 1028624 | 453314 | Chilson | Monitor |
| 706 | 6 | 1 | 21 | NENE | 1028589 | 453276 | Fall River | Monitor |
| 707 | 6 | 1 | 34 | SWNE | 1031935 | 441809 | Alluvial | Monitor |
| 708 | 7 | 1 | 3 | SESW | 1030254 | 434094 | Alluvial | Monitor |
| 709 | 7 | 1 | 15 | SENW | 1029286 | 426603 | Alluvial | Monitor |
| 3026 | 7 | 1 | 12 | NENE | 1043638 | 432833 | Chilson | Monitor |
| 4002 | 6 | 1 | 30 | NWSW | 1013414 | 446931 | Inyan Kara | Domestic |
| 7002 | 7 | 1 | 23 | NWNW | 1033333 | 421931 | Chilson | Stock |

Notes:
[1] Coordinate system is NAD 27 South Dakota State Plane South.
[2] Inyan Kara indicates that screened interval includes both Chilson and Fall River.
[3] Hydro ID 635 is not a well. It is a pipe from Hydro ID 5.
[4] Hydro ID 704 was originally completed in the Unkpapa aquifer. It was recompleted 1/28/2009 in the Chilson aquifer.

## Table 2: Historical Wells Not Present

| Hydro ID | Township (S) | Range (E) | Section | 1/4 - 1/4 Location | Easting[1] | Northing[1] | Screened Location[2] |
|---|---|---|---|---|---|---|---|
| 10 | 7 | 1 | 13 | NENE | 1011956 | 427239 | Chilson |
| 39 | 6 | 1 | 29 | NENE | 991314 | 448657 | Unknown |
| 48 | 6 | 1 | 19 | SENW | 983693 | 453037 | Unknown |
| 425 | 7 | 1 | 14 | SENW | 1002848 | 426208 | Chilson |
| 429 | 6 | 1 | 20 | SENE | 991556 | 452954 | Chilson |
| 431 | 6 | 1 | 20 | SENE | 991556 | 452954 | Chilson |
| 432 | 6 | 1 | 20 | SENE | 991556 | 452954 | Chilson |
| 433 | 6 | 1 | 20 | SENE | 991556 | 452954 | Chilson |
| 502 | 6 | 1 | 27 | NWSE | 1000389 | 446361 | Alluvial |
| 605[3] | 7 | 1 | 10 | SWSE | 1000213 | 428484 | NA |
| 621 | 6 | 1 | 27 | NWSE | 1000329 | 446398 | Alluvial |
| 634 | 6 | 1 | 34 | NESE | 1000901 | 440168 | Unknown |
| 646 | 7 | 1 | 15 | SWNE | 999646 | 426409 | Fall River |
| 651 | 7 | 1 | 14 | NWSE | 1004408 | 424246 | Chilson |
| 658 | 7 | 1 | 15 | SWNE | 999633 | 426398 | Chilson |
| 659 | 7 | 1 | 10 | SWNE | 1000274 | 431049 | Fall River |
| 660 | 7 | 1 | 10 | SWNE | 1000221 | 431030 | Chilson |
| 661 | 7 | 1 | 12 | NENW | 1009376 | 431971 | Chilson |
| 663 | 7 | 1 | 10 | SWSE | 999058 | 428346 | Chilson |
| 664 | 7 | 1 | 10 | SWSE | 999033 | 428338 | Fall River |
| 669 | 7 | 1 | 15 | NWNE | 999404 | 427910 | Chilson |
| 670 | 7 | 1 | 15 | NWNE | 999464 | 427937 | Fuson |
| 671 | 7 | 1 | 15 | NWNE | 999415 | 427870 | Fall River |
| 672 | 7 | 1 | 15 | NWNE | 999031 | 427480 | Fall River |
| 673 | 7 | 1 | 15 | NWNE | 999027 | 427512 | Fuson |
| 674 | 7 | 1 | 15 | NWNE | 998954 | 427513 | Chilson |

Notes: [1] Coordinate system is NAD 27 South Dakota State Plane South.
[2] Inyan Kara indicates that screened interval includes both Chilson and Fall River.
[3] 605 is not a well but a pipeline from well 668.

## Table 3: Historical Wells Plugged and Abandoned

| Hydro ID | Township (S) | Range (E) | Section | 1/4 - 1/4 Location | Easting[1] | Northing[1] | Screened Location[2] |
|---|---|---|---|---|---|---|---|
| 606 | 7 | 1 | 11 | SWSW | 1033713 | 428609 | Chilson |
| 636 | 7 | 1 | 11 | NESW | 1034774 | 429982 | Unknown |
| 652 | 7 | 1 | 2 | NWSE | 1036360 | 434742 | Inyan Kara |
| 653 | 7 | 1 | 22 | NWNE | 1030679 | 422487 | Unknown |
| 654 | 6 | 1 | 34 | NWNE | 1032372 | 443410 | Inyan Kara |
| 655 | 6 | 1 | 34 | NENE | 1033454 | 443307 | Inyan Kara |
| 665 | 7 | 1 | 11 | SWSW | 1033153 | 428901 | Fall River |
| 666 | 7 | 1 | 11 | SWSW | 1033128 | 428870 | Chilson |

Notes: [1] Coordinate system is NAD 27 South Dakota State Plane South.
[2] Inyan Kara indicates that screened interval includes both Chilson and Fall River.

# APPENDIX 2.2-B

# Well Inventory

# Table 1. Current Wells within 2 Kilometers of Project Area

| Hydro ID | Legal Location | | | | SD State Plane South NAD 27 | | NGVD29 | Construction Summary | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | T. | R. | Sec. | Qtr. Qtr. | East (ft) | North (ft) | Surface Elevation(1) (ft) | Date Completed | Total Depth (ft below ground surface) | Depth to Top of Screen or Bottom of Casing (ft below ground surface) | Depth to Bottom of Screen or Bottom of Open Hole (ft below ground surface) | Casing Diameter (in) Casing Depth (ft below ground surface) | Flowing Artesian | Aquifer(2) | Use | Other Name | Source |
| **ALLUVIAL** | | | | | | | | | | | | | | | | | |
| 676 | 6S | 1E | 34 | SESW | 1030846 | 439891 | 3666 (6) | 9/26/2007 | 18.50 (7) | 2-inch PVC<br>0.010-slot<br>12.5 | to 22.5 | 2-inch PVC<br>0 to 12.5 ft | no | Alluvial | Monitor | DB-GW676 | C |
| 677 | 7S | 1E | 4 | SWSW | 1023527 | 434077 | 3571 (6) | 9/25/2007 | 14.15 (7) | 2-inch PVC<br>0.010-slot<br>4 | to 14 | 2-inch PVC<br>0 to 4 ft | no | Alluvial | Monitor | DB-GW677 | C |
| 678 | 7S | 1E | 9 | SWNE | 1026522 | 431925 | 3596 (6) | 9/25/2007 | 14.42 (7) | 2-inch PVC<br>0.010-slot<br>4 | to 14 | 2-inch PVC<br>0 to 4 ft | no | Alluvial | Monitor | DB-GW678 | C |
| 679 | 6S | 1E | 27 | NWSE | 1032294 | 446245 | 3716 (6) | 9/26/2007 | 39.03 (7) | 2-inch PVC<br>0.010-slot<br>19 | to 39 | 2-inch PVC<br>0 to 19 ft | no | Alluvial | Monitor | DB-GW679 | C |
| 707 | 6S | 1E | 34 | SWNE | 1031935 | 441809 | 3692 (6) | 5/5/2011 | 40.18 (7) | 2-inch PVC<br>0.010-slot<br>30 | to 40 | 2-inch Sched 40 PVC<br>0 to 30 ft | no | Alluvial | Monitor | DB11-34-ALLUV-4 | C |
| 708 | 7S | 1E | 3 | SESW | 1030254 | 434094 | 3633 (6) | 5/4/2011 | 21.94 (7) | 2-inch PVC<br>0.010-slot<br>12 | to 22 | 2-inch Sched 40 PVC<br>0 to 12 ft | no | Alluvial | Monitor | DB11-3-ALLUV-3 | C |
| 709 | 7S | 1E | 15 | SENW | 1029286 | 426603 | 3595 (6) | 5/9/2011 | 38.25 (7) | 2-inch PVC<br>0.010-slot<br>28 | to 38 | 2-inch Sched 40 PVC<br>0 to 28 ft | no | Alluvial | Monitor | DB11-15-ALLUV-4 | C |
| **FALL RIVER** | | | | | | | | | | | | | | | | | |
| 5 | 7S | 1E | 14 | NENW | 1035181 | 427284 | 3643 | 12/26/1975 | 2267, cement bridge plug 850, last measured 175 | open hole 155 | to 175 | 28# 8 5/8-inch 0 to 155 ft and<br>4-inch steel 0 to 155 ft | yes | Fall River | Stock | D-17,<br>API 40 047 20065 | A, B, D, E, downhole tool |
| 7 | 7S | 1E | 23 | NWNW | 1033304 | 422417 | 3574 | Late 1950s | 200 | UNK | UNK | 6 | no | Fall River | Domestic | D-27, R. Kenobbie | A, B |
| 8 | 7S | 1E | 23 | SWSE | 1036052 | 418515 | 3542 | 1930s<br>Repaired<br>6/10/1951 | 240 | perforated 160 to 165 | and 222 to 227 | 3-inch from 6 to 27 feet below surface over 2-inch black steel with 6-inch at surface | yes | Fall River | Domestic | D-29, Englebert | A, B, C |
| 9 | 7S | 1E | 23 | NENE | 1038003 | 421806 | 3594 | 1960s | 90 | UNK | UNK | 6-inch (Source A)<br>2-inch steel (Source E) | yes | Fall River | Stock | D-25 | A, B, E |
| 14 | 7S | 1E | 2 | NWSW | 1033700 | 434723 | 3672 | UNK | 470 (source A)<br>300 (source E) | UNK | UNK | 4 | historically yes, presently no | Fall River | Stock | D-5 | A, B, E |
| 17 | 7S | 1E | 12 | SENW | 1040223 | 431329 | 3789 | 1954 | 156 | UNK | UNK | 3 | no | Fall River | Stock | D-13 | A, B, C |
| 18 | 7S | 1E | 9 | SWSW | 1022812 | 428960 | 3566 | Late 1920s<br>Early 1930s | 527 | UNK | UNK | 4 | yes | Fall River | Domestic | D-10, D. Andersen | A, B, E |
| 38 | 6S | 1E | 33 | SWNW | 1024328 | 442289 | 3634 | 11/12/1949 | 550 | open hole 494 | to 550 | 4-inch<br>0 to 494 ft | yes | Fall River | Stock | B-4 | A, B, C, F |
| 49 | 6S | 1E | 32 | NWNW | 1018932 | 444022 | 3628 | 1970s | 540<br>(historically 600) | screen<br>475 | to 540 | 4 | yes | Fall River | Stock | | A, E |
| 107 | 6S | 1E | 18 | SWNE | 1017018 | 458158 | 3708 | UNK | 90 | UNK | UNK | 5 | historically yes, presently unknown | Fall River | Domestic | | A |
| 108 | 6S | 1E | 18 | SWNE | 1016478 | 458698 | 3705 | UNK | 90 | UNK | UNK | UNK | UNK | Fall River | Domestic | | A |
| 111 | 6S | 1E | 17 | NWNE | 1022074 | 459586 | 3794 | UNK | 100 | UNK | UNK | 4 | no | Fall River | Stock | | A |
| 112 | 6S | 1E | 16 | SESE | 1027864 | 455881 | 3831 | UNK | 120 | UNK | UNK | 4 1/2 | no | Fall River | Stock | | A |
| 115 | 6S | 1E | 18 | SENE | 1017697 | 457640 | 3720 | Original before 1977<br>Replaced<br>10/2/1984 | 360 | 4-inch PVC<br>1/64-slot<br>200 to 220 | and 300 to 360 | 6-inch yellow mine 0 to 180 ft<br>4-inch PVC 160 to 200 ft<br>4-inch PVC 220 to 300 ft | yes | Fall River | Domestic | | A, C |
| 116 | 6S | 1E | 18 | SENE | 1017992 | 458111 | 3723 | UNK | UNK | UNK | UNK | 1 | historically yes, presently unknown | Fall River | Stock | | A |
| 138 | 6S | 1E | 18 | NENE | 1017537 | 459030 | 3724 | 1977 | 100 | UNK | UNK | UNK | historically yes, presently unknown | Fall River | Domestic | | H |
| 436 | 6S | 1E | 20 | NWNE | 1021450 | 454799 | 3737 | 8/18/1981 | 590 | open hole 505 | to 590 | 4-inch 10#/ft black iron<br>0 to 505 ft | no | Fall River | Monitor | D-3FR | C, J, L |
| 610 | 6S | 1E | 29 | SWNE | 1021599 | 447969 | 3704 | 6/27/1978 | 680 | 1-inch<br>40# black iron<br>torch slotted<br>630 | to 672 | 1-inch 40#/ft black iron<br>0 to 630 ft | no | Fall River | Monitor | D-20FR, BPZ-21 FR | C, J, K |
| 613 | 6S | 1E | 20 | NWNE | 1022125 | 453775 | 3738 | 8/14/1981 | 580, lithologic log to 600 | open hole 504 | to 580 | 4-inch 10#/ft black iron<br>0 to 504 ft | no | Fall River | Monitor | D-1FR | C, J, L |
| 623 | 6S | 1E | 20 | NENE | 1022686 | 454311 | 3750 | 8/17/1981 | 580 | open hole 503 | to 580 | 4-inch 10#/ft black iron<br>0 to 503 ft | no | Fall River | Monitor | D-4FR | C, E, J, L |
| 628 | 6S | 1E | 20 | SESE | 1022496 | 449718 | 3737 | UNK | 523 | 326 | 523 | UNK | no | Fall River | Stock | | GPS, downhole tool |
| 631 | 6S | 1E | 23 | SWSW | 1034177 | 449309 | 3744 | 2/1998 | 80 | 5-inch steel<br>1/4 x 6 slots<br>30 | to 70 | 5-inch 15.5#/ft steel<br>0 to 30 ft | no | Fall River | Stock | | C |
| 638 | 7S | 1E | 2 | NENE | 1038269 | 437976 | 3791 | Before 1979 | 180 | UNK | UNK | 2 | no | Fall River | Monitor | D-2 | B |
| 681 | 6S | 1E | 32 | NENW | 1020330 | 443725 | 3624 | 1/27/2008 | 600 | 3-inch PVC<br>0.020-slot<br>585 | to 600 | 6-inch SDR21 0 to 585 ft<br>3-inch PVC 575 to 585 ft | yes | Fall River | Monitor | DB07-32-3C | C |
| 683 | 6S | 1E | 29 | NESW | 1020212 | 446104 | 3669 | 3/4/2008 | 650 | 2-inch PVC<br>0.020-slot<br>635 | to 650 | 4-inch SDR17 0 to 635 ft<br>2-inch PVC 625 to 635 ft | no | Fall River | Monitor | DB07-29-7 | C |

# Table 1. Current Wells within 2 Kilometers of Project Area

| Hydro ID | Legal Location | | | | SD State Plane South NAD 27 | | NGVD29 | Construction Summary | | | | | | Flowing Artesian | Aquifer(2) | Use | Other Name | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | T. | R. | Sec. | Qtr. Qtr. | East (ft) | North (ft) | Surface Elevation(1) (ft) | Date Completed | Total Depth (ft below ground surface) | Depth to Top of Screen or Bottom of Casing (ft below ground surface) | Depth to Bottom of Screen or Bottom of Open Hole (ft below ground surface) | Casing Diameter (in) Casing Depth (ft below ground surface) | | | | | | |
| 685 | 6S | 1E | 32 | NWNE | 1020690 | 443409 | 3626 | 2/4/2008 | 595 | 2-inch PVC<br>0.020-slot<br>580 | to 595 | 4-inch SDR17 0 to 580 ft<br>2-inch PVC 570 to 580 ft | | yes | Fall River | Monitor | DB07-32-4C | C |
| 687 | 6S | 1E | 32 | NENW | 1020081 | 443724 | 3626 | 2/6/2008 | 605 | 2-inch PVC<br>0.020-slot<br>590 | to 605 | 4-inch SDR17 0 to 590 ft<br>2-inch PVC 580 to 590 ft | | yes | Fall River | Monitor | DB07-32-5 | C |
| 688 | 7S | 1E | 11 | NESW | 1035027 | 429974 | 3687 | 4/1/2008 | 255 | 3-inch PVC<br>0.020-slot<br>245 | to 255 | 6-inch SDR17 0 to 245 ft<br>3-inch PVC 235 to 245 ft | | no | Fall River | Monitor | DB08-11-17 | C |
| 691 | 6S | 1E | 32 | NENW | 1020364 | 443698 | 3626 | 3/10/2008 | 505 | 3-inch PVC<br>0.020-slot<br>490 | to 505 | 6-inch SDR17 0 to 490 ft<br>3-inch PVC 480 to 490 ft | | yes | Fall River | Monitor | DB08-32-9C | C |
| 694 | 7S | 1E | 15 | NWNW | 1028717 | 426836 | 3600 | 3/22/2008 | 392 | 3-inch PVC<br>0.020-slot<br>377 | to 392 | 6-inch SDR17 0 to 377 ft<br>3-inch PVC 367 to 377 ft | | yes | Fall River | Monitor | DB08-15-3 | C |
| 695 | 6S | 1E | 32 | SESE | 1022385 | 439312 | 3594 | 3/20/2008 | 508 | 3-inch PVC<br>0.020-slot<br>493 | to 508 | 6-inch SDR17 0 to 493 ft<br>3-inch PVC 483 to 493 ft | | yes | Fall River | Monitor | DB08-32-13 | C |
| 698 | 7S | 1E | 2 | NESW | 1035909 | 435651 | 3739 | 3/25/2008 | 205 | 3-inch PVC<br>0.020-slot<br>180 | to 205 | 6-inch SDR21 0 to 180 ft<br>3-inch PVC 170 to 180 ft | | no | Fall River | Monitor | DB08-2-1 | C |
| 706 | 6S | 1E | 21 | NENE | 1028589 | 453276 | 3823.29(3) | 12/5/2009 | 328 | 3-inch PVC<br>0.020-slot<br>284 | to 314 | 6-inch SDR17 0 to 284 ft<br>3-inch PVC 274 to 284 ft | | no | Fall River | Monitor | DB09-21-2 | C |
| **FUSON** | | | | | | | | | | | | | | | | | | |
| 614 | 6S | 1E | 20 | NWNE | 1022185 | 453769 | 3739 | 9/14/1981 | 620 | open hole 609 | to 620 | 4-inch 10#/ft black iron<br>0 to 609 ft | | no | Fuson | Monitor | D-1FU | C, J, L |
| **CHILSON** | | | | | | | | | | | | | | | | | | |
| 1 | 7S | 1E | 9 | SESE | 1027696 | 429227 | 3624 | 1950s | 600 | UNK | UNK | 4 | | yes | Chilson | Stock | D-11 | A, B |
| 2 | 7S | 1E | 16 | SESE | 1026724 | 423922 | 3554 | 1930s<br>Recompleted<br>11/17/1981 | 640 original<br>650 recompleted | 4-inch slotted 10#/ft black iron 566 to 608 | and 629 to 650 | 4-inch 10#/ft black iron<br>0 to 566 ft and 608 to 629 ft | | yes | Chilson | Domestic | D-20, W. Peterson | A, B, C |
| 3 | 7S | 1E | 22 | SWNW | 1028593 | 421104 | 3541 | 11/28/1970 | 2400, cement bridge plug 1030 | open hole 367 | to 1030 | 4 1/2-inch steel 0 to 389 suspended inside 8 5/8-inch 20# steel<br>0 to 367 ft | | yes | Chilson | Stock | D-24,<br>API 40 047 20045 | A, B, D |
| 12 | 7S | 1E | 4 | SESE | 1026978 | 434378 | 3641 | Late 1960s | 730 (source A)<br>805 (source B) | UNK | UNK | 4 1/2 | | yes | Chilson | Stock | D-7 | A, B |
| 13 | 7S | 1E | 3 | NWNW | 1028360 | 438470 | 3673 | 1950s Recompleted<br>10/22/1980 | 625 | open hole 580 | to 625 | 5 1/2-inch 14# steel<br>0 to 580 ft | | yes | Chilson | Domestic | D-6, K. Spencer | A, B, C |
| 15 | 7S | 1E | 2 | NENW | 1035304 | 438317 | 3713 | UNK | 280 (source A)<br>495 (source B) | UNK | UNK | 4 | | no | Chilson | Stock | D-3 | A, B, E |
| 16 | 7S | 1E | 1 | NESW | 1041428 | 434446 | 3869 | Mid 1970s | 330 | UNK | UNK | 4 1/2 | | no | Chilson | Domestic | D-1, C. Daniel | A, B |
| 42 | 7S | 1E | 5 | SWNE | 1021144 | 436481 | 3596 | 1949<br>Rehabilitated<br>11/15/2009 | Original 600<br>Current 580 | 4-inch PVC<br>0.25-slot<br>280 | to 300 with open hole below to 580 | 4-inch PVC 0 to 280 ft<br>8-inch steel 0 to 220 ft<br>reduced to 1 1/4-inch at surface | | yes | Chilson | Domestic | D-8, L. Putnam | A, B, C |
| 43 | 6S | 1E | 34 | SWSE | 1031123 | 439436 | 3672 | UNK | 350 | UNK | UNK | 4 | | historically yes until Triangle Mine dewatered then no, presently unknown | Chilson | Domestic | B-5, Spencer Homestead | A, B |
| 51 | 7S | 1E | 9 | SENE | 1027411 | 431487 | 3615 | 1890s | 550 | UNK | UNK | 10 | | yes | Chilson | Stock | D-9 | A, B |
| 61 | 7S | 1E | 11 | NWSE | 1036832 | 429987 | 3740 | UNK | 525 | UNK | UNK | 5 | | no | Chilson | Stock | D-12 | A, B |
| 96 | 41N | 60W | 22 | SWSW | 1011630 | 451853 | 3664 | UNK | 560 | UNK | UNK | 5 | | yes | Chilson | Domestic | Dixon | A |
| 102 | 6S | 1E | 18 | SWNE | 1016825 | 458312 | 3708 | UNK | 267 | UNK | UNK | 5 | | yes | Chilson | Domestic | | A |
| 109 | 6S | 1E | 17 | NENW | 1020801 | 459625 | 3835 | UNK | 220 | UNK | UNK | UNK | | no | Chilson | Domestic | Cook | A |
| 110 | 6S | 1E | 17 | NENE | 1023777 | 459643 | 3817 | UNK | 240 | UNK | UNK | 6 1/2 | | no | Chilson | Stock | | A |
| 147 | 6S | 1E | 17 | NESW | 1020879 | 456566 | 3729 | 2/9/1982 | 750 | open hole 650 | to 750 | 4 1/2-inch<br>0.219-wall steel<br>0 to 650 ft | | no | Chilson | Monitor | D-8LK, HAM-4 | C, J |
| 510 | 7S | 1E | 12 | SESE | 1042933 | 428178 | 3759 | 6/12/1988 | 540 | 5-inch PVC<br>0.064-slot<br>300 to 340 | and 480 to 520 | 5-inch PVC<br>0 to 300 ft and 340 to 480 ft | | yes | Chilson | Stock | | C |
| 609 | 6S | 1E | 29 | SWNE | 1021735 | 447808 | 3702 | 6/26/1978 | 1000 | 1-inch<br>40# black iron<br>torch slotted<br>903 | to 966 | 1-inch 40#/ft black iron<br>0 to 903 ft | | no | Chilson | Monitor | D-20LK, BPZ-20 | C, J, K |
| 611 | 6S | 1E | 20 | NWNE | 1021835 | 453954 | 3731 | 10/17/1981 | 815 | 8 5/8-inch<br>0.030-slot<br>galvanized steel<br>695 to 730 | and 755 to 800 | 20-inch steel 0 to 25 ft<br>10 3/4-inch steel 0 to 695 ft<br>8 5/8-inch steel 730 to 755 ft | | no | Chilson | Monitor | D-PW | C, J, L |
| 612 | 6S | 1E | 20 | NWNE | 1021755 | 454128 | 3732 | 8/14/1981 | 800 | open hole 692 | to 800 | 4-inch 10#/ft black iron<br>0 to 692 ft | | no | Chilson | Monitor | D-2LK | C, J, L |
| 615 | 6S | 1E | 20 | NWNE | 1022172 | 453708 | 3738 | 8/13/1981 | 800 | open hole 712 | to 800 | 4-inch 10#/ft black iron<br>0 to 712 ft | | no | Chilson | Monitor | D-1LK | C, J, L, downhole tool |
| 616 | 6S | 1E | 20 | SWNE | 1022132 | 453134 | 3745 | 9/15/1981 | 835 | open hole 735 | to 835 | 4-inch 10#/ft black iron<br>0 to 735 ft | | no | Chilson | Monitor | D-5LK | C, J, L |

## Table 1. Current Wells within 2 Kilometers of Project Area

| Hydro ID | Legal Location | | | | SD State Plane South NAD 27 | | NGVD29 | Construction Summary | | | | | Flowing Artesian | Aquifer(2) | Use | Other Name | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | T. | R. | Sec. | Qtr. Qtr. | East (ft) | North (ft) | Surface Elevation(1) (ft) | Date Completed | Total Depth (ft below ground surface) | Depth to Top of Screen or Bottom of Casing (ft below ground surface) | Depth to Bottom of Screen or Bottom of Open Hole (ft below ground surface) | Casing Diameter (in) Casing Depth (ft below ground surface) | | | | | |
| 617 | 6S | 1E | 20 | NWNE | 1021026 | 453582 | 3723 | 9/15/1981 | 810 | open hole 715 | to 810 | 4-inch 10#/ft black iron<br>0 to 715 ft | no | Chilson | Monitor | D-6LK | C, J, L |
| 619 | 7S | 1E | 2 | SENW | 1034866 | 436729 | 3701 | UNK | 286 | 231 | 286 | 4 | no | Chilson | Stock | D-4, Daniel West, MET | B, downhole tool |
| 620 | 6S | 1E | 35 | NWNW | 1033951 | 443209 | 3731 | UNK | UNK | UNK | UNK | UNK | no | Chilson | Stock | | GPS |
| 622 | 6S | 1E | 20 | NENE | 1022776 | 454033 | 3747 | 8/17/1981 | 780 | open hole 714 | to 780 | 4-inch 10#/ft black iron<br>0 to 714 ft | no | Chilson | Monitor | D-4LK | C, E, J, L |
| 650 | 7S | 1E | 1 | SESE | 1043781 | 433331 | 3820 | UNK | 196 | 146 | 196 | 4 | no | Chilson | Stock | | GPS, downhole tool |
| 657 | 6S | 1E | 20 | NWNE | 1021483 | 454729 | 3740 | 8/18/1981 | 800 | open hole 715 | to 800 | 4-inch 10#/ft black iron<br>0 to 715 ft | no | Chilson | Monitor | D-3LK | C, J, L |
| 680 | 7S | 1E | 11 | NESW | 1035078 | 429969 | 3688 | 12/19/2007 | 436 | 4.5-inch PVC 0.020-slot 426 | to 436 | 6-inch SDR21 0 to 426 ft<br>4.5-inch PVC 406 to 426 ft | no | Chilson | Monitor | DB07-11-11C | C |
| 682 | 7S | 1E | 11 | SENW | 1035139 | 431257 | 3720 | 2/21/2008 | 460 | 2-inch PVC 0.020-slot 450 | to 460 | 4-inch SDR17 0 to 450 ft<br>2-inch PVC 440 to 450 ft | no | Chilson | Monitor | DB07-11-2 | C |
| 684 | 7S | 1E | 11 | NESW | 1035191 | 429744 | 3691 | 2/13/2008 | 423 | 2-inch PVC 0.020-slot 413 | to 423 | 4-inch SDR17 0 to 413 ft<br>2-inch PVC 403 to 413 ft | no | Chilson | Monitor | DB07-11-14C | C |
| 686 | 7S | 1E | 11 | NESW | 1034970 | 429749 | 3694 | 2/24/2008 | 428 | 2-inch PVC 0.020-slot 418 | to 428 | 4-inch SDR17 0 to 418 ft<br>2-inch PVC 408 to 418 | no | Chilson | Monitor | DB07-11-15 | C |
| 689 | 6S | 1E | 32 | NENW | 1020316 | 443789 | 3626 | 3/11/2008 | 730 | 3-inch PVC 0.020-slot 715 | to 730 | 6-inch SDR17 0 to 715 ft<br>3-inch PVC 705 to 715 ft | yes | Chilson | Monitor | DB08-32-10 | C |
| 692 | 7S | 1E | 11 | NESW | 1035075 | 430014 | 3701 | 4/16/2008 | 335 | 3-inch PVC 0.020-slot 325 | to 335 | 6-inch SDR17 0 to 325 ft<br>3-inch PVC 315 to 325 ft | no | Chilson | Monitor | DB08-11-19 | C |
| 696 | 7S | 1E | 15 | NWNW | 1028538 | 427141 | 3602 | 3/21/2008 | 587 | 3-inch PVC 0.020-slot 572 | to 587 | 6-inch SDR17 0 to 572 ft<br>3-inch PVC 562 to 572 ft | yes | Chilson | Monitor | DB08-15-2 | C |
| 697 | 6S | 1E | 32 | SESE | 1022350 | 439347 | 3594 | 3/18/2008 | 682 | 3-inch PVC 0.020-slot 667 | to 682 | 6-inch SDR17 0 to 667 ft<br>3-inch PVC 657 to 667 ft | yes | Chilson | Monitor | DB08-32-12 | C |
| 704(4) | 7S | 1E | 5 | SWNE | 1020966 | 436647 | 3599 | Original 4/29/2008<br>Perforated 2/4/2009 | UNK | UNK | UNK | UNK | UNK | Chilson (Beginning 2/4/2009) | Domestic | L. Putnam<br>704 Unkpapa | O |
| 705 | 6S | 1E | 21 | NENE | 1028624 | 453314 | 3825.53(3) | 12/5/2009 | Borehole TD 600<br>Cemented to 460 | 3-inch PVC 0.020-slot 428 | to 458 | 6-inch SDR17 0 to 428 ft<br>3-inch PVC 418 to 428 ft | no | Chilson | Monitor | DB09-21-1 | C |
| 3026 | 7S | 1E | 12 | NENE | 1043638 | 432833 | 3822 | 3/26/2008 | 196 | 3-inch PVC 0.020-slot 166 | to 196 | 6-inch SDR21 0 to 166 ft<br>3-inch PVC 156 to 166 ft | no | Chilson | Monitor | DB08-1-6 | C |
| 7002 | 7S | 1E | 23 | NWNW | 1033333 | 421931 | 3571 | 1930s | 500 | UNK | UNK | 5 1/2 | yes | Chilson | Stock | D-26 | A, B |
| **INYAN KARA** | | | | | | | | | | | | | | | | | |
| 40(5) | 6S | 1E | 30 | SWNW | 1013415 | 447182 | 3635 | About 1969 | 660<br>(680 for BY-1) | UNK | UNK | 6 | yes | Inyan Kara | Domestic | 40S, 40U<br>possibly BY-1 | A, G<br>C for BY-1 |
| 668 | 7S | 1E | 15 | NWNE | 1031029 | 427450 | 3622 | 1/31/1977 | 574 | 10-inch stainless steel 280 to 335 (300 to 350 source E) | and 8-inch stainless steel 480 to 555 (495 to 550 source E) | 10-inch steel 0 to 280 ft (0 to 300 ft source E) and 335 to 480 ft (350 to 495 ft source E) | yes | Inyan Kara | Stock | Burdock Well | C, E, K, N |
| 4002 | 6S | 1E | 30 | NWSW | 1013414 | 446931 | 3621 | 1940s | 700 | UNK | UNK | 6 | yes | Inyan Kara | Domestic | 40L | A, G |
| **UNKPAPA** | | | | | | | | | | | | | | | | | |
| 114 | 7S | 2E | 7 | SESW | 1045410 | 428654 | 3764 | UNK | 365 | UNK | UNK | UNK | no | Unkpapa | Stock | E-2, Bennett Canyon Well | A, B, I |
| 506 | 7S | 2E | 8 | SWNW | 1050129 | 430704 | 3936 | UNK | 470 | UNK | UNK | UNK | no | Unkpapa | Stock | E-3 | B |
| 690 | 7S | 1E | 11 | NESW | 1035114 | 429970 | 3700 | 4/15/2008 | 631 | 3-inch PVC 0.020-slot 621 | to 631 | 6-inch 18# 0 to 621 ft<br>3-inch PVC 611 to 621 ft | yes | Unkpapa | Monitor | DB08-11-18 | C |
| 693 | 6S | 1E | 32 | NENW | 1020327 | 443661 | 3626 | 3/8/2008 | 930 | 3-inch PVC 0.020-slot 910 | to 930 | 6-inch 18# 0 to 910 ft<br>3-inch PVC 890 to 910 ft | yes | Unkpapa | Monitor | DB08-32-11 | C |
| 703 | 7S | 1E | 1 | SWSE | 1041621 | 434334 | 3877 | 4/18/2008 | 525 | 3-inch PVC 0.020-slot 475 | to 525 | 6-inch 18# 0 to 475 ft<br>3-inch PVC 465 to 475 ft | no | Unkpapa | Domestic | C. Daniel<br>DB08-1-7 | C |
| 704(4) | 7S | 1E | 5 | SWNE | 1020966 | 436647 | 3599 | 4/29/2008 | 955 | 3-inch PVC 0.020-slot 915 | to 955 | 6-inch 18# 0 to 915 ft<br>3-inch PVC 905 to 915 ft | yes | Unkpapa (Cemented to Chilson 1/28/2009) | Domestic | L. Putnam<br>DB08-5-1 | C |
| **UNKNOWN** | | | | | | | | | | | | | | | | | |
| 4 | 7S | 1E | 15 | SESE | 1032516 | 423080 | 3580 | 3/5/1965 | 2264, cement bridge plug 1645 | open hole 971 | to 1645 | 24# 8 5/8-inch 0 to 971 ft<br>reduced to 3-inch at surface | yes | Unknown | Stock | D-19,<br>API 40 047 05093 | A, B, D |
| 6 | 7S | 1E | 14 | NESE | 1037218 | 425012 | 3671 | Late 1950s | 280 original<br>200 last measured | open hole 135 | to 200 | 12-inch steel<br>0 to 135 ft | no | Unknown | Stock | | A, E |

# Table 1. Current Wells within 2 Kilometers of Project Area

| | Legal Location | | | | SD State Plane South NAD 27 | | NGVD29 | Construction Summary | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hydro ID | T. | R. | Sec. | Qtr. Qtr. | East (ft) | North (ft) | Surface Elevation(1) (ft) | Date Completed | Total Depth (ft below ground surface) | Depth to Top of Screen or Bottom of Casing (ft below ground surface) | Depth to Bottom of Screen or Bottom of Open Hole (ft below ground surface) | Casing Diameter (in)<br>Casing Depth (ft below ground surface) | Flowing Artesian | Aquifer(2) | Use | Other Name | Source |
| 37 | 7S | 2E | 18 | NWSW | 1044183 | 423947 | 3689 | UNK | 145 | open hole 93 | to 145 | 5 1/2-inch<br>0 to 93 ft | no | Unknown | Stock | | A, E, downhole tool |
| 41 | 6S | 1E | 31 | SWNE | 1015385 | 442081 | 3611 | UNK | UNK | UNK | UNK | 6 | yes | Unknown | Stock | B-3 | A, B, G |
| 106 | 6S | 1E | 18 | NENE | 1018099 | 459625 | 3724 | UNK | 196 | open hole 160 | to 196 | 7-inch steel 0 to 160 ft | yes | Unknown | Stock | | A, E, downhole tool |
| 113 | 7S | 2E | 6 | NESW | 1046437 | 434417 | 3844 | UNK | 40 | UNK | UNK | UNK | no | Unknown | Stock | E-1, Bennett #2 Well | A, B, I |
| 117 | 6S | 1E | 8 | SWSE | 1022177 | 460796 | 3923 | UNK | UNK | UNK | UNK | 6 | No | Unknown | Stock | | A |
| 220 | 6S | 1E | 19 | SENE | 1017872 | 452334 | 3680 | 10/16/1984 | 900 | historically 4-inch slotted PVC 780 to 800 and 840 to 880 | presently 6-inch PVC screen 463 to 523, caved below | historically 6" yellow mine 0-520 ft and 4" PVC 500-780, 800-840 & 880-900 ft, presently 6" PVC 0-463 ft | yes | Unknown | Stock | | C, E |
| 270 | 6S | 1E | 19 | NWSW | 1014108 | 451942 | 3659 | UNK | UNK | UNK | UNK | 2-inch steel | yes | Unknown | Stock | | GPS, E |
| 618 | 7S | 1E | 2 | SENE | 1038074 | 435906 | 3759 | UNK | 133 | 62 | 133 | 5 | no | Unknown | Stock | | GPS, downhole tool |
| 637 | 7S | 1E | 11 | NESE | 1038075 | 430320 | 3743 | Fall 1976 | UNK | UNK | UNK | 2 | no | Unknown | Monitor | BPZ-5 | K, M |
| 639 | 7S | 2E | 7 | SENW | 1045704 | 430722 | 3771 | UNK | UNK | UNK | UNK | UNK | no | Unknown | Stock | | GPS |
| 640 | 7S | 1E | 12 | SESE | 1043010 | 427965 | 3754 | UNK | UNK | UNK | UNK | 1 | no | Unknown | Stock | | GPS |
| 642 | 7S | 1E | 12 | SESE | 1042926 | 428042 | 3757 | UNK | 33 | open hole 12 | to 33 | 5-inch steel<br>0 to 12 | no | Unknown | Stock | | GPS, E, downhole tool |
| 645 | 7S | 1E | 16 | NENE | 1027681 | 427998 | 3609 | UNK | UNK | UNK | UNK | UNK | no | Unknown | Stock | | GPS |
| 656 | 6S | 1E | 31 | SENW | 1014230 | 442000 | 3622 | UNK | UNK | UNK | UNK | UNK | yes | Unknown | Stock | | GPS |
| 662 | 7S | 1E | 11 | SESW | 1035381 | 428928 | 3679 | 7/26/1978 | 880 | 5 1/2-inch 14# torch slotted 666 | to 780 | 5 1/2-inch 14# steel<br>0 to 666 ft | yes | Unknown | Monitor | Sundance Well | C, K, N |

Notes:
(1) Surface elevations are based on a digital elevation model (DEM), except where noted. Accuracy is plus or minus 15 feet.
(2) Inyan Kara indicates screened interval is across Fall River and Chilson.
(3) Surveyed by Andersen Engineers, March 2011
(4) 704 was originally completed in the Unkpapa aquifer. It was recompleted 1/28/2009 in the Chilson aquifer.
(5) Hydro ID 40 possibly replaced by BY-1 (depth 680 ft and casing diameter 5.5 inches) on 3/4/1982
(6) Surveyed top of casing minus measured stick-up
(7) Measured depth from top of casing minus measured stick-up
UNK = Unknown

Sources:
A. Water Wells in Edgemont Project Area, Silver King Mines, May 1977, in letter from Keith Andersen, Silver King Mines, Inc., to John Hatch, South Dakota Water Rights Commission, January 12, 1979
B. Tennessee Valley Authority Draft Environmental Statement, 1979, Table 2.5.2-1
C. South Dakota Water Well Records - Notice of Well Construction Records, Artesian Well Repair Records, and Well Drillers Reports
D. South Dakota Oil and Gas Records
E. Dewey Burdock Groundwater Well Report for 2010 and 2011 Field Work Completed, M. Beshore, Powertech (USA) Inc., October 4, 2011
F. Responses to Nuclear Regulatory Commission Comments (Revision 1), C. Hocking , RESPEC, to M. Hollenbeck, Powertech (USA) Inc., July 22, 2010
G. Letter from SKM to TVA, Domestic and Livestock Wells Monitored During Dewey Pump Test, April 12, 1982
H. Additional Water Wells in Edgemont Project Area, Silver King Mines, Inc., Interoffice Correspondence, Andersen to Caywood, August 3, 1979
I. Forest Service Wells and Springs, in letter from Keith Andersen, Silver King Mines, Inc., to John Hatch, South Dakota Water Rights Commission, January 12, 1979
J. Hydrogeologic Investigations at Proposed Uranium Mine Near Dewey, South Dakota, Tennessee Valley Authority, WR28-2-520-128, J. Mark Bogss, October 1983
K. Coordinates, Elevations and Water Levels for Burdock Piezometers, in letter from Keith Andersen, Silver King Mines, Inc., to John Hatch, South Dakota Water Rights Commission, January 12, 1979
L. Baseline Water Quality and Water Level/Flow Rates, in letter from Keith Andersen, Silver King Mines, Inc., to Steve Stampfli, Office of Surface Mining, South Dakota Department of Water and Natural Resources, March 3, 1982
M. Burdock Mine Area Hydrology Status Report, Silver King Mines, Inc. Interoffice Correspondence from Keith Andersen to R.M. Caywood, December 18, 1978, included in letter from Keith Andersen to John Hatch, South Dakota Water Rights Commisssion, January 12, 1979
N. Analysis of Aquifer Tests conducted at the Proposed Burdock Uranium Mine Site, Burdock, South Dakota, Tennessee Valley Authority, WR28-1-520-109, J.M. Boggs and A.M. Jenkins, May 1980
O. Interoffice communication, Len Eakin, Powertech (USA) Inc., to Mike Beshore, Powertech (USA) Inc., May 9, 2011

# Table 2. Historical Wells Noted in Data Sources within 2 Kilometers but No Longer Present at Surface

| Hydro ID | Legal Location | | | | SD State Plane South NAD 27 | | NGVD29 | Construction Summary | | | | | Flowing Artesian | Former Aquifer | Previous Use | Other Name | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | T. | R. | Sec. | Qtr. Qtr. | East (ft) | North (ft) | Surface Elevation(1) (ft) | Date Completed | Total Depth (ft) | Depth to Top Screen (ft) | Depth to Bottom Screen (ft) | Casing Diameter (in) | | | | | |
| **ALLUVIAL** | | | | | | | | | | | | | | | | | |
| 502 | 6S | 1E | 27 | NWSE | 1000389 | 446361 | 3716 | UNK | 46 | UNK | UNK | UNK | no | Alluvial | Unknown | B-2 | B |
| 621 | 6S | 1E | 27 | NWSE | 1000329 | 446398 | 3717 | UNK | 50 | UNK | UNK | UNK | no | Alluvial | Unknown | B-1 | B |
| **FALL RIVER** | | | | | | | | | | | | | | | | | |
| 646 | 7S | 1E | 15 | SWNE | 999646 | 426409 | 3611 | August 1977 | 293 | 251 | 293 | 1 | yes | Fall River | Monitor | B-9FR | C |
| 659 | 7S | 1E | 10 | SWNE | 1000274 | 431049 | 3651 | Fall 1976 | UNK | UNK | UNK | UNK | yes | Fall River | Monitor | B-6FR | C |
| 664 | 7S | 1E | 10 | SWSE | 999033 | 428338 | 3621 | 11/7/1978 | 360 | 315 | 360 | 4.5 | yes | Fall River | Monitor | B-11FR | C |
| 671 | 7S | 1E | 15 | NWNE | 999415 | 427870 | 3623 | 10/18/1978 | 350 | 300 | 350 | 4.5 | yes | Fall River | Monitor | B-10FR | C |
| 672 | 7S | 1E | 15 | NWNE | 999031 | 427480 | 3622 | Fall 1976 | 376 | 334 | 376 | 4 | yes | Fall River | Monitor | B-1FR | K, N |
| **FUSON** | | | | | | | | | | | | | | | | | |
| 670 | 7S | 1E | 15 | NWNE | 999464 | 427937 | 3623 | 10/19/1978 | 395 | 377 | 395 | 4.5 | yes | Fuson | Monitor | B-10FU | C, K, N |
| 673 | 7S | 1E | 15 | NWNE | 999027 | 427512 | 3622 | 11/6/1978 | 420 | 400 | 420 | 4.5 | no | Fuson | Monitor | B-1FU, B-2FU | C, K, N |
| **CHILSON** | | | | | | | | | | | | | | | | | |
| 10 | 7S | 1E | 13 | NENE | 1011956 | 427239 | 3736 | 1970s | 200 | UNK | UNK | UNK | no | Chilson | Stock | D-15 | A, B |
| 425 | 7S | 1E | 14 | SENW | 1002848 | 426208 | 3630 | UNK | 237 | UNK | UNK | UNK | UNK | Chilson | Unknown | | USGS |
| 429 | 6S | 1E | 20 | SENE | 991556 | 452954 | 3783 | NA | 800 | NA | NA | NA | NA | Chilson | NA | | |
| 431 | 6S | 1E | 20 | SENE | 991556 | 452954 | 3783 | NA | 815 | NA | NA | NA | NA | Chilson | NA | | |
| 432 | 6S | 1E | 20 | SENE | 991556 | 452954 | 3783 | NA | 800 | NA | NA | NA | NA | Chilson | NA | | |
| 433 | 6S | 1E | 20 | SENE | 991556 | 452954 | 3783 | NA | 835 | NA | NA | NA | NA | Chilson | NA | | |
| 651 | 7S | 1E | 14 | NWSE | 1004408 | 424246 | 3600 | NA | NA | NA | NA | NA | NA | Chilson | NA | | E |
| 658 | 7S | 1E | 15 | SWNE | 999633 | 426398 | 3611 | August 1977 | 545 | 503 | 545 | 1 | yes | Chilson | Monitor | B-9LAK | K, M, N |
| 660 | 7S | 1E | 10 | SWNE | 1000221 | 431030 | 3652 | Fall 1976 | UNK | UNK | UNK | UNK | yes | Chilson | Monitor | B-6 | O |
| 661 | 7S | 1E | 12 | NENW | 1009376 | 431971 | 3694 | Fall 1976 | UNK | UNK | UNK | UNK | no | Chilson | Monitor | B-8 | O |
| 663 | 7S | 1E | 10 | SWSE | 999058 | 428346 | 3621 | 11/7/1978 | 550 | 504 | 550 | 4.5 | yes | Chilson | Monitor | B-11LAK | C, K, N |
| 669 | 7S | 1E | 15 | NWNE | 999404 | 427910 | 3622 | 10/25/1978 | 550 | 510 | 550 | 4.5 | yes | Chilson | Monitor | B-10LAK | C, K, N |
| 674 | 7S | 1E | 15 | NWNE | 998954 | 427513 | 3621 | 11/6/1978 | 570 | 525 | 570 | 4.5 | yes | Chilson | Monitor | B-2LAK | C, K, N |
| **UNKNOWN** | | | | | | | | | | | | | | | | | |
| 39 | 6S | 1E | 29 | NENE | 991314 | 448657 | 3733 | UNK | 700 | UNK | UNK | 5 | no | Unknown | Stock | | A |
| 48 | 6S | 1E | 19 | SENW | 983693 | 453037 | 3663 | Late 1960s | 725 | UNK | UNK | 2 1/2 | yes | Unknown | Stock | | A |
| 634 | 6S | 1E | 34 | NESE | 1000901 | 440168 | 3689 | UNK | UNK | UNK | UNK | UNK | no | Unknown | Unknown | | GPS |
| **OTHER** | | | | | | | | | | | | | | | | | |
| 605(2) | 7S | 1E | 10 | SWSE | 1000213 | 428484 | 3642 | NA | NA | NA | NA | NA | NA | Not a Well(2) | NA | | E |

Notes:
(1) Surface elevations are based on a digital elevation model (DEM), except where noted. Accuracy is plus or minus 15 feet.
(2) Hydro ID 605 is not a well. It is a pipe from Hydro ID 668.
UNK = Unknown
NA = Not applicable, not a well

## Table 3. Plugged and Abandoned Wells within 2 Kilometers of the Project Area

| Hydro ID | Legal Location |  |  |  | SD State Plane South NAD 27 |  | NGVD29 | Construction Summary |  |  |  |  | Flowing Artesian | Former Aquifer (2) | Previous Use | Other Name | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | T. | R. | Sec. | Qtr. Qtr. | East (ft) | North (ft) | Surface Elevation (1) (ft) | Date Completed | Total Depth (ft) | Depth to Top Screen (ft) | Depth to Bottom Screen (ft) | Casing Diameter (in) |  |  |  |  |  |
| **FALL RIVER** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 665 | 7S | 1E | 11 | SWSW | 1033153 | 428901 | 3672 | August 1977 | 252 | 210 | 252 | 1 | no | Fall River | Monitor | B-7FR | K, M, N |
| **CHILSON** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 606 | 7S | 1E | 11 | SWSW | 1033713 | 428609 | 3668 | UNK | UNK | UNK | UNK | UNK |  | Chilson | Unknown | D-16 | B |
| 666 | 7S | 1E | 11 | SWSW | 1033128 | 428870 | 3669 | August 1977 | 441 | 399 | 441 | 1 | no | Chilson | Monitor | B-7LAK | C |
| **INYAN KARA** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 652 | 7S | 1E | 2 | NWSE | 1036360 | 434742 | 3748 | UNK | UNK | UNK | UNK | UNK |  | Inyan Kara | Unknown |  | C |
| 654 | 6S | 1E | 34 | NWNE | 1032372 | 443410 | 3687 | UNK | UNK | UNK | UNK | 8 |  | Inyan Kara | Unknown |  | C |
| 655 | 6S | 1E | 34 | NENE | 1033454 | 443307 | 3719 | UNK | UNK | UNK | UNK | 12 |  | Inyan Kara | Unknown |  | GPS |
| **UNKNOWN** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 636 | 7S | 1E | 11 | NESW | 1034774 | 429982 | 3698 | UNK | UNK | UNK | UNK | 7 |  | Unknown | Unknown |  | GPS |
| 653 | 7S | 1E | 22 | NWNE | 1030679 | 422487 | 3569 | UNK | UNK | UNK | UNK | UNK |  | Unknown | Unknown |  | GPS |

Notes: (1) Land elevations based on Digital Elevation Model (DEM).
(2) Inyan Kara indicates that screened interval includes both Chilson and Fall River.
UNK = Unknown

# SOURCE A

# WATER WELLS IN EDGEMONT PROJECT AREA

(Silver King Mines, Inc., May 1977, in a letter from Keith Andersen, Silver King Mines, Inc., to John Hatch, South Dakota Water Rights Commission, January 12, 1979)

## WATER WELLS IN EDGEMONT PROJECT AREA

| Well No. | Location | | | |
|---|---|---|---|---|
| 1 | SE/4 SE/4 | Sec. | 9 | T7S,R1E |
| 2 | SE/4 SE/4 | Sec. | 16 | T7S,R1E |
| 3 | SW/4 NW/4 | Sec. | 22 | T7S,R1E |
| 4 | SE/4 SE/4 | Sec. | 15 | T7S,R1E |
| 5 | NE/4 NW/4 | Sec. | 14 | T7S,R1E |
| 6 | NE/4 SE/4 | Sec. | 14 | T7S,R1E |
| 7 | NW/4 NW/4 | Sec. | 23 | T7S,R1E |
| 8 | NW/4 SE/4 | Sec. | 23 | T7S,R1E |
| 9 | NE/4 NE/4 | Sec. | 23 | T7S,R1E |
| 10 | NE/4 NE/4 | Sec. | 13 | T7S,R1E |
| 11 | NW/4 SW/4 | Sec. | 24 | T7S,R1E |
| 12 | SE/4 SE/4 | Sec. | 4 | T7S,R1E |
| 13 | NW/4 NW/4 | Sec. | 3 | T7S,R1E |
| 14 | NW/4 SW/4 | Sec. | 2 | T7S,R1E |
| 15 | NW/4 NW/4 | Sec. | 2 | T7S,R1E |
| 16 | NW/4 SE/4 | Sec. | 1 | T7S,R1E |
| 17 | SE/4 NW/4 | Sec. | 12 | T7S,R1E |
| 18 | NW/4 SW/4 | Sec. | 9 | T7S,R1E |
| 19 | NW/4 NW/4 | Sec. | 18 | T7S,R1E |
| 20 | NW/4 SW/4 | Sec. | 17 | T7S,R1E |
| 21 | SW/4 NW/4 | Sec. | 19 | T7S,R1E |
| 22 | NE/4 SW/4 | Sec. | 27 | T40N, R60W |
| 23 | NW/4 NW/4 | Sec. | 29 | T7S, R1E |
| 24 | NE/4 NW/4 | Sec. | 28 | T7S,R1E |
| 25 | SE/4 NW/4 | Sec. | 27 | T7S,R1E |
| 26 | SW/4 NE/4 | Sec. | 35 | T7S,R1E |
| 27 | SE/4 SE/4 | Sec. | 33 | T7S,R1E |
| 28 | NE/4 SW/4 | Sec. | 22 | T8S,R2E |
| 29 | NE/4 NW/4 | Sec. | 16 | T8S,R2E |
| 30 | SE/4 SE/4 | Sec. | 31 | T7S,R2E |
| 31 | SW/4 NW/4 | Sec. | 31 | T7S,R2E |

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| Well No. | Location | | | |
|---|---|---|---|---|
| 32 | SW/4 SW/4 | Sec. 30 | T7S,R2E | |
| 33 | NW/4 SE/4 | Sec. 25 | T7S,R1E | |
| 34 | NW/4 NW/4 | Sec. 30 | T7S,R2E | |
| 35 | SW/4 NE/4 | Sec. 19 | T7S,R2E | |
| 36 | NW/4 NE/4 | Sec. 30 | T7S,R2E | |
| 37 | NW/4 SW/4 | Sec. 18 | T7S,R2E | |
| 38 | SW/4 NW/4 | Sec. 33 | T6S,R1E | |
| 39 | NE/4 NE/4 | Sec. 29 | T6S,R1E | |
| 40 | NW/4 SW/4 | Sec. 30 | T6S,R1E | |
| 41 | SW/4 NW/4 | Sec. 31 | T6S,R1E | |
| 42 | SW/4 NE/4 | Sec. 5 | T7S,R1E | |
| 43 | SE/4 SW/4 | Sec. 34 | T6S,R1E | |
| 44 | NW/4 SE/4 | Sec. 31 | T7S,R2E | |
| 45 | NW/4 NW/4 | Sec. 5 | T8S,R2E | |
| 46 | SW/4 NE/4 | Sec. 31 | T7S,R2E | |
| 47 | SW/4 SW/4 | Sec. 32 | T7S,R2E | |
| 48 | SE/4 NW/4 | Sec. 19 | T6S,R1E | |
| 49 | SW/4 SW/4 | Sec. 29 | T6S,R1E | |
| 50 | SW/4 SW/4 | Sec. 28 | T41N,R60W | |
| 51 | SW/4 NE/4 | Sec. 9 | T7S,R1E | |
| 52 | NE/ SE/4 | Sec. 30 | T7S,R2E | |
| 53 | SW/4 NE/4 | Sec. 30 | T7S,R2E | |
| 54 | NE/4 SE/4 | Sec. 25 | T7S,R1E | |
| 55 | NW/4 NE/4 | Sec. 36 | T7S,R1E | |
| 56 | SE/4 SE/4 | Sec. 32 | T7S,R2E | |
| 57 | NE/4 SE/4 | Sec. 5 | T8S,R2E | |
| 58 | NW/4 NE/4 | Sec. 31 | T7S,R1E | |
| 59 | NE/4 NW/4 | Sec. 5 | T8S,R2E | |
| 60 | NE/4 SW/4 | Sec. 33 | T7S,R2E | |
| 61 | NW/4 SE/4 | Sec. 11 | T7S,R1E | |
| 62 | SW/4 SW/4 | Sec. 25 | T7S,R1E | |
| 63 | SW/4 NW/4 | Sec. 36 | T7S,R1E | |

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| Well No. | Location | | | | |
|---|---|---|---|---|---|
| 64 | SW/4 | NE/4 | Sec. | 9 | T8S,R2E |
| 65 | NW/4 | NE/4 | Sec. | 9 | T8S,R2E |
| 66 | NE/4 | NW/4 | Sec. | 8 | T8S,R2E |
| 67 | SE/4 | NW/4 | Sec. | 8 | T8S,R2E |
| 68 | NE/4 | NE/4 | Sec. | 8 | T8S,R2E |
| 69 | SW/4 | SE/4 | Sec. | 25 | T7S,R1E |
| 70 | SE/4 | SW/4 | Sec. | 25 | T7S,R1E |
| 71 | NW/4 | SE/4 | Sec. | 6 | T8S,R2E |
| 72 | NW/4 | SE/4 | Sec. | 6 | T8S,R2E |
| 73 | NE/4 | SW/4 | Sec. | 6 | T8S,R2E |
| 74 | NE/4 | SW/4 | Sec. | 6 | T8S,R2E |
| 75 | SW/4 | SW/4 | Sec. | 17 | T8S,R2E |
| 76 | SE/4 | NW/4 | Sec. | 17 | T8S,R2E |
| 77 | NW/4 | NE/4 | Sec. | 17 | T8S,R2E |
| 78 | NE/4 | SE/4 | Sec. | 20 | T8S,R2E |
| 79 | NE/4 | SE/4 | Sec. | 27 | T8S,R2E |
| 80 | SW/4 | NW/4 | Sec. | 35 | T8S,R2E |
| 81 | SW/4 | NW/4 | Sec. | 14 | T8S,R2E |
| 82 | SW/4 | SW/4 | Sec. | 10 | T8S,R2E |
| 83 | NE/4 | SW/4 | Sec. | 14 | T8S,R2E |
| 84 | SW/4 | NW/4 | Sec. | 10 | T8S,R2E |
| 85 | NE/4 | SE/4 | Sec. | 28 | T8S,R2E |
| 86 | NW/4 | SW/4 | Sec. | 6 | T8S,R2E |
| 87 | NW/4 | NE/4 | Sec. | 1 | T8S,R1E |
| 88 | NE/4 | SE/4 | Sec. | 35 | T7S,R1E |
| 88 | SE/4 | SE/4 | Sec. | 35 | T7S,R1E |
| 89 | NW/4 | NE/4 | Sec. | 11 | T8S,R1E |
| 90 | SE/4 | NW/4 | Sec. | 23 | T8S,R2E |
| 91 | SE/4 | NW/4 | Sec. | 12 | T8S,R2E |
| 92 | SE/4 | SW/4 | Sec. | 23 | T8S,R2E |
| 93 | SE/4 | NE/4 | Sec. | 2 | T8S,R2E |
| 94 | SW/4 | SW/4 | Sec. | 34 | T7S,R2E |

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| Well No. | Location | | |
|---|---|---|---|
| 95 | SE/4 | Sec. 25 | T40N,R61W |
| 96 | SW/4 SW/4 | Sec. 22 | T41N,R60W |
| 97 | Not Located | | |
| 98 | SW/4 NW/4 | Sec. 17 | T41N,R60W |
| 99 | NE/4 NE/4 | Sec. 17 | T41N,R60W |
| 100 | NW/4 SE/4 | Sec. 7 | T41N,R60W |
| 101 | SW/4 NE/4 | Sec. 1 | T41N,R61W |
| 102 | SW/4 NE/4 | Sec. 18 | T6S,R1E |
| 103 | NW/4 NW/4 | Sec. 10 | T41N,R60W |
| 104 | NW/4 SW/4 | Sec. 10 | T41N,R60W |
| 105 | SE/4 NW/4 | Sec. 9 | T41N,R60W |
| 106 | NE/4 NE/4 | Sec. 18 | T6S,R1E |
| 107 | SE/4 NE/4 | Sec. 18 | T6S,R1E |
| 108 | SE/4 NE/4 | Sec. 18 | T6S,R1E |
| 109 | NE/4 NW/4 | Sec. 17 | T6S,R1E |
| 110 | NE/4 NE/4 | Sec. 17 | T6S,R1E |
| 111 | NW/4 NE/4 | Sec. 17 | T6S,R1E |
| 112 | SE/4 | Sec. 16 | T6S,R1E |
| 113 | NE/4 SW/4 | Sec. 6 | T7S,R2E |
| 114 | NE/4 SW/4 | Sec. 7 | T7S,R2E |
| 115 | SE/4 NE/4 | Sec. 18 | T6S,R1E |
| 116 | SE/4 NE/4 | Sec. 18 | T6S,R1E |
| 117 | SW/4 SE/4 | Sec. 8 | T6S,R1E |
| 118 | NE/4 SE/4 | Sec. 7 | T6S,R1E |
| 119 | NW/4 NW/4 | Sec. 8 | T6S,R1E |
| 120 | NW/4 SW/4 | Sec. 5 | T6S,R1E |
| 121 | SW/4 SW/4 | Sec. 31 | T5S,R1E |
| 122 | NE/4 NW/4 | Sec. 30 | T5S,R1E |
| 123 | NE/4 NW/4 | Sec. 21 | T42N,R60W |
| 124 | NW/4 SW/4 | Sec. 18 | T5S,R1E |
| 125 | SW/4 SW/4 | Sec. 6 | T6S,R1E |

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| Well No. | Location |
|---|---|
| 126 | SE/4 SW/4 Sec. 16 T41N,R60W |
| 127 | SW/4 NE/4 Sec. 7 T41N,R60W |
| 128 | NW/4 SE/4 Sec. 1 T41N,R61W |
| 129 | Sec. 7 Sec. 5 T41N,R60W |
| 130 | |
| 131 | NW/4 SE/4 Sec. 4 T8S,R2E |
| 132 | NW/4 SE/4 Sec. 4 T8S,R2E |
| 133 | |
| 134 | SE/4 NW/4 Sec. 29 T40N,R60W |

## Water Wells in Edgemont Project Area

| Map # | Owner | Use | Depth | Probable Aquifer | Remarks |
|---|---|---|---|---|---|
| 1 | Peterson & Son Inc. | Stock | 600 | K 1 | Flowing 1.1 gpm, stopped during test. Casing was cut off closer to ground & flow recovered to 1.3 gpm, 6 wks after test. |
| 2. | Peterson & Son Inc. | Domestic | 640 | K 1 | Flowing est. 15 gpm. |
| 3 | Peterson & Son Inc. | Stock | Oil test | | Flowing 3 gpm. |
| 4. | Peterson & Son Inc. | Stock | Oil Test | | Couldn't measure- broken out around casing. Also used by Glen Peterson for garden. |
| 5. | Peterson & Son Inc. | Stock | Oil Test | | Plugged at 850", possible Sundance flow. Flowing 6.6 gpm, slowed to 5 gpm during test |
| 6. | Glen Peterson | Stock | 280' | K f | SWL 11'2", Siphon Arrangement into tank. |
| 7. | Glen Peterson<br>" " | Domestic | 500'<br>200" | K 1<br>K f | Flowing 4.25 gpm. Slowed to 3.6 during test<br>SWL 12' 8" |
| 8. | Leslie Coates<br>" " | Domestic | 500<br>240 | K 1<br>K f | Flowing 4.2 gpm.<br>Flow est. 1 gpm. Pumped to house. |
| 9. | Leslie Coates | Stock | 90 ? | K f | Flowing 2.5 gpm. |
| 10 | Leslie Coates | Stock | 200 | K 1 | SWL 78' New well. |
| 11 | Leslie Coates | Stock | Oil test | | Flowing 5 gpm. |
| 12 | Leslie Coates | Stock | 730' | K 1 | Flowing 0.6 gpm, slowed to < 0.1 gpm during test. Recovered to 0.3 gpm after 6 weeks. |
| 13 | Miles Spencer | Domestic | 500 | K 1 | Flowing 2.5 gpm., slowed to 1.2 gpm during test, Recovered to 2.0 gpm after 6 weeks. |
| 14. | Earl Darrow | Stock | 470 | K 1 | Barely flowing. Stopped during test. SWL recovered to 1.0 ft. |
| 15 | Earl Darrow | Stock | 280 | K 1 | Pump jack, couldn't measure accurately SWL approximately 24' |
| 16 | Earl Darrow | Stock | 330 | K 1 | New well, SWL 157' 7" |
| 17 | H. P. Heck | Stock | 156 | K f | Windmill, couldn't measure |
| 18 | Dick Andersen | Domestic | 527 | K f | Flowing 7.5 gpm. |

## Water Wells in Edgemont Project Area

| Map # | Owner | Use | Depth | Probable Aquifer | Remarks |
|---|---|---|---|---|---|
| 19 | Dick Andersen | Stock | 740 | K f | Pump jack, couldn't measure. |
| 20 | Edwin Andersen | Domestic | 530 | K f | Flowing 4.5 gpm. |
| 21. | Tubbs Ranch | Stock | 910 | K f | Flowing 14 gpm. |
| 22. | Coates, Andersen | Stock | 800 | K f | Pump jack, reported SWL 30' |
| 23 | Tubbs Ranch | Stock | 600 | K f | Flowing 0.8 gpm. |
| 24 | Tubbs Ranch | Domestic | | | Siphon arrangement, water level 23' |
| 25 | Tubbs Ranch | Stock | | | Windmill, couldn't measure, reported to barely flow. |
| 26 | Tubbs Ranch | Stock | 350 | K f | Windmill, couldn't measure, reported to barely flow. |
| 27 | Tubbs & Schultz | Stock | 900 | K l | Submersible pump to pipeline. SWL 15' |
| 28 | Tubbs Ranch | Stock | 300 | K f | Will flow 20 gpm. H2S |
| 29 | B. Childers | Stock | | | Wild well, flowing est. 35 gpm. H2S around casing. |
| 30 | Harold Dodson | Domestic | 120 | K f | Barely flows, pumped to house. |
| | " " | Stock | 120 | K f | Flows 0.75 gpm |
| 31 | F. A. Heck | Domestic | 104 | K f | Flows 1.3 gpm. |
| 32 | Tony Bryan | Domestic | 90 | K f | Pumped to house, couldn't measure, flow est. ½ gpm. |
| 33 | H. P. Heck | Domestic | 96 | K f | Piped into house, flowing reported 1.25 gpm |
| 34 | Tony Bryan | Stock | 330 | K l | 2 wells, one no flow & not used, one flows 1.5 gpm. |
| 35 | Tony Bryan | Stock | 148 | K l | Pumped well, not visited. |
| 36 | Tony Bryan | Stock | 255 | K l | Flowing 10 gpm. |
| 37 | Tony Bryan | Stock | 145 | K l | Pumped well, not visited |
| 38 | Lloyd Putnam | Stock | 550 | K l | Flowing 1.5 gpm. |
| 39 | Norris Darrow | Stock | 700 | K l | Windmill, reported SWL 15' |
| 40 | Norris Darrow | Domestic<br>Domestic | 660<br>700 | K l<br>K l | Two wells piped together, both flow, but couldn't measure |

## Water Wells in Edgemont Project Area

| Map # | Owner | Use | Depth | Probable Aquifer | Remarks |
|---|---|---|---|---|---|
| 41 | Robert Bakewell | Domestic | | | Flows 12 gpm. |
| 42 | Lloyd Putnam | Domestic | 600 | K l | Flows est. 25 gpm. |
| 43 | Preston Richardson | Domestic | 350 | K l | Submersible pump, couldn't measure, stopped flowing when old Triangle mine dewatered. |
| 44 | Harold Dodson | Stock | 130 | K f | Will flow est. 40 gpm. |
| 45 | Harold Dodson | Stock | 190 | K f | Flows 3.1 gpm. H2S |
| 46 | Harold Dodson | Stock | Oil test | K f | Plugged at 140', but couldn't measure. Flowing around casing. |
| 47 | Harold Dodson | Stock | 90 | K f | SWL 10' |
| 48 | Norris Darrow | Stock | 725 | K l | Will flow est. 60 gpm. |
| 49 | Norris Darrow | Stock | 600 | K l | Flows 5 gpm. |
| 50 | Lloyd Putnam | Stock | 609 | K l | Flows 1.5 gpm., may be 2 wells piped together. |
| 51 | Burlington R.R. | Stock | 550 | K l | Flows 15.5 gpm., used by Leslie Coates. |
| 52 | Tony Bryan | Stock | | | Flows 2.8 gpm. |
| 53 | Tony Bryan | Stock | | | Windmill, couldn't measure. |
| 54 | Tony Bryan | Stock | 90 | K f | Flows 0.5 gpm. |
| 55 | Tony Bryan | Stock | 92 | K f | Flows 9 gpm. |
| 56 | Effie Gow | Domestic | 300 | K l | Broken out around casing, flowing |
| 57 | Effie Gow | Garden | 270 | K l | Couldn't measure, reported 100+ gpm. H2S Used by Rev. Brown to irrigate garden. |
| 58 | F. A. Heck | Stock | 100+ | K f | Flows 4 gpm. |
| 59 | F. A. Heck | Stock | 118 | K f | Flows 2.8 gpm H2S |
| 60 | F. A. Heck | Stock | | | Windmill, couldn't measure. |
| 61 | Earl Darrow | Stock | 525 | K l | Pumpjack, couldn't measure. |
| 62 | F. A. Heck | Stock | | | Couldn't measure, flowing est. 2 gpm into covered tank. |

## Water Wells in Edgemont Project Area

| Map # | Owner | Use | Depth | Probable Aquifer | Remarks |
|---|---|---|---|---|---|
| 63 | Tony Bryan | Stock | 100+ | K f | Flows 1.5 gpm. |
| 64 | Leonard McElhaney | Stock | | | Flows 5 gpm H2S, may flow more through big valve. |
| 65 | " " | ? | | | 2 wells, one windmill, SWL 15', neither apparently used. |
| 66 | " " | Stock | | | Valve at well head shut off except for small line to H. Dodson's stock tank. Reported by Keene as flowing 270 gpm. in 1970 |
| 67 | Leonard McElhaney | Stock | | | Flows 25 gpm. H2S. |
| 68 | " " | Domestic<br>Stock | 230<br>230 | K l<br>K l | Piped to house, couldn't measure.<br>Flows 6 gpm. |
| 69 | H. P. Heck | Stock | 130 | K f | Flows 1.2 gpm. |
| 70 | H. P. Heck | Stock | 375 | K f, K l | Flows 1.0 gpm. |
| 71 | Ed Benton | Domestic | | K f | Pumped to house, reported to barely flow |
| 72 | Ed Benton | Stock | 212 | K f | Yard water, Flows 13 gpm H2S |
| 73 | Ed Benton | Stock | 560 | K l | Flows 1.6 gpm. |
| 74 | Ed Benton | Stock | 305 | K f | Casing rusted out, flows, couldn't measure |
| 75 | Ed Benton | Stock | 430 | K f | Windmill, reported to pump dry |
| 76 | Ed Benton | Stock | 420 | K f | Broken out around casing, est. 7 or 8 gpm. |
| 77 | Darrell Heldman | Stock | 400 | K f | Broken out around casing, est. 5 gpm. |
| 78 | " " | " | 410 | K f | Pump jack, Keene reports SWL 30' |
| 79 | B. Childers | Domestic | 337 | K f | Couldn't measure, pump set at 250' |
| 80 | " " | Stock | 650 | K l | Pump jack, Keene reports SWL 100' |
| 81 | " " | " | 440 | Kl | Flows 4 gpm, sl. H2S |
| 82 | " " | " | 200 | K f | Flows 9 gpm., H2S |
| 83 | " " | " | 270 | K f | Pump jack, couldn't measure. |

## Water Wells in Edgemont Project Area

| Map # | Owner | Use | Depth | Probable Aquifer | Remarks |
|---|---|---|---|---|---|
| 84 | Dick Miller | Stock | 155 | K f | Flows 0.25 gpm. |
| 85 | Tubbs Ranch | Domestic | 415 | K f | Pumped to house,<br>Reported SWL 30' |
| 86 | Tubbs Ranch | Stock | 360 | K f | Pump jack, SWL reported 20' |
| 87 | Tubbs Ranch | Appears abandoned | 380 | K f | Plugged with wooden plug. Reported SWL 20' |
| 88 | Tubbs Ranch | Appears abandoned | 320 | K f | Two wells, one may be caved in, one SWL 10' |
| 89 | Porter & Benton | Pipeline | 860 | K 1 | Submersible pump, runs extensive pipeline. SWL reported 5' |
| 90 | B. Childers | Stock | Oil test | | SWL 1.0 ' |
| 91 | Carl Reutter | Stock | 150 | K f | Windmill SWL 34' |
| 92 | Carl Reutter | Domestic | 298 | K f | Pumped to house, Keene reports SWL 132' |
| 93 | Bob Runge | Domestic | 200 | K 1 | Two wells, couldn't measure, Keene reports SWL 80' |
| 94 | Bob Runge | Stock | 200+ | K 1 | Flows 0.75 gpm. |
| 95 | Wayne Jackson | Pipeline | 860<br>~~880~~ | K f | Barely flows, submersible pump to pipeline. |
| 96 | Billy Stearns | Domestic | 560 | K 1 | Flows 4.8 gpm. |
| 97 | Billy Stearns | Stock | | K 1 | Uranium test cased to 200', hole reported to be caving below that & sealing off flow. Flows. |
| 98 | Billy Stearns | Stock | Oil test | | Leaking around top of casing, flows est 2 g |
| 99 | Gerald Darrow | Domestic | 420 | K 1 | Flows 2.2 gpm. |
| 100 | " " | Stock | 530 | K 1 | Flows 150 gpm (by Hodson) apparently used to fill water trucks. |
| 101 | " " | Morresy Pipeline | 665 | K 1 | Pipeline serves ranches west, submersible pump. Hodson reports flow 3 gpm. |
| 102 | Lloyd Darrow | Domestic | 267 | K 1 | Will flow est. 100 gpm. Sells water |
| 103 | Lloyd Darrow | Stock | 350 | K 1 | Flows 1.3 gpm. |

### Water Wells in Edgemont Project Area

| Map # | Owner | Use | Depth | Probable Aquifer | Remarks |
|---|---|---|---|---|---|
| 104 | Lloyd Darrow | Stock | | K l | Jensen jack, reported SWL 6' |
| 105 | Lloyd Darrow | Stock | | K l | Not visited, reported SWL 8 to 10' |
| 106 | Lloyd Darrow | Stock | | | Flows 3.5 gpm. |
| 107 | Earl Darrow | Domestic | 90 | K f | Pumped into house, flow est. 1 gpm. |
| 108 | Chet Taylor | Domestic | 90 | K f | Taylor lives here part of time. Info reported by Earl Darrow. Flow rep. 1 gpm |
| 109 | Vivian Cook | Domestic | 220 | Kl | Reported SWL 22' |
| 110 | Vivian Cook | Stock | 240 | K l | Reported SWL 30' |
| 111 | Vivian Cook | Not used | 100 | K f | Owner plans to develop, reported SWL 5' |
| 112 | Miles Spencer | Stock | 120 | K f | Windmill, couldn't measure. |
| 113 | Miles Spencer | Stock | | | Back up well for Spencer pipeline. |
| 114 | No info | | | | Forest Service. |
| 115 | Bud Hollenbeck | Domestic | | K f | Flows 3 gpm. |
| 116 | Bud Hollenbeck | | | K f | Flows 2.75 gpm. At Dewey Post Office. |
| 117 | Bud Hollenbeck | Stock<br>Garden | | | Submersible Pump. SWL 27' |
| 118 | Bud Hollenbeck | Stock | Oil test | | Flowing out of casing at ground level |
| 119 | Bud Hollenbeck | Stock | | | Submersible pump, reported SWL 6' |
| 120 | Forest Service | Stock | | | Pumpjack, couldn't measure. |
| 121 | Bud Hollenbeck | Stock | 430 | K l | Will flow?? est. 100 gpm. |
| 122 | Bud Hollenbeck | Stock | | | Windmill, couldn't measure. |
| 123 | Bud Hollenbeck | Stock | | | Pump jack, couldn't measure. |
| 124 | Bud Hollenbeck | Stock | | | Not visited, reported windmill. |
| 125 | Bud Hollenbeck | Stock | | | Casing rusted off. Flows at ground level. |
| 126 | Francis Carr | Domestic | | K l | Flows, couldn't measure. |
| 127 | Francis Carr | Stock | Oil test | K l | Casing rusted off, flows at ground level. |

## Water Wells in Edgemont Project Area

| Map # | Owner | Use | Depth | Probable Aquifer | Remarks |
|---|---|---|---|---|---|
| 128 | Francis Carr | Stock | Oil test | K l | Couldn't measure, est. 5 gpm. |
| 129 | There are several old oil tests in this area. The ones reported as being used are reported above. There appears to be some flow from some of these but the casings seem to be bad and all there is now are some marshy areas. Some use of water for stock from these is possible. | | | | |
| 130 | Dick Miller | Domestic | 155 | K f | ? |
| 131 | Dick Miller | Stock | 110 | K f | *Flows 0.8 gpm* |
| 132 | Dick Miller | Stock | 300 | K l | *Flows est. 2 gpm* |
| 133 | Dick Miller | Stock | 300 | K l | Not contacted. Information from Keene |
| *134* | *Roberts & Daniels* | *Stock* | *860* | | |

| # | S. | to Electricity | Dia. | Condition | Setting, Capacity, Age, etc. | Use | Requirement | |
|---|---|---|---|---|---|---|---|---|
| 1 | S | 300 ft. | 4" | 25 yrs. - fair | none | | | |
| 2 | D.S.I. | 300 ft. | 5" | 45 yrs. - poor | none | | | casing rusted out -<br>flowing around casing |
| 3 | S | 1/2 mile | 4" | 10 yrs. | none | | | oil test<br>open hole from top of F. R. |
| 4 | S.I. | 700 ft. | 3" | 10 yrs. - poor | none | | | oil test<br>flowing around casing |
| 5 | S | 2 miles | 5" | 10 yrs. - fair | none | | | oil test - open<br>hole from top of FR |
| 6 | S | 1 mile | 12" | 20 yrs. | none | | | |
| 7 FR | D | on site | 6" | 20 yrs. | jet pump at 25 ft. | | | |
| 7 LAK | S.I. | " " | 5½" | 40 yrs. - poor | none | | | |
| 8 FR | D.I. | on site | | 45 yrs. - poor | jet pump in basement | | | |
| 8 LAK | S.I. | on site | 6" | 45 poor | none | | | |
| 9 | S | 1 mile | 6" | 10 yrs. | none | | | |
| 10 | S | 2 miles | | 2 yrs. - good | pump jack | | | |
| 11 | S | 1/2 mile | 8" | 10 yrs. | none | | | oil test |
| 12 | S | 2000 ft. | 4½" | 10 yrs. - poor | none | | | open hole from top FR |
| 13 | D.S.I. | on site | 5" | 20 yrs. - fair | none | | | |
| 14 | S | 1/2 mile | 4" | poor | none | | | first pump test stopped flow -<br>well not used since flow stopped |
| 15 | S | on site | 4" | fair | cylinder type | | | |

| Well # | D. S. | Distance to Electricity | Well Dia. | Age and Condition | Pump Information-Type Setting, Capacity, Age, etc. | Season of Use | Water Requirement | Remarks |
|---|---|---|---|---|---|---|---|---|
| 16 | S | on site | 4½ | 1 yr. - good | no pump installed yet | | | |
| 17 | S | 2 miles | UNK. | | windmill | | | |
| 18 | D.S.I. | on site | 4" | 48 yrs. | pressure pump | | | |
| 19 | S | 1 mile | 6" | 16 yrs. - fair | pump jack | | | |
| 20 | D.S.I. | on site | 6" | 51 yrs. - poor | shallow well jet pump | | | casing rusted out - was repaired |
| 21 | S | 1½ mile | 7" | 65 yrs. | none | | | oil test |
| 22 | S | on site | 3" | 10 yrs. - good | cylinder type | | | |
| 23 | S | 1 mile | 6" | | none | | | |
| 24 | D.S. | on site | 3" | | none | | | |
| 25 | S | 2 miles | 4½" | | windmill | | | |
| 26 | S | 1 mile | 5" | | windmill | | | |
| 27 | S | on site | 12" | | submersible pump | | | serues pipeline |
| 28 | S | 1/2 mile | 6" | poor | none | | | |
| 29 | S | 1/2 mile | 5" | poor | none | | | casing rusted out |
| 30 | D.I. | on site | 6" | 24 yrs. | deep well jet pump<br>set @ 80 ft | | | |

| Well # | D. S. | Distance to Electricity | Well Dia. | Age and Condition | Pump Information-Type Setting, Capacity, Age, etc. | Season of Use | Water Requirement | Remarks |
|---|---|---|---|---|---|---|---|---|
| 30 | S | on site | 6" | cleaned 1977<br>22 years | none | | | |
| 31 | D.S.I. | on site | 5½" | 28 yrs. | none | | | |
| 32 | D.S.I. | on site | 6" | | pump type unknown | | | |
| 33 | D.S. | on site | 5" | 32 yrs. | none | | | |
| 34 | S | 1 mile | 2½" | | none | | | 2 wells - one does not flow and is not used |
| 35 | | 2 miles | 8 | poor | windmill | | | |
| 36 | S | 1½ mile | 4" | poor | none | | | |
| 37 | | 2½ miles | 5½ | poor | cylinder type | | | |
| 38 | S | ½ mile | 4' | 26 yrs. | none | | | |
| 39 | S | ½ mile | 5" | poor | windmill | | | |
| 40 | D.S.I. | on site | 6" | 8 yrs. | none | | | } piped together |
| 40 | D.S.I. | on site | 6" | 31 yrs. poor | none | | | } |
| 41 | D.S.I. | on site | 6" | | submersible | | | serves pipeline |
| 42 | D.S.I. | on site | 5" | 33 yrs. poor | none | | | casing rusted out and repaired |
| 43 | D | on site | 4" | poor | submersible | | | |

| Well # | D. S. | Distance to Electricity | Well Dia. | Age and Condition | Pump Information-Type Setting, Capacity, Age, etc. | Season of Use | Water Requirement | Remarks |
|---|---|---|---|---|---|---|---|---|
| 44 | S | 1/2 mile | 6" | 20 yrs. | none | | | |
| 45 | S | on site | 4" | 8 yrs. poor | none | | | |
| 46 | D.S. | 1/2 mile | 6" | 18 yrs. poor | none | | | oil test - leaking around casing |
| 47 | D.S.I. | on site | 6" | 18 yrs. fair | none | | | |
| 48 | S | on site | 2½" | 10 yr. | none | | | |
| 49 | S | 1 mile | 4" | 3 yrs. | none | | | |
| 50 N | S | 2 miles | 4" | 40 yrs. poor | none | | | |
| 50 S | S | 2 miles | 6" | 5 yrs. poor | none | | | surface casing only ? |
| 51 | S | 1 mile | 10" | 80 yrs. poor | none | | | repaired 1930's ? |
| 52 | S | 1/2 mile | 2½" | | none | | | |
| 53 | S | 1 mile | 6" | | windmill | | | |
| 54 | S | 1500 ft. | 6" | | none | | | |
| 55 | S | 2000 ft. | 6" | | none | | | |
| 56 | D.S.I. | on site | 3" | 10 yrs. poor | submersible | | | leaking around casing |
| 57 | S.I. | 1/2 mile | 4" | | none | | | |

| Well # | D. S. | Distance to Electricity | Well Dia. | Age and Condition | Pump Information-Type Setting, Capacity, Age, etc. | Season of Use | Water Requirement | Remarks |
|---|---|---|---|---|---|---|---|---|
| 58 | S | 100 ft. | 6" | | none | | | |
| 59 | S | 1500 ft. | 4" | poor | none | | | |
| 60 | S | 1 mile | UNK. | | windmill | | | |
| 61 | U | 3 miles | 5" | | pump jack | | | |
| 62 | S | 1½ mile | 6" | 1 yr. good | none | | | well replaced 1977 |
| 63 | S | 2000 ft. | 5" | | none | | | |
| 64 | S | 1/2 mile | 2½" | poor | none | | | |
| 65 | U | 1/2 mile | 6" | poor | none | | | |
| 66 | S | Approx. ½ mile | 5" | | none | | | |
| 67 | S | Approx. ½ mile | 5" | poor | none | | | |
| 68 | D | on site | 4" | | none | | | |
| 68 | S.I. | on site | 4" | | none | | | |
| 69 | S | 400 ft. | 6" | 18 yrs. | none | | | |
| 70 | S | 2000 ft. | 4" | 7 yrs. poor | none | | | open hole from top Fall River |
| 71 | D | on site | 5" | | pump type unknown | | | |

| Well # | D. S. | Distance to Electricity | Well Dia. | Age and Condition | Pump Information-Type Setting, Capacity, Age, etc. | Season of Use | Water Requirement | Remarks |
|---|---|---|---|---|---|---|---|---|
| 72 | S.I. | on site | 6" | 32 yrs. poor | none | | | |
| 73 | D.S.I | on site | 5" | 2 yrs. good | submersible | | | |
| 74 | S | 1/2 mile | 5" | 30 yrs. poor | none | | | casing rusted out |
| 75 | S | Approx. 1 mile | 5" | | windmill | | | pumps dry |
| 76 | S | Approx. 1½ mile | 7" | 18 yrs. poor | none | | | casing rusted out |
| 77 | S | Approx. 1½ Mile | 5" | poor | none | | | casing rusted out |
| 78 | D.S. | on site | 5" | | cylinder | | | |
| 79 | D.S.I | on site | 6" | | submersible set at 250' | | | |
| 80 | S | Approx. 3000 ft. | 6" | | cylinder | | | |
| 81 | S | Approx. 1½ mile | 4" | | none | | | |
| 82 | S | Approx. 1½ mile | 4½" | | none | | | |
| 83 | S | Approx. 1 mile | 6" | | cylinder | | | |
| 84 | S | Approx. 1 mile | 2" | | none | | | |
| 85 | D | on site | | | | | | |
| 86 | S | 1/2 mile | 4" | poor | cylinder | | | stopped flowing when well #66 flowing uncontrolled about 1970 |

| Well # | D. S. | Distance to Electricity | Well Dia. | Age and Condition | Pump Information-Type Setting, Capacity, Age, etc. | Season of Use | Water Requirement | Remarks |
|---|---|---|---|---|---|---|---|---|
| 87 | U | 3/4 mile | 4" | poor | none | | | same as 86 |
| 88 | S.U. | 1500 ft. | 8" | poor | none | | | was used with pump jack in 1977 - not used in 1978 |
| 88 | S | on site | 6" | | pump type unknown probably submersible | | | serues pipeline |
| 89 | D.S. | on site | 6" | good | submersible | | | serues pipeline |
| 90 | S.U. | on site | 6" | | none | | | oil test |
| 91 | S | 1 mile | 5" | | windmill | | | |
| 92 | D.S.I. | on site | 4½" | | submersible | | | |
| 93 | D.S.I. | on site | 2" | | submersible | | | |
| 93 | S.U. | on site | 6" | | none | | | |
| 94 | S | on site | 5" | | none | | | |
| 95 | D.S.I. | on site | 10" | | submersible | | | serues pipeline |
| 96 | D.S.I. | on site | 5" | | none | | | |
| 97 | S | 1 mile | 4" | poor | none | | | cased to 200" |
| 98 | S | 2 miles | 10' | poor | none | | | oil test |
| 99 | D.S.I. | on site | 4" | | none | | | |

| Well # | D. S. | Distance to Electricity | Well Dia. | Age and Condition | Pump Information-Type Setting, Capacity, Age, etc. | Season of Use | Water Requirement | Remarks |
|---|---|---|---|---|---|---|---|---|
| 100 | S | | 8" | | none | | | |
| 101 | D<br>S | on site | 7" | | submersible | | | serues extensive pipeline |
| 102 | DSI | on site | 5" | fair | none | | | |
| 103 | S | 1 mile | 4" | | none | | | |
| 104 | S | 1 mile | 4½" | | Jensen jack | | | |
| 105 | S | 3 miles | 4" | | pump jack | | | |
| 106 | S | 1/2 mile | 4" | | none | | | |
| 107 | DSI | on site | 5" | poor | none | | | |
| 108 | DSI | on site | 6" | poor | none | | | |
| 109 | DSI | on site | 6" | | submersible - set @ 90' | | | |
| 110 | SI | on site | 6½" | | submersible | | | |
| 111 | SU | 200 ft. | 4" | | none | | | |
| 112 | S | 1 mile | 4½ | | windmill | | | |
| 113 | S | 2 miles | UNK | | windmill | | | |
| 114 | S<br>U | 3 miles | UNK | | windmill | | | |

| D. S. | Distance to Electricity | Well Dia. | Age and Condition | Pump Information-Type Setting, Capacity, Age, etc. | Season of Use | Water Requirement | Remarks |
|---|---|---|---|---|---|---|---|
| DSI | on site | 3½" | | jet pump | | | |
| U | on site | 1" | | none | | | |
| S.I. | on site | 6" | | submersible pump | | | |
| S | 1500 ft. | 9½ | poor | none | | | oil test |
| S | on site | 5" | | submersible pump | | | |
| S | on site | 2" | | pump jack | | | |
| S | 1½ mile | 5" | | none | | | |
| S | 5 miles | 7" | | windmill | | | |
| S | 4½ mile | 6" | | cylinder | | | |
| S | 5 miles | 4" | | windmill | | | |
| S | 1½ miles | 6" | poor | none | | | casing rusted off |
| DST | on site | 6½" | | none | | | |
| S | 2 miles | 6" | poor | none | | | oil test - casing rusted off |
| S | 2½ miles | 2" | poor | none | | | oil test |

| Well # | D. S. | Distance to Electricity | Well Dia. | Age and Condition | Pump Information-Type Setting, Capacity, Age, etc. | Season of Use | Water Requirement | Remarks |
|---|---|---|---|---|---|---|---|---|
| 130 | U | on site | UNK | | none | | | covered up by owner<br>$H_2S$ is not used |
| 131 | S | 200 ft. | 3" | | none | | | |
| 132 | S.I. | on site | approx.5" | | pump type unknown | | | |
| 133 | U | 1500 ft. | 6" | | none | | | |
| 134 | S.U. | on site | 1" | | UNK | | | |
| | | | | | | | | |
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# SOURCE B

# DRAFT ENVIRONMENTAL STATEMENT FOR EDGEMONT URANIUM MINE TABLE 2.5.2-1

(Tennessee Valley Authority, 1979)

## Table 2.5.2-1

## Summary of Wells Within a Four-Mile (6.5 km.) Radius of the TVA Burdock, No. 1 Shaft Site

Well No.: Based on the Federal system of township and range. Each township within the project area is assigned a letter in consecutive order beginning with "A" in the northeast corner and ending with "F" in the southern part. Similarly, wells are numbered in consecutive order within a township--for example: B-1, B-2, etc. Location: Number based on township, range, section, 1/4 section, and 1/4 section. Aquifer: Qa, Quaternary alluvial deposits; Kf, Cretaceous, Fall River Formation; Kl, Cretaceous, Lakota Formation; Jm, Jurassic, Morrison Formation; Js, Jurassic, Sundance Formation; Trs, Triassic, Spearfish Formation; PmK, Permian, Minnekahta Limestone. Depth: Given in feet (ft.) and meters (m.) below land surface. Use Rate and Flow Rate: In gallons per minute (gpm) and liters per second (l/s). Elevation of Land Surface and Elevation of Water Surface: In feet (ft.) and meters (m.) above sea level. Superscript a indicates flow rate less than 1 gpm. Superscript b indicates estimated water surface elevations.

|  |  |  |  |  |  | Depth |  | Use Rate |  | Flow Rate |  | Elevation |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | Well No. | Latitude | Longitude | Location | Aquifer | (ft.) | (m.) | (gal/min) | (l/s) | (gal/min) | (l/s) | Land Surf. (ft) | Land Surf. (m) | Water Surf. (ft) | Water Surf. (m) | Remarks |
| 621 | B-1 | 43°30'00" | 103°58'57" | 6-1-27Db | Qa | 50 | 15 | 30 | 1.9 | - | - | 3715 | 1132 | 3700 | 1128 |  |
| 5o2 | B-2 | 43°29'58" | 103°58'57" | 6-1-27Db | Qa | 46 | 14 | 30 | 1.9 | - | - | 3715 | 1132 | 3703 | 1128 |  |
| 41 | B-3 | 43°29'10" | 104°02'43" | 6-1-31Bd | - | - | - | - | - | 12 | .8 | 3605 | 1099 | 3610$^b$ | 1100 |  |
| 56 | B-4 | 43°29'09" | 104°03'40" | 6-1-33Bc | Kl | 550 | 168 | - | - | 2 | .1 | 3630 | 1106 | 3630$^b$ | 1106 |  |
| 45 | B-5 | 43°28'51" | 103°59'06" | 6-1-34Dc | Kl | 350 | 107 | - | - | - | - | 3663 | 1116 | - | - | Flowed until Triangle mine dewatered. 1/3 h.p. pump. |
| 16 | D-1 | 43°28'20" | 103°56'47" | 7-1-1Bd | Kl | 330 | 101 | - | - | - | - | 3905 | 1190 | 3747 | 1146 |  |
| 638 | D-2 | 43°28'32" | 103°57'34" | 7-1-2Aa | Kf | 180 | 55 | 10 | .6 | - | - | 3749 | 1143 | - | - | Water contains iron. |
| 15 | D-3 | 43°28'36" | 103°58'15" | 7-1-2Bb | Kl | 495 | 151 | - | - | a | - | 3705 | 1129 | 3705$^b$ | 1129 | Unused. |
| 649 | D-4 | 43°28'28" | 103°58'20" | 7-1-2Bc | Kl | 280 | 85 | 5 | .3 | - | - | 3698 | 1127 | 3674 | 1120 | Water contains iron. |
| 19 | D-5 | 43°28'01" | 103°58'22" | 7-1-2Cc | Kl | 470 | 143 | - | - | 4 | - | 3679 | 1121 | 3681$^b$ | 1122 | Unused. |
| 13 | D-6 | 43°28'38" | 103°59'42" | 7-1-3Bb | Kl | 500 | 152 | - | - | 2 | .1 | 3660 | 1116 | 3661$^b$ | 1116 | A.E.C. water analysis. |
| 12 | D-7 | 43°28'02" | 104°00'00" | 7-1-4Dd | Kl | 805 | 245 | - | - | 1 | .06 | 3645 | 1111 | 3646$^b$ | 1111 |  |
| 412 | D-8 | 43°28'17" | 104°01'19" | 7-1-6Ac | Kl | 600 | 183 | - | - | 25 | 1.6 | 3600 | 1097 | 3610$^b$ | 1100 | Flow rate in 1969, 30 gpm (1.9 l/s). |
| 51 | D-9 | 43°27'30" | 103°58'52" | 7-1-9Ad | Kl | 550 | 168 | - | - | 16 | 1.0 | 3615 | 1102 | 3620$^b$ | 1103 | Water contains iron & sulphur. |
| 18 | D-10 | 43°27'03" | 104°00'54" | 7-1-9Cc | Kf | 527 | 161 | - | - | 8 | .5 | 3700 | 1128 | 3701$^b$ | 1128 |  |

## TABLE 2.5.2-1 (continued)

D-14
not in
database

56

| | Well No. | Latitude | Longitude | Location | Aquifer | Depth (ft.) | Depth (m) | Use Rate (gal/min) | Use Rate (l/s) | Flow Rate (gal/min) | Flow Rate (l/s) | Elevation Land Surf. (ft) | Elevation Land Surf. (m) | Elevation Water Surf. (ft) | Elevation Water Surf. (m) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | D-11 | 43°27'03" | 103°59'46" | 7-1-9Dd | Kl | 600 | 183 | - | - | 1 | .06 | 3624 | 1105 | 3631 | 1107 | Water contains iron. |
| 61 | D-12 | 43°27'05" | 103°57'47" | 7-1-11Dc | Kl | 525 | 160 | - | - | - | - | 3700 | 1128 | - | - | A.E.C. water analysis. |
| 17 | D-13 | 43°28'25" | 103°56'53" | 7-1-12Bd | Kf | 156 | 48 | - | - | - | - | 3750 | 1143 | - | - | |
| | D-14 | 43°27'04" | 103°56'21" | 7-1-12Dd | - | - | - | - | - | - | - | 3830 | 1167 | - | - | |
| 10 | D-15 | 43°26'55" | 103°56'12" | 7-1-13Aa | Kl | 200 | 61 | - | - | - | - | 3740 | 1140 | 3662$^b$ | 1116 | |
| 606 | D-16 | 43°26'54" | 103°58'24" | 7-1-14Bb | - | - | - | - | - | 8 | - | 3675 | 1120 | 3675$^b$ | 1120 | |
| 5 | D-17 | 43°44'45" | 103°58'25" | 7-1-14Ba | Kl | 850 | 259 | - | - | 7 | .4 | 3630 | 1106 | 3634$^b$ | 1108 | Water contains iron. |
| (651) | D-18 | 43°25'23" | 103°57'48" | 7-1-14Db | Kl | 280 | 85 | 1 | .06 | - | - | 3610 | 1100 | 3596$^b$ | 1097 | |
| 4 | D-19 | 43°25'39" | 103°58'43" | 7-1-15Dd | - | 2264 | 690 | - | - | - | - | 3576 | 1090 | 3580$^b$ | 1091 | |
| 2 | D-20 | 43°26'15" | 103°59'58" | 7-1-16Dd | Kl | 640 | 195 | - | - | 16 | .9 | 3565 | 1086 | 3560$^b$ | 1085 | A.E.C. water analysis. |
| 30 | D-21 | 43°26'18" | 104°02'01" | 7-1-17Cb | Kf | 530 | 162 | - | - | 4 | .3 | 3555 | 1084 | 3558$^b$ | 1084 | A.E.C. water analysis. |
| 19 | D-22 | 43°26'33" | 104°03'06" | 7-1-18Bc | Kf | 740 | 226 | - | - | - | - | 3700 | 1128 | - | - | |
| 21 | D-23 | 43°25'40" | 104°03'12" | 7-1-19Bc | Kf | 910 | 277 | - | - | 16 | .9 | 3580 | 1091 | 3585$^b$ | 1093 | |
| 3 | D-24 | 43°25'42" | 103°59'31" | 7-1-22Bc | - | 2400 | 732 | - | - | 3 | .2 | 3548 | 1081 | 3550$^b$ | 1082 | |
| 9 | D-25 | 43°25'59" | 103°57'24" | 7-1-23Aa | Kf | 90 | 27 | - | - | 3 | .2 | 3625 | 1106 | 3625$^b$ | 1105 | Flow rate 1969, 10 gpm (.6 l/s). |
| 7002 | D-26 | 43°26'02" | 103°58'26" | 7-1-23Bb | Kl | 500 | 152 | - | - | 5 | .3 | 3574 | 1089 | 3574$^b$ | 1089 | |
| 7 | D-27 | 43°26'00" | 103°58'28" | 7-1-23Bb | Kf | 200 | 61 | 3 | .2 | - | - | 3574 | 1089 | 3561$^b$ | 1085 | |
| 8002 | D-28 | 43°25'26" | 103°57'48" | 7-1-23Dc | Kl | 500 | 152 | - | - | 5 | .3 | 3542 | 1080 | 3542$^b$ | 1080 | Casing perforated in 10 ft (3 m.) intervals below elevations 3222 (982 m.) and 3384 (1031 m.). |
| 8 | D-29 | 43°25'27" | 103°57'44" | 7-1-23Dc | Kf | 240 | 73 | - | - | 1 | .06 | 3542 | 1080 | 3542$^b$ | 1080 | |
| 503 | D-30 | 43°25'24" | 103°57'30" | 7-1-23Dd | Js-PmK | 1470 | 448 | - | - | 5 | .3 | 3550 | 1082 | 3550$^b$ | 1082 | |
| 11 | D-31 | 43°25'32" | 103°57'07" | 7-1-24Cb | Js-PmK | 2480 | 756 | - | - | 6 | .4 | 3577 | 1090 | 3578$^b$ | 1091 | |
| 70 | D-32 | 43°24'32" | 103°55'58" | 7-1-25Ca | Kl | 375 | 114 | - | - | 2 | .1 | 3508 | 1069 | 3508$^b$ | 1069 | |
| 33 | D-33 | 43°24'43" | 103°56'37" | 7-1-25Db | Kf | 96 | 29 | - | - | 1 | .06 | 3510 | 1070 | 3510$^b$ | 1070 | |
| 54 | D-34 | 43°24'45" | 103°56'29" | 7-1-25Db | Kf | 90 | 28 | - | - | 1 | .06 | 3528 | 1075 | 3528$^b$ | 1075 | |

## TABLE 2.5.2-1 (continued)

57

|  | Well No. | Latitude | Longitude | Location | Aquifer | Depth (ft) | Depth (m) | Use Rate (gal/min) | Use Rate (l/s) | Flow Rate (gal/min) | Flow Rate (l/s) | Elevation Land Surf. (ft) | Elevation Land Surf. (m) | Elevation Water Surf. (ft) | Elevation Water Surf. (m) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 69 | D-35 | 43°24'28" | 103°56'38" | 7-1-25Dc | Kf | 130 | 40 | - | - | 1 | .06 | 3510 | 1070 | 3510$^b$ | 1070 |  |
| 504 | D-36 | 43°24'30" | 103°56'2[illegible]" | 7-1-25Dd | Kf | 450 | 137 | - | - | 3 | .2 | 3508 | 1069 | 3508$^b$ | 1069 |  |
| 505 | D-37 | 43°24'42" | 103°57'5[illegible]" | 7-1-26Ca | Kl | 260 | 79 | - | - | 2 | .1 | 3530 | 1076 | 3530$^b$ | 1076 |  |
| 25 | D-38 | 43°24'47" | 103°59'27" | 7-1-27Ac | Kf | 350 | 107 | - | - | - | - | 3560 | 1085 | 3560$^b$ | 1085 |  |
| 24 | D-39 | 43°25'01" | 104°00'[illegible]6" | 7-1-28Da | Kf | 600 | 183 | - | - | - | - | 3576 | 1090 | 3563 | 1083 |  |
| 23 | D-40 | 43°25'01" | 104°02'2[illegible]" | 7-1-29Db | Kf | 600 | 183 | - | - | 1 | .06 | 3590 | 1094 | 3580$^b$ | 1094 |  |
| 27 | D-41 | 43°23'30" | 104°00'[illegible]" | 7-1-33Dc | Kl | 600 | 183 | - | - | - | - | 3670 | 1119 | - | - |  |
| 26 | D-42 | 43°24'05" | 103°57'4[illegible]" | 7-1-35Ac | Kf | 350 | 107 | - | - | 1 | .06 | 3545 | 1081 | 3546$^b$ | 1081 |  |
| 88 | D-43 | 43°23'44" | 103°57'3[illegible]" | 7-1-35Da | Kf | 320 | 98 | - | - | - | - | 3555 | 1084 | 3545 | 1081 | Slight flow in 1969; no flow in 1976. |
| 8802 | D-44 | 43°23'37" | 103°57'22" | 7-1-35Dd | Kf | 320 | 98 | - | - | - | - | 3565 | 1084 | - | - | 1968 Flow, 15 gpm (.9 l/s); no flow in 1976. |
| 87 | D-45 | 43°23'10" | 103°58'2[illegible]" | 7-1-36Aa | Kf | 92 | 28 | - | - | 9 | .6 | 3500 | 1067 | 3504$^b$ | 1068 |  |
| 63 | D-46 | 43°23'55" | 103°55'3[illegible]" | 7-1-36Ca | Kf | 100 | 30 | - | - | 1.5 | .2 | 3535 | 1077 | 3536$^b$ | 1078 |  |
| 113 | E-1 | 43°28'08" | 103°55'[illegible]" | 7-2-5Ca | - | 40 | 12 | - | - | - | - | 3860 | 1177 | - | - |  |
| 114 | E-2 | 43°27'11" | 103°55'4[illegible]" | 7-2-7Cd | - | 365 | 111 | - | - | - | - | 3755 | 1145 | 3475 | 1059 |  |
| 506 | E-3 | 43°27'32" | 103°54'45" | 7-2-8Dc | Js | 470 | 143 | - | - | - | - | 3970 | 1210 | - | - | Unused. |
| 507 | E-4 | 43°25'57" | 103°55'33" | 7-2-19Ba | Kl | 145 | 44 | - | - | - | - | 3640 | 1109 | - | - |  |
| 35 | E-5 | 43°25'38" | 103°55'3[illegible]" | 7-2-19Ca | Kl | 148 | 45 | - | - | - | - | 3620 | 1103 | - | - | Flow rate in 1969, 2 gpm (.1 l/s); no flow in 1976;unused. |
| 508 | E-6 | 43°25'15" | 103°55'2[illegible]" | 7-2-19Dc | Kl | 255 | 78 | - | - | 10 | .6 | 3600 | 1097 | 3605$^b$ | 1099 |  |
| E-7 not in database → | E-7 | 43°25'11" | 103°55'[illegible]" | 7-2-30Aa | - | - | - | - | - | - | - | 3600 | 1097 | - | - |  |
| 36 | E-8 | 43°26'13" | 103°56'2[illegible]" | 7-2-30Db | Kl | 330 | 101 | - | - | 2 | .1 | 3530 | 1076 | 3530$^b$ | 1076 |  |
| 32 | E-9 | 43°24'27" | 103°55'5[illegible]" | 7-2-30Cc | Kf | 90 | 27 | - | - | 4 | - | 3522 | 1074 | 3522$^b$ | 1074 |  |
| 31 | E-10 | 43°24'07" | 103°55'52" | 7-2-31Bc | Kf | 104 | 32 | - | - | 1.3 | .08 | 3495 | 1065 | 3500$^b$ | 1067 |  |

# SOURCE C

# SOUTH DAKOTA WELL COMPLETION REPORTS

Hydro ID 2

1 of 1

7-1-16

# NOTICE OF WELL CONSTRUCTION

Feldkum

## (1) WELL CONSTRUCTION

Location of well: SE 1/4 SE 1/4 ________ Section 16 Township 7S Range 1E

Well owner Peterson & Son, Inc. (Name) Edgemont, SD (Address)

Date well drilling completed 11-17-81 Purpose of well Domestic (domestic, irrigation, municipal, industrial, other)

### WELL LOG

| Layers, top to top in feet | Description of layer |
|---|---|
| 0-380 | Blk Sh |
| 380-470 | lB gy clst & ss |
| 470-495 | Gy ss & clst |
| 495-565 | Gy, rd-brn & gn clst |
| 565-580 | Gy ss |
| 580-650 | Gy clst |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

Attach sheet if more space is needed

Depth to top of water producing aquifer 555

Depth to static water level flowing

Name of producing aquifer (if known) Lakota

Total depth of drill hole 650

Depth to bottom of casing 650

Casing information: In the space below show kind, size, weight, length and diameter, etc., for production casing and surface casing, if used.

4" blk iron 10#/ft

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

slotted 566-608
629-650

If a flowing well, flow of completed well 30

Silver King Mines, Inc.
Name of Drilling Contractor

## (2) PUMP INSTALLATION

Company name and size of pump ________ HP ________

Type of pump ________ Capacity of installed pump ________

Depth of pump placement ________ ft., Date of pump installation ________

## (3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter [illegible] WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ________ ft., tube diameter ________

tube material ________.

DEC 1981
[illegible]ON OF
[illegible]GHTS

________
Name of Pump Installation Contractor

Hydro ID 8

Form No. 4 JUN 16 1951

ARTESIAN WELL REPAIR

OFFICE OF STATE ENGINEER
PIERRE, S. DAK.

OFFICE OF STATE ENGINEER
Pierre, South Dakota

Well No. 24-6R (do not fill in)

Fall River COUNTY

Location SE of S¼ SW Section 23 Twp. 7S Range 1E

Owner J.E. Stewart Address Dickenson, N. Dak

Depth 240 Drawdown ______ Type Rig Used Repair

Flow (gpm) 2½ Pressure Strong Date Measured June 10, 1951

Grd. Elev. ______ Water Level Below Ground Surface ______

Temperature ______ Character Water (~~soft~~, medium, ~~hard~~)

|   |   |
|---|---|
|   |   |
| X |   |

Date Commenced June 6 Date Completed June 10

Bonded Driller H.P. Norbeck Address Redfield, S.D

Section 23

CASING DETAIL (old)

| Type | Size | Length | Depth |
|---|---|---|---|
| Blk Std | 2" | 240' | 240' |
|  |  |  |  |
|  |  |  |  |

PERFORATIONS

~~Type Size Length Depth~~

Perforations of WATER BEARING SANDS

From 160' To 165'

222' 227'

SOURCE OF INFORMATION

Norbeck Co. Report

Repaired by: H.P. Norbeck

Address Redfield

RECORD OF WELL AFTER REPAIR

Depth 237 Date Completed June 10, 1951

Flow (gpm) 2½ Date Measured June 10, 1951

Water Level Below Ground Surface ______

CASING DETAIL (new)

| Type | Size | Length | Depth |
|---|---|---|---|
| Std Csg | 3" | 31' | 37' |
| driven over old 2" with 600# hammer |  |  |  |
| "M" Copper tube | 1½" | 231' | 237' |

PERFORATIONS

| Type | Size | ~~Length~~ | ~~Depth~~ |
|---|---|---|---|
| Drilled | ¼" | 158' to | 168' |
|  |  | 220 | 230 |

Did you reach bottom on this well? No

If not, how far down did you get? 237'

What do you think caused this well to fail? 2" corroded out permitting water to come up outside

Do you believe the repair was successful? Very Well - flowed only 2 GPM when drilled - this is a Dakota Sandstone well about 2 mi from outc.

13 Recompletion

Fall River 1 of 1

# NOTICE OF WELL CONSTRUCTION

## (1) WELL CONSTRUCTION

Location of well: NW 1/4 NW 1/4 ______ Section 3 Township 7S Range 1E

Well owner Kathryn Spencer (Name) Dewey Route, Edgemont, SD 57735 (Address)

Date well drilling completed 10-22-80 Purpose of well Domestic (domestic, irrigation, municipal, industrial, other)

### WELL LOG

(Litho Log Footages)

| | Layers, top to top in feet | Description of layer |
|---|---|---|
| Ksc → | 0-320 | Dark gray shale |
| Kfu → | 320-395 | Gray mudstone with 10% gray siltstone |
| | 395-445 | Gray mudstone with 5%-20% gray vfgss |
| Klf → | 445-490 | Green mudstone |
| | 490-520 | AA w/10-30% G & GR Wt slst |
| | 520-545 | Gray fgss |
| | 545-560 | well cemented vf - fgss |
| | 560-575 | Gray mudstone with 10% dark brown mudstone |
| | 575-590 | AA with 10-20% gray vfgss |
| | 590-615 | Gray fine grain sandstone |
| | 615-620 | Green mudstone with <5% gray vfgss |
| | 620-625 | Green mudstone with 50% brown-red mudstone |
| | | |
| | | |

Attach sheet if more space is needed

Depth to top of water producing aquifer 580 ft.

Depth to static water level flows ft.

Name of producing aquifer (if known) Lakota

Total depth of drill hole 625 ft.

Depth to bottom of casing 580 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

5 1/2" 14 lbs/ft.

Random twenties

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

45 ft. open hole

If a flowing well, flow of completed well 1.00 G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

## (2) PUMP INSTALLATION

Company name and size of pump ______ HP ______

Type of pump ______ Capacity of installed pump ______ G.P.M.

Depth of pump placement ______ ft., Date of pump installation ______

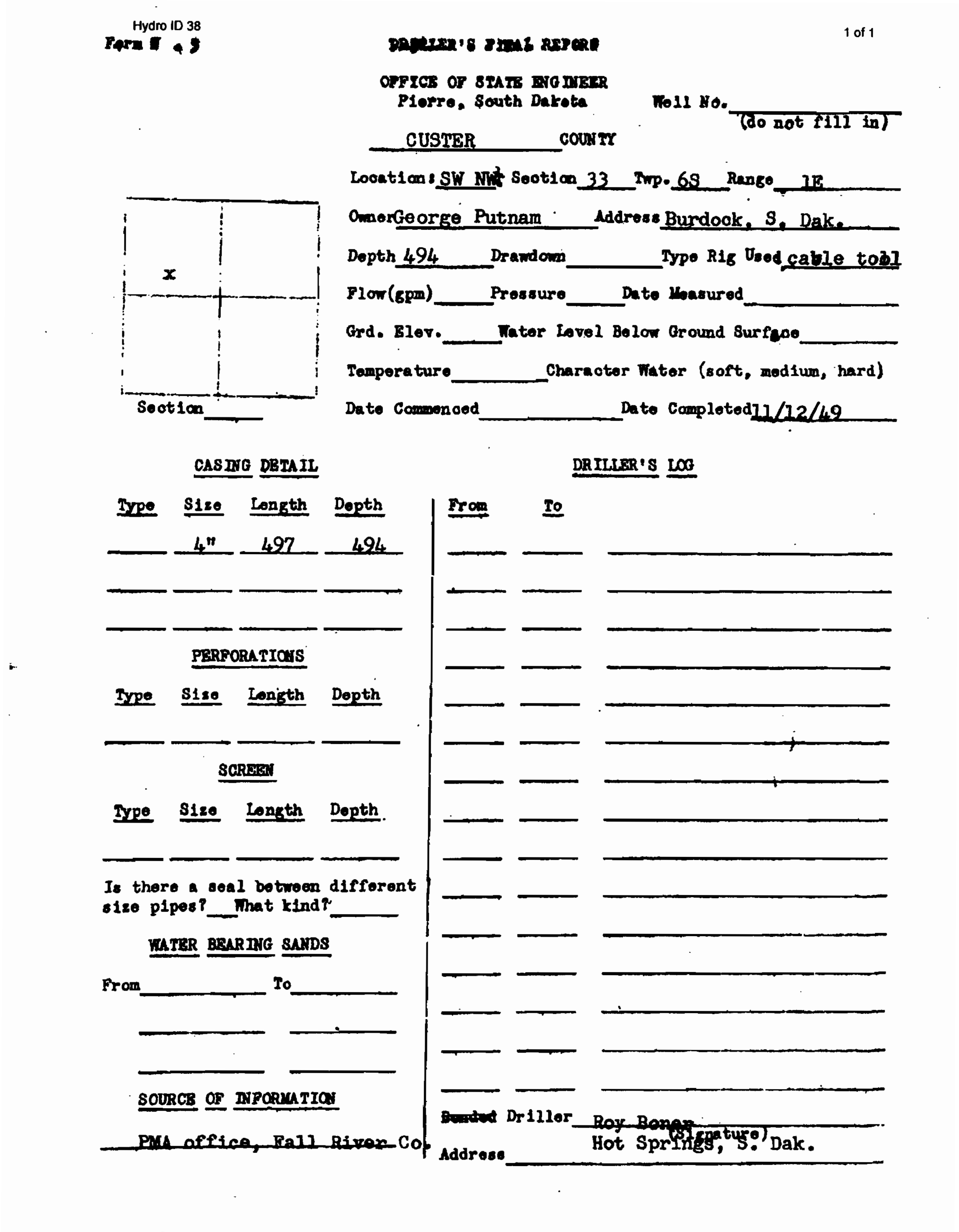
## (3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ______ ft., tube diameter ______,

tube material ______.

______
Name of Pump Installation Contractor



Hydro ID 38

Form # 4 5

1 of 1

## DRILLER'S FINAL REPORT

OFFICE OF STATE ENGINEER
Pierre, South Dakota

Well No. ____________ (do not fill in)

CUSTER COUNTY

Location: SW NW¼ Section 33 Twp. 6S Range 1E

x

Section ______

Owner George Putnam Address Burdock, S. Dak.

Depth 494 Drawdown ______ Type Rig Used cable tool

Flow(gpm) ______ Pressure ______ Date Measured ______

Grd. Elev. ______ Water Level Below Ground Surface ______

Temperature ______ Character Water (soft, medium, hard)

Date Commenced ______ Date Completed 11/12/49

### CASING DETAIL

| Type | Size | Length | Depth |
|---|---|---|---|
|  | 4" | 497 | 494 |

### PERFORATIONS

| Type | Size | Length | Depth |
|---|---|---|---|
|  |  |  |  |

### SCREEN

| Type | Size | Length | Depth |
|---|---|---|---|
|  |  |  |  |

Is there a seal between different size pipes? ___ What kind? ______

### WATER BEARING SANDS

From ______ To ______

### SOURCE OF INFORMATION

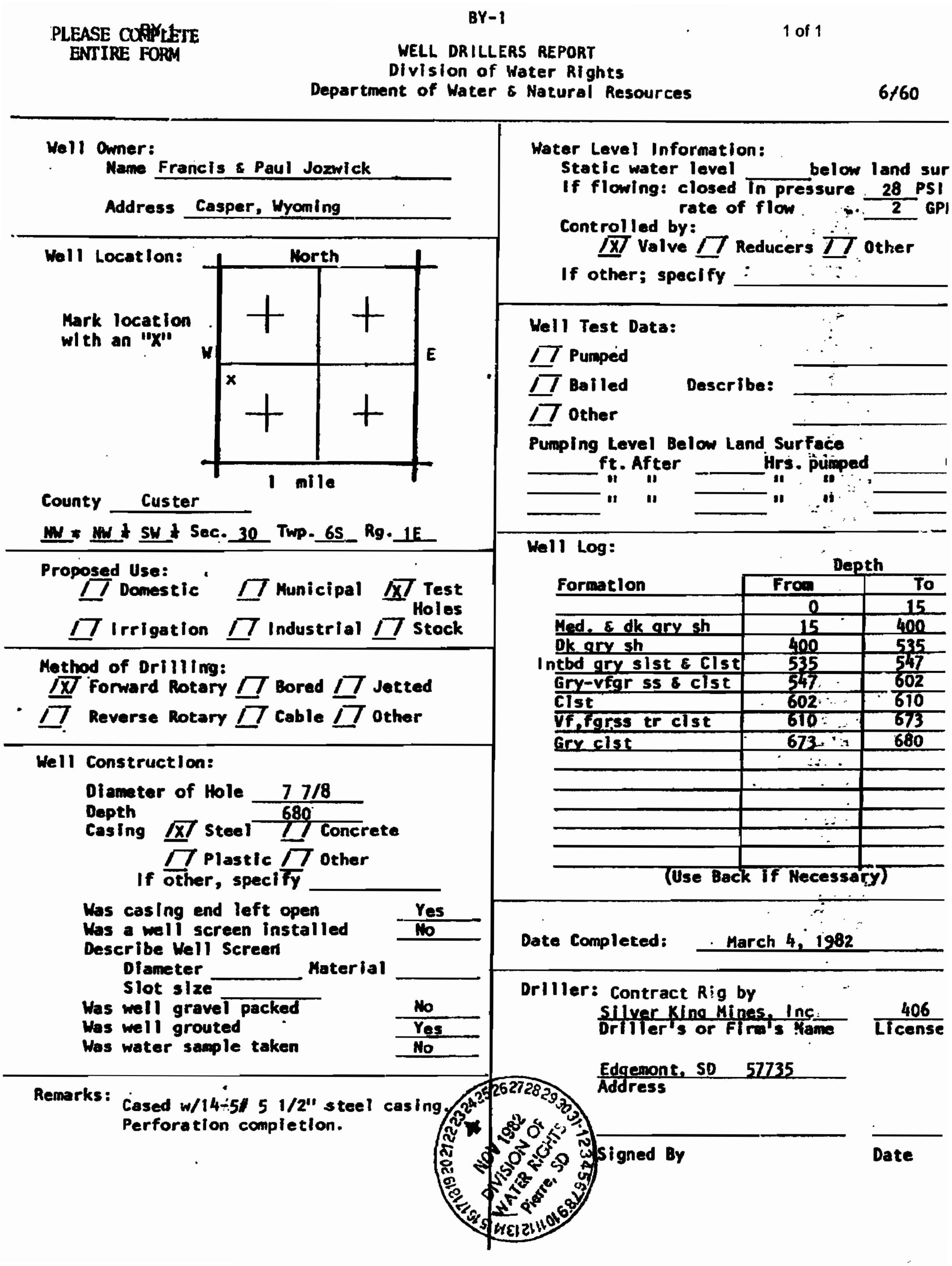
PMA office, Fall River Co.

### DRILLER'S LOG

| From | To |  |
|---|---|---|
|  |  |  |

~~Bonded~~ Driller Roy Bonen
(Signature)

Address Hot Springs, S. Dak.



BY-1

PLEASE COMPLETE ENTIRE FORM

1 of 1

## WELL DRILLERS REPORT
Division of Water Rights
Department of Water & Natural Resources

6/60

**Well Owner:**
Name Francis & Paul Jozwick
Address Casper, Wyoming

**Well Location:**

Mark location with an "X"

County Custer
NW ¼ NW ¼ SW ¼ Sec. 30 Twp. 6S Rg. 1E

**Proposed Use:**
☐ Domestic ☐ Municipal ☒ Test Holes
☐ Irrigation ☐ Industrial ☐ Stock

**Method of Drilling:**
☒ Forward Rotary ☐ Bored ☐ Jetted
☐ Reverse Rotary ☐ Cable ☐ Other

**Well Construction:**

Diameter of Hole 7 7/8
Depth 680
Casing ☒ Steel ☐ Concrete
☐ Plastic ☐ Other
If other, specify

| | |
|---|---|
| Was casing end left open | Yes |
| Was a well screen installed | No |
| Describe Well Screen | |
| Diameter | Material |
| Slot size | |
| Was well gravel packed | No |
| Was well grouted | Yes |
| Was water sample taken | No |

**Remarks:** Cased w/14-5# 5 1/2" steel casing. Perforation completion.

**Water Level Information:**
Static water level ______ below land sur
If flowing: closed in pressure 28 PSI
rate of flow 2 GPI
Controlled by:
☒ Valve ☐ Reducers ☐ Other
If other; specify

**Well Test Data:**
☐ Pumped
☐ Bailed Describe:
☐ Other

Pumping Level Below Land Surface
______ ft. After ______ Hrs. pumped ______
" " " "
" " " "

**Well Log:**

| Formation | Depth From | Depth To |
|---|---|---|
| | 0 | 15 |
| Med. & dk gry sh | 15 | 400 |
| Dk gry sh | 400 | 535 |
| Intbd gry slst & Clst | 535 | 547 |
| Gry-vfgr ss & clst | 547 | 602 |
| Clst | 602 | 610 |
| Vf,fgrss tr clst | 610 | 673 |
| Gry clst | 673 | 680 |

(Use Back if Necessary)

**Date Completed:** March 4, 1982

**Driller:** Contract Rig by
Silver King Mines, Inc. 406
Driller's or Firm's Name License

Edgemont, SD 57735
Address

Signed By Date

NOV 1982
DIVISION OF WATER RIGHTS
Pierre, SD

Possibly Hydro ID 42

SD EForm - 1623 V1

1 of 1

# SOUTH DAKOTA WELL REHABILITATION REPORT

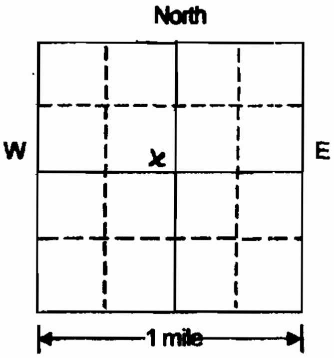
11-02

Location SE¼ NW¼ Sec 5 Twp 7S Rg 1E

County

FALL River

Please mark well location with an "X"



Rehabilitation Completion Date 11-15-09

Well owner:

Name PuTnam + PuTnam, LLP.

Address 778 CEdar ST.

City, State, Zip Dewey S.D. 57735-5011

Describe original construction if possible. (Attach original log if available), DRilled 1949 WEll DRilled 580', CASED 8" To 220' OPen HoLed To BoTTom

RECEIVED
JAN - 6 2010
WATER RIGHTS PROGRAM

PROPOSED USE:
☒ Domestic ☐ Municipal ☒ Stock
☐ Irrigation ☐ Industrial

Description of condition of well before rehabilitation:

CASing DeTeraTing Above and BeLow Ground

Description of rehabilitation work completed:

Swabbed Well For 310', PuT 4" PVC cassing SoLid For 280' 20' of Screen PuT ShaLe Packer aT 220' and TRimmy Line PResre GrouTed Back To SurFace Reduced casing To 1¼" and PuT on Ball Valve To control Well.

Recasing information: Material P.V.C. Diameter 4 Inches Depth 300 Feet

Describe screen or perforations .25 FacTory SloTTed Screen Location From 280 To 300

From ______ To ______

Grout: ☒ YES ☐ NO Describe grouting procedure and grout: PuT Trimmy Line To 220' to ShaLe Packer PResured 44 Bags CemenT Back To SurFace

Well Test Data: Specific capacity ______ Static water level FLowing

If a flowing well GPM 75 Shut in 10 PSI

This well rehabilitation was completed under license # 724 and this report is true and accurate.

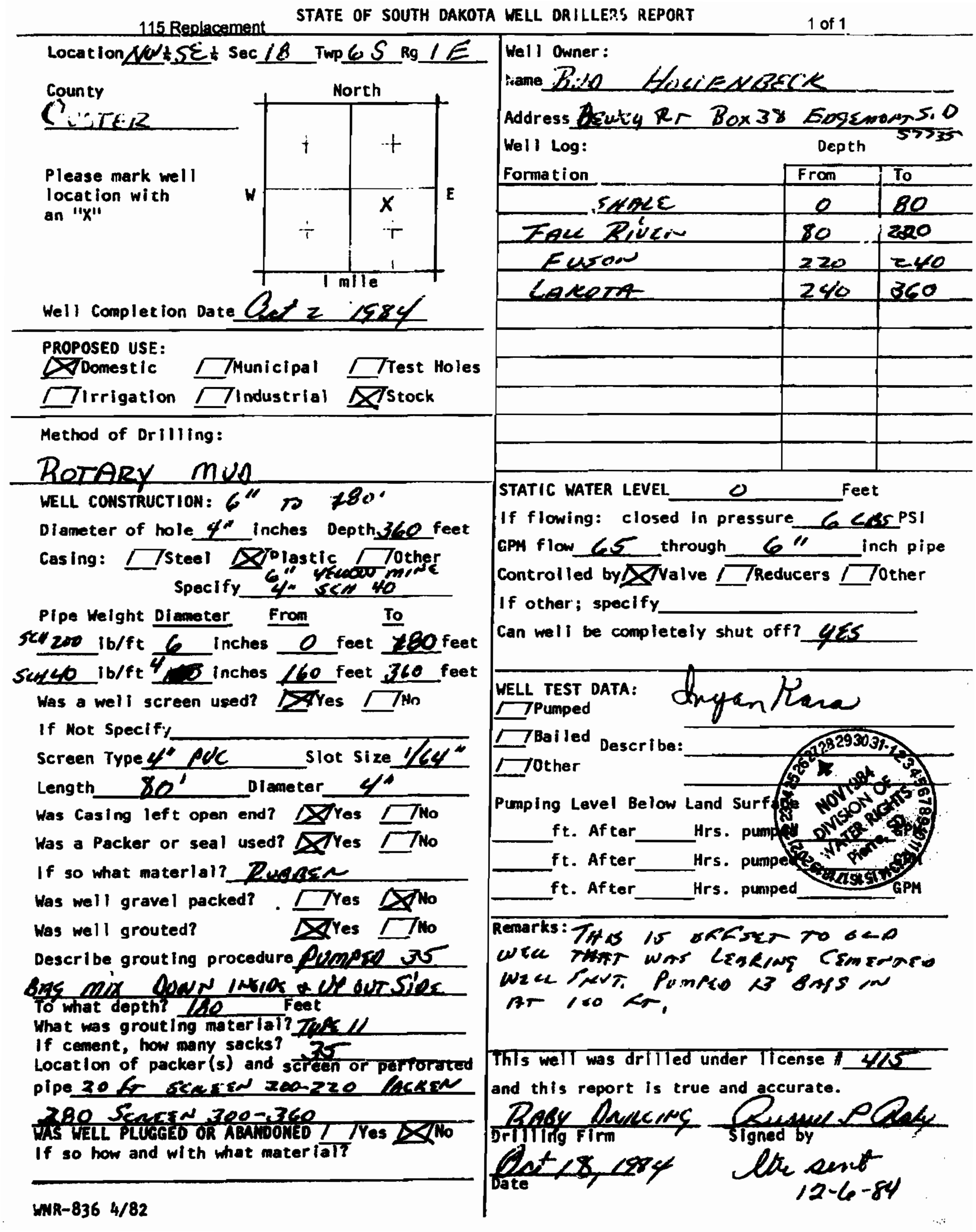
Drilling firm: J+M DRilling

Signature of Licensed Representative: Jim McNamara

Signature of Well Owner: Lloyd Putnam

Date: 1-4-2010

1-6-10



115 Replacement

## STATE OF SOUTH DAKOTA WELL DRILLERS REPORT

1 of 1

Location NW¼ SE¼ Sec 18 Twp 6 S Rg 1 E

County CUSTER

Please mark well location with an "X"

North / W / E / 1 mile

X

Well Completion Date Oct 2 1984

PROPOSED USE:
☒ Domestic ☐ Municipal ☐ Test Holes
☐ Irrigation ☐ Industrial ☒ Stock

Method of Drilling:

ROTARY MUD

WELL CONSTRUCTION: 6" TO 180'

Diameter of hole 4" inches Depth 360 feet

Casing: ☐ Steel ☒ Plastic ☐ Other
6" YELLOW MINE
Specify 4" SCH 40

| Pipe Weight | Diameter | From | To |
|---|---|---|---|
| SCH 200 lb/ft | 6 inches | 0 feet | 180 feet |
| SCH 40 lb/ft | 4 inches | 160 feet | 360 feet |

Was a well screen used? ☒ Yes ☐ No

If Not Specify

Screen Type 4" PVC Slot Size 1/64"

Length 80' Diameter 4"

Was Casing left open end? ☒ Yes ☐ No

Was a Packer or seal used? ☒ Yes ☐ No

If so what material? RUBBER

Was well gravel packed? ☐ Yes ☒ No

Was well grouted? ☒ Yes ☐ No

Describe grouting procedure PUMPED 35 BAG MIX DOWN INSIDE & UP OUTSIDE

To what depth? 180 Feet

What was grouting material? TYPE II

If cement, how many sacks? 35

Location of packer(s) and screen or perforated pipe 20 FT SCREEN 200-220 PACKER 280 SCREEN 300-360

WAS WELL PLUGGED OR ABANDONED ☐ Yes ☒ No

If so how and with what material?

WNR-836 4/82

Well Owner:

Name Bill HOLLENBECK

Address DEWEY RT BOX 38 EDGEMONT S.D 57735

Well Log:

| Formation | Depth From | Depth To |
|---|---|---|
| SHALE | 0 | 80 |
| FALL RIVER | 80 | 220 |
| FUSON | 220 | 240 |
| LAKOTA | 240 | 360 |

STATIC WATER LEVEL 0 Feet

If flowing: closed in pressure 6 LBS PSI

GPM flow 65 through 6" inch pipe

Controlled by ☒ Valve ☐ Reducers ☐ Other

If other; specify

Can well be completely shut off? YES

WELL TEST DATA: Inyan Kara
☐ Pumped
☐ Bailed Describe:
☐ Other

Pumping Level Below Land Surface

___ ft. After ___ Hrs. pumped ___ GPM
___ ft. After ___ Hrs. pumped ___ GPM
___ ft. After ___ Hrs. pumped ___ GPM

NOV 1984
DIVISION OF WATER RIGHTS
Pierre, SD

Remarks: THIS IS OFFSET TO OLD WELL THAT WAS LEAKING CEMENTED WELL SHUT. PUMPED 13 BAGS IN AT 160 FT.

This well was drilled under license # 415 and this report is true and accurate.

BABY DRILLING Russell P Baby
Drilling Firm Signed by

Oct 18, 1984
Date

Ltr sent 12-6-84

HAM-4

PLEASE COMPLETE
ENTIRE FORM

Hydro ID 147

1 of 1

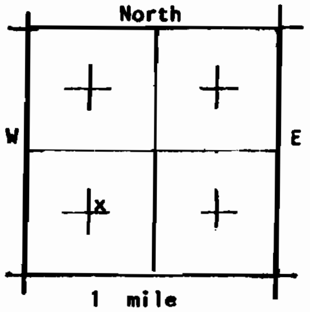
WELL DRILLERS REPORT
Division of Water Rights
Department of Water & Natural Resources

6/60

**Well Owner:**
Name Tennessee Valley Authority
Address

**Well Location:**

Mark location with an "X"



County Custer

SW ¼ NE ¼ SW ¼ Sec. 17 Twp. 6S Rg. 1E

**Proposed Use:**
☐ Domestic ☐ Municipal ☒ Test Holes
☐ Irrigation ☐ Industrial ☐ Stock

**Method of Drilling:**
☒ Forward Rotary ☐ Bored ☐ Jetted
☐ Reverse Rotary ☐ Cable ☐ Other

**Well Construction:**
Diameter of Hole 6 1/8
Depth 750
Casing ☒ Steel ☐ Concrete
☐ Plastic ☐ Other
If other, specify

| | |
|---|---|
| Was casing end left open | Yes |
| Was a well screen installed | No |
| Describe Well Screen | |
| Diameter | |
| Material | |
| Slot size | |
| Was well gravel packed | No |
| Was well grouted | Yes |
| Was water sample taken | No |

**Remarks:** Cased w/.219 wall 4 1/2" steel casing.
Open hole completion.

NOV 1982
DIVISION OF WATER RIGHTS
Pierre, SD

**Water Level Information:**
Static water level 34' below land surface
If flowing: closed in pressure PSI
rate of flow GPM
Controlled by:
☐ Valve ☐ Reducers ☐ Other
If other; specify

**Well Test Data:**
☐ Pumped
☐ Bailed Describe:
☐ Other

Pumping Level Below Land Surface
ft. After Hrs. pumped GPM
" " " " "
" " " " "

**Well Log:**

| Formation | Depth From | Depth To |
|---|---|---|
| Alluvium | 0 | 33 |
| Gry shale | 33 | 403 |
| Intbd gry sltst & sh | 403 | 416 |
| Intbd gry vfgr ss & clst | 416 | 485 |
| Br fgr ss | 485 | 507 |
| Gr & rd vfgrss & gry clst | 507 | 550 |
| Rd f,mgrss | 550 | 576 |
| Dr brn clst | 576 | 585 |
| Rd mgrss | 585 | 596 |
| Intbd gry, brn clst & gry slst | 596 | 651 |
| lt ortn f,mge'ss | 561 | 693 |
| brn clst | 693 | 695 |
| O: f, m, cgr ss | 695 | 742 |
| gry clst | 742 | 750 |

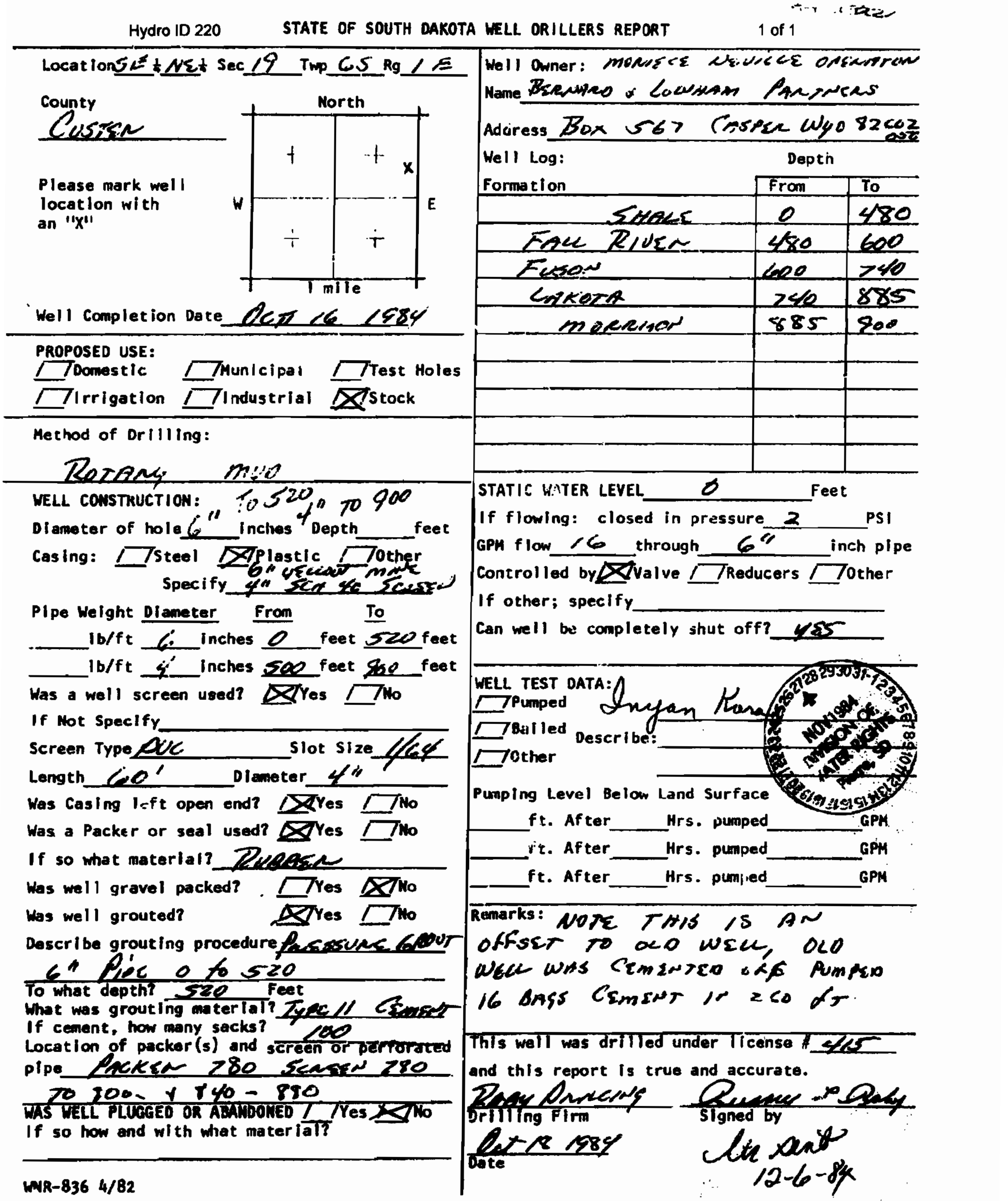
(Use Back if Necessary)

Date Completed: February 9, 1982

**Driller:**
Silver King Mines, Inc. — Driller's or Firm's Name
405 — License NO.
Edgemont, SD 57735 — Address

Signed By

Date



Hydro ID 220

## STATE OF SOUTH DAKOTA WELL DRILLERS REPORT

1 of 1

Location SE ¼ NE ¼ Sec 19 Twp 6S Rg 1E

County Custer

Please mark well location with an "X"

Well Completion Date Oct 16 1984

PROPOSED USE:
☐ Domestic ☐ Municipal ☐ Test Holes
☐ Irrigation ☐ Industrial ☒ Stock

Method of Drilling:
Rotary mud

WELL CONSTRUCTION: to 520 4" to 900
Diameter of hole 6" inches Depth ___ feet
Casing: ☐ Steel ☒ Plastic ☐ Other
Specify 6" Yellow Mine 4" SCH 40 Screen

| Pipe Weight | Diameter | From | To |
|---|---|---|---|
| ___ lb/ft | 6 inches | 0 feet | 520 feet |
| ___ lb/ft | 4' inches | 500 feet | 960 feet |

Was a well screen used? ☒ Yes ☐ No
If Not Specify ___
Screen Type PVC Slot Size 1/64
Length 60' Diameter 4"
Was Casing left open end? ☒ Yes ☐ No
Was a Packer or seal used? ☒ Yes ☐ No
If so what material? Rubber
Was well gravel packed? ☐ Yes ☒ No
Was well grouted? ☒ Yes ☐ No
Describe grouting procedure Pressure Grout 6" Pipe 0 to 520
To what depth? 520 Feet
What was grouting material? Type II Cement
If cement, how many sacks? 100
Location of packer(s) and screen or perforated pipe Packer 780 Screen 780 to 300 + 840 - 880
WAS WELL PLUGGED OR ABANDONED ☐ Yes ☒ No
If so how and with what material? ___

WNR-836 4/82

Well Owner: Moriece Neuville Operation
Name Bernard & Lowham Partners
Address Box 567 Casper Wyo 82602

Well Log:

| Formation | Depth From | Depth To |
|---|---|---|
| Shale | 0 | 480 |
| Fall River | 480 | 600 |
| Fuson | 600 | 740 |
| Lakota | 740 | 885 |
| Morrison | 885 | 900 |

STATIC WATER LEVEL 0 Feet
If flowing: closed in pressure 2 PSI
GPM flow 16 through 6" inch pipe
Controlled by ☒ Valve ☐ Reducers ☐ Other
If other; specify ___
Can well be completely shut off? Yes

WELL TEST DATA: Inyan Kara
☐ Pumped
☐ Bailed Describe:
☐ Other

NOV 1984
DIVISION OF WATER RIGHTS

Pumping Level Below Land Surface
___ ft. After ___ Hrs. pumped ___ GPM
___ ft. After ___ Hrs. pumped ___ GPM
___ ft. After ___ Hrs. pumped ___ GPM

Remarks: Note this is an offset to old well, old well was cemented and pumped 16 bags cement in 200 ft.

This well was drilled under license # 415 and this report is true and accurate.

Rosy Drilling
Drilling Firm

Signed by

Oct 12 1984
Date

12-6-84

Hydro ID 436

1 of 1

# NOTICE OF WELL CONSTRUCTION

Custer

## ) WELL CONSTRUCTION

Location of well: NW 1/4 NE 1/4 Section 20 Township 6S Range 1E

Well owner Tennessee Valley Authority (Name) (Address)

Date well drilling completed 8-18-81 Purpose of well Observation (domestic, irrigation, municipal, industrial, other)

### WELL LOG

| Layers, top to top in feet | Description of layer |
|---|---|
| 0-430 | Blk sh |
| 430-495 | 18 gy clst & ss |
| 495-520 | Ln & brn ss |
| 520-530 | Gy & brn-gy clst |
| 530-545 | Rd-brn & tn ss |
| 545-565 | Rd-ppl clst |
| 565-590 | Pk, tn & brn ss |
| | |
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Attach sheet if more space is needed

Depth to top of water producing aquifer 505 ft.

Depth to static water level 21.0 ft.

Name of producing aquifer (if known) Fall River

Total depth of drill hole 590 ft.

Depth to bottom of casing 505 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4" blk iron 10#/ft

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

open hole 505-590

If a flowing well, flow of completed well NA G.P.M.

Silver King Mines, Inc.

Name of Drilling Contractor

## (2) PUMP INSTALLATION

Company name and size of pump ______ HP ______

Type of pump ______ Capacity of installed pump ______ G.P.M.

Depth of pump placement ______ ft., Date of pump installation ______

## (3) WATER SURFACE MEASURING TUBE

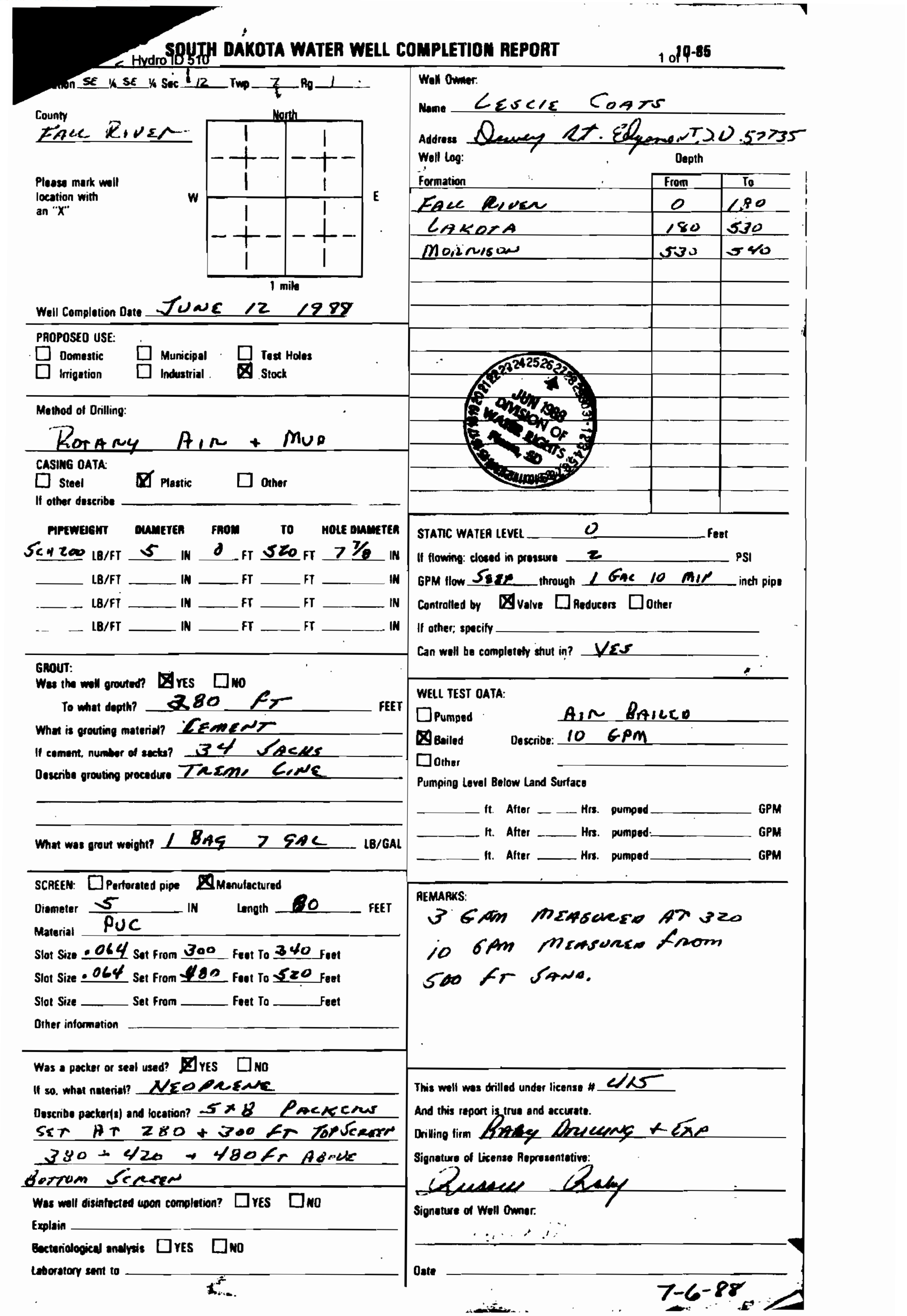
On some wells an air-tight water surface measuring tube is required: See Section 46.409 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ______ ft., tube diameter ______

tube material ______.

Name of Pump Installation Contractor

DEC 1981
DIVISION OF WATER RIGHTS
Pierre, SD



Hydro ID 510

## SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 10-85

tion SE ¼ SE ¼ Sec 12 Twp 7 Rg 1

County FALL RIVER

Please mark well location with an "X"

North / W / E / 1 mile

Well Completion Date JUNE 12 1988

PROPOSED USE:
☐ Domestic ☐ Municipal ☐ Test Holes
☐ Irrigation ☐ Industrial ☒ Stock

Method of Drilling: ROTARY AIR + MUD

CASING DATA:
☐ Steel ☒ Plastic ☐ Other
If other describe

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| SCH 200 LB/FT | 5 IN | 0 FT | 520 FT | 7 7/8 IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

GROUT:
Was the well grouted? ☒ YES ☐ NO
To what depth? 280 FT FEET
What is grouting material? CEMENT
If cement, number of sacks? 34 SACKS
Describe grouting procedure TREMI LINE
What was grout weight? 1 BAG 7 GAL LB/GAL

SCREEN: ☐ Perforated pipe ☒ Manufactured
Diameter 5 IN Length 80 FEET
Material PVC
Slot Size .064 Set From 300 Feet To 340 Feet
Slot Size .064 Set From 480 Feet To 520 Feet
Slot Size Set From Feet To Feet
Other information

Was a packer or seal used? ☒ YES ☐ NO
If so, what material? NEOPRENE
Describe packer(s) and location? 5 x 8 PACKERS SET AT 280 + 300 FT TOP SCREEN 380 + 420 + 480 FT ABOVE BOTTOM SCREEN

Was well disinfected upon completion? ☐ YES ☐ NO
Explain
Bacteriological analysis ☐ YES ☐ NO
Laboratory sent to

Well Owner:
Name LESLIE COATS
Address Dewey Rt. Edgemont, SD 57735

Well Log:

| Formation | Depth From | Depth To |
|---|---|---|
| FALL RIVER | 0 | 180 |
| LAKOTA | 180 | 530 |
| MORRISON | 530 | 540 |

JUN 1988
DIVISION OF WATER RIGHTS
Pierre, SD

STATIC WATER LEVEL 0 Feet
If flowing: closed in pressure 2 PSI
GPM flow SEEP through 1 GAL 10 MIN inch pipe
Controlled by ☒ Valve ☐ Reducers ☐ Other
If other; specify
Can well be completely shut in? YES

WELL TEST DATA:
☐ Pumped AIR BAILED
☒ Bailed Describe: 10 GPM
☐ Other

Pumping Level Below Land Surface
ft. After Hrs. pumped GPM
ft. After Hrs. pumped GPM
ft. After Hrs. pumped GPM

REMARKS:
3 GPM MEASURED AT 320
10 GPM MEASURED FROM
500 FT SAND.

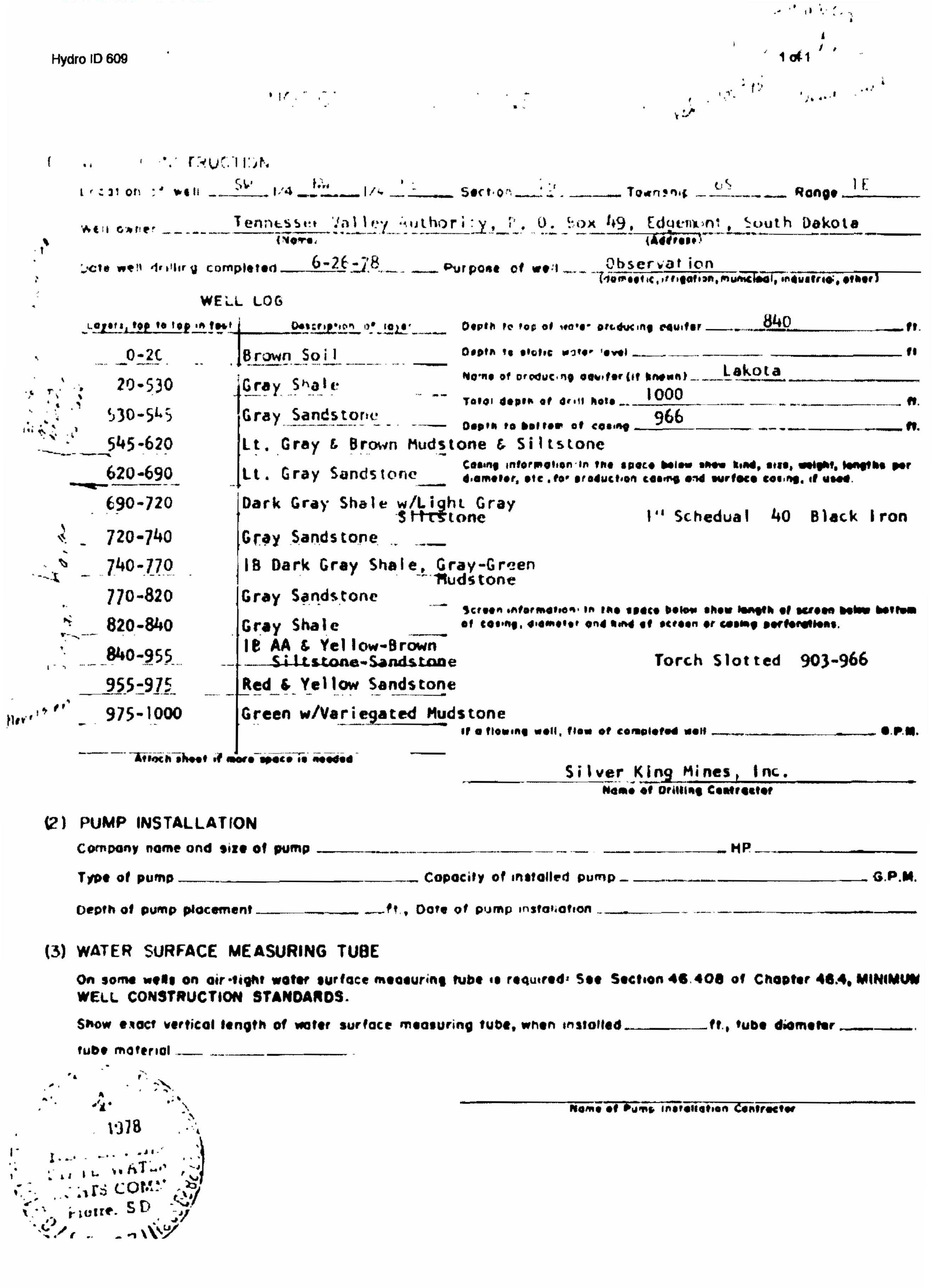
This well was drilled under license # 415
And this report is true and accurate.
Drilling firm Raby Drilling + Exp
Signature of License Representative:
Russell Raby
Signature of Well Owner:

Date

7-6-88

Hydro ID 609

1 of 1



(1) WELL CONSTRUCTION

Location of well SW 1/4 [illegible] 1/4 [illegible] Section [illegible] Township 6S Range 1E

Well owner Tennessee Valley Authority, P. O. Box 49, Edgemont, South Dakota
(Name) (Address)

Date well drilling completed 6-26-78 Purpose of well Observation
(domestic, irrigation, municipal, industrial, other)

WELL LOG

| Layers, top to top in feet | Description of layer |
|---|---|
| 0-20 | Brown Soil |
| 20-530 | Gray Shale |
| 530-545 | Gray Sandstone |
| 545-620 | Lt. Gray & Brown Mudstone & Siltstone |
| 620-690 | Lt. Gray Sandstone |
| 690-720 | Dark Gray Shale w/Light Gray Siltstone |
| 720-740 | Gray Sandstone |
| 740-770 | IB Dark Gray Shale, Gray-Green Mudstone |
| 770-820 | Gray Sandstone |
| 820-840 | Gray Shale |
| 840-955 | IB AA & Yellow-Brown Siltstone-Sandstone |
| 955-975 | Red & Yellow Sandstone |
| 975-1000 | Green w/Variegated Mudstone |

Attach sheet if more space is needed

Depth to top of water producing aquifer 840 ft.

Depth to static water level ft.

Name of producing aquifer (if known) Lakota

Total depth of drill hole 1000 ft.

Depth to bottom of casing 966 ft.

Casing information in the space below show kind, size, weight, lengths per diameter, etc. for production casing and surface casing, if used.

1" Schedual 40 Black Iron

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

Torch Slotted 903-966

If a flowing well, flow of completed well G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump HP

Type of pump Capacity of installed pump G.P.M.

Depth of pump placement ft., Date of pump installation

(3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ft., tube diameter

tube material

Name of Pump Installation Contractor

1978
WATER RIGHTS COMM
Pierre, SD

Hydro ID 610

1 of 2

[illegible] 1/4 [illegible] 1/4 [illegible] Section 21 Township 6 Range 1E

Well owner Tennessee Valley Authority, P.O. Box 49, Edgemont, South Dakota
(Name) (Address)

Date well drilling completed 6-27-78 Purpose of well Observation
(domestic, irrigation, municipal, industrial, other)

WELL LOG

| Layers, top to top in feet | Description of layer |
|---|---|
| 0-20 | Brown Sandy Soil |
| 20-540 | Gray Shale |
| 540-605 | Gray Siltstone |
| 605-680 | LB Gray Sandstone & Gray Shale |

Attach sheet if more space is needed

Depth to top of water producing aquifer 605 ft

Depth to static water level ft

Name of producing aquifer (if known) Fall River

Total depth of drill hole 680 ft

Depth to bottom of casing 672 ft

Casing information in the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used

1" Schedual 40 Black Iron

Screen information: in the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

Torch Slotted 630-672

If a flowing well, flow of completed well G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

## (2) PUMP INSTALLATION

Company name and size of pump HP

Type of pump Capacity of installed pump G.P.M.

Depth of pump placement ft, Date of pump installation

## (3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required. See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ft., tube diameter

tube material

Name of Pump Installation Contractor

1978
WATER
RIGHTS COMM

Hydro ID 610
BPZ-21 FR

2 of 2

# NOTICE OF WELL CONSTRUCTION

## (1) WELL CONSTRUCTION

Location of well: SW 1/4 NW 1/4 NE Section 29 Township 6S Range 1E

Well owner: Tennessee Valley Authority, P.O. Box 49, Edgemont, South Dakota (Name) (Address)

Date well drilling completed 6-27-78 Purpose of well Observation (domestic, irrigation, municipal, industrial, other)

### WELL LOG

| Layers, top to top in feet | Description of layer |
|---|---|
| 0-20 | Brown Sandy Soil |
| 20-540 | Gray Shale |
| 540-605 | Gray Siltstone |
| 605-680 | IB Gray Sandstone & Gray Shale |

Attach sheet if more space is needed

Depth to top of water producing aquifer 605 ft.

Depth to static water level ______ ft.

Name of producing aquifer (if known) Fall River

Total depth of drill hole 680 ft.

Depth to bottom of casing 672 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

1" Schedual 40 Black Iron

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

Torch Slotted 630-672

If a flowing well, flow of completed well ______ G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

## (2) PUMP INSTALLATION

Company name and size of pump ______ HP ______

Type of pump ______ Capacity of installed pump ______ G.P.M.

Depth of pump placement ______ ft., Date of pump installation ______

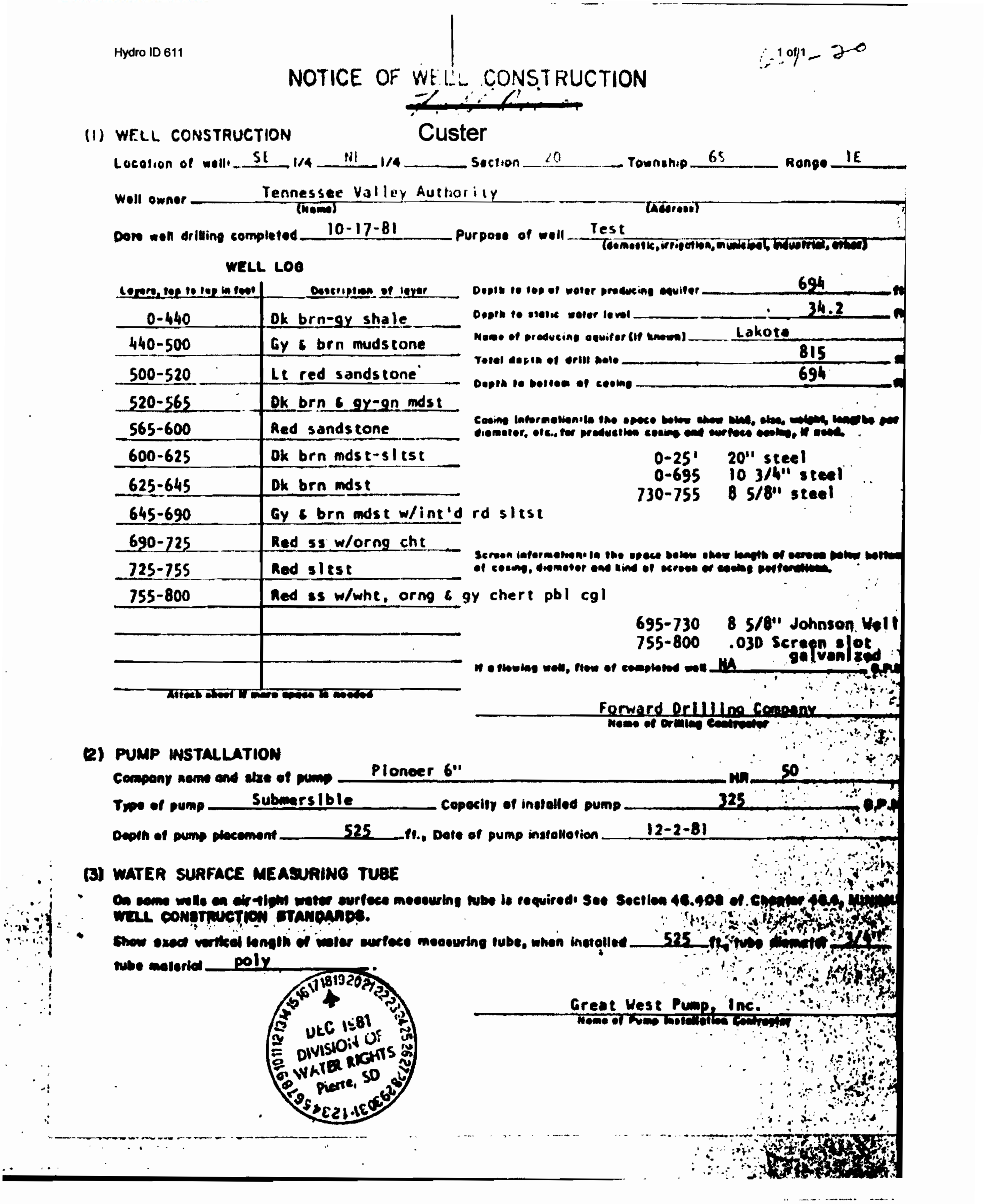
## (3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ______ ft., tube diameter ______,

tube material ______

______
Name of Pump Installation Contractor



Hydro ID 611

1 of 1

# NOTICE OF WELL CONSTRUCTION

## (1) WELL CONSTRUCTION

Custer

Location of well: SE 1/4 NE 1/4 Section 20 Township 6S Range 1E

Well owner Tennessee Valley Authority (Name) (Address)

Date well drilling completed 10-17-81 Purpose of well Test (domestic, irrigation, municipal, industrial, other)

**WELL LOG**

| Layers, top to top in feet | Description of layer |
|---|---|
| 0-440 | Dk brn-gy shale |
| 440-500 | Gy & brn mudstone |
| 500-520 | Lt red sandstone |
| 520-565 | Dk brn & gy-gn mdst |
| 565-600 | Red sandstone |
| 600-625 | Dk brn mdst-sltst |
| 625-645 | Dk brn mdst |
| 645-690 | Gy & brn mdst w/int'd rd sltst |
| 690-725 | Red ss w/orng cht |
| 725-755 | Red sltst |
| 755-800 | Red ss w/wht, orng & gy chert pbl cgl |

Attach sheet if more space is needed

Depth to top of water producing aquifer 694 ft

Depth to static water level 34.2 ft

Name of producing aquifer (if known) Lakota

Total depth of drill hole 815 ft

Depth to bottom of casing 694 ft

Casing information: In the space below show kind, size, weight, length per diameter, etc., for production casing and surface casing, if used.

0-25' 20" steel
0-695 10 3/4" steel
730-755 8 5/8" steel

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

695-730 8 5/8" Johnson Well
755-800 .030 Screen slot galvanized

If a flowing well, flow of completed well NA G.P.M.

Forward Drilling Company
Name of Drilling Contractor

## (2) PUMP INSTALLATION

Company name and size of pump Pioneer 6" HP 50

Type of pump Submersible Capacity of installed pump 325 G.P.M.

Depth of pump placement 525 ft., Date of pump installation 12-2-81

## (3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed 525 ft., tube diameter 3/4"

tube material poly

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Pierre, SD

Great West Pump, Inc.
Name of Pump Installation Contractor

1 of 1

Hydro ID 612

# NOTICE OF WELL CONSTRUCTION

## (1) WELL CONSTRUCTION

Custer

Location of well: SE 1/4 NE 1/4 ____ 1/4 Section 20 Township 6S Range 1E

Well owner Tennessee Valley Authority (Name) ____ (Address)

Date well drilling completed 8-14-81 Purpose of well Observation (domestic, irrigation, municipal, industrial, other)

### WELL LOG

| Layers, top to top in feet | Description of layer |
|---|---|
| 0-425 | Blk sh |
| 425-495 | lB gy clst & ss |
| 495-505 | Rd & brn ss |
| 505-525 | Gy clst |
| 525-530 | Rd & orng -brn clst |
| 530-545 | Brn & rd-brn ss |
| 545-555 | Gy & wht sltst w/fy-gn clst |
| 555-585 | Orng, rd & brn ss |
| 585-610 | Gy-wht sltst w/gn clst |
| 610-640 | Tn-gy ss |
| 640-650 | Gy clst & gy wht sltst |
| 650-700 | Gy & gn clst |
| 700-730 | Tn, orng & rd-brn ss |
| 730-745 | lB Gy ss & sltst |

Attach sheet if more space is needed

| 745-800 | Tn-brn ss |
|---|---|

Depth to top of water producing aquifer 692

Depth to static water level 26.6

Name of producing aquifer (if known) Lakota

Total depth of drill hole 800

Depth to bottom of casing 692

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4" blk Iron 10#/ft

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

open hole 692-800

If a flowing well, flow of completed well NA G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

## (2) PUMP INSTALLATION

Company name and size of pump ____ HP.

Type of pump ____ Capacity of installed pump ____ G.P.M.

Depth of pump placement ____ ft., Date of pump installation ____

## (3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ____ ft., tube diameter ____

tube material ____.

____
Name of Pump Installation Contractor

DEC 1981
DIVISION OF WATER RIGHTS

Hydro ID 613

1 of 1

# NOTICE OF WELL CONSTRUCTION

Custer

## (1) WELL CONSTRUCTION

Location of well: SE 1/4 NE 1/4 ______ Section 2[illegible] Township 6S Range 1F

Well owner Tennessee Valley Authority (Name) ______ (Address)

Date well drilling completed 8-14-81 Purpose of well Observation (domestic, irrigation, municipal, industrial, other)

### WELL LOG

| Layers, top to top in feet | Description of layer |
|---|---|
| 0-430 | Blk sh |
| 430-510 | lB gy clst & ss |
| 510-600 | Tn-gy & rd-brn ss w/ gy, gn & rd clst |

Attach sheet if more space is needed

Depth to top of water producing aquifer 504

Depth to static water level · 26.2

Name of producing aquifer (if known) Fall River

Total depth of drill hole 580

Depth to bottom of casing 504

Casing information: In the space below show kind, size, weight, length per diameter, etc., for production casing and surface casing, if used.

4" blk iron 10#/ft

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

open hole 504-580

If a flowing well, flow of completed well NA

Silver King Mines, Inc.
Name of Drilling Contractor

## (2) PUMP INSTALLATION

Company name and size of pump ______ HP

Type of pump ______ Capacity of installed pump ______

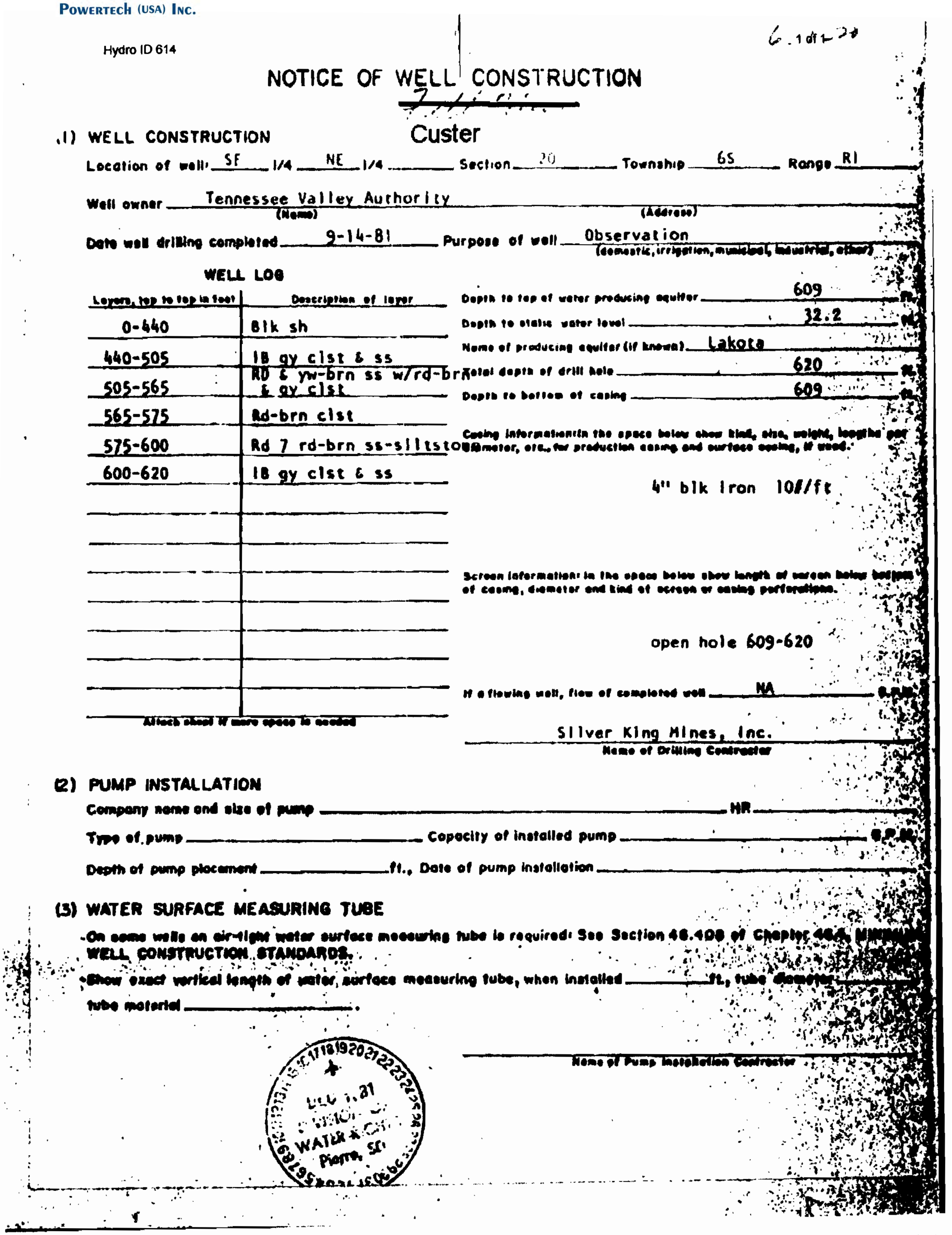
Depth of pump placement ______ ft., Date of pump installation ______

## (3) WATER SURFACE MEASURING TUBE

- On some wells an air-tight water surface measuring tube is required: See Section 46,408 of Chapter [illegible] WELL CONSTRUCTION STANDARDS.
- Show exact vertical length of water surface measuring tube, when installed ______ ft. [illegible] tube material ______.

______
Name of Pump Installation Company

DEC 1981
DIVISION OF WATER RIGHTS
Pierre, SD



6 . 1 of 1-28

# NOTICE OF WELL CONSTRUCTION

## (1) WELL CONSTRUCTION

Custer

Location of well: SE 1/4 NE 1/4 ______ Section 20 Township 6S Range R1

Well owner Tennessee Valley Authority (Name) ______ (Address)

Date well drilling completed 9-14-81 Purpose of well Observation (domestic, irrigation, municipal, industrial, other)

WELL LOG

| Layers, top to top in feet | Description of layer |
|---|---|
| 0-440 | Blk sh |
| 440-505 | 1B gy clst & ss |
| 505-565 | RD & yw-brn ss w/rd-br & gy clst |
| 565-575 | Rd-brn clst |
| 575-600 | Rd 7 rd-brn ss-siltsto |
| 600-620 | 1B gy clst & ss |
| | |
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Attach sheet if more space is needed

Depth to top of water producing aquifer 609 ft.

Depth to static water level 32.2 ft.

Name of producing aquifer (if known) Lakota

Total depth of drill hole 620 ft.

Depth to bottom of casing 609 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4" blk iron 10#/ft

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

open hole 609-620

If a flowing well, flow of completed well NA G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

## (2) PUMP INSTALLATION

Company name and size of pump ______ HP ______

Type of pump ______ Capacity of installed pump ______ G.P.M.

Depth of pump placement ______ ft., Date of pump installation ______

## (3) WATER SURFACE MEASURING TUBE

- On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.
- Show exact vertical length of water surface measuring tube, when installed ______ ft., tube diameter ______

tube material ______.

DEC 1, 81
WATER
Pierre, SD

______
Name of Pump Installation Contractor

Hydro ID 615

1 of 1

# NOTICE OF WELL CONSTRUCTION

## 1) WELL CONSTRUCTION

Custer

Location of well: SE 1/4 NE 1/4 ______ Section 20 Township 6S Range 1E

Well owner Tennessee Valley Authority (Name) ______ (Address)

Date well drilling completed 8-13-81 Purpose of well Observation (domestic, irrigation, municipal, industrial, other)

### WELL LOG

| Layers, top to top in feet | Description of layer |
|---|---|
| 0-435 | Blk sh |
| 435-505 | Intbd gy clst, ss |
| 505-525 | Lt tn & brn ss |
| 525-550 | IB gy clst-ss |
| 550-590 | IB rd brn & gy sltst & clst |
| 590-600 | Rd & brn ss |
| 600-620 | IB gy-gn & rd-brn sltst & clst |
| 620-645 | Gy-wht sltst |
| 645-685 | IB gy-wht sltst & pk sltst |
| 685-695 | Pk & brn ss w/gy clst |
| 695-800 | Brn, orng, tn, pk, rd & yw ss |
| | |
| | |
| | |

Attach sheet if more space is needed

Depth to top of water producing aquifer 712 ft.

Depth to static water level 39.7 ft.

Name of producing aquifer (if known) Lakota

Total depth of drill hole 800 ft.

Depth to bottom of casing 712 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4" blk Iron 10#/ft

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

open hole 712-800

If a flowing well, flow of completed well NA G.P.M.

Silver King Mines, Inc.

Name of Drilling Contractor

## (2) PUMP INSTALLATION

Company name and size of pump ______ HP ______

Type of pump ______ Capacity of installed pump ______ G.P.M.

Depth of pump placement ______ ft., Date of pump installation ______

## (3) WATER SURFACE MEASURING TUBE

- On some wells an air-tight water surface measuring tube is required. See Section 46.408 of Chapter [illegible], MINIMUM WELL CONSTRUCTION STANDARDS.
- Show exact vertical length of water surface measuring tube, when installed ______ ft., tube diameter ______ tube material ______.

DEC 1981
DIVISION OF WATER RIGHTS
Pierre, SD

______
Name of Pump Installation Contractor

Hydro ID 616

1 of 1

# NOTICE OF WELL CONSTRUCTION

~~Fall River~~

CUSTER

## 1) WELL CONSTRUCTION

Location of well: SE 1/4 NE 1/4 ________ Section 20 Township 6S Range R1

Well owner Tennessee Valley Authority (Name) ________ (Address)

Date well drilling completed 9-15-81 Purpose of well Observation (domestic, irrigation, municipal, industrial, other)

### WELL LOG

| Layers, top to top in feet | Description of layer |
|---|---|
| 0-465 | Blk sh |
| 465-530 | lB gy clst & ss |
| 530-550 | Rd & yw-brn ss |
| 550-605 | lB gn sltst & gn-gy clst |
| 605-645 | Gy clst w/gy-wht sltst |
| 645-680 | Gy ss |
| 680-720 | Gy w/gn clst |
| 720-760 | lB rd & yw-brn ss, gy sltst & rd-brn & brngy clst |
| 760-835 | Tn ss |
| | |
| | |
| | |
| | |
| | |

Attach sheet if more space is needed

Depth to top of water producing aquifer 735 ft.

Depth to static water level 45.8 ft.

Name of producing aquifer (if known) Lakota

Total depth of drill hole 835 ft.

Depth to bottom of casing 735 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4" blk iron 10#/ft

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

open hole 735-835

If a flowing well, flow of completed well NA G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

## (2) PUMP INSTALLATION

Company name and size of pump ________ HP ________

Type of pump ________ Capacity of installed pump ________ G.P.M.

Depth of pump placement ________ ft., Date of pump installation ________

## (3) WATER SURFACE MEASURING TUBE

- On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.
- Show exact vertical length of water surface measuring tube, when installed ________ ft., tube diameter ________ tube material ________.

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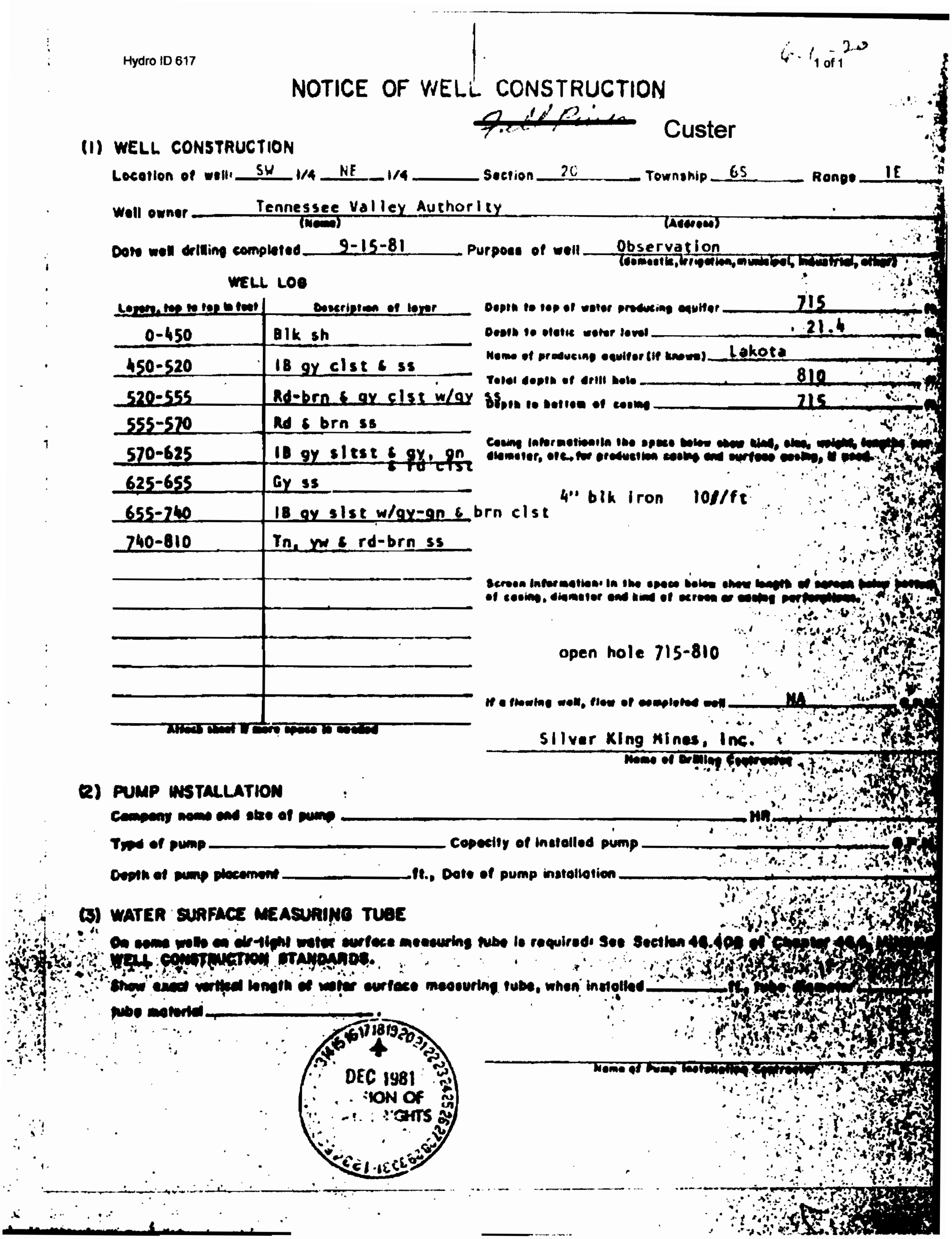
DIVISION OF WATER RIGHTS

________
Name of Pump Installation Contractor



Hydro ID 617

6-1-20
1 of 1

# NOTICE OF WELL CONSTRUCTION

~~Fall River~~ Custer

## (1) WELL CONSTRUCTION

Location of well: SW 1/4 NE 1/4 Section 20 Township 6S Range 1E

Well owner Tennessee Valley Authority (Name) (Address)

Date well drilling completed 9-15-81 Purpose of well Observation (domestic, irrigation, municipal, industrial, other)

### WELL LOG

| Layers, top to top in feet | Description of layer |
|---|---|
| 0-450 | Blk sh |
| 450-520 | lB gy clst & ss |
| 520-555 | Rd-brn & gy clst w/gy ss |
| 555-570 | Rd & brn ss |
| 570-625 | lB gy sltst & gy, gn & rd clst |
| 625-655 | Gy ss |
| 655-740 | lB gy slst w/gy-gn & brn clst |
| 740-810 | Tn, yw & rd-brn ss |
| | |
| | |
| | |
| | |
| | |

Attach sheet if more space is needed

Depth to top of water producing aquifer 715

Depth to static water level 21.4

Name of producing aquifer (if known) Lakota

Total depth of drill hole 810

Depth to bottom of casing 715

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4" blk iron 10#/ft

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

open hole 715-810

If a flowing well, flow of completed well NA

Silver King Mines, Inc.
Name of Drilling Contractor

## (2) PUMP INSTALLATION

Company name and size of pump ______ HP

Type of pump ______ Capacity of installed pump ______

Depth of pump placement ______ ft., Date of pump installation ______

## (3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ______ ft., tube diameter

tube material ______

DEC 1981

Name of Pump Installation Contractor

Hydro ID 622

~~[illegible]~~
Custer

DWM-50

# NOTICE OF WELL CONSTRUCTION

## (1) WELL CONSTRUCTION

Location of well: NE 1/4 NE 1/4 ____ Section 20 Township 6S Range 1E

Well owner Tennessee Valley Authority (Name) ____ (Address)

Date well drilling completed 8-17-81 Purpose of well Observation (domestic, irrigation, municipal, industrial, other)

### WELL LOG

| Layers, top to top in feet | Description of layer |
|---|---|
| 0-420 | Blk sh |
| 420-490 | lB gy clst & ss |
| 490-585 | lB gy, pk & orng sltst & rd-brn & gn clst |
| 585-615 | Gy-gn & rd-brn clst |
| 615-650 | Gy-wht sltst |
| 650-690 | Gy & gn clst |
| 690-735 | Gy w/rd & ywbrn ss w/brn-gy clst |
| 735-778+ | Tn & yw-brn ss |

Attach sheet if more space is needed

Depth to top of water producing aquifer 714 ft.

Depth to static water level 49.7 ft.

Name of producing aquifer (if known) Lakota

Total depth of drill hole 780 ft.

Depth to bottom of casing 714 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4" blk iron 10#/ft

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

open hole 714-780

If a flowing well, flow of completed well NA G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

## (2) PUMP INSTALLATION

Company name and size of pump ____ HP ____

Type of pump ____ Capacity of installed pump ____ G.P.M.

Depth of pump placement ____ ft., Date of pump installation ____

## (3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ____ ft., tube diameter ____,

tube material ____ .

____
Name of Pump Installation Contractor

Hydro ID 622 DWM-52 2 of 2

Custer

# NOTICE OF WELL CONSTRUCTION

## (1) WELL CONSTRUCTION

Location of well: NE 1/4 NE 1/4 Section 20 Township 6S Range R1

Well owner Tennessee Valley Authority (Name) (Address)

Date well drilling completed 8-17-81 Purpose of well Observation (domestic, irrigation, municipal, industrial, other)

### WELL LOG

| Layers, top to top in feet | Description of layer |
|---|---|
| 0-420 | Blk sh |
| 420-500 | lB gy clst & ss |
| 500-580 | Gy, rd & tn ss w/gy & brn clst |

Attach sheet if more space is needed

Depth to top of water producing aquifer 503 ft.

Depth to static water level 34.7 ft.

Name of producing aquifer (if known) Fall River

Total depth of drill hole 580 ft.

Depth to bottom of casing 503 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4" blk iron 10#/ft

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

open hole 503-580

If a flowing well, flow of completed well NA G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

## (2) PUMP INSTALLATION

Company name and size of pump ________ HP ________

Type of pump ________ Capacity of installed pump ________ G.P.M.

Depth of pump placement ________ ft, Date of pump installation ________

## (3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ________ ft., tube diameter ________, tube material ________.

________
Name of Pump Installation Contractor

Hydro ID 623

6. 1 of 1 2-1

# NOTICE OF WELL CONSTRUCTION

~~Fall River~~

Custer

## (1) WELL CONSTRUCTION

Location of well: NE 1/4 NE 1/4 ______ Section 2 Township 6S Range R1

Well owner Tennessee Valley Authority (Name) ______ (Address)

Date well drilling completed 8-17-81 Purpose of well Observation (domestic, irrigation, municipal, industrial, other)

### WELL LOG

| Layers, top to top in feet | Description of layer |
|---|---|
| 0-420 | Blk sh |
| 420-500 | lB gy clst & ss |
| 500-580 | Gy, rd & tn ss w/gy & brn clst |

Attach sheet if more space is needed

Depth to top of water producing aquifer 503 ft.

Depth to static water level 34.2 ft.

Name of producing aquifer (if known) Fall River

Total depth of drill hole 580 ft.

Depth to bottom of casing 503 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4" blk iron 10#/ft

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

open hole 503-580

If a flowing well, flow of completed well NA G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

## (2) PUMP INSTALLATION

Company name and size of pump ______ HP ______

Type of pump ______ Capacity of installed pump ______ G.P.M.

Depth of pump placement ______ ft., Date of pump installation ______

## (3) WATER SURFACE MEASURING TUBE

- On some wells an air-tight water surface measuring tube is required: See Section 46.409 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.
- Show exact vertical length of water surface measuring tube, when installed ______ ft., tube diameter ______ tube material ______.

DEC 1 81
DIVISION OF WATER RIGHTS
Pierre, SD

______
Name of Pump Installation Contractor

1 of 1

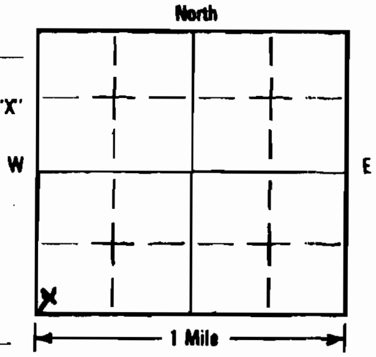
# SOUTH DAKOTA WATER WELL COMPLETION REPORT

07-92

Location SW ¼ SW ¼ Sec 23 Twp 6S Rg 1E

County Custer

Please mark well location with an "X"



Well Completion Date Feb 98

Well Owner: Lloyd & John Putnam

Business Name: Putnam & Putnam

Address: HC 59 Box 22
Edgmont SD 57735

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Sand & Gravel | 0 | 75 |
| Shale | 75 | 80 |

**LOCATION:**

Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ` ft. from ~~[illegible]~~ NONE (identify source).

**PROPOSED USE:**

☒ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☐ Monitoring well

**METHOD OF DRILLING:** Air Rotary

**CASING DATA:** ☒ Steel ☒ Plastic ☐ Other

If other describe

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| 15.5 LB/FT | 5 IN | 0 FT | 70 FT | 7⅞ IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| Cement | 5 | 6 gal lb./gal | 0 ft. | 30 ft. |
| | | lb./gal | ft. | ft. |

Describe grouting procedure Pumped

**SCREEN:** ☒ Perforated pipe ☐ Manufactured

Diameter 5 IN Length 40 FEET

Material Steel

Slot Size ¼ x 16 Set From 30 Feet to 70 Feet

Other information

**WAS A PACKER OR SEAL USED?** ☒ YES ☐ NO

If so, what material? Rubber packer @ 30 ft

Describe packer(s) and location?

**DISINFECTION:** Was well disinfected upon completion?

✓ YES, How: Chlorinated

NO, Why Not?

Laboratory sent to for water quality analysis

**STATIC WATER LEVEL** 20 Feet

If flowing: closed in pressure PSI

GPM flow through inch pipe

Controlled by ☐ Valve ☐ Reducers ☐ Other

Reduced Flowrate GPM

Can well be completely shut in?

**WELL TEST DATA:**

☐ Pumped
☐ Bailed
☒ Other

Describe: Air lift
~~[illegible]~~ 15-20 gpm

Pumping Level Below Land Surface

ft. After Hrs. pumped GPM

ft. After Hrs. pumped GPM

If pump installed, pump rate GPM

FEB 1999
WATER RIGHTS PROGRAM
Pierre, SD

**REMARKS**

This well was drilled under license # 603

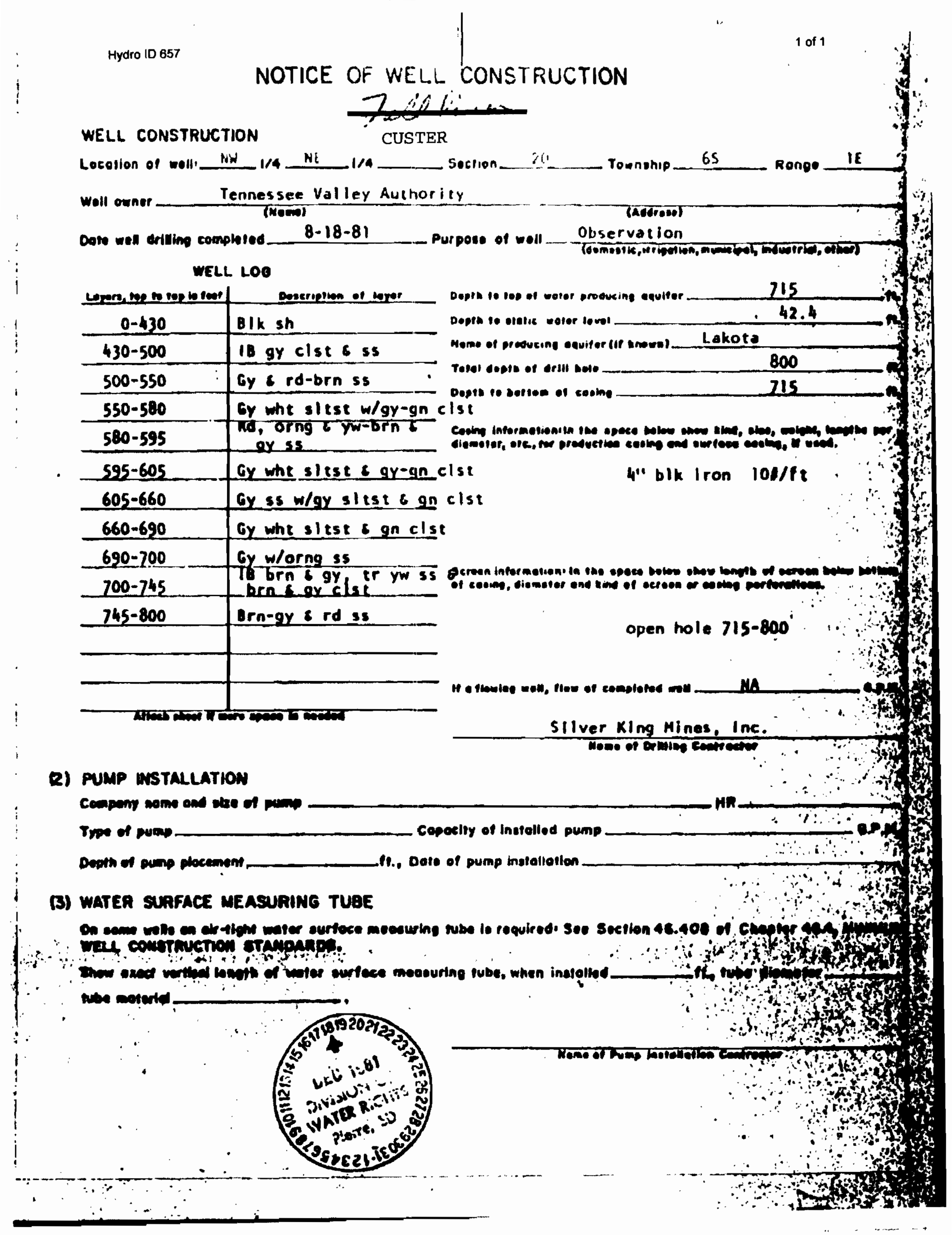
And this report is true and accurate.

Drilling firm Uptaller Drilling

Signature of License Representative: Craig Uptaller

Signature of Well Owner or Equitable Property Holder: Putnam & Putnam Partnership by John A Putnam

Date: 01.22.99



Hydro ID 657

1 of 1

## NOTICE OF WELL CONSTRUCTION

~~Fall River~~

CUSTER

**WELL CONSTRUCTION**

Location of well: NW 1/4 NE 1/4 ______ Section 20 Township 6S Range 1E

Well owner Tennessee Valley Authority (Name) ______ (Address)

Date well drilling completed 8-18-81 Purpose of well Observation (domestic, irrigation, municipal, industrial, other)

**WELL LOG**

| Layers, top to top in feet | Description of layer |
|---|---|
| 0-430 | Blk sh |
| 430-500 | lB gy clst & ss |
| 500-550 | Gy & rd-brn ss |
| 550-580 | Gy wht sltst w/gy-gn clst |
| 580-595 | Rd, orng & yw-brn & gy ss |
| 595-605 | Gy wht sltst & gy-gn clst |
| 605-660 | Gy ss w/gy sltst & gn clst |
| 660-690 | Gy wht sltst & gn clst |
| 690-700 | Gy w/orng ss |
| 700-745 | lB brn & gy, tr yw ss brn & gy clst |
| 745-800 | Brn-gy & rd ss |
| | |
| | |
| | |

Attach sheet if more space is needed

Depth to top of water producing aquifer 715 ft.

Depth to static water level 42.4 ft.

Name of producing aquifer (if known) Lakota

Total depth of drill hole 800 ft.

Depth to bottom of casing 715 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4" blk Iron 10#/ft

Screen information: In the space below show length of screen below bott of casing, diameter and kind of screen or casing perforations.

open hole 715-800'

If a flowing well, flow of completed well NA G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

**(2) PUMP INSTALLATION**

Company name and size of pump ______ HP ______

Type of pump ______ Capacity of installed pump ______ G.P.M.

Depth of pump placement ______ ft., Date of pump installation ______

**(3) WATER SURFACE MEASURING TUBE**

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, Minimum WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ______ ft., tube diameter ______

tube material ______.

DEC 1981
DIVISION OF WATER RIGHTS
Pierre, SD

______
Name of Pump Installation Contractor

Hydro ID 662

1 of 1

[illegible] CONSTRUCTION

Range

Well owner Tennessee Valley Authority, P. O. Box 49, Edgemont, South Dakota
(Name) (Address)

Date well drilling completed 1-26-78 Purpose of well Test
(domestic, irrigation, municipal, industrial, other)

WELL LOG

| Layers, top to top in feet | Description of layer |
|---|---|
| 0-30 | Brown & Gray Soil |
| 30-95 | Brown-Gray Mudstone, Siltstone |
| 95-135 | IB Lt. Gray Sandstone, and Gray Mudstone |
| 135-205 | Variegated Mudstone & Siltstone |
| 205-280 | Tan & Gray Sandstone |
| 280-305 | Gray & Green Mudstone |
| 305-335 | Gray Sandstone |
| 335-400 | IB Brown-Gray Mudstone, Gray Sandstone |
| 400-665 | Gray, Brown & Green Mudstones |
| 665-780 | IB Red-Brown Sandstone and Gray & Green Claystone |
| 780-840 | Black Shale & Gray-Green Claystone |
| 840-880 | Red Siltstone-Mudstone |

Attach sheet if more space is needed

Depth to top of water producing aquifer 665 ft.

Depth to static water level + 240 ft.

Name of producing aquifer (if known) Sundance

Total depth of drill hole 880 ft.

Depth to bottom of casing 780 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

5½" 14# Steel Casing

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

Torch Slotted 666-780

If a flowing well, flow of completed well 4 G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

## (2) PUMP INSTALLATION

Company name and size of pump ______ HP ______

Type of pump ______ Capacity of installed pump ______ G.P.M.

Depth of pump placement ______ ft., Date of pump installation ______

## (3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ______ ft., tube diameter ______, tube material ______

______
Name of Pump Installation Contractor

1978
STATE WATER RIGHTS COMM
Pierre SD

# NOTICE OF WELL CONSTRUCTION

[illegible] Range 1E

Well owner Tennessee Valley Authority, P. O. Box 49, Edgemont, South Dakota
(Name) (Address)

Date well drilling completed 11-7-79 Purpose of well Observation
(domestic, irrigation, municipal, industrial, other)

WELL LOG

| Layers, top to bottom in feet | Description of layer |
|---|---|
| 0-20 | Weathered Brown Clay and Silt |
| 20-250 | Dark Gray Shale |
| 250-375 | Interbedded Gray Claystone, Lt. Gray Sandstone |
| 375-410 | Dark Gray Claystone |
| 410-505 | Lt. Gray-White Siltstone and Green Claystone |
| 505-550 | Red-Brown Sandstone w/Gray Mudstone |

Attach sheet if more space is needed

Depth to top of water producing aquifer 504 ft.

Depth to static water level ______ ft.

Name of producing aquifer (if known). Lakota

Total depth of drill hole 550 ft

Depth to bottom of casing 504 ft.

Casing information in the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4½" Schedual 40 Black Iron

Screen information. In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

Open Hole 504-550

If a flowing well, flow of completed well est. 40 G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

## (2) PUMP INSTALLATION

Company name and size of pump ______ HP ______

Type of pump ______ Capacity of installed pump ______ G.P.M.

Depth of pump placement ______ ft., Date of pump installation ______

## (3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ______ ft., tube diameter ______,

tube material ______

______
Name of Pump Installation Contractor

1978
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Pierre, SD

## [illegible] CONSTRUCTION

Township [illegible] Range [illegible]

Owner: Tennessee Valley Authority, P. O. Box 49, (Name) Edgemont, South Dakota (Address)

Date well drilling completed 11-7-78 Purpose of well Observation (domestic, irrigation, municipal, industrial, other)

### WELL LOG

| Layers, top to foot in feet | Description of layer |
|---|---|
| 0-20 | Weathered Brown Clay and Silt |
| 20-250 | Dark Gray Shale |
| 250-360 | Gray Sandstone w/Lt. Med. Gray Claystone & Lt. Gray Siltstone |

Attach sheet if more space is needed

Depth to top of water producing aquifer 315 ft.

Depth to static water level ______ ft.

Name of producing aquifer (if known) Fall River

Total depth of drill hole 360 ft.

Depth to bottom of casing 315 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4½" Schedual 40 Black Iron

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

Open Hole 315-360

If a flowing well, flow of completed well est. 2 G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

### (2) PUMP INSTALLATION

Company name and size of pump ______ HP ______

Type of pump ______ Capacity of installed pump ______ G.P.M.

Depth of pump placement ______ ft., Date of pump installation ______

### (3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ______ ft., tube diameter ______

tube material ______

Name of Pump Installation Contractor

4
[illegible] 1978
STATE WATER
RIGHTS COMM
Pierre, SD

Hydro ID 668

[illegible]

1 of 2

[illegible]

# NOTICE OF WELL CONSTRUCTION

## (1) WELL CONSTRUCTION

Location of well NW 1/4 NE 1/4 Section 15 Township 7S Range 1E

Well owner Jennessee Valley Authority - Box 49 - Edgemont, South Dakota
(Name) (Address)

Date well drilling completed 1-31-77 Purpose of well Test, Dewatering
(domestic, irrigation, municipal, industrial, other)

### WELL LOG

| Layers, top to top in feet | Description of layer |
|---|---|
| 0 - 15 | Alluvium & brn sh |
| 15 - 240 | Dk gy fissile sh |
| 240 - 340 | Dk gy sh, md gy clst |
| 340 - 365 | Md gy-gn clst |
| 365 - 420 | Wh-lt gy sltst-vfgrss |
| 420 - 445 | Lt gn & gy clst |
| 445 - 475 | AA w/tr lt gy & brn vf-fgrss |
| 475 - 485 | Gy fgrss |
| 485 - 500 | AA w/brn mdst |
| [illegible]0 - 560 | Pk & org calc cem vfgrss |
| 560 - 574 | Lt-dk gy mdst |
| | |
| | |
| | |

Attach sheet if more space is needed

Depth to top of water producing aquifer 280, 480 ft.

Depth to static water level Flowing ft.

Name of producing aquifer (if known) Fall River, Lakota

Total depth of drill hole 574 ft.

Depth to bottom of casing 480 ft.

Casing information in the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

Schedule 40 Blk Iron 10" diameter
0 - 280
335 - 480

Screen information: in the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

Johnson Well Screen Stainless Steel .030 slot size
10" diam 280 - 335
8" diam 480 - 555

If a flowing well, flow of completed well 35 G.P.M.

Forward Drilling Co.
Name of Drilling Contractor

## (2) PUMP INSTALLATION

Company name and size of pump Pioneer # P 300 34T 6" HP 50

Type of pump submersible Capacity of installed pump 300 G.P.M.

Depth of pump placement 455 ft, Date of pump installation Feb. 10, 1977

## (3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46 408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ______ ft, tube diameter ______,

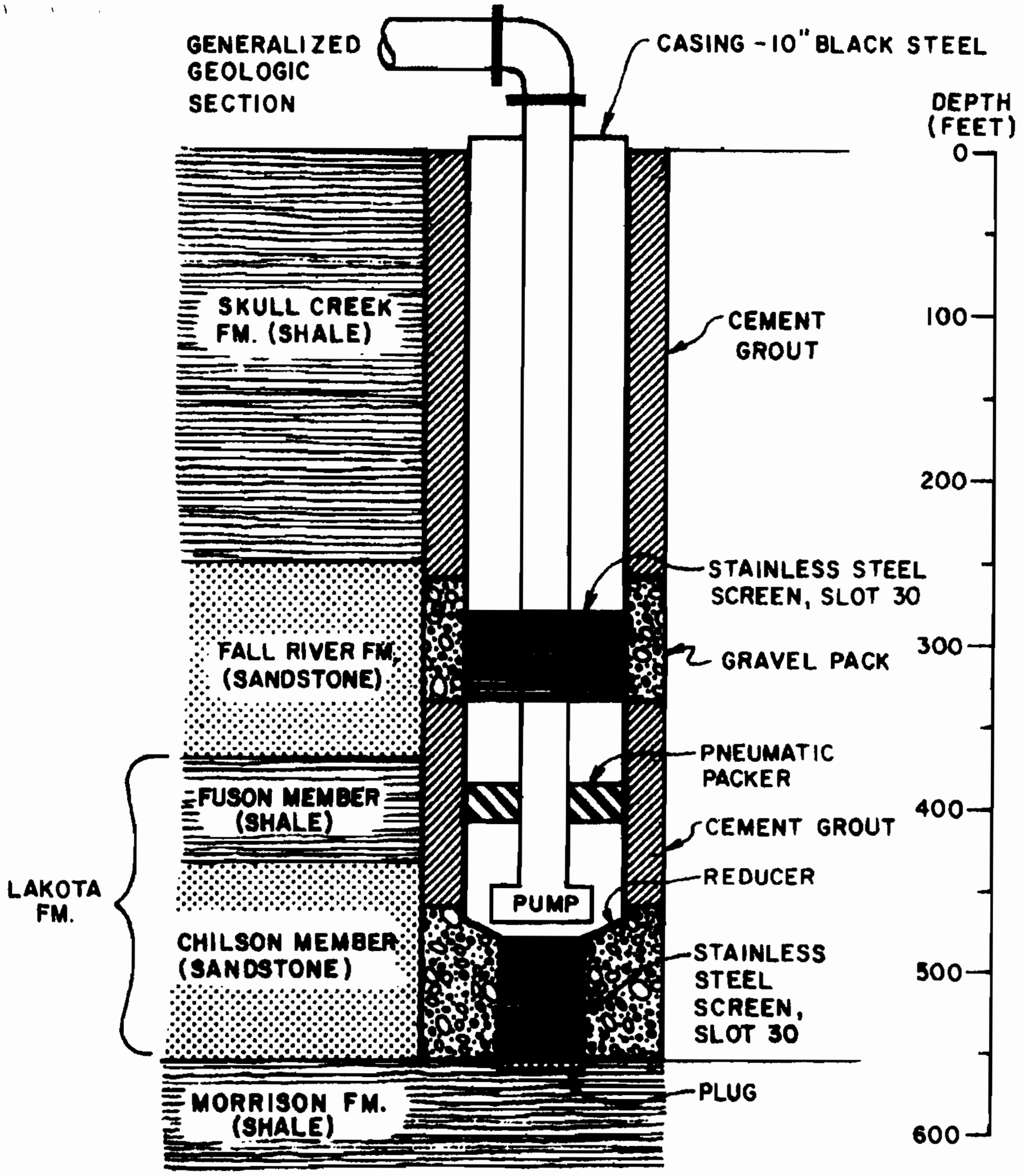
tube material ______

Forward Drilling Co.
Name of Pump Installation Contractor

[illegible]

Hydro ID 668

2 of 2
36



Source: Analysis of Aquifer Tests Conducted at the Proposed Burdock Uranium Mine Site, Burdock, South Dakota, WR-28-1-520-109, TVA, Boggs and Jenkins, May 1980.

**Figure 2 : Burdock Well Profile**

1 of 1

# NOTICE OF WELL CONSTRUCTION

Township ______ Range 1E

Well owner Tennessee Valley Authority, P. O. Box 49, Edgemont, South Dakota
(Name) (Address)

Date well drilling completed 10-25-78 Purpose of well Observation
(domestic, irrigation, municipal, industrial, other)

**WELL LOG**

| Layers, top to top in feet | Description of layer |
|---|---|
| 0-25 | Brown Weathered Shale |
| 25-235 | Gray Shale |
| 235-265 | AA with Lt. Gray Sandstone Siltstone |
| 265-335 | Brown Mudstone with Gray Sandstone & Gray-Green Mudstone |
| 335-355 | Gray Shale & Sandstone Siltstone |
| 355-370 | Tan-Gray Siltstone |
| 370-390 | Gray & Green Shale |
| 390-405 | Dark Brown Mudstone |
| 405-440 | Lt. Green Claystone-Siltstone |
| 440-475 | White Siltstone, Sandstone |
| 475-485 | Green Mudstone |
| 485-495 | Tan Mudstone-Siltstone |
| 495-510 | Gray Sandstone, Brown Mudstone |
| 510-550 | Red-Brown SS |

Attach sheet if more space is needed

Depth to top of water producing aquifer 510 ft.

Depth to static water level ______ ft.

Name of producing aquifer (if known) Lakota

Total depth of drill hole 550 ft.

Depth to bottom of casing 510 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4½" Black Iron Schedual 40

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

Open Hole 510-550

If a flowing well, flow of completed well est. 35 G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

## (2) PUMP INSTALLATION

Company name and size of pump ______ HP ______

Type of pump ______ Capacity of installed pump ______ G.P.M.

Depth of pump placement ______ ft., Date of pump installation ______

## (3) WATER SURFACE MEASURING TUBE

**On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.**

Show exact vertical length of water surface measuring tube, when installed ______ ft., tube diameter ______

tube material ______

______
Name of Pump Installation Contractor

1978
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Pierre, SD

Hydro ID 670

1 of 1

# NOTICE OF WELL CONSTRUCTION

FILED

Township ___ Range 1E

Well owner Tennessee Valley Authority, P. O. Box 49, Edgemont, South Dakota
(Name) (Address)

Date well drilling completed 10-19-78 Purpose of well Observation
(domestic, irrigation, municipal, industrial, other)

WELL LOG

| Layers, top to top in feet | Description of layer |
|---|---|
| 0-20 | Weathered Brown Clay & Silt |
| 20-250 | Dark Gray Shale |
| 250-260 | Interbedded Gray Clay-stone & Lt. Gray Sandstone |
| 260-355 | Gray Clay Stone |
| 355-375 | Lt. Gray-White Siltstone<br>Gray Claystone |
| 375-390 | Gray & Green Shale |
| 390-395 | Dark Brown Mudstone |

Attach sheet if more space is needed

Depth to top of water producing aquifer 377 ft.

Depth to static water level ___ ft.

Name of producing aquifer (if known) Lakota-Fuson

Total depth of drill hole 395 ft.

Depth to bottom of casing 377 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4½" Schedual 40 Black Iron

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

Open Hole 377-395

If a flowing well, flow of completed well < 1 G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

## (2) PUMP INSTALLATION

Company name and size of pump ___ HP ___

Type of pump ___ Capacity of installed pump ___ G.P.M.

Depth of pump placement ___ ft, Date of pump installation ___

## (3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ___ ft, tube diameter ___

tube material ___

___
Name of Pump Installation Contractor

1978
STATE WATER
RIGHTS COMM
Pierre, S D

# NOTICE OF WELL CONSTRUCTION

RECEIVED

Well owner: Tennessee Valley Authority, P. O. Box 49, Edgemont, South Dakota
(Name) (Address)

Date well drilling completed 10-18-78 Purpose of well Observation
(domestic, irrigation, municipal, industrial, other)

## WELL LOG

| Layers, top to top in feet | Description of layer |
|---|---|
| 0-10 | Weathered Brown Clay & Silt |
| 10-250 | Dark Gray Shale |
| 250-260 | Interbedded Gray Claystone & Lt. Gray Sandstone |
| 260-295 | Med. & Lt. Gray Claystone |
| 295-300 | AA w/trace green & Red-Brown Claystone |
| 300-335 | Lt. Gray Sandstone, Medium & Lt. Gray Claystone |
| 335-350 | Gray-Green Mudstone, Gray Shale & Sandstone |

Attach sheet if more space is needed

Depth to top of water producing aquifer 300' ft.

Depth to static water level ______ ft.

Name of producing aquifer (if known) Fall River

Total depth of drill hole 350 ft.

Depth to bottom of casing 300' ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used

4½" Schedual 40 Black Iron

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

Open Hole 300-350

If a flowing well, flow of completed well est. 2 G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

## (2) PUMP INSTALLATION

Company name and size of pump ______ HP ______

Type of pump ______ Capacity of installed pump ______ G.P.M.

Depth of pump placement ______ ft., Date of pump installation ______

## (3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required! See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ______ ft., tube diameter ______

tube material ______

______
Name of Pump Installation Contractor

1978
WATER RIGHTS COMM
Pierre, SD

Hydro ID 673

1 of 1

# NOTICE OF WELL CONSTRUCTION

Township 7 Range 1E

Well owner Tennessee Valley Authority, P. O. Box 49, Edgemont, South Dakota
(Name) (Address)

Date well drilling completed 11-6-78 Purpose of well Observation
(domestic, irrigation, municipal, industrial, other)

## WELL LOG

| Layers, top to top in feet | Description of layer |
|---|---|
| 0-260 | Dark Gray Shale |
| 260-280 | Gray Shale & Sandstone |
| 280-350 | Gray Sandstone-Siltstone |
| 350-355 | Dark Brown Shale |
| 355-395 | Gray Shale & Sandstone |
| 395-420 | Gray-Green Mudstone |

Attach sheet if more space is needed

Depth to top of water producing aquifer 400 ft.

Depth to static water level ______ ft.

Name of producing aquifer (if known) Lakota-Fuson

Total depth of drill hole 420 ft.

Depth to bottom of casing 400 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4½" Schedual 40 Black Iron

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

Open Hole 400-420

If a flowing well, flow of completed well ______ G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

## (2) PUMP INSTALLATION

Company name and size of pump ______ HP ______

Type of pump ______ Capacity of installed pump ______ G.P.M.

Depth of pump placement ______ ft., Date of pump installation ______

## (3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ______ ft, tube diameter ______,

tube material ______

1978
STATE WATER
RIGHTS COMM
Pierre, SD

Name of Pump Installation Contractor

Hydro ID 674

1 of 1

# NOTICE OF WELL CONSTRUCTION

Sec ____ Township ____ Range 11

Well owner Tennessee Valley Authority, P. O. Box 49, Edgemont, South Dakota
(Name) (Address)

Date well drilling completed 11-6-78 Purpose of well Observation
(domestic, irrigation, municipal, industrial, other)

## WELL LOG

| Layers, top to top in feet | Description of layer |
|---|---|
| 0-10 | Orange-Brown Weathered Shale |
| 10-270 | Dark Gray-Black Shale |
| 270-280 | AA w/Lt. Gray Siltstone Sandstone |
| 280-390 | Interbedded Dark Gray Carb. mudstone, Gray & Tan Sandstone |
| 390-430 | Dark Brown Mudstone w/Green-Gray Claystone |
| 430-455 | Green w/Brown & Gray Claystone |
| 455-470 | Dark Brown-Gray Mudstone, trace Green Claystone; Tan Sandstone |
| 470-500 | Green Claystone w/White Lt. Tan Siltstone-Sandstone |
| 500-525 | Gray-Brown Mudstone w/Tan Sandstone |
| 525-570 | Gray Sandstone w/Gray-Brown Mudstone |

Attach sheet if more space is needed

Depth to top of water producing aquifer 525 ft.

Depth to static water level ____ ft.

Name of producing aquifer (if known) Lakota

Total depth of drill hole 570 ft.

Depth to bottom of casing 525 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4½" Schedual 40 Black Iron

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

Open Hole 525-570

If a flowing well, flow of completed well est. 35 G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

## (2) PUMP INSTALLATION

Company name and size of pump ____ HP ____

Type of pump ____ Capacity of installed pump ____ G.P.M.

Depth of pump placement ____ ft., Date of pump installation ____

## (3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

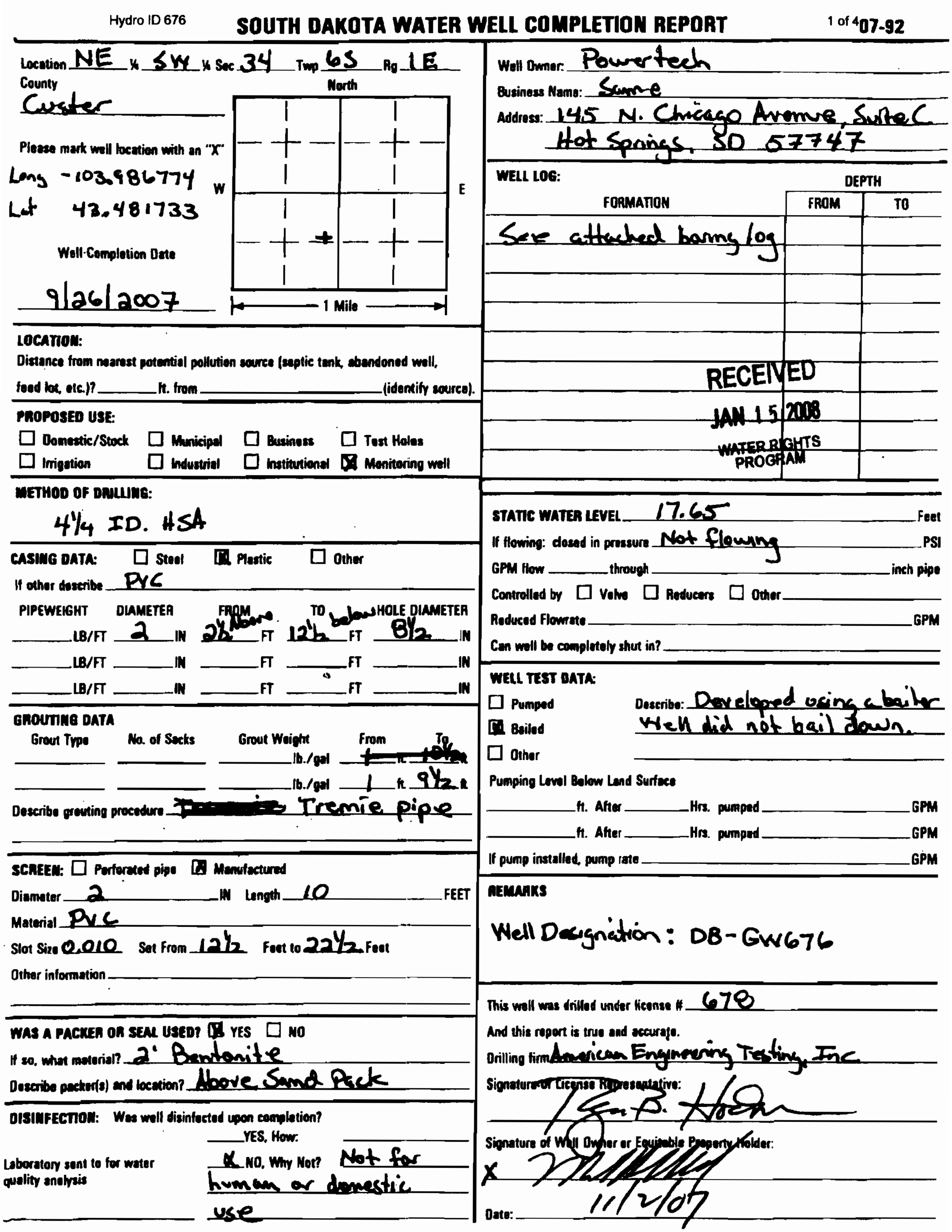
Show exact vertical length of water surface measuring tube, when installed ____ ft., tube diameter ____

tube material ____

____
Name of Pump Installation Contractor

1978
STATE WATER RIGHTS COMM
Pierre, SD

POWERTECH (USA) INC.



Hydro ID 676

# SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 4 07-92

Location NE ¼ SW ¼ Sec 34 Twp 6S Rg 1E

County Custer

North

Please mark well location with an "X"

W E

Long -103.986774

Lat 43.481733

Well Completion Date 9/26/2007

1 Mile

Well Owner: Powertech

Business Name: Same

Address: 145 N. Chicago Avenue, Suite C
Hot Springs, SD 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| See attached boring log | | |

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**LOCATION:**
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from ______ (identify source).

**PROPOSED USE:**
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

**METHOD OF DRILLING:**
4¼ ID. HSA

**CASING DATA:** ☐ Steel ☒ Plastic ☐ Other
If other describe PVC

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| LB/FT | 2 IN | 2½ above FT | 12½ below FT | 8½ IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| | | lb./gal | ~~1~~ ft | ~~10½~~ ft |
| | | lb./gal | 1 ft | 9½ ft |

Describe grouting procedure ~~[illegible]~~ Tremie pipe

**SCREEN:** ☐ Perforated pipe ☒ Manufactured
Diameter 2 IN Length 10 FEET
Material PVC
Slot Size 0.010 Set From 12½ Feet to 22½ Feet
Other information

**WAS A PACKER OR SEAL USED?** ☒ YES ☐ NO
If so, what material? 2' Bentonite
Describe packer(s) and location? Above Sand Pack

**DISINFECTION:** Was well disinfected upon completion?
____ YES, How:
X NO, Why Not? Not for human or domestic use
Laboratory sent to for water quality analysis

**STATIC WATER LEVEL** 17.65 Feet
If flowing: closed in pressure Not flowing PSI
GPM flow ______ through ______ inch pipe
Controlled by ☐ Valve ☐ Reducers ☐ Other
Reduced Flowrate ______ GPM
Can well be completely shut in?

**WELL TEST DATA:**
☐ Pumped
☒ Bailed
☐ Other
Describe: Developed using a bailer. Well did not bail down.

Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM
If pump installed, pump rate ____ GPM

**REMARKS**
Well Designation: DB-GW676

This well was drilled under license # 678
And this report is true and accurate.
Drilling firm American Engineering Testing, Inc
Signature of License Representative:
Signature of Well Owner or Equitable Property Holder:
X
Date: 11/2/07

ydro ID 676

AMERICAN
ENGINEERING
TESTING, INC.

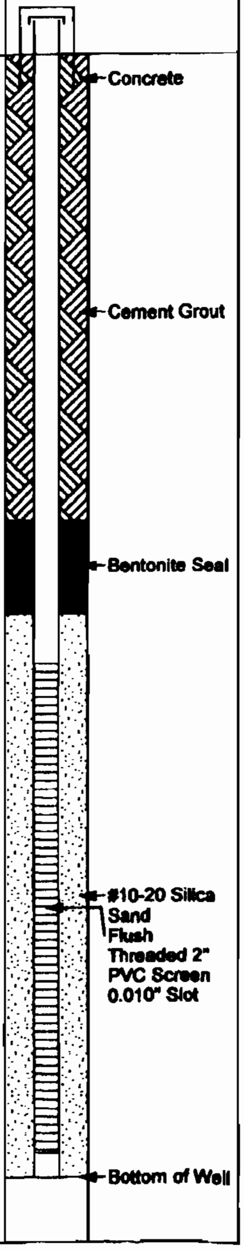
2 of 4

# BORING/WELL CONSTRUCTION LOG

| | | | |
|---|---|---|---|
| **PROJECT NUMBER** | 18-02617 | **BORING/WELL NUMBER** | B-4/DB-GW676 |
| **PROJECT NAME** | Dewey Burdock Monitor Well Installation | **DATE DRILLED** | 9/25/07 |
| **LOCATION** | Burdock, South Dakota | **CASING TYPE/DIAMETER** | 2" ID Schedule 40 PVC |
| **DRILLING METHOD** | 4.25" ID HSA | **SCREEN TYPE** | 2" ID Schedule 40 PVC Slotted 0.010" |
| **SAMPLING METHOD** | Continuous | **PACKING TYPE** | #10-20 Silica Sand |
| **GROUND ELEVATION** | | **GROUT TYPE** | Cement |
| **TOP OF CASING** | | **DEPTH TO WATER** | 17.50 |
| **LOGGED BY** | CH | **GROUND WATER ELEVATION** | |
| **REMARKS** | Well was completed with a 4" Pro Top | | |

| HNU (ppm) | Blow Count | RECOVERY (inches) | SAMPLER TYPE | INTERVAL | DEPTH (ft. BGL) | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION | GW LEVEL |
|---|---|---|---|---|---|---|---|---|---|
| | | | CSTS 1 | | | CS | | **TOPSOIL**, with organics, dark brown, dry | |
| | | | CSTS 2 | | 1 | | | **SANDY SILT**, red, dry | |
| | | | | | 2 | | | | |
| | | | | | 3 | | | | |
| | | | CSTS 3 | | 4 | | | | |
| | | | | | 5 | | | | |
| | | | | | 6 | | | | |
| | | | | | 7 | | | | |
| | | | | | 8 | | | | |
| | | | CSTS 4 | | 9 | | | | |
| | | | | | 10 | | | | |
| | | | | | 11 | | | | |
| | | | | | 12 | | | | |
| | | | CSTS 5 | | 13 | | | **SILTY SANDY GRAVEL**, with cobbles, red to brown, dry to moist | |
| | | | CSTS 6 | | 14 | | | Same wet at 17.5 feet | |
| | | | | | 15 | | | | |
| | | | | | 16 | | | | |
| | | | | | 17 | | | | ▽ |
| | | | | | 18 | | | | |
| | | | CSTS 7 | | 19 | | | Same saturated | |
| | | | | | 20 | | | | |
| | | | | | 21 | | | | |
| | | | | | 22 | | | | |
| | | | | | 23 | | | End of Boring | |

BORING ABANDONED



AET_ENV1 18-02617 MW.GPJ AET_ENV.GDT 11/2/07

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• MATERIALS
• ENVIRONMENTAL

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January 11, 2008

Mr. Ken Buhler
Department of Environment and Natural Resources (DENR)
Water Rights Division
Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501-3181

Subject: South Dakota Water Well Completion Reports
Wells Installed for Powertech
Burdock, South Dakota
AET No. 18-02617

Dear Mr. Buhler:

Enclosed please find the well completion reports for five groundwater monitoring wells, DB-GW675, DB-GW676, DB-GW677, DB-GW678 & DB-GW679 .The wells were completed to obtain information on the potential shallow groundwater impacts from previous uranium mining within the project area prior to initiating new uranium production activities within the Dewey-Burdock, South Dakota area. If you have any questions or need any additional information please contact me at (605) 388-0029.

Sincerely,

Clarke Knigge

Clarke L. Knigge, CPRR
Environmental Scientist
Project Manager

CLK

attachments

pc: Mr. Cory Foreman, RESPEC

Y:\wp8\Environmental\Correspondence\18-02617 MW Completion Report.wpd

1745 Samco Road • Rapid City, SD 57702 • 605-388-0029 • Fax 605-388-0064 • www.amengtest.com
Chanhassen • Duluth • Mankato • Marshall • Rochester • St. Paul, MN/Pierre • Rapid City • Sioux Falls, SD/La Crosse • Wausau, WI
AN AFFIRMATIVE ACTION AND EQUAL OPPORTUNITY EMPLOYER.

NOTES: Hydro ID 676 JOB # 4 of 4

<u>B-4</u> DB - GW 676

6" → TOPSOIL W/ ORGANICS - DK BROWN, DRY

TO 5' → SANDY SILT, RED, DRY

TO 10' → SILTY SAND, RED, DRY

SAME TO 13'

@ 13' → SILTY SANDY GRAVEL W/ COBBLES, RED TO BROWN, DRY TO MOIST

SAME TO 20'; WET @ 17.5'

Same to 22½' Sat.

Hydro ID 677

# SOUTH DAKOTA WATER WELL COMPLETION REPORT

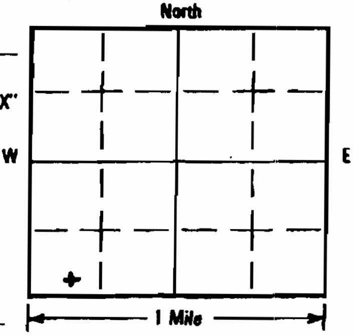
1 of 4 07-92

Location SW ¼ SW ¼ Sec 4 Twp 7S Rg 1E

County
Fall River

Please mark well location with an "X"

Long -104.0131
Lat 43.464791



Well-Completion Date
9/25/2007

**LOCATION:**
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from ____ (identify source).

**PROPOSED USE:**
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

**METHOD OF DRILLING:**
4¼ HSA

**CASING DATA:** ☐ Steel ☒ Plastic ☐ Other
If other describe PVC

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| LB/FT | 2 IN | 2½ above FT | 4 below FT | 8½ IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| | | lb./gal | ft | ft |
| | | lb./gal | ft | ft |

Describe grouting procedure Top 1' filled w/Concrete

**SCREEN:** ☐ Perforated pipe ☒ Manufactured
Diameter 2 IN Length 10 FEET
Material PVC
Slot Size 0.010 Set From 4 Feet to 14 Feet
Other information

**WAS A PACKER OR SEAL USED?** ☒ YES ☐ NO
If so, what material? 2' Bentonite Plug
Describe packer(s) and location? Above Sand Pack

**DISINFECTION:** Was well disinfected upon completion?
____ YES, How:
X NO, Why Not? Not for Human or Domestic Animal use

Laboratory sent to for water quality analysis

Well Owner: Powertech
Business Name: Same.
Address: 145 N. Chicago Avenue, Suite C
Hot Springs, SD 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| See Attached Boring Log | | |

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STATIC WATER LEVEL ≈ 9 Feet
If flowing: closed in pressure Not flowing PSI
GPM flow ____ through ____ inch pipe
Controlled by ☐ Valve ☐ Reducers ☐ Other
Reduced Flowrate ____ GPM
Can well be completely shut in?

**WELL TEST DATA:**
☐ Pumped
☒ Bailed
☐ Other

Describe: Developed utilizing a bailer. Well did not bail down

Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM
If pump installed, pump rate ____ GPM

**REMARKS**

DB-GW677

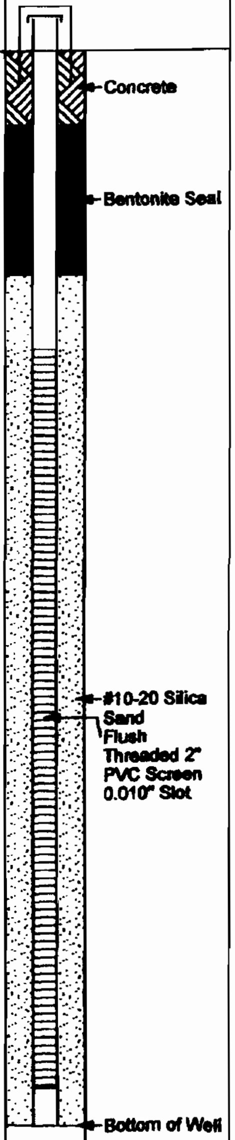
This well was drilled under license # 678
And this report is true and accurate.
Drilling firm American Engineering Testing
Signature of License Representative:
Signature of Well Owner or Equitable Property Holder:
x
Date: 11/2/07

AMERICAN
ENGINEERING
TESTING, INC.

# BORING/WELL CONSTRUCTION LOG

| | | | |
|---|---|---|---|
| **PROJECT NUMBER** | 18-02617 | **BORING/WELL NUMBER** | B-2/DB-GW677 |
| **PROJECT NAME** | Dewey Burdock Monitor Well Installation | **DATE DRILLED** | 9/25/07 |
| **LOCATION** | Burdock, South Dakota | **CASING TYPE/DIAMETER** | 2" ID Schedule 40 PVC |
| **DRILLING METHOD** | 4.25" ID HSA | **SCREEN TYPE** | 2" ID Schedule 40 PVC Slotted 0.010" |
| **SAMPLING METHOD** | Continuous | **PACKING TYPE** | #10-20 Silica Sand |
| **GROUND ELEVATION** | | **GROUT TYPE** | Cement |
| **TOP OF CASING** | | **DEPTH TO WATER** | 9.00 |
| **LOGGED BY** | CH | **GROUND WATER ELEVATION** | |
| **REMARKS** | Well was completed with a 4" Pro Top | | |

| HNU (ppm) | Blow Count | RECOVERY (inches) | SAMPLER TYPE | INTERVAL | DEPTH (ft. BGL) | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION | GW LEVEL |
|---|---|---|---|---|---|---|---|---|---|
| | | | CSTS 1 | | 0–4<br>1<br>2<br>3 | CL | | **SANDY SILT**, medium grain, tan | |
| | | | CSTS 2 | | 4<br>5 | | | **SANDY SILT** | |
| | | | CSTS 3 | | 6<br>7 | | | **SILTY SAND**, poorly sorted | |
| | | | CSTS 4 | | 8 | | | **SILTY SAND**, tan | |
| | | | CSTS 5 | | 9<br>10<br>11<br>12 | | | **SAND**, very fine grained, tan, wet | ▽ |
| | | | CSTS 6 | | 13<br>14 | | | **SHALE**(Belle Fourche), dark gray, fissile | |



AET_ENVI 18-02617 MW.GPJ AET_ENVI.GDT 11/2/07

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• MATERIALS
• ENVIRONMENTAL

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January 11, 2008

Mr. Ken Buhler
Department of Environment and Natural Resources (DENR)
Water Rights Division
Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501-3181

Subject: South Dakota Water Well Completion Reports
Wells Installed for Powertech
Burdock, South Dakota
AET No. 18-02617

Dear Mr. Buhler:

Enclosed please find the well completion reports for five groundwater monitoring wells, DB-GW675, DB-GW676, DB-GW677, DB-GW678 & DB-GW679 .The wells were completed to obtain information on the potential shallow groundwater impacts from previous uranium mining within the project area prior to initiating new uranium production activities within the Dewey-Burdock, South Dakota area. If you have any questions or need any additional information please contact me at (605) 388-0029.

Sincerely,

Clarke L. Knigge, CPRR
Environmental Scientist
Project Manager

CLK

attachments

pc: Mr. Cory Foreman, RESPEC

Y:\wp8\Environmental\Correspondence\18-02617 MW Completion Report.wpd

**DB-GW677**

| | |
|---|---|
| Location | south of Putnam house |

Construction Details

| | |
|---|---|
| Total Depth | 14.5’ |
| Screen Inverval | 4.5 – 14.5’ |
| Sand pack | 3 – 14.5’ |
| Bentonite | 1 – 3’ |
| Cement | 0 – 1’ |

| | |
|---|---|
| Water Level | ~9’ below surface |

Lithology

| | |
|---|---|
| 0 – 4 ft | med tan, sandy silt |
| 4 – 6 ft | sandy silt |
| 6 – 7.5 ft | cobbles in silty sand, poorly sorted |
| 7.5 – 9 ft | tan, silty sand |
| 9 – 12.5 ft | wet, tan, very fine grained sand |
| 12.5 -14.5 ft | dark gray, fissile shale (Belle Fourche Fm) |

Hydro ID 678

# SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 4 07-92

Location SW ¼ NE ¼ Sec 9 Twp 7S Rg 1E

County Fall River

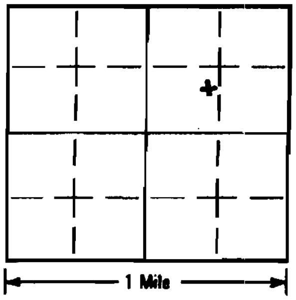
Please mark well location with an "X"

Long -104.001135

Lat 43.459121

Well Completion Date 9/25/2007

North



**LOCATION:**

Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from ______ (identify source).

**PROPOSED USE:**

☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

**METHOD OF DRILLING:**

4¼ ID HSA

**CASING DATA:** ☐ Steel ☒ Plastic ☐ Other

If other describe PVC

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| LB/FT | 2 IN | 2' above FT | 4 below FT | 8½ IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| | | lb./gal | ft. | ft. |
| | | lb./gal | ft. | ft. |

Describe grouting procedure Top 1' filled w/ Concrete

**SCREEN:** ☐ Perforated pipe ☒ Manufactured

Diameter 2 IN Length 10 FEET

Material PVC

Slot Size 0.010 Set From 4 Feet to 14 Feet

Other information

**WAS A PACKER OR SEAL USED?** ☒ YES ☐ NO

If so, what material? 2' Bentonite

Describe packer(s) and location? Above Sand Pack

**DISINFECTION:** Was well disinfected upon completion?

Laboratory sent to for water quality analysis

____ YES, How:

X NO, Why Not? Well not used for human or domestic animal consump

Well Owner: Powertech

Business Name: Same

Address: 145 N. Chicago Avenue, Suite C
Hot Springs, SD 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| See Attached Log | | |

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STATIC WATER LEVEL ≈ 9.6 Feet

If flowing: closed in pressure Not flowing PSI

GPM flow ______ through ______ inch pipe

Controlled by ☐ Valve ☐ Reducers ☐ Other

Reduced Flowrate ______ GPM

Can well be completely shut in? ______

**WELL TEST DATA:**

☐ Pumped
☒ Bailed
☐ Other

Describe: Developed using a bailer. Well did not bail down

Pumping Level Below Land Surface

______ ft. After ______ Hrs. pumped ______ GPM

______ ft. After ______ Hrs. pumped ______ GPM

If pump installed, pump rate ______ GPM

**REMARKS**

Well Designation DB-GW678

This well was drilled under license # 678

And this report is true and accurate.

Drilling firm American Eng. Testing, Inc.

Signature of License Representative:

Signature of Well Owner or Equitable Property Holder:

X

Date: 11/2/07

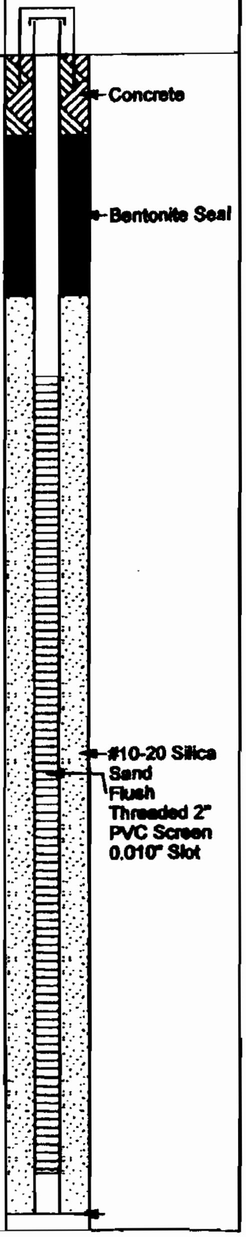
AMERICAN
ENGINEERING
TESTING, INC.

# BORING/WELL CONSTRUCTION LOG

PROJECT NUMBER 18-02617
PROJECT NAME Dewey Burdock Monitor Well Installation
LOCATION Burdock, South Dakota
DRILLING METHOD 4.25" ID HSA
SAMPLING METHOD Continuous
GROUND ELEVATION
TOP OF CASING
LOGGED BY CH
REMARKS Well was completed with a 4" Pro Top

BORING/WELL NUMBER B-3/DB-GW678
DATE DRILLED 9/25/07
CASING TYPE/DIAMETER 2" ID Schedule 40 PVC
SCREEN TYPE 2" ID Schedule 40 PVC Slotted 0.010"
PACKING TYPE #10-20 Silica Sand
GROUT TYPE Cement
DEPTH TO WATER ~8.00
GROUND WATER ELEVATION

| HNU (ppm) | Blow Count | RECOVERY (inches) | SAMPLER TYPE | INTERVAL | DEPTH (ft. BGL) | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION | GW LEVEL |
|---|---|---|---|---|---|---|---|---|---|
| | | | CSTS 1 | | | | | **SILTY SAND**, very fine grained, red | |
| | | | | | 1 | | | | |
| | | | | | 2 | | | | |
| | | | | | 3 | | | | |
| | | | CSTS 2 | | 4 | | | **SILTY SAND**, very fine grained, red | |
| | | | | | 5 | | | | |
| | | | | | 6 | | | | |
| | | | | | 7 | | | | |
| | | | | | 8 | | | | |
| | | | CSTS 3 | | 9 | | | **SILTY SAND**, very fine grained with 1-inch beds of medium to course sand | |
| | | | | | 10 | | | | |
| | | | | | 11 | | | | |
| | | | | | 12 | | | | |
| | | | | | 13 | | | | |
| | | | | | 14 | | | | |



AET_ENVI 18-02617 MW.GPJ AET_ENVI.GDT 11/2/07

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January 11, 2008

Mr. Ken Buhler
Department of Environment and Natural Resources (DENR)
Water Rights Division
Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501-3181

Subject: South Dakota Water Well Completion Reports
Wells Installed for Powertech
Burdock, South Dakota
AET No. 18-02617

Dear Mr. Buhler:

Enclosed please find the well completion reports for five groundwater monitoring wells, DB-GW675, DB-GW676, DB-GW677, DB-GW678 & DB-GW679 .The wells were completed to obtain information on the potential shallow groundwater impacts from previous uranium mining within the project area prior to initiating new uranium production activities within the Dewey-Burdock, South Dakota area. If you have any questions or need any additional information please contact me at (605) 388-0029.

Sincerely,

Clarke Knigge

Clarke L. Knigge, CPRR
Environmental Scientist
Project Manager

CLK

attachments

pc: Mr. Cory Foreman, RESPEC

Y:\wp8\Environmental\Correspondence\18-02617 MW Completion Report.wpd

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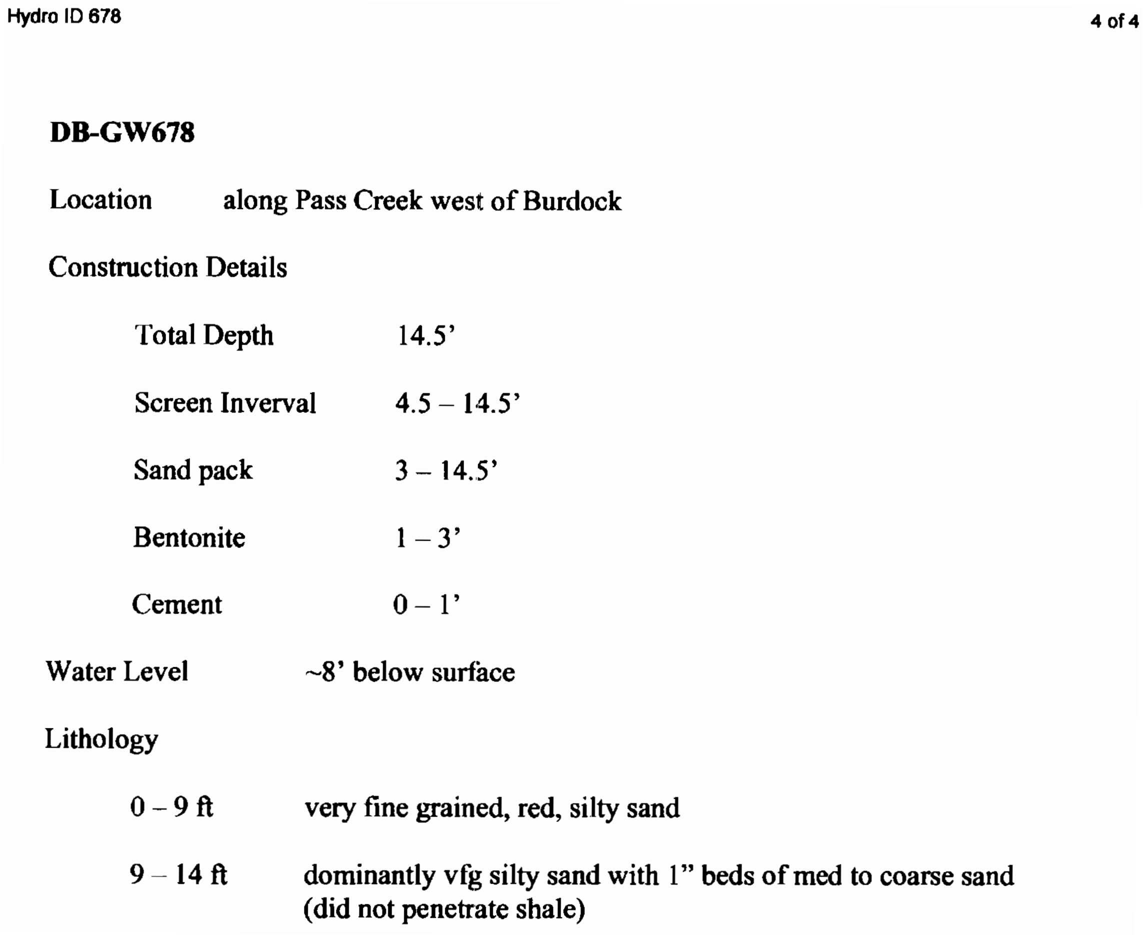


Hydro ID 678

4 of 4

**DB-GW678**

Location along Pass Creek west of Burdock

Construction Details

| | |
|---|---|
| Total Depth | 14.5’ |
| Screen Inverval | 4.5 – 14.5’ |
| Sand pack | 3 – 14.5’ |
| Bentonite | 1 – 3’ |
| Cement | 0 – 1’ |

Water Level ~8’ below surface

Lithology

| | |
|---|---|
| 0 – 9 ft | very fine grained, red, silty sand |
| 9 – 14 ft | dominantly vfg silty sand with 1” beds of med to coarse sand (did not penetrate shale) |

POWERTECH (USA) INC.

Hydro ID 679

# SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 4 07-92

Location NW ¼ SE ¼ Sec 27 Twp 6S Rg 1E

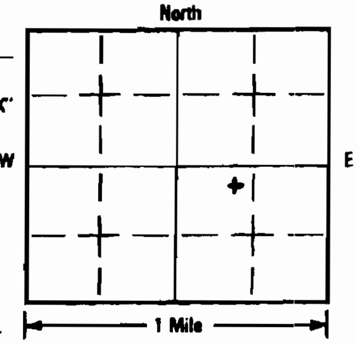
County
Custer

Please mark well location with an "X"

Long -103.983091

Lat 43.499534

Well Completion Date
9/26/2007



Well Owner: Powertech

Business Name: Same

Address: 145 N. Chicago Avenue, Suite C
Hot Springs, SD 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| See attached boring log | | |

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**LOCATION:**
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from ____ (identify source).

**PROPOSED USE:**
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

**METHOD OF DRILLING:**
4¼ ID HSA

**CASING DATA:** ☐ Steel ☒ Plastic ☐ Other
If other describe PVC

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| LB/FT | ~~2~~ IN | ~~19~~ FT | ~~39~~ FT | ~~8½~~ IN |
| LB/FT | 2 IN | 2' above FT | 19 below FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| | | lb./gal | 1 ft. | 16 ft |
| | | lb./gal | ft. | ft |

Describe grouting procedure Tremie pipe placement

**SCREEN:** ☐ Perforated pipe ☒ Manufactured
Diameter 2 IN Length 20 FEET
Material PVC
Slot Size 0.010 Set From 19 Feet to 39 Feet
Other information

**WAS A PACKER OR SEAL USED?** ☒ YES ☐ NO
If so, what material? 2' Bentonite
Describe packer(s) and location? Above Sand Pack

**DISINFECTION:** Was well disinfected upon completion?
____ YES, How:
X NO, Why Not? Well not used for human or domestic animals

Laboratory sent to for water quality analysis

**STATIC WATER LEVEL** 31.28 Feet
If flowing: closed in pressure Not flowing PSI
GPM flow ____ through ____ inch pipe
Controlled by ☐ Valve ☐ Reducers ☐ Other
Reduced Flowrate ____ GPM
Can well be completely shut in?

**WELL TEST DATA:**
☐ Pumped
☒ Bailed
☐ Other

Describe: Well developed using a bailer. Well did not bail down

Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM
If pump installed, pump rate ____ GPM

**REMARKS**

Well Description: DB-GW679

This well was drilled under license # 678
And this report is true and accurate.
Drilling firm American Engineering Testing, Inc
Signature of License Representative:
Signature of Well Owner or Equitable Property Holder:
X
Date: 11/7/07

1-15-08

AMERICAN ENGINEERING TESTING, INC.

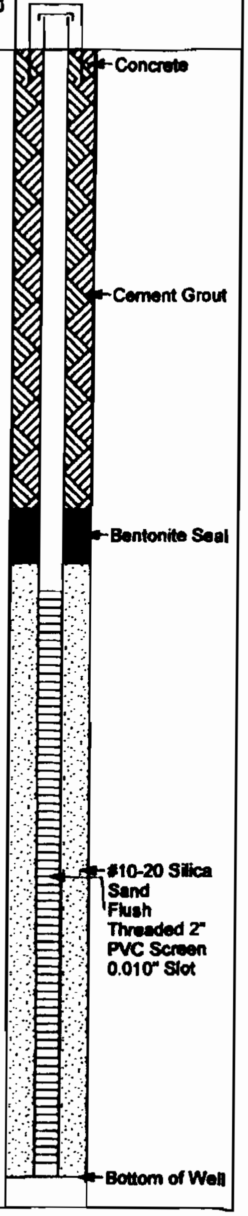
2 of 4

# BORING/WELL CONSTRUCTION LOG

| | | | |
|---|---|---|---|
| **PROJECT NUMBER** | 18-02617 | **BORING/WELL NUMBER** | B-5/DB-GW679 |
| **PROJECT NAME** | Dewey Burdock Monitor Well Installation | **DATE DRILLED** | 9/25/07 |
| **LOCATION** | Burdock, South Dakota | **CASING TYPE/DIAMETER** | 2" ID Schedule 40 PVC |
| **DRILLING METHOD** | 4.25" ID HSA | **SCREEN TYPE** | 2" ID Schedule 40 PVC Slotted 0.010" |
| **SAMPLING METHOD** | Continuous | **PACKING TYPE** | #10-20 Silica Sand |
| **GROUND ELEVATION** | | **GROUT TYPE** | Cement |
| **TOP OF CASING** | | **DEPTH TO WATER** | |
| **LOGGED BY** | CH | **GROUND WATER ELEVATION** | |
| **REMARKS** | Well was completed with a 4" Pro Top | | |

| HNU (ppm) | Blow Count | RECOVERY (inches) | SAMPLER TYPE | INTERVAL | DEPTH (ft. BGL) | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION | GW LEVEL |
|---|---|---|---|---|---|---|---|---|---|
| | | | CSTS 1 | | 1 | | | **TOPSOIL**, dark brown, dry<br>**SANDY SILT**, red, dry | |
| | | | CSTS 2 | | 2 | | | | |
| | | | | | 3 | | | | |
| | | | | | 4 | | | **SILTY SAND**, red to tan, dry to moist | |
| | | | CSTS 3 | | 5 | | | | |
| | | | | | 6 | | | | |
| | | | | | 7 | | | | |
| | | | | | 8 | | | | |
| | | | | | 9 | | | | |
| | | | CSTS 4 | | 10 | | | | |
| | | | | | 11 | | | | |
| | | | | | 12 | | | | |
| | | | | | 13 | | | | |
| | | | | | 14 | | | | |
| | | | CSTS 5 | | 15 | | | | |
| | | | | | 16 | | | | |
| | | | | | 17 | | | **SAND WITH GRAVEL**, red moist | |
| | | | CSTS 6 | | 18 | | | **COBBLES**, no recovery | |
| | | | CSTS 7 | | 19 | | | **SILTY SAND TO SAND** red to tan, moist | |
| | | | CSTS 8 | | 20 | | | | |
| | | | | | 21 | | | | |
| | | | | | 22 | | | | |
| | | | | | 23 | | | | |
| | | | | | 24 | | | **SAND with GRAVEL**, red, moist | |
| | | | CSTS 9 | | 25 | | | | |
| | | | | | 26 | | | | |
| | | | | | 27 | | | **SANDY LEAN CLAY**, red moist | |
| | | | CSTS 10 | | 28 | | | | |
| | | | | | 29 | | | **SAND WITH GRAVEL**, red moist 6 inch gray layer of sand at 30 feet | |
| | | | CSTS 11 | | 30 | | | | |
| | | | | | 31 | | | | |
| | | | | | 32 | | | | |
| | | | | | 33 | | | | |
| | | | | | 34 | | | | |
| | | | CSTS 12 | | 35 | | | | |
| | | | | | 36 | | | | |
| | | | CSTS 13 | | 37 | | | **SHALE**, black, moist | |
| | | | | | 38 | | | | |
| | | | | | 39 | | | | |

BORING ABANDONED



AET_ENVI 18-02617 MW.GPJ AET_ENVI.GDT 11/2/07

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TESTING, INC.

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January 11, 2008

Mr. Ken Buhler
Department of Environment and Natural Resources (DENR)
Water Rights Division
Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501-3181

Subject: South Dakota Water Well Completion Reports
Wells Installed for Powertech
Burdock, South Dakota
AET No. 18-02617

Dear Mr. Buhler:

Enclosed please find the well completion reports for five groundwater monitoring wells, DB-GW675, DB-GW676, DB-GW677, DB-GW678 & DB-GW679 .The wells were completed to obtain information on the potential shallow groundwater impacts from previous uranium mining within the project area prior to initiating new uranium production activities within the Dewey-Burdock, South Dakota area. If you have any questions or need any additional information please contact me at (605) 388-0029.

Sincerely,

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Environmental Scientist
Project Manager

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attachments

pc: Mr. Cory Foreman, RESPEC

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B-5 Hydro ID 619B - GW679 4 of 4

6" Topsoil - Dk Brn, Dry

To 5' Sandy Silt, Red Dry

To 10' Silty Sand, Rd to Tan, Dry to moist

To 15 Same, Red

To 17 Same

17-17½ Sand w/Gravel, Red, moist

17½-18 Cobbles, no recovery

TO 25 Silty Sand to Sand, Rd to Tan, moist

T 27 Sand w/gravel, Red, moist

To 29 Sandy Loam Clay, Red, wet

To 30 Sand w/ gravel, Red, moist, 6" Gray layer of Sand.

To 35 Sand w/gravel, Red, moist sat @ 34.

To 36½ Same

To 39 Shale, Dk Black, moist

COMPLETED BY: ______ REVIEWED BY: ______

POWERTECH (USA) INC.

NE 1/4 SW 1/4

Hydro ID 680

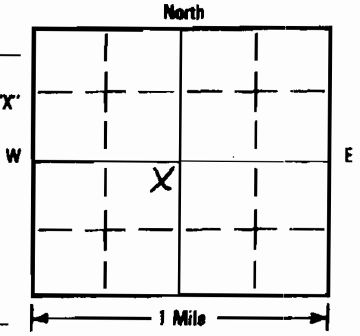
# SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 11 07-92

Location ~~SW~~ ¼ ~~NW~~ ¼ Sec 11 Twp 7S Rg 1E

County Fall River

Please mark well location with an "X"



Well Completion Date 12-19-07

**LOCATION:**
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from NONE Present (identify source).

**PROPOSED USE:**
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

**METHOD OF DRILLING:**
Mud Rotary

**CASING DATA:** ☐ Steel ☒ Plastic ☐ Other

If other describe ____

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| SDR 21 LB/FT | 6 IN | 0 FT | 426 FT | 8¾ IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| CMT | 95.3 | 15.1 lb./gal | 426 ft. | 0 ft. |
| | | lb./gal | ft. | ft. |

Describe grouting procedure pump

**SCREEN:** ☐ Perforated pipe ☒ Manufactured
Diameter 4½ IN Length 10 FEET
Material PVC
Slot Size .025 Set From 436 Feet to 426 Feet
Other information Set With K Packer

**WAS A PACKER OR SEAL USED?** ☑ YES ☐ NO
If so, what material? 6" K Packer
Describe packer(s) and location? · Packer 406'

**DISINFECTION:** Was well disinfected upon completion?
____ YES, How: ____
X NO, Why Not? N A

Laboratory sent to for water quality analysis
Respec

1-14-08

Well Owner: [redacted] [redacted] Powertec
Business Name: Powertech USA Inc
Address: P.O. Box 723
Hot Springs S.D 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Skull Creek Sh | 0' | 122' |
| Fall River SS | 122' | 250' |
| Fuson Sh | 250' | 317' |
| Lakota SS | 317' | 436' |

**STATIC WATER LEVEL** 29 Feet
If flowing: closed in pressure NA PSI
GPM flow ____ through ____ inch pipe
Controlled by ☐ Valve ☐ Reducers ☐ Other ____
Reduced Flowrate ____ GPM
Can well be completely shut in? YES

**WELL TEST DATA:**
☐ Pumped Describe: Airlift AT 385'
☐ Bailed
☑ Other
Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped 240 cubic Feet GPM
____ ft. After ____ Hrs. pumped ____ GPM
If pump installed, pump rate ____ GPM

**REMARKS** Well DB-07-11-11C
lithology attached.

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This well was drilled under license # 745
And this report is true and accurate.
Drilling firm DAVIS Drilling Inc
Signature of License Representative: Stan Davis
Signature of Well Owner or Equitable Property Holder: Powertech (USA) Inc
Date: 12-31-07

Hydro ID 680

# PowerTech (USA) Inc.

2 of 11

DRILLED WITH: AIR ☐ WATER ☒ HOLE NO. DB07-11-11C

T.D. 450' LOCATION: Section 11 T7S R1E 10' SE of 11-4C

BIT SIZE 6¼" to 3" core w/ 4½" bit.

SAMPLE LOG BY LE LEASE: (PROJECT) Dewey Burdock

DATE 10/10/07 COUNTY Fall R. County STATE SD

DEPTH | LITHOLOGY | CARBON | PYRITE | OTHER Mineralization | Alteration %: Primary Oxidation, Reduction, Secondary Oxidation

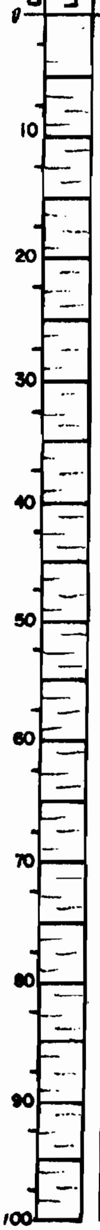
**SAMPLE DESCRIPTION**
(Amounts in Percent, %)

L = Limonite (Lmn)
SOX Surf. Oxidation
Rd. Reduced
Rdt. Reduction
P = Pyrite (Pyr)
$P_T$ = Pyrite Tarnish

POX = Primary Oxid.
BSOX = Base of Surf. Oxid.
2OX = Secondary Oxid.
Tz = Transition Zone
fld = Feldspar

T = Trace
1 = Minor
2 = Moderate
3 = Abundant

C = Carbon
K = Kaolin
B = Bleached
Cht = Chert



0-5'

silty CLAYSTONE, med. brown

5-120'

SHALE, dk. gray-grayish black

PAGE 1 OF 3

Hydro ID 680

# PowerTech (USA) Inc.

3 of 11

DRILLED WITH: AIR ☐ WATER ☐ HOLE NO. DGMT-11-11C

T.D. ______ LOCATION: ______

BIT SIZE ______

SAMPLE LOG BY ______ LEASE: (PROJECT) ______

DATE ______ COUNTY ______ STATE ______

**SAMPLE DESCRIPTION** (Amounts in Percent, %)

L = Limonite (Lmn) · SOX Surf. Oxidation · Rd. Reduced · Rdt. Reduction · P = Pyrite (Pyr) · $P_T$ = Pyrite Tarnish

POX = Primary Oxid. · BSOX = Base of Surf. Oxid. · SOX = Secondary Oxid. · Tz = Transition Zone · fld = Feldspar

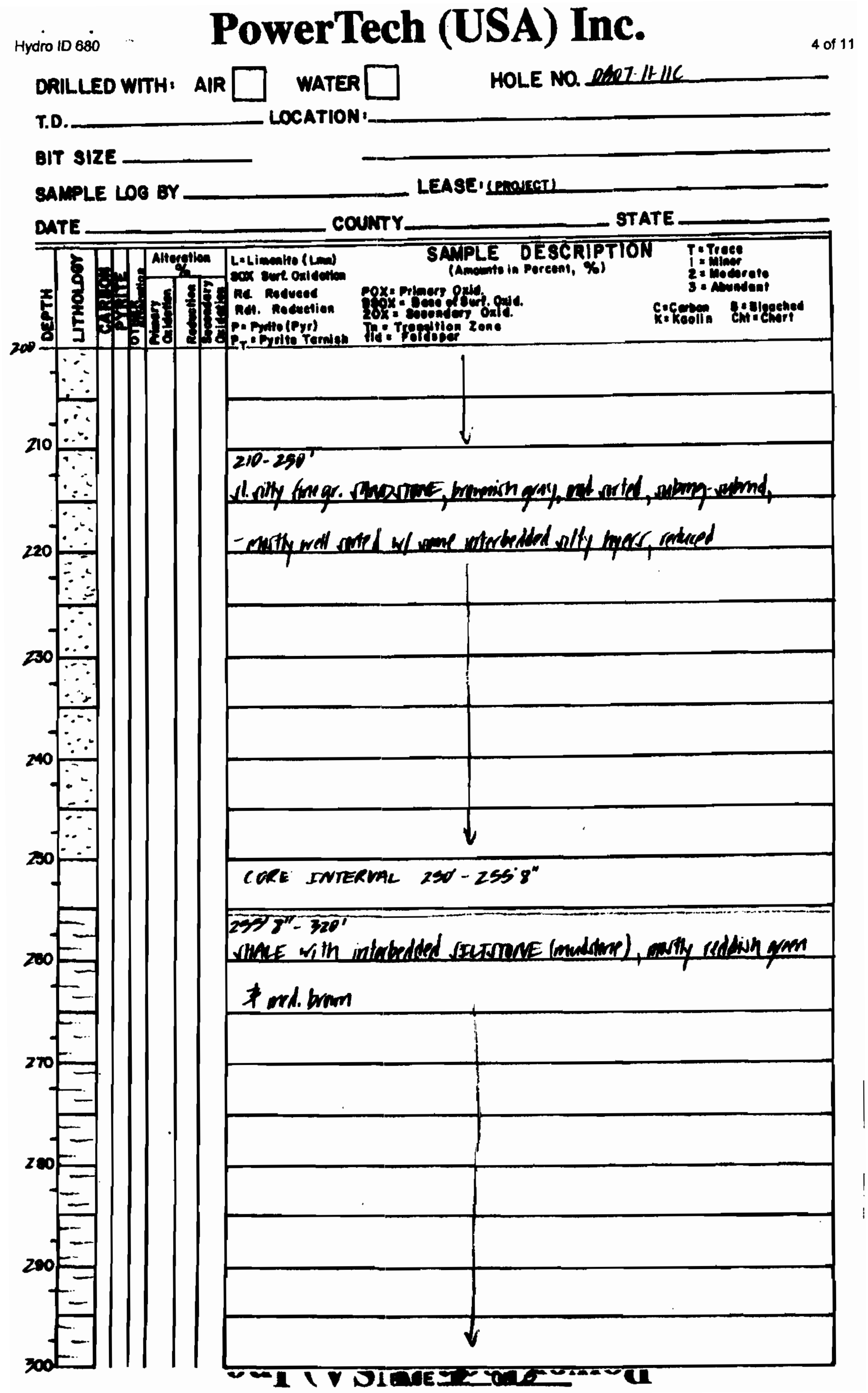
T = Trace · 1 = Minor · 2 = Moderate · 3 = Abundant

C = Carbon · B = Bleached · K = Kaolin · Cht = Chert

Columns: DEPTH · LITHOLOGY · CARBON · PYRITE · OTHER · Alteration %: Primary Oxidation · Reduction · Secondary Oxidation

| DEPTH | SAMPLE DESCRIPTION |
|---|---|
| 100 | ↓ |
| 110 | |
| 120 | 120-135'<br>silty SHALE, dk. gray<br>↓ |
| 130 | |
| 140 | 135-210'<br>sandy SILTSTONE, silty fine gr. SANDSTONE, grayish brown, poorly sorted, subang; alternating sandy & silty layers,<br>↓ |
| 150 | |
| 160 | |
| 170 | |
| 180 | |
| 190 | |
| 200 | |

PAGE 2 OF 5



Hydro ID 680

# PowerTech (USA) Inc.

4 of 11

DRILLED WITH: AIR ☐ WATER ☐ HOLE NO. DA07-11-11C

T.D. LOCATION:

BIT SIZE

SAMPLE LOG BY LEASE: (PROJECT)

DATE COUNTY STATE

| DEPTH | LITHOLOGY | CARBON | PYRITE | OTHER Mineralization | Alteration % Primary Oxidation | Reduction | Secondary Oxidation | SAMPLE DESCRIPTION (Amounts in Percent, %) |
|---|---|---|---|---|---|---|---|---|
| 200 | | | | | | | | |
| 210 | | | | | | | | 210-250' sl. silty fine gr. SANDSTONE, brownish gray, mod sorted, subang-subrnd, - mostly well sorted w/ some interbedded silty layers, reduced |
| 220 | | | | | | | | |
| 230 | | | | | | | | |
| 240 | | | | | | | | |
| 250 | | | | | | | | CORE INTERVAL 250 - 255'8" |
| | | | | | | | | 255' 8" - 320' SHALE with interbedded SILTSTONE (mudstone), mostly reddish gray & med. brown |
| 260 | | | | | | | | |
| 270 | | | | | | | | |
| 280 | | | | | | | | |
| 290 | | | | | | | | |
| 300 | | | | | | | | |

L = Limonite (Lmn)
SOX Surf. Oxidation
Rd. Reduced
Rdt. Reduction
P = Pyrite (Pyr)
$P_T$ = Pyrite Tarnish
POX = Primary Oxid.
BSOX = Base of Surf. Oxid.
SOX = Secondary Oxid.
Tn = Transition Zone
fld = Feldspar
T = Trace
1 = Minor
2 = Moderate
3 = Abundant
C = Carbon
K = Kaolin
B = Bleached
Cht = Chert

Hydro ID 680

# PowerTech (USA) Inc.

DRILLED WITH: AIR ☐ WATER ☐ HOLE NO. DB07-11-11C

T.D. ______ LOCATION: ______

BIT SIZE ______

SAMPLE LOG BY ______ LEASE: (PROJECT) ______

DATE ______ COUNTY ______ STATE ______

DEPTH | LITHOLOGY | CARBON | PYRITE | OTHER | Alteration %: Primary Oxidation, Reduction, Secondary Oxidation

**SAMPLE DESCRIPTION**
(Amounts in Percent, %)

L = Limonite (Lim)
SOX Surf. Oxidation
Rd. Reduced
Rdt. Reduction
P = Pyrite (Pyr)
$P_T$ = Pyrite Tarnish

POX = Primary Oxid.
BSOX = Base of Surf. Oxid.
2OX = Secondary Oxid.
Tz = Transition Zone
fld = Feldspar

T = Trace
1 = Minor
2 = Moderate
3 = Abundant

C = Carbon
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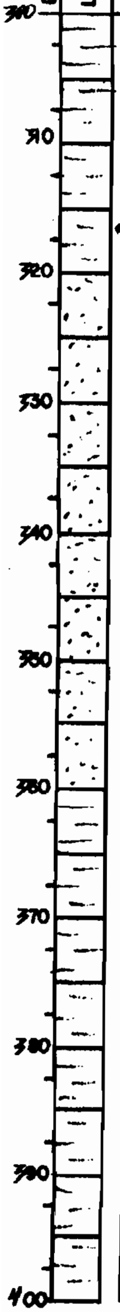


320-360'
fine gr. SANDSTONE, lt. brown-grayish brown, well sorted, ang-subrnd,
- more silty from 335-360' = mod sorted, mostly reduced <5% ox.

360-410'
mostly SHALE with some silt interbeds, med. gray

PAGE 4 OF 5

Hydro ID 680

# PowerTech (USA) Inc.

6 of 11

DRILLED WITH: AIR ☐ WATER ☐

HOLE NO. DB07-11-11C

T.D. ______ LOCATION: ______

BIT SIZE ______

SAMPLE LOG BY ______ LEASE: (PROJECT) ______

DATE ______ COUNTY ______ STATE ______

SAMPLE DESCRIPTION (Amounts in Percent, %)

L = Limonite (Lmn)
SOX Surf. Oxidation
Rd. Reduced
Rdt. Reduction
P = Pyrite (Pyr)
$P_T$ = Pyrite Tarnish

POX = Primary Oxid.
BSOX = Base of Surf. Oxid.
SOX = Secondary Oxid.
Tn = Transition Zone
fld = Feldspar

T = Trace
1 = Minor
2 = Moderate
3 = Abundant

C = Carbon
K = Kaolin
B = Bleached
Cht = Chert

| DEPTH | LITHOLOGY | CARBON | PYRITE | OTHER Mineralization | Alteration % Primary Oxidation | Reduction | Secondary Oxidation | SAMPLE DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| 400 | | | | | | | | ↓ |
| | | | | | | | | ↓ |
| 410 | | | | | | | | CORE INTERVAL 410'-420' ↓ |
| | | | | | | | | ↓ |
| 420 | | | | | | | | CORE INTERVAL 420-430' ↓ |
| | | | | | | | | ↓ |
| 430 | | | | | | | | CORE INTERVAL 430-440' ↓ |
| | | | | | | | | ↓ |
| 440 | | | | | | | | CORE INTERVAL 440'-450' ↓ |
| | | | | | | | | ↓ TD 450' END OF HOLE |
| 450 | | | | | | | | |
| | | | | | | | | |
| 460 | | | | | | | | |
| | | | | | | | | |
| 470 | | | | | | | | |
| | | | | | | | | |
| 480 | | | | | | | | |
| | | | | | | | | |
| 490 | | | | | | | | |
| | | | | | | | | |
| 500 | | | | | | | | |

PAGE 5 OF 5

Hydro ID 680

# PowerTech (USA) Inc.

7 of 11

DRILLED WITH: AIR ☐ WATER ☒ HOLE NO. DB07-11-11C

T.D. 450' LOCATION: Sec 11, T7S, R1E 10' SE of 11-4C

BIT SIZE 6¼" to 3" core of 4.5" bit

SAMPLE LOG BY DJ LEASE: (PROJECT) Dewey Burdock

DATE 10/09/07 COUNTY Fall River STATE SD

DEPTH | LITHOLOGY | CARBON | PYRITE | OTHER Alteration | Alteration %: Primary Oxidation, Reduction, Secondary Oxidation

**SAMPLE DESCRIPTION**
(Amounts in Percent, %)

L = Limonite (Lm)
SOX Surf. Oxidation
Rd. Reduced
Rdt. Reduction
P = Pyrite (Pyr)
$P_T$ = Pyrite Tarnish

POX = Primary Oxid.
BSOX = Base of Surf. Oxid.
2OX = Secondary Oxid.
Tn = Transition Zone
fld = Feldspar

T = Trace
1 = Minor
2 = Moderate
3 = Abundant

C = Carbon
K = Kaolin
B = Bleached
Cht = Chert

2500

CORE interval starts @ 249,1" grey, fine-grained, subrounded, pyritic clean, well-sorted, trace silt, qtz ss. colorless qtz grains. Heavy pyrite @ 250,4" to 250,5.5"

At 250,9" contact black + dark gray fissile shale + mudstone.

2510

2520

2530

2540

254,9" Increase in plastic clay content and decrease in fissility

255,2" grades quickly back to fissile shale and mudstone.

2550

255,8" TD of core run.

2560

2570

2580

2590

CONFIDENTIAL

2600

PAGE 1 OF CORE

# PowerTech (USA) Inc.

DRILLED WITH: AIR ☐ WATER ☐ HOLE NO. DB07-11-11C

T.D. ____ LOCATION: ____

BIT SIZE 6¼"

SAMPLE LOG BY ____ LEASE: (PROJECT) ____

DATE ____ COUNTY ____ STATE ____

**SAMPLE DESCRIPTION** (Amounts in Percent, %)

L = Limonite (Lim)
SOX Surf. Oxidation
Rd. Reduced
Rdt. Reduction
P = Pyrite (Pyr)
$P_T$ = Pyrite Tarnish
POX = Primary Oxid.
BSOX = Base of Surf. Oxid.
2OX = Secondary Oxid.
Tn = Transition Zone
fld = Feldspar
T = Trace
1 = Minor
2 = Moderate
3 = Abundant
C = Carbon
K = Kaolin
B = Bleached
Cht = Chert

| DEPTH | LITHOLOGY | CARBON | PYRITE | OTHER Alteration | Alteration % Primary Oxidation | Alteration % Reduction | Alteration % Secondary Oxidation | SAMPLE DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| 410 | | | | | | | | 410'-413 lt.gray-gray low fissility SHALE/CLAYSTONE |
| | | | | | | | | *410' 7½" - 410' 10½" SILTSTONE layer - well cemented |
| 4/10 | | | | | | | | |
| 4/20 | | | | | | | | |
| 4/30 | | | | | | | | 413'-419'10" lt.gray-gray SHALE, subparallel fissility, v. low strength |
| 4/40 | | | | | | | | |
| 4/50 | | | | | | | | |
| 4/60 | | | | | | | | |
| 4/70 | | | | | | | | |
| 4/80 | | | | | | | | |
| 4/90 | | | | | | | | |
| | | | | | | | | *TOTAL RUN LENGTH 10'4" recovered 9'6" |
| 4200 | | | | | | | | |

CONFIDENTIAL

PAGE 2 OF CORE

Hydro ID 680

# PowerTech (USA) Inc.

9 of 11

DRILLED WITH: AIR ☐ WATER ☐ HOLE NO. DB07-11-11C

T.D. ______ LOCATION: ______

BIT SIZE ______

SAMPLE LOG BY ______ LEASE: (PROJECT) ______

DATE ______ COUNTY ______ STATE ______

DEPTH | LITHOLOGY | CARBON | PYRITE | OTHER Alteration | Alteration %: Primary Oxidation, Reduction, Secondary Oxidation

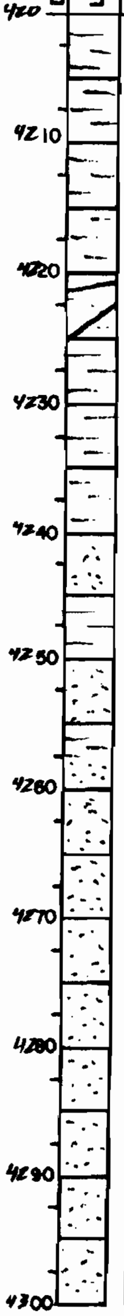
**SAMPLE DESCRIPTION**
(Amounts in Percent, %)

L=Limonite (Lmn)
SOX Surf. Oxidation
Rd. Reduced
Rdt. Reduction
P= Pyrite (Pyr)
$P_T$ = Pyrite Tarnish

POX= Primary Oxid.
BSOX = Base of Surf. Oxid.
2OX = Secondary Oxid.
Tn = Transition Zone
fld = Feldspar

T= Trace
1 = Minor
2 = Moderate
3 = Abundant

C=Carbon
K=Kaolin
B=Bleached
Cht=Chert



420-424' lt.gray-gray SHALE, subparallel fissility, v. low strength

←★ low angle slip plane 422'1"
←★ 422'6" slip plane ~45°

424-500' sl. silty, fine gr. SANDSTONE lt.gray - lt.brownish gray,
- mod-well sorted, subang-subrnded, mostly subrnded, mostly well-
- cemented, mod. cemented 425-425'3" & 426'-426'5.5",
- ss/shale interbedded from 424'-425'X", continuous carbon layers
- from 426'-426'5.5", scat. pyrite

CONFIDENTIA

★ TOTAL RUN LENGTH 16'7" recovered 16'0"

PAGE 3 OF CORE

# PowerTech (USA) Inc.

DRILLED WITH: AIR ☐ WATER ☐ HOLE NO. DB07-11-11C 10 of 11

T.D. ______ LOCATION: ______

BIT SIZE ______ ______

SAMPLE LOG BY ______ LEASE: (PROJECT) ______

DATE ______ COUNTY ______ STATE ______

| DEPTH | LITHOLOGY | CARBON | PYRITE | OTHER Alteration | Alteration % Primary Oxidation | Reduction | Secondary Oxidation | SAMPLE DESCRIPTION (Amounts in Percent, %) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | L=Limonite (Lim)<br>SOX Surf. Oxidation<br>Rd. Reduced<br>Rdt. Reduction<br>P= Pyrite (Pyr)<br>P$_T$= Pyrite Tarnish<br>POX= Primary Oxid.<br>BSOX= Base of Surf. Oxid.<br>2OX= Secondary Oxid.<br>Tn= Transition Zone<br>fld= Feldspar<br>T=Trace<br>1=Minor<br>2=Moderate<br>3=Abundant<br>C=Carbon<br>K=Kaolin<br>B=Bleached<br>Cht=Chert |
| 430 | | | | | | | | 430-431' SAMPLE WASHED AWAY |
| | | | | | | | | |
| 4310 | | | | | | | | 431-432'6" v.sl. silty, fine gr. SANDSTONE, lt. gray - lt. brownish gray,<br>- well-sorted, subang-subrnded, mostly subrnded, well-cemented, scat. pyrite |
| | | | | | | | | |
| 4320 | | | | | | | | |
| | | | | | | | | 432'6" - 438'5" silty, v. fine gr. SANDSTONE, lt. gray - lt. brownish gray,<br>- mod. sorted, subang-subrnded, mod. cemented - poorly cemented, scat. pyrite, |
| 4330 | | | | | | | | - thin, continuous, low angle carbon stringers 432'9" - 433'6" |
| | | | | | | | | - calcite cement ? - will need to test w/ acid, coated qtz. grains -> |
| 4340 | | | | | | | | - translucent "root beer" colored coating, low angle bedding evident by |
| | | | | | | | | - alternating dk + lt. layers in sands. |
| 4350 | | | | | | | | ~200 μR/hr 435-436', 40 μR/hr rest of sands |
| | | | | | | | | |
| 4360 | | | | | | | | |
| | | | | | | | | |
| 4370 | | | | | | | | |
| | | | | | | | | |
| 4380 | | | | | | | | * bottom 8" SAA, but mostly fine gr. SS |
| | | | | | | | | 438'5" - 440'0" SAMPLE WASHED AWAY |
| 4390 | | | | | | | | |
| | | | | | | | | |
| 4400 | | | | | | | | |

CONFIDENTIAL

PAGE 4 OF CORE

Hydro ID 680

# PowerTech (USA) Inc.

11 of 11

DRILLED WITH: AIR ☐ WATER ☐ HOLE NO. DB07-11-11C

T.D. ______ LOCATION: ______

BIT SIZE ______

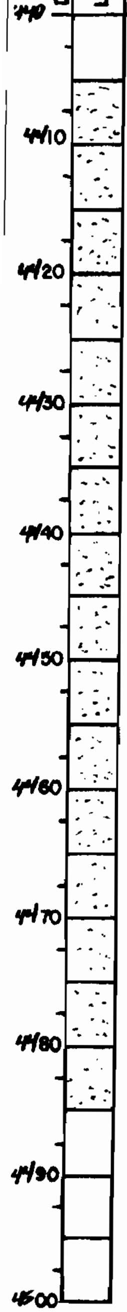
SAMPLE LOG BY ______ LEASE: (PROJECT) ______

DATE ______ COUNTY ______ STATE ______

**SAMPLE DESCRIPTION**
(Amounts in Percent, %)

| | | |
|---|---|---|
| L=Limonite (Lmn) | | T = Trace |
| SOX Surf. Oxidation | | 1 = Minor |
| Rd. Reduced | POX= Primary Oxid. | 2 = Moderate |
| Rdt. Reduction | BSOX = Base of Surf. Oxid. | 3 = Abundant |
| P= Pyrite (Pyr) | 2OX = Secondary Oxid. | C=Carbon B=Bleached |
| $P_T$ = Pyrite Tarnish | Tn = Transition Zone<br>fld = Feldspar | X=Kaolin Cht=Chert |

DEPTH | LITHOLOGY | CARBON | PYRITE | OTHER Mineralization | Alteration %: Primary Oxidation | Oxidation | Reduction | Secondary Oxidation



440 - 440'6" CORE WASHED AWAY

440'6" - 441'10" fine gr. SANDSTONE, lt. gray - lt. brownish gray, mod-well
- sorted, subang - subrounded, mostly subrounded, well-cemented, thin, continuous
- carbon layers

441'10" - 448'10" fine-med. gr. SANDSTONE, lt brownish gray - med. gray, poorly
- sorted, ang - subrounded, sub. coarse gr. sand in 441'10" -> 444'0", med-coarse
- gr. SANDSTONE 444'0" -> 446'1", dominant coarse gr. at bottom, sub. pyrite,
- fine gr SS 446'1" - 447'3", med gr. SS 447'3" - 448'10"
- lots of chert = coarse grains - angular

* med-coarse gr SS (444'0" - 446'1")

- 20 μR/hr = all core

* fine gr. SS (446'1" - 447'3")

* med gr. SS w/ sub - abundant coarse gr. (447'3" - 448'10")

- carbon fossil stringer @ 447'10"

448'10" - 449'7" CORE LOSS

CONFIDENTIAL

* TOTAL RUN LENGTH 9'7" recovered 8'6"

PAGE 5 OF CORE

Hydro ID 681

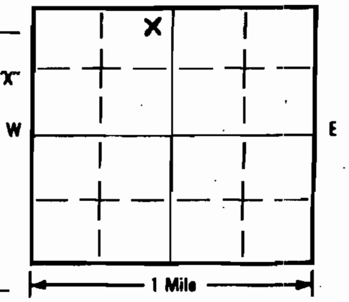
# SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NE ¼ NW ¼ Sec 32 Twp 6S Rg 1E

County CUSTER

Please mark well location with an "X"



Well Completion Date 1-27-08

Well Owner: Power-tech

Business Name: Power-tech USA Inc

Address: P.O Box 723
Hot Springs S.D 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Skull Creek Shale | 0 | 470' |
| Fall River Sandstone | 470' | 585' |

**LOCATION:**
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from NONE Present (identify source).

**PROPOSED USE:**
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

**METHOD OF DRILLING:**
Mud Rotary

**CASING DATA:** ☐ Steel ☒ Plastic ☐ Other
If other describe

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| SDR 21 LB/FT | 6 IN | 0 FT | 585 FT | 8¾ IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| CMT | 96 | 15.2 lb./gal | 585 ft | 0 ft |
| | | lb./gal | ft | ft |

Describe grouting procedure pump

**SCREEN:** ☐ Perforated pipe ☒ Manufactured
Diameter 3 IN Length 15 FEET
Material PVC
Slot Size .020 Set From 600 Feet to 585 Feet
Other information Set K Packer

**WAS A PACKER OR SEAL USED?** ☒ YES ☐ NO
If so, what material? 6" K Packer
Describe packer(s) and location? Packer 575'

**DISINFECTION:** Was well disinfected upon completion?
____ YES, How:
✓ NO, Why Not? NA

Laboratory sent to for water quality analysis
Respec

**STATIC WATER LEVEL** 0 Feet
If flowing: closed in pressure 6.1 PSI
GPM flow 10 through 2 inch pipe
Controlled by ☒ Valve ☐ Reducers ☐ Other
Reduced Flowrate ____ GPM
Can well be completely shut in? YES

**WELL TEST DATA:**
☐ Pumped Describe: Air lift at 575'
☐ Bailed
☒ Other
Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM
If pump installed, pump rate ____ GPM

**REMARKS** Dewey Burdock 32-3C

RECEIVED
FEB 22 2008
WATER RIGHTS PROGRAM

This well was drilled under license # 745
And this report is true and accurate.
Drilling firm Davis Drilling Inc
Signature of License Representative: Stan Dav
Signature of Well Owner or Equitable Property Holder: PowerTech
Date: 2/13/08

7S

Hydro ID 682

# SOUTH DAKOTA WATER WELL COMPLETION REPORT

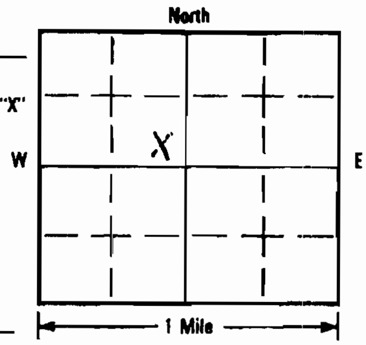
1 of 1

07-92

ocation SE ¼ NW ¼ Sec 11 Twp 6S Rg 1E

ounty Fall River

lease mark well location with an "X"



Well Completion Date 2-21-08

**OCATION:**

istance from nearest potential pollution source (septic tank, abandoned well, eed lot, etc.)? ______ ft. from NONE present (identify source).

**ROPOSED USE:**

☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes

☐ Irrigation ☐ Industrial ☐ Institutional ☑ Monitoring well

**ETHOD OF DRILLING:**

Mud, Rotary

**ASING DATA:** ☐ Steel ☑ Plastic ☐ Other

 other describe ______

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| DR 17 LB/FT | 4 IN | 0 FT | 450 FT | 6¾ IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| CMT | 67 | 15.4 lb./gal | 0 ft. | 450 ft. |
| | | lb./gal | ft. | ft. |

Describe grouting procedure Pump

**SCREEN:** ☐ Perforated pipe ☑ Manufactured

Diameter 2 IN Length 10 FEET

Material PVC

Slot Size .020 Set From 460 Feet to 450 Feet

Other information Set K Packer

**WAS A PACKER OR SEAL USED?** ☑ YES ☐ NO

If so, what material? 4" K Packer

Describe packer(s) and location? Packer 440'

**DISINFECTION:** Was well disinfected upon completion?

______ YES, How:

X NO, Why Not? NA

aboratory sent to for water quality analysis

Respec

Well Owner: Power Tech

Business Name: PowerTech USA Inc

Address: P.O. Box 723

Hot Springs SD 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Skull Creek Shale | 0 | 145 |
| Fall River Sandstone | 145 | 310 |
| Fuson Shale | 310 | 335 |
| Lakota | 335 | 460 |

**STATIC WATER LEVEL** 54.2 Feet

If flowing: closed in pressure ______ PSI

GPM flow ______ through ______ inch pipe

Controlled by ☐ Valve ☐ Reducers ☐ Other ______

Reduced Flowrate ______ GPM

Can well be completely shut in? Yes

**WELL TEST DATA:**

☐ Pumped Describe: Airlift at 435'

☐ Bailed

☑ Other

Pumping Level Below Land Surface

______ ft. After ______ Hrs. pumped ______ GPM

______ ft. After ______ Hrs. pumped ______ GPM

If pump installed, pump rate ______ GPM

**REMARKS** Dewey Burdock

7-11-2

RECEIVED
MAR 24 2008
WATER RIGHTS PROGRAM

This well was drilled under license # 745

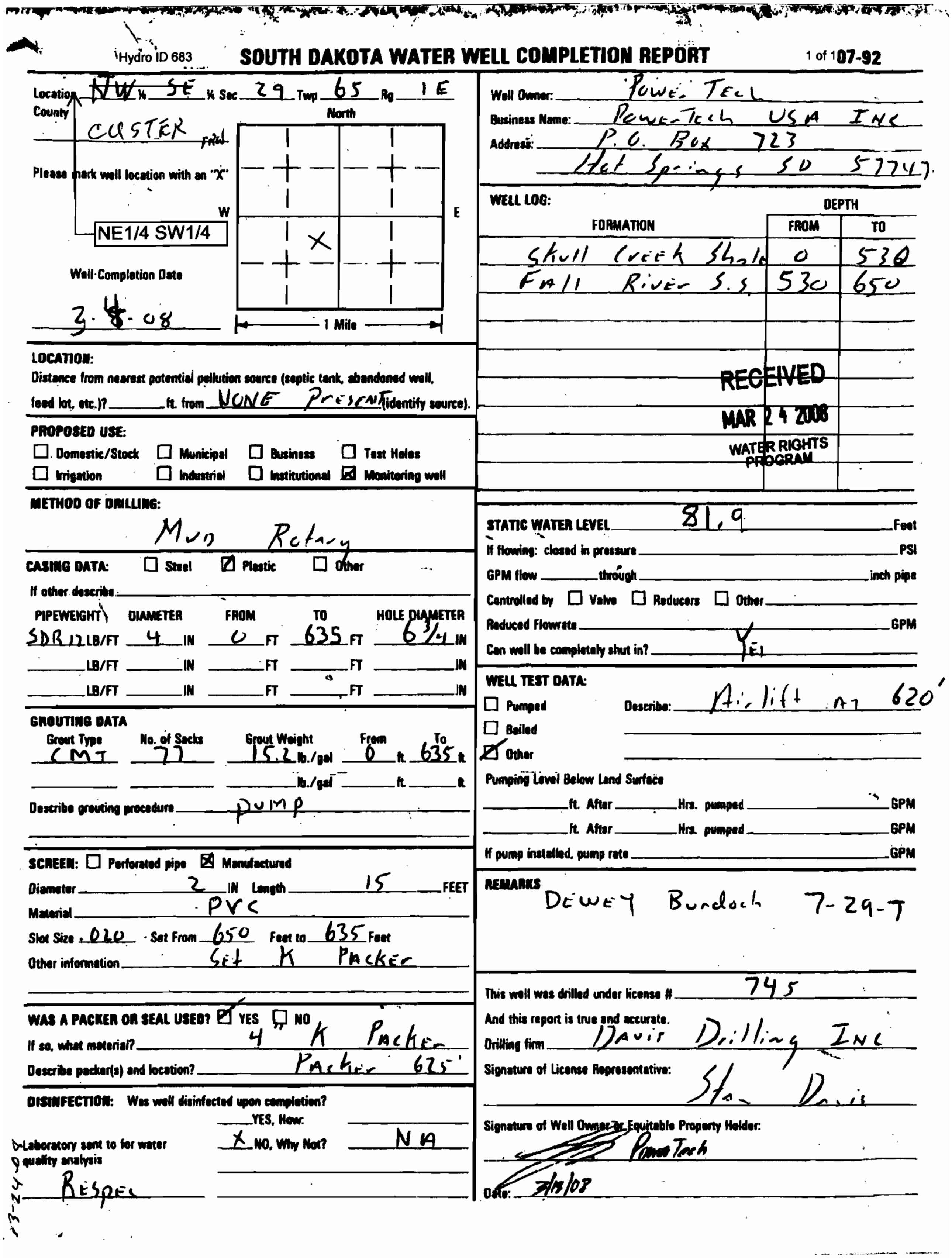
And this report is true and accurate

Drilling firm Davis Drilling Inc

Signature of License Representative: Stan Davis

Signature of Well Owner or Equitable Property Holder: PowerTech

Date: 3/5/08



Hydro ID 683

## SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NW ¼ SE ¼ Sec. 29 Twp 6S Rg 1E
County CUSTER Fall

Please mark well location with an "X"

NE1/4 SW1/4

Well Completion Date 3-8-08

**LOCATION:**
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from NONE Present (identify source).

**PROPOSED USE:**
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

**METHOD OF DRILLING:**
Mud Rotary

**CASING DATA:** ☐ Steel ☒ Plastic ☐ Other
If other describe ____

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| SDR 17 LB/FT | 4 IN | 0 FT | 635 FT | 6¾ IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| CMT | 77 | 15.2 lb./gal | 0 ft. | 635 ft. |
| | | lb./gal | ft. | ft. |

Describe grouting procedure pump

**SCREEN:** ☐ Perforated pipe ☒ Manufactured
Diameter 2 IN Length 15 FEET
Material PVC
Slot Size .020 Set From 650 Feet to 635 Feet
Other information Set K Packer

**WAS A PACKER OR SEAL USED?** ☒ YES ☐ NO
If so, what material? 4" K Packer
Describe packer(s) and location? Packer 625'

**DISINFECTION:** Was well disinfected upon completion?
____ YES, How:
X NO, Why Not? NA

Laboratory sent to for water quality analysis
Respec

Well Owner: Power Tech
Business Name: Power-Tech USA Inc
Address: P.O. Box 723
Hot Springs SD 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Skull Creek Shale | 0 | 530 |
| Fall River S.S. | 530 | 650 |

RECEIVED
MAR 24 2008
WATER RIGHTS PROGRAM

STATIC WATER LEVEL 81.9 Feet
If flowing: closed in pressure ____ PSI
GPM flow ____ through ____ inch pipe
Controlled by ☐ Valve ☐ Reducers ☐ Other ____
Reduced Flowrate ____ GPM
Can well be completely shut in? Yes

**WELL TEST DATA:**
☐ Pumped
☐ Bailed
☒ Other
Describe: Air lift at 620'

Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM
If pump installed, pump rate ____ GPM

**REMARKS**
Dewey Burdock 7-29-7

This well was drilled under license # 745
And this report is true and accurate.
Drilling firm Davis Drilling Inc
Signature of License Representative: Stan Davis
Signature of Well Owner or Equitable Property Holder: PowerTech
Date: 3/13/08

POWERTECH (USA) INC.

Hydro ID 684

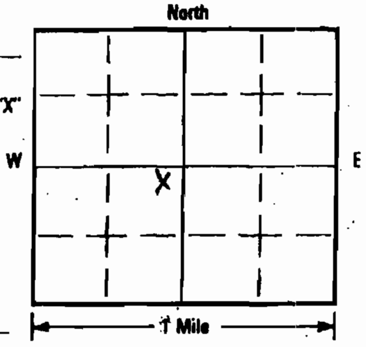
# SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NE ¼ SW ¼ Sec 11 Twp 7S Rg 1E

County Fall River

Please mark well location with an "X"



Well Completion Date 2-13-08

**LOCATION:**
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from NONE Present (identify source).

**PROPOSED USE:**
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

**METHOD OF DRILLING:**
Mud Rotary

**CASING DATA:** ☐ Steel ☑ Plastic ☐ Other
If other describe ____

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| SDR 17 LB/FT | 4 IN | 0 FT | 413 FT | 6¾ IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| CMT | 66 | 15.2 lb./gal | 0 ft. | 413 ft. |
| | | lb./gal | ft. | ft. |

Describe grouting procedure pump

**SCREEN:** ☐ Perforated pipe ☒ Manufactured
Diameter 2 IN Length 10 FEET
Material PVC
Slot Size .020 Set From 423 Feet to 413 Feet
Other information Sil K Packer

**WAS A PACKER OR SEAL USED?** ☑ YES ☐ NO
If so, what material? 4" K Packer,
Describe packer(s) and location? Packer 403'

**DISINFECTION:** Was well disinfected upon completion?
____ YES, How: ____
X NO, Why Not? NA

Laboratory sent to for water quality analysis
Respec

3-11-08

Well Owner: Power Tech
Business Name: Power Tech USA Inc
Address: P.O. Box 723
Hot Springs SD 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Skull Creek Shale | 0 | 102' |
| Fall River Sandstone | 102' | 238' |
| Fuson Shale | 238' | 300' |
| Lakota Sandstone | 300' | 423' |

RECEIVED
MAR 11 2008
WATER RIGHTS PROGRAM

STATIC WATER LEVEL 28.8 Feet
If flowing: closed in pressure ____ PSI
GPM flow ____ through ____ inch pipe
Controlled by ☐ Valve ☐ Reducers ☐ Other ____
Reduced Flowrate ____ GPM
Can well be completely shut in? Yes

**WELL TEST DATA:**
☐ Pumped Describe: Air lift AT 400'
☐ Bailed
☑ Other
Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM
If pump installed, pump rate ____ GPM

**REMARKS** DEWEY Burdock 11-14 C

This well was drilled under license # 745
And this report is true and accurate.
Drilling firm DAVIS Drilling Inc
Signature of License Representative: Steve Davis
Signature of Well Owner or Equitable Property Holder: PowerTech
Date: 2/7/08

Hydro ID 685

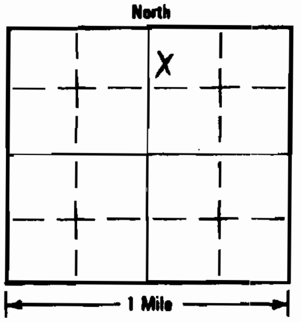
# SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NW ¼ NE ¼ Sec 32 Twp 6S Rg 1E

County Custer

Please mark well location with an "X"



Well Completion Date 2-4-08

Well Owner: Powertech

Business Name: Powertech USA Inc

Address: P.O. Box 723
Hot Springs S.D. 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Skull Creek Shale | 0 | 473' |
| Fall River Sandstone | 473' | 595' |

RECEIVED
MAR - 6 2008
WATER RIGHTS PROGRAM

**LOCATION:**

Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from NONE Present (identify source).

**PROPOSED USE:**

☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

**METHOD OF DRILLING:** Mud Rotary

**CASING DATA:** ☐ Steel ☒ Plastic ☐ Other

If other describe 0

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| SDR 17 LB/FT | 4 IN | ~~595~~ FT | 580 FT | 6¾ IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| CMT | 77 | 15.2 lb./gal | 0 ft. | 580 ft. |
| | | lb./gal | ft. | ft. |

Describe grouting procedure pump

**SCREEN:** ☐ Perforated pipe ☒ Manufactured

Diameter 2 IN Length 15 FEET

Material PVC

Slot Size .020 Set From 595 Feet to 580 Feet

Other information Set K Packer

**WAS A PACKER OR SEAL USED?** ☑ YES ☐ NO

If so, what material? 4" K Packer

Describe packer(s) and location? Packer 570'

**DISINFECTION:** Was well disinfected upon completion?

____ YES, How: ______

X NO, Why Not? NA

Laboratory sent to for water quality analysis Kelper

5-7-08

**STATIC WATER LEVEL** 0 Feet

If flowing: closed in pressure 6 PSI

GPM flow 15 through 2 inch pipe

Controlled by ☑ Valve ☐ Reducers ☐ Other

Reduced Flowrate ______ GPM

Can well be completely shut in? Yes

**WELL TEST DATA:**

☐ Pumped Describe: Air lift at 570'
☐ Bailed
☐ Other

Pumping Level Below Land Surface

______ ft. After ______ Hrs. pumped ______ GPM
______ ft. After ______ Hrs. pumped ______ GPM

If pump installed, pump rate ______ GPM

**REMARKS** Dewey Burdock 32-4 C

This well was drilled under license # 745

And this report is true and accurate.

Drilling firm Davis Drilling Inc

Signature of License Representative:

Signature of Well Owner or Equitable Property Holder: PowerTech

Date: 2/27/08

POWERTECH (USA) INC.

7S

Hydro ID 686

# SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

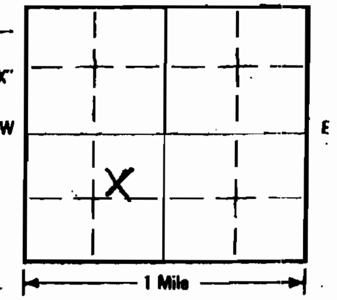
Location [redacted] ¼ [redacted] ¼ Sec [redacted] Twp 6S Rg 1E

County NE SW 11

Fall River

Please mark well location with an "X"

North



Well Completion Date

2-24-08

Well Owner: Power Tech

Business Name: Power Tech USA Inc

Address: P.O. Box 723
Hot Springs S.D 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Skull Creek Shale | 0 | 120 |
| Fall River SS | 120 | 255 |
| Fuson Shale | 255 | 315 |
| Lakota Sand Stone | 315 | 428 |

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**LOCATION:**

Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from NONE Present (identify source).

**PROPOSED USE:**

☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

**METHOD OF DRILLING:**

Mud Rotary

**CASING DATA:** ☐ Steel ☑ Plastic ☐ Other

If other describe ____

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| SDR 17 LB/FT | 4 IN | 0 FT | 419 FT | 6¾ IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| CMT | 70 | 15.2 lb./gal | 0 ft. | 418 ft. |
|  | / | lb./gal | ft. | ft. |

Describe grouting procedure Pump

**SCREEN:** ☐ Perforated pipe ☒ Manufactured

Diameter 2 IN Length 10 FEET

Material PVC

Slot Size .020 Set From 418 Feet to 428 Feet

Other information Set K Packer

**WAS A PACKER OR SEAL USED?** ☑ YES ☐ NO

If so, what material? 4" K Packer

Describe packer(s) and location? Packer 408'

**DISINFECTION:** Was well disinfected upon completion?

____ YES, How: ____

X NO, Why Not? NA

Laboratory sent to for water quality analysis
Respec

STATIC WATER LEVEL 32.6 Feet

If flowing: closed in pressure ____ PSI

GPM flow ____ through ____ inch pipe

Controlled by ☐ Valve ☐ Reducers ☐ Other ____

Reduced Flowrate ____ GPM

Can well be completely shut in? Yes

**WELL TEST DATA:**

☐ Pumped
☐ Bailed
☑ Other

Describe: Airlift AT 405'

Pumping Level Below Land Surface

____ ft. After ____ Hrs. pumped ____ GPM

____ ft. After ____ Hrs. pumped ____ GPM

If pump installed, pump rate ____ GPM

**REMARKS** Dewey Burdock 7-11-15

This well was drilled under license # 745

And this report is true and accurate.

Drilling firm DAVIS Drilling Inc

Signature of License Representative: Stan Davis

Signature of Well Owner or Equitable Property Holder: PowerTech

Date: 3/5/08

Hydro ID 687

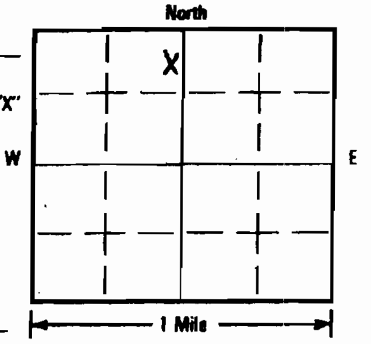
# SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NE ¼ NW ¼ Sec 32 Twp 6S Rg 1E

County Custer

Please mark well location with an "X"



Well Completion Date 2-6-08

**LOCATION:**

Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from NONE Present (identify source).

**PROPOSED USE:**

☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☑ Monitoring well

**METHOD OF DRILLING:**

Mud Rotary

**CASING DATA:** ☐ Steel ☒ Plastic ☐ Other

If other describe

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| SDR 17 LB/FT | 4 IN | 0 FT | 590 FT | 6¾ IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| CMT | 60 | 15.2 lb./gal | 590 ft. | 0 ft |
|  |  | lb./gal | ft. | ft |

Describe grouting procedure pump

**SCREEN:** ☐ Perforated pipe ☑ Manufactured

Diameter 2 IN Length 15 FEET

Material PVC

Slot Size .020 Set From 605 Feet to 590 Feet

Other information Sch K Packer

**WAS A PACKER OR SEAL USED?** ☑ YES ☐ NO

If so, what material? 4" K Packer

Describe packer(s) and location? Packer 580'

**DISINFECTION:** Was well disinfected upon completion?

____ YES, How: ____

✓ NO, Why Not? N/A

Laboratory sent to for water quality analysis

[illegible]

3-7-08

Well Owner: Powertech

Business Name: Powertech USA Inc

Address: P.O. Box 723
Hot Springs S.D 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Skull Creek Shale | 0 | 480' |
| Fall River Sandstone | 480' | 605' |

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**STATIC WATER LEVEL** 0 Feet

If flowing: closed in pressure 3 PSI

GPM flow 5 through 2 inch pipe

Controlled by ☑ Valve ☐ Reducers ☐ Other

Reduced Flowrate ______ GPM

Can well be completely shut in? Yes

**WELL TEST DATA:**

☐ Pumped
☐ Bailed
☑ Other

Describe: Air lift at 580'

Pumping Level Below Land Surface

____ ft. After ____ Hrs. pumped ____ GPM

____ ft. After ____ Hrs. pumped ____ GPM

If pump installed, pump rate ____ GPM

**REMARKS** DEWEY Burdock 7-32-5

This well was drilled under license # 745

And this report is true and accurate.

Drilling firm DAVIS Drilling INC

Signature of License Representative: Davis

Signature of Well Owner or Equitable Property Holder: PowerTech

Date: 2/27/08

POWERTECH (USA) INC.

Hydro ID 688 7S

# SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NE ¼ SW ¼ Sec 11 Twp 6S Rg 1E

County Fall River

North

Please mark well location with an "X"

| | | | |
|---|---|---|---|
| | | | |
| | X | | |
| | | | |
| | | | |

W E

← 1 Mile →

Well Completion Date 4-1-08

Well Owner: Powe- Tech

Business Name: Powe- Tech USA INC

Address: P.O. Box 723
Hot Springs S.D 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Skull Creek | 0 | 128 |
| Fall River | 128 | 255 |

**LOCATION:**
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from None Present (identify source).

**PROPOSED USE:**
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

**METHOD OF DRILLING:**
Mud & Rotary

**CASING DATA:** ☐ Steel ☒ Plastic ☐ Other
If other describe ______

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| SDR 17 LB/FT | 6 IN | 0 FT | 245 FT | 8 3/4 IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| CMT | 45 | 15.3 lb./gal | 0 ft. | 245 ft. |
| | | lb./gal | ft. | ft. |

Describe grouting procedure Pump

**STATIC WATER LEVEL** 39 Feet
If flowing: closed in pressure ______ PSI
GPM flow ______ through ______ inch pipe
Controlled by ☐ Valve ☐ Reducers ☐ Other ______
Reduced Flowrate ______ GPM
Can well be completely shut in? Yes

**WELL TEST DATA:**
☐ Pumped Describe: Airlift at 230'
☐ Bailed
☐ Other
Pumping Level Below Land Surface
______ ft. After ______ Hrs. pumped ______ GPM
______ ft. After ______ Hrs. pumped ______ GPM
If pump installed, pump rate ______ GPM

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**SCREEN:** ☐ Perforated pipe ☒ Manufactured
Diameter 3 IN Length 10 FEET
Material PVC
Slot Size .020 Set From 245 Feet to 255 Feet
Other information Set K Packer

**WAS A PACKER OR SEAL USED?** ☑ YES ☐ NO
If so, what material? 6" & 3" K Packer
Describe packer(s) and location? Packer set at 235'

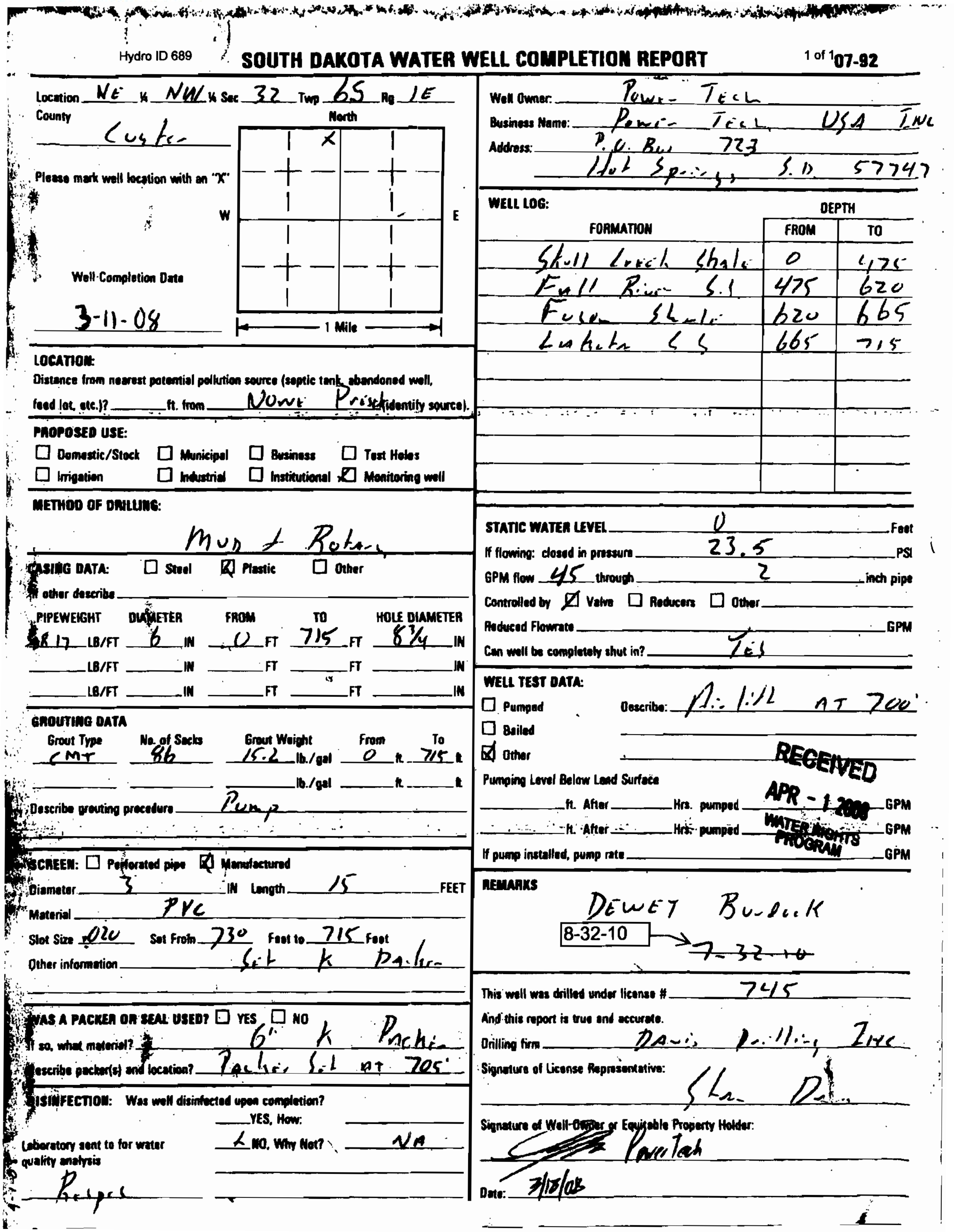
**DISINFECTION:** Was well disinfected upon completion?
______ YES, How: ______
X NO, Why Not? NA

Laboratory sent to for water quality analysis
Reiper

5-1-08

**REMARKS**
Dewey Burdock
8-11-17

This well was drilled under license # 745
And this report is true and accurate.
Drilling firm Davis Drilling
Signature of License Representative: Stan Davis
Signature of Well-Owner or Equitable Property Holder:
Date: 4/22/08



Hydro ID 689

# SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NE ¼ NW ¼ Sec 32 Twp 6S Rg 1E

County Custer

Please mark well location with an "X"

North, W, E, 1 Mile: X

Well Completion Date 3-11-08

**LOCATION:**

Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from None Present (identify source).

**PROPOSED USE:**

☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

**METHOD OF DRILLING:**

Mud + Rotary

**CASING DATA:** ☐ Steel ☒ Plastic ☐ Other

If other describe ______

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| SDR 17 LB/FT | 6 IN | 0 FT | 715 FT | 8¾ IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| CMT | 86 | 15.2 lb./gal | 0 ft. | 715 ft |
| | | lb./gal | ft. | ft |

Describe grouting procedure Pump

**SCREEN:** ☐ Perforated pipe ☒ Manufactured

Diameter 3 IN Length 15 FEET

Material PVC

Slot Size .020 Set From 730 Feet to 715 Feet

Other information Set K Packer

**WAS A PACKER OR SEAL USED?** ☐ YES ☐ NO

If so, what material? 6" K Packer

Describe packer(s) and location? Packer Set at 705'

**DISINFECTION:** Was well disinfected upon completion?

______ YES, How: ______

✓ NO, Why Not? NA

Laboratory sent to for water quality analysis [illegible]

Well Owner: Power Tech

Business Name: Power Tech USA Inc

Address: P.O. Box 723
Hot Springs, S.D. 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Skull Creek Shale | 0 | 475 |
| Fall River S.S | 475 | 620 |
| Fuson Shale | 620 | 665 |
| Lakota S S | 665 | 715 |

STATIC WATER LEVEL 0 Feet

If flowing: closed in pressure 23.5 PSI

GPM flow 45 through 2 inch pipe

Controlled by ☒ Valve ☐ Reducers ☐ Other ______

Reduced Flowrate ______ GPM

Can well be completely shut in? Yes

**WELL TEST DATA:**

☐ Pumped Describe: Air lift at 700'
☐ Bailed
☒ Other

Pumping Level Below Land Surface

______ ft. After ______ Hrs. pumped ______ GPM
______ ft. After ______ Hrs. pumped ______ GPM

If pump installed, pump rate ______ GPM

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**REMARKS**

DEWEY BURDOCK

8-32-10 → ~~7-32-10~~

This well was drilled under license # 745

And this report is true and accurate.

Drilling firm Davis Drilling Inc

Signature of License Representative:

Signature of Well Owner or Equitable Property Holder: Powertech

Date: 3/18/08

17 7S

Hydro ID 690

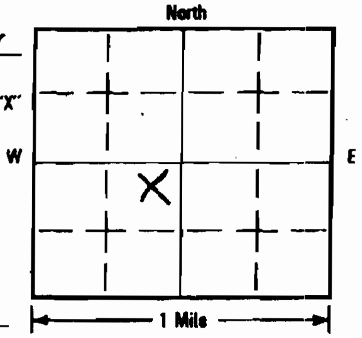
# SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NE ¼ SW ¼ Sec 11 Twp ~~6S~~ Rg 1E

County Fall River

Please mark well location with an "X"



Well Completion Date

4-15-08

Well Owner: Power Tech

Business Name: Power Tech USA Inc

Address: P.O. Box 723
Hot Springs S.D 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Skull Creek | 0 | 115 |
| Fall River | 115 | 245 |
| Fuson | 245 | 310 |
| Lakota | 310 | 455 |
| Morrison | 455 | 560 |
| UNKPAPA | 560 | 621 |

**LOCATION:**
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from NONE Present (identify source).

**PROPOSED USE:**
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

**METHOD OF DRILLING:** Mud & Rotary

**CASING DATA:** ☒ Steel ☐ Plastic ☐ Other

If other describe

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| 18 LB/FT | 6 IN | 0 FT | 621 FT | 8¾ IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| Cmt | 104 | 15.2 lb./gal | 0 ft. | 621 ft. |
| | | lb./gal | ft. | ft. |

Describe grouting procedure Pump

**SCREEN:** ☐ Perforated pipe ☒ Manufactured

Diameter 3 IN Length 10 FEET

Material PVC

Slot Size .020 Set From 621 Feet to 631 Feet

Other information Set K Packer

**WAS A PACKER OR SEAL USED?** ☑ YES ☐ NO

If so, what material? 6" X 3' K Packer

Describe packer(s) and location? Packer set at 611'

**DISINFECTION:** Was well disinfected upon completion?
____ YES, How:
X NO, Why Not? NA

Laboratory sent to for water quality analysis
Report

STATIC WATER LEVEL 0 Feet

If flowing: closed in pressure 41 PSI

GPM flow 14 through 2 inch pipe

Controlled by ☒ Valve ☐ Reducers ☐ Other

Reduced Flowrate ____ GPM

Can well be completely shut in? Yes

**WELL TEST DATA:**
☐ Pumped Describe: Air lift at 605'
☐ Bailed
☐ Other

Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM
If pump installed, pump rate ____ GPM

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**REMARKS** DEWEY Burdock
8-11-18

This well was drilled under license # 745

And this report is true and accurate.

Drilling firm Davis Drilling

Signature of License Representative: Stan Davis

Signature of Well Owner or Equitable Property Holder:

Date: 5/5/08

Hydro ID 691

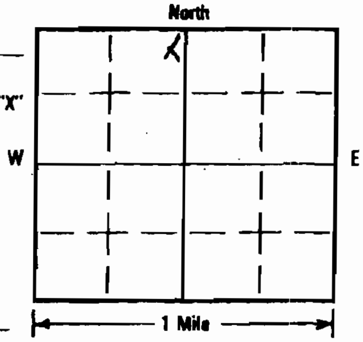
# SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NE ¼ NW ¼ Sec 32 Twp 6S Rg 1E

County Custer

Please mark well location with an "X"



Well Completion Date 3-10-08

**LOCATION:**

Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from None Present (identify source).

**PROPOSED USE:**

☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

**METHOD OF DRILLING:**

Mud Rotary

**CASING DATA:** ☐ Steel ☒ Plastic ☐ Other

If other describe

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| SDR 17 LB/FT | 6 IN | 0 FT | 490 FT | 8¾ IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| CMT | 107 | 15.2 lb./gal | 0 ft. | 490 ft. |
| | | lb./gal | ft. | ft. |

Describe grouting procedure Pump

**SCREEN:** ☐ Perforated pipe ☒ Manufactured

Diameter 3 IN Length 15 FEET

Material PVC

Slot Size .020 Set From 490 Feet to 505 Feet

Other information Set K Packer

**WAS A PACKER OR SEAL USED?** ☒ YES ☐ NO

If so, what material? 6" K Packer

Describe packer(s) and location? Packer set at 480'

**DISINFECTION:** Was well disinfected upon completion?

____ YES, How:

X NO, Why Not? NA

Laboratory sent to for water quality analysis

Respec

3-1-08

Well Owner: Power Tech

Business Name: Power Tech USA Inc

Address: P.O. Box 773
Hot Springs S.D 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Skull Creek Shale | 0 | 475 |
| Fall River S.S | 475 | 505 |

STATIC WATER LEVEL 0 Feet

If flowing: closed in pressure 6.5 PSI

GPM flow 6 through 2 inch pipe

Controlled by ☒ Valve ☐ Reducers ☐ Other

Reduced Flowrate ______ GPM

Can well be completely shut in? Yes

**WELL TEST DATA:**

☐ Pumped Describe: Artesian at 475'
☐ Bailed
☒ Other

Pumping Level Below Land Surface

______ ft. After ______ Hrs. pumped ______ GPM

______ ft. After ______ Hrs. pumped ______ GPM

If pump installed, pump rate ______ GPM

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**REMARKS**

DEWEY Burdock

8-32-9C

This well was drilled under license # 745

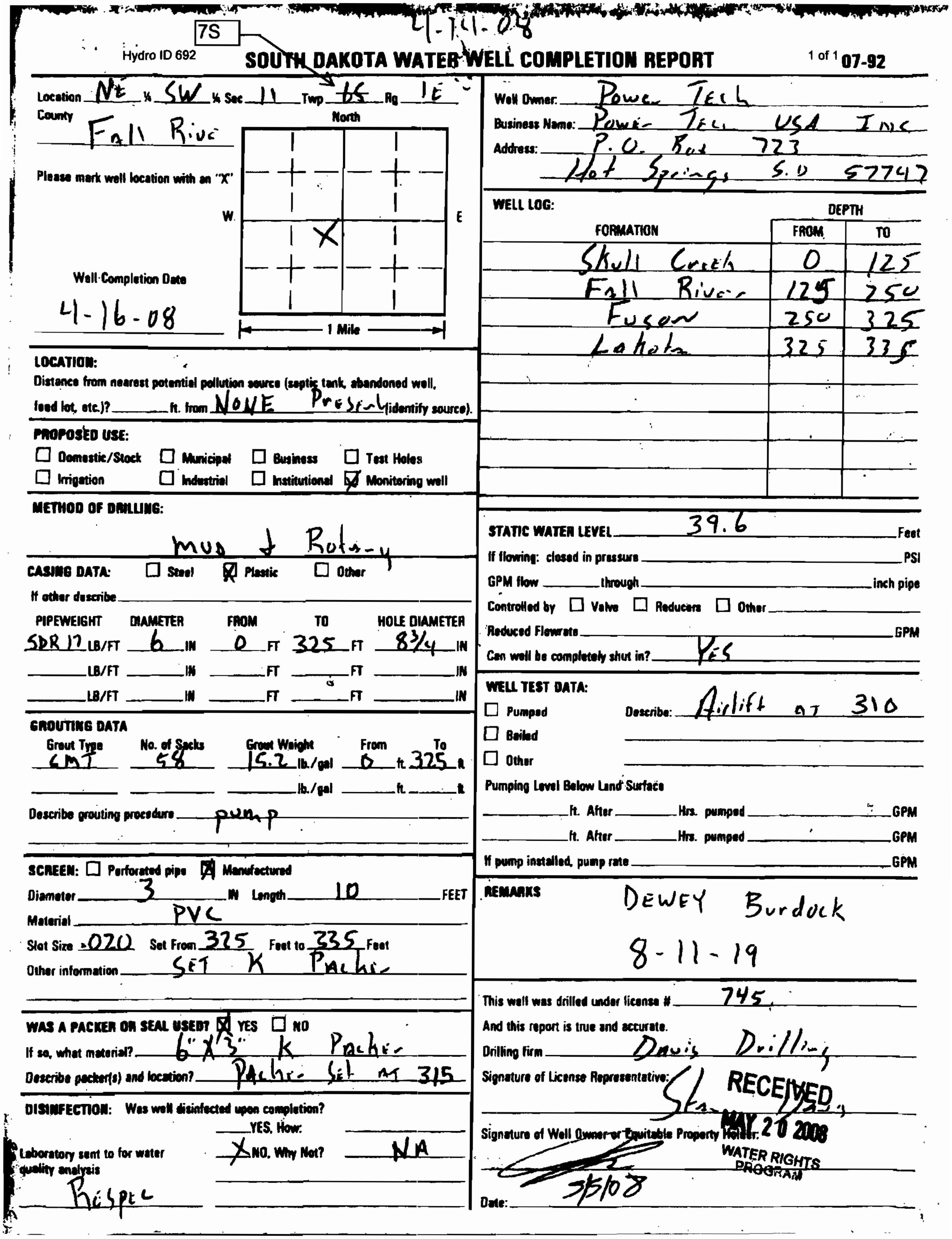
And this report is true and accurate.

Drilling firm Davis Drilling Inc

Signature of License Representative: Glen Davis

Signature of Well Owner or Equitable Property Holder: PowerTech

Date: 3/7/08



4-14-08

Hydro ID 692 7S

## SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NE ¼ SW ¼ Sec 11 Twp 6S Rg 1E

County Fall River

Please mark well location with an "X"

North

W. E

1 Mile

Well Completion Date 4-16-08

Well Owner: Power Tech

Business Name: Power Tech USA Inc

Address: P.O. Box 723
Hot Springs S.D 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Skull Creek | 0 | 125 |
| Fall River | 125 | 250 |
| Fuson | 250 | 325 |
| Lakota | 325 | 335 |

**LOCATION:**
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from NONE Present (identify source).

**PROPOSED USE:**
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

**METHOD OF DRILLING:** Mud & Rotary

**CASING DATA:** ☐ Steel ☒ Plastic ☐ Other
If other describe ____

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| SDR 17 LB/FT | 6 IN | 0 FT | 325 FT | 8 3/4 IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| CMT | 58 | 15.2 lb./gal | 0 ft. | 325 ft |
| | | lb./gal | ft. | ft |

Describe grouting procedure pump

**SCREEN:** ☐ Perforated pipe ☒ Manufactured
Diameter 3 IN Length 10 FEET
Material PVC
Slot Size .020 Set From 325 Feet to 335 Feet
Other information SET K Packer

**WAS A PACKER OR SEAL USED?** ☒ YES ☐ NO
If so, what material? 6" X 3" K Packer
Describe packer(s) and location? Packer Set at 315

**DISINFECTION:** Was well disinfected upon completion?
____ YES, How: ____
X NO, Why Not? NA

Laboratory sent to for water quality analysis
Respec

**STATIC WATER LEVEL** 39.6 Feet
If flowing: closed in pressure ____ PSI
GPM flow ____ through ____ inch pipe
Controlled by ☐ Valve ☐ Reducers ☐ Other ____
Reduced Flowrate ____ GPM
Can well be completely shut in? Yes

**WELL TEST DATA:**
☐ Pumped Describe: Airlift at 310
☐ Bailed
☐ Other
Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM
If pump installed, pump rate ____ GPM

**REMARKS** DEWEY Burdock
8-11-19

This well was drilled under license # 745
And this report is true and accurate.
Drilling Firm Davis Drilling
Signature of License Representative:
Signature of Well Owner or Equitable Property Holder:
Date: 3/5/08

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Hydro ID 693

# SOUTH DAKOTA WATER WELL COMPLETION REPORT

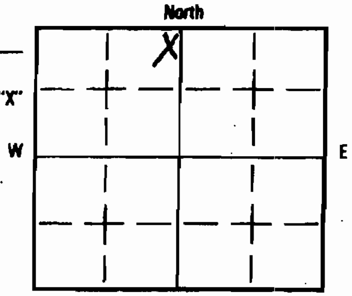
1 of 1 07-92

Location NE ¼ NW ¼ Sec 32 Twp 6S Rg 1E

County

Custer

North



Please mark well location with an "X"

Well Completion Date

3-8-08

**LOCATION:**

Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from None Present (identify source).

**PROPOSED USE:**

☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

**METHOD OF DRILLING:**

Mud Rotary

**CASING DATA:** ☒ Steel ☒ Plastic ☐ Other

If other describe ______

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| 18 LB/FT | 6 IN | 0 FT | 910 FT | 8¾ IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| CMT | 219 | 15.7 lb./gal | 0 ft. | 910 ft. |
| | | lb./gal | ft. | ft. |

Describe grouting procedure Pump Mix cement

**SCREEN:** ☐ Perforated pipe ☒ Manufactured

Diameter 3 IN Length 20 FEET

Material PVC

Slot Size .020 Set From 910 Feet to 930 Feet

Other information Set K Packer

**WAS A PACKER OR SEAL USED?** ☑ YES ☐ NO

If so, what material? 6" K Packer

Describe packer(s) and location? Packer set 890'

**DISINFECTION:** Was well disinfected upon completion?

______ YES, How: ______

X NO, Why Not? NA

Laboratory sent to for water quality analysis

Respec

Well Owner: Power Tech

Business Name: Power Tech USA Inc

Address: P.O. Box 723
Hot Springs S.D. 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Skull Creek Shale | 0 | 475 |
| Fall River S.S | 475 | 620 |
| Fuson Shale | 620 | 670 |
| Lakota S.S | 670 | 765 |
| Morrison Shale | 765 | 865 |
| UNKPAPA S.S | 865 | 910 |
| | | |
| | | |
| | | |

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STATIC WATER LEVEL 0 Feet

If flowing: closed in pressure 55 PSI

GPM flow 2 through 2 inch pipe

Controlled by ☑ Valve ☐ Reducers ☐ Other ______

Reduced Flowrate ______ GPM

Can well be completely shut in? Yes

**WELL TEST DATA:**

☐ Pumped
☐ Bailed
☑ Other

Describe: Airlift AT 845'

Pumping Level Below Land Surface

______ ft. After ______ Hrs. pumped ______ GPM

______ ft. After ______ Hrs. pumped ______ GPM

If pump installed, pump rate ______ GPM

**REMARKS**

DEWEY Burdock 8-32-11

This well was drilled under license # 745

And this report is true and accurate.

Drilling firm Davis Drilling Inc

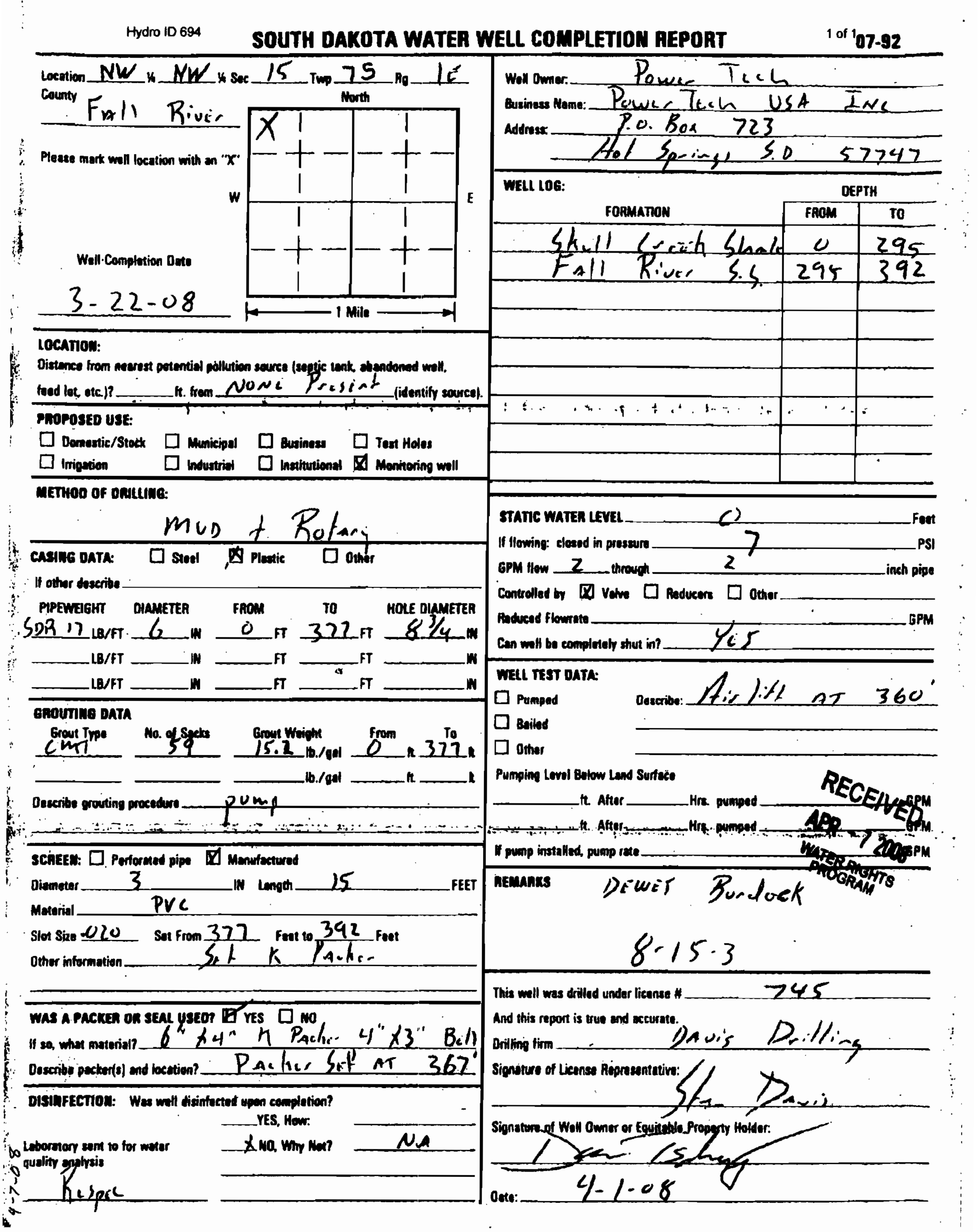
Signature of License Representative:

Stan Davis

Signature of Well Owner or Equitable Property Holder:

PowerTech

Date: 3/18/08



Hydro ID 694

# SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NW ¼ NW ¼ Sec 15 Twp 7S Rg 1E

County Fall River

Please mark well location with an "X"

North

W X E

1 Mile

Well-Completion Date 3-22-08

Well Owner: Power Tech

Business Name: Power Tech USA Inc

Address: P.O. Box 723
Hot Springs S.D 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Skull Creek Shale | 0 | 295 |
| Fall River S.S | 295 | 392 |

**LOCATION:**

Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from None Present (identify source).

**PROPOSED USE:**

☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

**METHOD OF DRILLING:**

Mud + Rotary

**CASING DATA:** ☐ Steel ☒ Plastic ☐ Other

If other describe ______

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| SDR 17 LB/FT | 6 IN | 0 FT | 377 FT | 8 3/4 IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| CMT | 59 | 15.2 lb./gal | 0 ft | 377 ft |
| | | lb./gal | ft | ft |

Describe grouting procedure pump

**SCREEN:** ☐ Perforated pipe ☒ Manufactured

Diameter 3 IN Length 15 FEET

Material PVC

Slot Size .020 Set From 377 Feet to 392 Feet

Other information Set K Packer

**WAS A PACKER OR SEAL USED?** ☒ YES ☐ NO

If so, what material? 6" x 4" K Packer 4" x 3" Bell

Describe packer(s) and location? Packer Set AT 367'

**DISINFECTION:** Was well disinfected upon completion?

____ YES, How: ______

X NO, Why Not? NA

Laboratory sent to for water quality analysis Kespec

**STATIC WATER LEVEL** 0 Feet

If flowing: closed in pressure 7 PSI

GPM flow 2 through 2 inch pipe

Controlled by ☒ Valve ☐ Reducers ☐ Other ______

Reduced Flowrate ______ GPM

Can well be completely shut in? Yes

**WELL TEST DATA:**

☐ Pumped Describe: Air lift AT 360'
☐ Bailed
☐ Other

Pumping Level Below Land Surface

______ ft. After ______ Hrs. pumped ______ GPM
______ ft. After ______ Hrs. pumped ______ GPM

If pump installed, pump rate ______ GPM

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**REMARKS** Dewey Burdock

8-15-3

This well was drilled under license # 745

And this report is true and accurate.

Drilling firm Davis Drilling

Signature of License Representative: Stan Davis

Signature of Well Owner or Equitable Property Holder:

Date: 4-1-08

4-7-08

SE Hydro ID 695

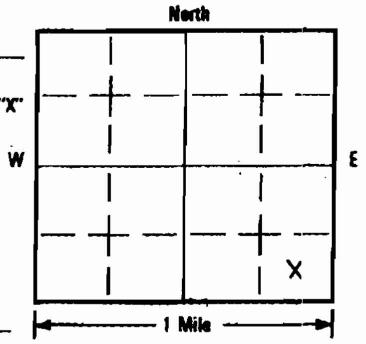
# SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location SW ¼ SE ¼ Sec 32 Twp 6S Rg 1E

County Custer

Please mark well location with an "X"



Well Completion Date 3-20-08

**LOCATION:**
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from None Present (identify source).

**PROPOSED USE:**
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

**METHOD OF DRILLING:**
Mud & Rotary

**CASING DATA:** ☐ Steel ☒ Plastic ☐ Other

If other describe

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| SDR 17 LB/FT | 6 IN | 0 FT | 493 FT | 8¾ IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| CMT | 106.4 | 15.1 lb./gal | 0 ft. | 493 ft. |
| | | lb./gal | ft. | ft. |

Describe grouting procedure Pump

**SCREEN:** ☐ Perforated pipe ☒ Manufactured
Diameter 3 IN Length 15 FEET
Material PVC
Slot Size .020 Set From 493 Feet to 508 Feet
Other information Set K Packer

**WAS A PACKER OR SEAL USED?** ☒ YES ☐ NO
If so, what material? 6" x 4" K-Packer 4" X 3" bell
Describe packer(s) and location? Packer Set at 483'

**DISINFECTION:** Was well disinfected upon completion?
____ YES, How:
X NO, Why Not? N/A

Laboratory sent to for water quality analysis
Respec

Well Owner: Power Tech
Business Name: Power Tech USA Inc
Address: P.O. Box 723
Hot Springs SD 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Skull Creek Shale | 0 | 415 |
| Fall River S.S | 415 | 508 |

**STATIC WATER LEVEL** 0 Feet
If flowing: closed in pressure 13 PSI
GPM flow 3 through 2 inch pipe
Controlled by ☒ Valve ☐ Reducers ☐ Other
Reduced Flowrate / GPM
Can well be completely shut in? Yes

**WELL TEST DATA:**
☐ Pumped Describe: Air-lift AT 480'
☐ Bailed
☐ Other
Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM
If pump installed, pump rate

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**REMARKS**
Dewey Burdock
8-32-13

This well was drilled under license # 745
And this report is true and accurate.
Drilling firm Davis Drilling
Signature of License Representative: Stan Davis
Signature of Well Owner or Equitable Property Holder:
Date: 4-1-08

Hydro ID 696

# SOUTH DAKOTA WATER WELL COMPLETION REPORT

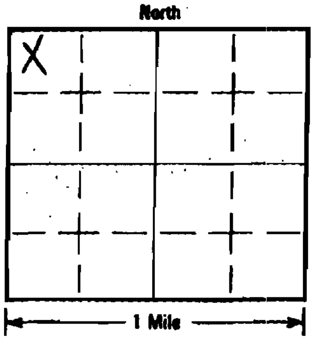
1 of 1 07-92

Location NW ¼ NW ¼ Sec 15 Twp 7S Rg 1E

County Fall River

North

Please mark well location with an "X"



Well Completion Date 3-21-08

**LOCATION:**
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from NONE Present (identify source).

**PROPOSED USE:**
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

**METHOD OF DRILLING:**
Mud & Rotary

**CASING DATA:** ☐ Steel ☒ Plastic ☐ Other
If other describe

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| SDR 17 LB/FT | 6 IN | 0 FT | 572 FT | 8¾ IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| Cmt | 86 | 15.1 lb./gal | 0 ft. | 572 ft. |
| | | lb./gal | ft. | ft. |

Describe grouting procedure pump

**SCREEN:** ☐ Perforated pipe ☒ Manufactured
Diameter 3 IN Length 15 FEET
Material PVC
Slot Size .020 Set From 572 Feet to 587 Feet
Other information Set K Packer

**WAS A PACKER OR SEAL USED?** ☒ YES ☐ NO
If so, what material? 6" X 4" K Packer 4" X 3" bell
Describe packer(s) and location? Packer set at 562'

**DISINFECTION:** Was well disinfected upon completion?
____ YES, How: ____
X NO, Why Not? NA

Laboratory sent to for water quality analysis
Respec

Well Owner: Power Tech
Business Name: Power Tech USA Inc
Address: P.O. Box 723
Hot Springs S.D 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Skull Creek Shale | 0 | 295 |
| Fall River S.S | 295 | 425 |
| Fuson Shale | 425 | 475 |
| Lakota | 475 | 587 |

STATIC WATER LEVEL 0 Feet
If flowing: closed in pressure 15 PSI
GPM flow 60 through 2 inch pipe
Controlled by ☒ Valve ☐ Reducers ☐ Other
Reduced Flowrate ______ GPM
Can well be completely shut in? Yes

**WELL TEST DATA:**
☐ Pumped Describe: Airlift At 560
☐ Bailed
☐ Other

Pumping Level Below Land Surface
______ ft. After ______ Hrs. pumped ______ GPM
______ ft. After ______ Hrs. pumped ______ GPM
If pump installed, pump rate ______ GPM

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**REMARKS** Dewey Burdock

8-15-2

This well was drilled under license # 745
And this report is true and accurate.
Drilling firm Davis Drilling
Signature of License Representative:
Signature of Well Owner or Equitable Property Holder:
Date: 4-1-08

4-2-08

SE Hydro ID 697

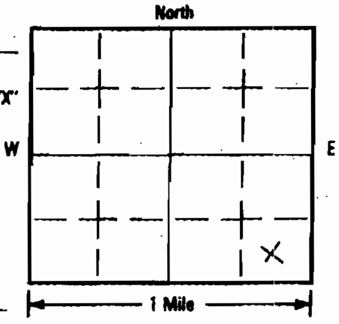
# SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location SW ¼ SE ¼ Sec 32 Twp 6S Rg 1E

County Custer

Please mark well location with an "X"



Well Completion Date 3-18-08

Well Owner: Power Tech

Business Name: Power Tech USA Inc

Address: P.O. Box 723
Hot Springs SD 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Skull Creek Shale | 0 | 415 |
| ~~Fuson~~ Fall River | 415 | 550 |
| Fuson Shale | 550 | 635 |
| Lakota S.S | 635 | 682 |

**LOCATION:**
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from NONE Present (identify source).

**PROPOSED USE:**
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

**METHOD OF DRILLING:** Mud & [illegible]

**CASING DATA:** ☐ Steel ☑ Plastic ☐ Other
If other describe ______

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| SDR 17 LB/FT | 6 IN | 0 FT | 667 FT | 8¾ IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| CMT | 112 | 13.0 lb./gal | 0 ft. | 667 ft. |
| | | lb./gal | ft. | ft. |

Describe grouting procedure Pump, Bio Mix
Cellophane

**SCREEN:** ☐ Perforated pipe ☒ Manufactured
Diameter 3 IN Length 15 FEET
Material PVC
Slot Size .020 Set From 667 Feet to 682 Feet
Other information \ Set in Packer

**WAS A PACKER OR SEAL USED?** ☑ YES ☐ NO
If so, what material? 6" x 4" K Packer 4" x 3" bell
Describe packer(s) and location? Packer set at 657

**DISINFECTION:** Was well disinfected upon completion?
______ YES, How: ______
X NO, Why Not? NA

Laboratory sent to for water quality analysis
Respec

**STATIC WATER LEVEL** 0 Feet
If flowing: closed in pressure 40 PSI
GPM flow 30 through 2 inch pipe
Controlled by ☒ Valve ☐ Reducers ☐ Other ______
Reduced Flowrate ______ GPM
Can well be completely shut in? Yes

**WELL TEST DATA:**
☐ Pumped Describe: Air lift at 650'
☐ Bailed
☐ Other

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Pumping Level Below Land Surface
______ ft. After ______ Hrs. pumped ______ GPM
______ ft. After ______ Hrs. pumped ______ GPM
If pump installed, pump rate ______ GPM

**REMARKS** Dewey Burdock
8-32-12

This well was drilled under license # 745
And this report is true and accurate.
Drilling firm Davis Drilling Inc
Signature of License Representative: Glen Davis
Signature of Well Owner or Equitable Property Holder:
Date: 4-1-08

POWERTECH (USA) INC.

Hydro ID 698

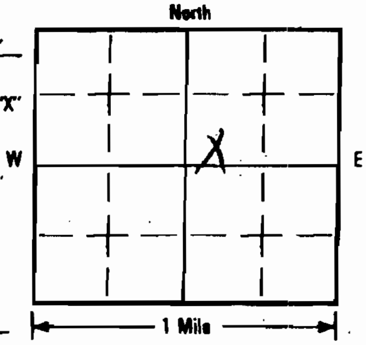
# SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location SW ¼ NE ¼ Sec 2 Twp 7S Rg 1E

County Fall River

Please mark well location with an "X"



Well Completion Date 3-25-08

Well Owner: Power Tech

Business Name: Power Tech USA Inc.

Address: P.O. Box 723

Hot Springs S.D 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Skull Creek Shale | 0 | 75 |
| Fall River S.S | 75 | 205 |

**LOCATION:**

Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from NONE Present (identify source).

**PROPOSED USE:**

☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes

☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

**METHOD OF DRILLING:** Mud & Rotary

**CASING DATA:** ☐ Steel ☒ Plastic ☐ Other

If other describe ______

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| SDR 21 LB/FT | 6 IN | 0 FT | 180 FT | 8 ¾ IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| CMT | 35 | 15.6 lb./gal | 0 ft. | 180 ft. |
| | | lb./gal | ft. | ft. |

Describe grouting procedure pump

**SCREEN:** ☐ Perforated pipe ☒ Manufactured

Diameter 3 IN Length 25 FEET

Material PVC

Slot Size .020 Set From 180 Feet to 205 Feet

Other information Set K Packer

**WAS A PACKER OR SEAL USED?** ☒ YES ☐ NO

If so, what material? 6" X 3" K Packer

Describe packer(s) and location? Packer Set at 170'

**DISINFECTION:** Was well disinfected upon completion?

____ YES, How: ______

X NO, Why Not? NA

Laboratory sent to for water quality analysis Respec

5-1-08

**STATIC WATER LEVEL** 34.36 Feet

If flowing: closed in pressure ______ PSI

GPM flow ______ through ______ inch pipe

Controlled by ☐ Valve ☐ Reducers ☐ Other ______

Reduced Flowrate ______ GPM

Can well be completely shut in? Yes

**WELL TEST DATA:**

☐ Pumped Describe: Airlift at 165'

☐ Bailed

☐ Other

Pumping Level Below Land Surface

______ ft. After ______ Hrs. pumped ______ GPM

______ ft. After ______ Hrs. pumped ______ GPM

If pump installed, pump rate ______ GPM

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**REMARKS** Dewey Burdock

8-2-1

This well was drilled under license # 745

And this report is true and accurate.

Drilling firm Davis Drilling

Signature of License Representative: Stan Davis

Signature of Well Owner or Equitable Property Holder:

Date: 4/22/08

4/14-08

Hydro ID 703

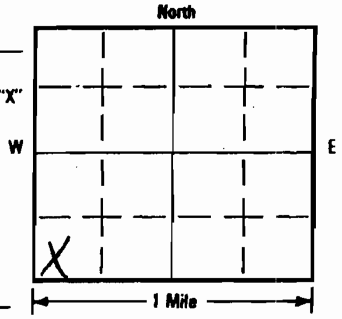
# SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location SW ¼ SW ¼ Sec 1 Twp 7S Rg 1E

County Fall River

Please mark well location with an "X"



Well Completion Date 4-18-08

Well Owner: Power Tech

Business Name: Power Tech USA Inc

Address: P.O. Box 723
Hot Springs S.D 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Fall River | 0 | 100 |
| Fuson | 100 | 150 |
| Lakota | 150 | 305 |
| Morrison | 305 | 410 |
| UNK PAPA | 410 | 525 |
| | | |
| | | |
| | | |
| | | |

**LOCATION:**

Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? 200 ft. from Septic Tank (identify source).

**PROPOSED USE:**

☑ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☐ Monitoring well

**METHOD OF DRILLING:**

Mud & Rotary

**CASING DATA:** ☒ Steel ☐ Plastic ☐ Other

If other describe

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| 18 LB/FT | 6 IN | 0 FT | 475 FT | 8¼ IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| Cmt | 82 | 15.3 lb./gal | 0 ft | 475 ft |
| | | lb./gal | ft | ft |

Describe grouting procedure pump

**SCREEN:** ☐ Perforated pipe ☒ Manufactured

Diameter 3 IN Length 50 FEET

Material PVL

Slot Size .020 Set From 475 Feet to 525 Feet

Other information Set K Packer

**WAS A PACKER OR SEAL USED?** ☑ YES ☐ NO

If so, what material? 6' x 3" K Packer

Describe packer(s) and location? Packer set at 465'

**DISINFECTION:** Was well disinfected upon completion?

___ YES, How:

X NO, Why Not? NA

Laboratory sent to for water quality analysis

Relpic

5-20-08

**STATIC WATER LEVEL** 110 Feet

If flowing: closed in pressure ___ PSI

GPM flow ___ through ___ inch pipe

Controlled by ☐ Valve ☐ Reducers ☐ Other

Reduced Flowrate ___ GPM

Can well be completely shut in? Yes

**WELL TEST DATA:**

☐ Pumped Describe: Air lift at 416
☐ Bailed
☐ Other

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Pumping Level Below Land Surface

___ ft. After ___ Hrs. pumped ___ GPM
___ ft. After ___ Hrs. pumped ___ GPM

If pump installed, pump rate ___ GPM

**REMARKS** DEWEY Burdock

8-1-7

This well was drilled under license # 745

And this report is true and accurate.

Drilling firm Davis Drilling Inc

Signature of License Representative: Stan Davis

Signature of Well Owner or Equitable Property Holder:

Date: 5/5/08

Hydro ID 704 Unkpapa

# SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NW ¼ NW ¼ Sec. 5 Twp 7S Rg 1E

County Fall River

Please mark well location with an "X"

North / W / E — X (NW corner) — 1 Mile

Well Completion Date 4-29-08

Well Owner: Power Tech

Business Name: Power Tech USA Inc

Address: P.O. Box 723

Hot Springs S.D 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Skull Creek | 0 | 455 |
| Fall River | 455 | 600 |
| Fuson | 600 | 655 |
| Lakota | 655 | 735 |
| Morrison | 735 | 890 |
| UNK PAPA | 890 | 955 |

**LOCATION:**
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from None Present (identify source).

**PROPOSED USE:**
☒ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☐ Monitoring well

**METHOD OF DRILLING:**
Mud & Rotary

**CASING DATA:** ☒ Steel ☐ Plastic ☐ Other
If other describe

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| 14 LB/FT | 6 IN | 0 FT | 915 FT | 8¾ IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| CMT | 203 | 153 lb./gal | 0 ft. | 915 ft. |
| | | lb./gal | ft. | ft. |

Describe grouting procedure Mtb Cementing

**SCREEN:** ☐ Perforated pipe ☒ Manufactured
Diameter 3" IN Length 40 FEET
Material PVC
Slot Size .020 Set From 915 Feet to 955 Feet
Other information Sil K Packer

**WAS A PACKER OR SEAL USED?** ☒ YES ☐ NO
If so, what material? 3' x 6" K Packer
Describe packer(s) and location? Packer Set 905

**DISINFECTION:** Was well disinfected upon completion?
____ YES, How:
X NO, Why Not? NA

Laboratory sent to for water quality analysis Respec

STATIC WATER LEVEL 0 Feet
If flowing: closed in pressure 42 PSI
GPM flow ½ through 2 inch pipe
Controlled by ☒ Valve ☐ Reducers ☐ Other
Reduced Flowrate ____ GPM
Can well be completely shut in? Yes

**WELL TEST DATA:**
☐ Pumped Describe: Air lift at 900'
☐ Bailed
☐ Other
Pumping Level Below Land Surface
____ ft. ____ hrs. pumped ____ GPM
____ ft. ____ hrs. pumped ____ GPM
If pump installed, pump rate ____ GPM

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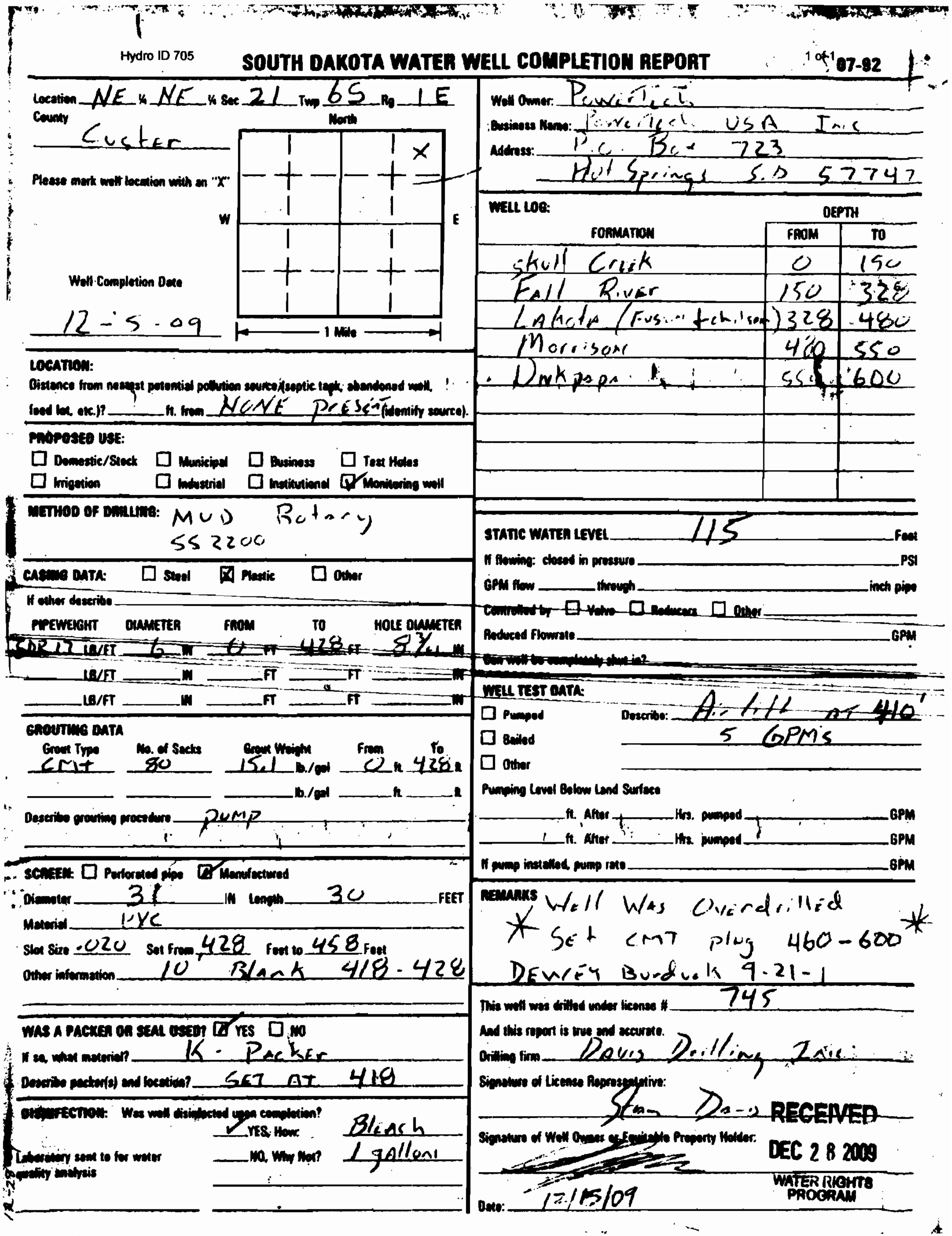
**REMARKS** Dewey Burdock
8-5-1

This well was drilled under license # 745
And this report is true and accurate.
Drilling firm David Drilling Inc
Signature of License Representative: Ste Dav
Signature of Well-Owner or Equitable Property Holder:
Date: 5/5/08



Hydro ID 705

## SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NE ¼ NE ¼ Sec 21 Twp 6S Rg 1E

County Custer

North

W E

Please mark well location with an "X"

X

1 Mile

Well Completion Date 12-5-09

Well Owner: PowerTech

Business Name: PowerTech USA Inc

Address: P.O. Box 723
Hot Springs S.D 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Skull Creek | 0 | 150 |
| Fall River | 150 | 328 |
| Lakota (Fuson [illegible]) | 328 | 480 |
| Morrison | 480 | 550 |
| Unkpapa | 550 | 600 |

**LOCATION:**

Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from NONE Present (identify source).

**PROPOSED USE:**

☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☑ Monitoring well

**METHOD OF DRILLING:** MUD Rotary
SS 2200

**CASING DATA:** ☐ Steel ☒ Plastic ☐ Other

If other describe ______

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| SDR 17 LB/FT | 6 IN | 0 FT | 428 FT | 8¾ IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| CMT | 80 | 15.1 lb./gal | 0 ft | 428 ft |
| | | lb./gal | ft | ft |

Describe grouting procedure pump

**SCREEN:** ☐ Perforated pipe ☑ Manufactured

Diameter 31 IN Length 30 FEET

Material PVC

Slot Size .020 Set From 428 Feet to 458 Feet

Other information 10' Blank 418-428

**WAS A PACKER OR SEAL USED?** ☑ YES ☐ NO

If so, what material? K-Packer

Describe packer(s) and location? SET AT 418

**DISINFECTION:** Was well disinfected upon completion?
✓ YES, How: Bleach
___ NO, Why Not? 1 gallon

Laboratory sent to for water quality analysis ______

**STATIC WATER LEVEL** 115 Feet

If flowing: closed in pressure ______ PSI

GPM flow ______ through ______ inch pipe

Controlled by ☐ Valve ☐ Reducers ☐ Other ______

Reduced Flowrate ______ GPM

Can well be completely shut in? ______

**WELL TEST DATA:**

☐ Pumped Describe: Air lift at 410'
☐ Bailed 5 GPM's
☐ Other

Pumping Level Below Land Surface

______ ft. After ______ Hrs. pumped ______ GPM
______ ft. After ______ Hrs. pumped ______ GPM

If pump installed, pump rate ______ GPM

**REMARKS** Well Was Overdrilled
* Set CMT plug 460-600 *
DEWEY Burdock 9-21-1

This well was drilled under license # 745

And this report is true and accurate.

Drilling firm Davis Drilling Inc

Signature of License Representative: Stan Davis

Signature of Well Owner or Equitable Property Holder:

Date: 12/15/09

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DEC 28 2009
WATER RIGHTS PROGRAM

Hydro ID 706

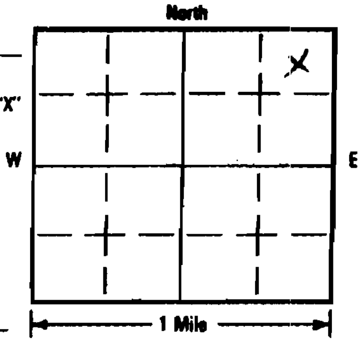
# SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NE ¼ NE ¼ Sec 21 Twp 6S Rg 1E

County CUSTER

Please mark well location with an "X"



Well Completion Date 12 5 09

Well Owner: Power Tech

Business Name: Power Tech USA Inc

Address: P.O. Box 723
Hot Springs S.D 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Skull Creek | 0 | 150 |
| Fall River | 150 | 316 |
| Lakota (Fuson/Chilson) | 316 | 328 |

**LOCATION:**
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from NONE PRESENT (identify source).

**PROPOSED USE:**
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☑ Monitoring well

**METHOD OF DRILLING:** Mud Rotary
SS 2200

**STATIC WATER LEVEL** 110 Feet
If flowing: closed in pressure ______ PSI
GPM flow ______ through ______ inch pipe
Controlled by ☐ Valve ☐ Reducers ☐ Other ______
Reduced Flowrate ______ GPM
Can well be completely shut in? ______

**CASING DATA:** ☐ Steel ☒ Plastic ☐ Other
If other describe ______

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| SDR17 LB/FT | 6 IN | 0 FT | 284 FT | 8 7/4 IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**WELL TEST DATA:**
☐ Pumped Describe: Airlift at 274'
☐ Bailed 5-10 GPMs
☐ Other

**GROUTING DATA**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| CMT | 56 | 15.1 lb./gal | 0 ft. | 284 ft. |
| | | lb./gal | ft. | ft. |

Describe grouting procedure PUMP

Pumping Level Below Land Surface
______ ft. After ______ Hrs. pumped ______ GPM
______ ft. After ______ Hrs. pumped ______ GPM
If pump installed, pump rate ______ GPM

**SCREEN:** ☐ Perforated pipe ☒ Manufactured
Diameter 3 IN Length 30 FEET
Material PVC
Slot Size .020 Set From 284 Feet to 314 Feet
Other information 10' Blank 274-284

**REMARKS**

DEWEY Burdock 9-21-2

This well was drilled under license # 745
And this report is true and accurate.
Drilling firm Davis Drilling Inc
Signature of License Representative: Stan Davis

**WAS A PACKER OR SEAL USED?** ☑ YES ☐ NO
If so, what material? K-Packer
Describe packer(s) and location? SET AT 274'

**DISINFECTION:** Was well disinfected upon completion?
✓ YES, How: Bleach 1 gallon
___ NO, Why Not?

Laboratory sent to for water quality analysis

Signature of Well Owner or Equitable Property Holder:

Date: 12/15/09

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DEC 28 2009
WATER RIGHTS PROGRAM

Hydro ID 707 NE

SD EForm - 1621LD V1 1 of 3

11-02

# SOUTH DAKOTA WATER WELL COMPLETION REPORT

Location ¼ ~~NW~~ ¼ Sec 34 Twp 6S Rg 1E

County Custer County

Please mark well location with an "X"

North W E

1 Mile

Well Completion Date

May 5, 2011

Distance to nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)?

ft. from Unknown (identify source)

**PROPOSED USE:**

☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test holes
☐ Irrigation ☐ Industrial ☐ Institutional ☑ Monitoring well

**METHOD OF DRILLING:**

3.25" HSA to 40.0' 4.25"HSA?

4.25"?

**CASING DATA:** ☐ Steel ☑ Plastic ☐ Other

If other describe

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| LB/FT | 2.00 IN | 0.0 FT | 30.0 FT | 3.25 IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA:**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| Cement | 8 | Lb/gal | 0.0 Ft | 26.0 Ft |
| Bentonite | 1 | Lb/gal | 26.0 Ft | 28.0 Ft |

Describe grouting procedure

**SCREEN:** ☐ Perforated pipe ☑ Manufactured

Diameter 2.00 inches Length 10.0 Feet

Material Sch 40 PVC

Slot Size 0.010" Set From 30.0 Feet to 40.0 Feet

Other information 12-20 Silica Sand from 28' to 40'

**WAS A PACKER OR SEAL USED?** ☐ Yes ☑ No

If so, what material?

Describe packer(s) and location

**DISINFECTION:** Was well disinfected upon completion?

☐ Yes, How?

☑ No, Why Not? Monitoring well only.

Lab to which water quality sample sent for analysis

Well Owner: ...

Business Name: Powertech, Inc.

Address: 145 N Chicago Street

City, State, Zip: Hot Springs SD 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Topsoil - Silty Lean Clay with sand, | | |
| brown, moist (CL) | 0 | 0.5' |
| Silty Sand, red-brn, dry (SM | 0.5' | 12' |
| Silty Lean Clay, red-brn, moist (CL) | 12' | 21' |
| Silty Gravel with sand, lt brn, moist to | | |
| wet @35' (GM) | 21' | 40' |

**STATIC WATER LEVEL** FEET

If flowing: closed in pressure PSI

GPM flow through inch pipe

Controlled by ☐ Valve ☐ Reducers ☐ Other

Reduced flow rate GPM

Can well be completely shut in?

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WATER RIGHTS PROGRAM

**WELL TEST DATA:**

☐ Pumped Describe: NA
☐ Bailed
☐ Other

Pumping Level Below Land Surface

Ft. After Hrs. pumped GPM

Ft. After Hrs. pumped GPM

If pump installed, pump rate: GPM

**REMARKS**

Monitoring well 11-34-4

This well was drilled under license # 678 and this report is true and accurate.

Drilling firm: American Engineering Testing, Inc.

Signature of License Representative:

Signature of Well Owner or Equitable Property Holder:

Date:

# SOIL BORING AND MONITORING WELL LOG

Hydro ID 707

JB NO. 17 - 12-11 VERTICAL SCALE 1" = 5' BORING NO. 11-34-4 WELL NO. 2 of 3 MW- 11-34-4

PROJECT power tech

| Boring No. | Date | Time |
|---|---|---|
| Boring Started | 5-5-11 | 10.55 |
| Boring Completed | 11 | 15:00 |
| Finished Pulling Casing | n/a | NA |
| Boring Filled | | ND |
| Depth to Frost | | |

**Method of Advancing Boring**

Continuous Sampling From — To —

______ In. Flite Auger To ______

3 1/4 In. Hollow Stem Auger to 40

______ In. Casing To ______

______ In. Casing To ______

P. D. or C. O. Tube From ______ To ______

Jet With Water From ______ To ______

Jet with Drilling Mud From ______ To ______

Remarks

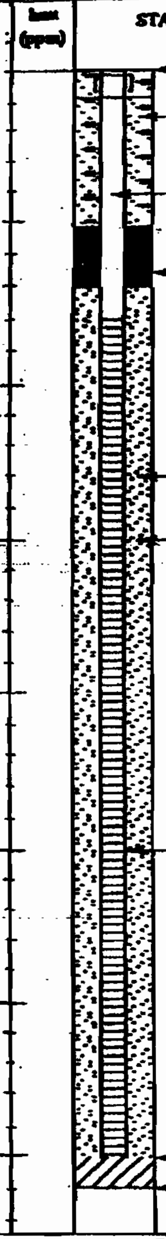
State Plane NAD27

441813 1032064

Lmt (ppm)

STANDPIPE ELEVATION ______

## Well Construction



Flush Mount/Standup

Grout from 26 ' to 0 '.

8 bags of ~~Bentonite~~ used portland

2" - PVC Riser Pipe, from 30 ' to +1.5 '.

Bentonite from 28 ' to 26 '.

______ buckets used

1 bags used

# 12-20 Silica Sand Pack

Sand from 40 ' to 28 '.

7 bags of sand

Flush Threaded 2" - PVC Screen

.010 " Screen Size Opening

from 40 ' to 30 '.

Bottom of Well 40.0

Natural Material

**WATER LEVEL MEASUREMENTS**

| DATE | TIME | SAMPLED DEPTH | CASING DEPTH | WATER LEVEL | WATER ELEVATION |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

START 10:55 COMPLETE 15:00

METHOD 4 1/4 HSA to 40'

CREW CHIEF/LOGGER:

Hydro ID 707

3 of 3

# GEOTECHNICAL FIELD DATA SHEET

**Project Number:** 17-1211 **Date:** 5-5-11 **Boring Number:** 11-34-4

**Project Location:** DEWEY **Crew Chief:** B.Th

**Boring Start Time:** 10:55 **Boring Completion Time:** 15:00

**Data Reviewed by:**

| Depth of Layer | Sample No./Depth | BLOWS<br>Set | <br>1 ½ FT | <br>[illegible] | <br>[illegible] | [illegible] | SOIL CLASSIFICATION |
|---|---|---|---|---|---|---|---|
| -.5' | / | | | | | | Topsoil- Silty sand [illegible] moist |
| | / | | | | | | organics (SM) |
| -5'- | / | | | | | | Silty sand , Reddish Brn |
| | / | | | | | | Dry (SM) |
| 12.0'- | / | | | | | | Silty lean clay Reddish Brn moist c. |
| 21.0 - | / | | | | | | Silty sand [illegible] Lt Brn |
| | / | | | | | | moist to wet @ 35.0' (SM) |
| | / | | | | | | EOB 40.0' |
| | / | | | | | | |
| | / | | | | | | set well |
| | / | | | | | | 1-10' SC |
| | / | | | | | | 3-10' R |
| | / | | | | | | 1-5' R |
| | / | | | | | | 7 Bags sand 12-20 |
| | / | | | | | | 1 Bag Bnt chips |
| | / | | | | | | |
| | / | | | | | | |
| | / | | | | | | |
| | / | | | | | | |

**Method of Advancing Boring**

Continuous Sampling From: ______ To: ______

______ In. Flite Auger To: ______

4 1/2 In. Hollow Stem Auger To: 40

Jet With Drilling Mud From: ______ To: ______

**Water Level Checks After Completion of Boring**

| | Date | Time | Casing in Grnd | W.L. * | Cav |
|---|---|---|---|---|---|
| At Completion | 5-5-11 | 10:55 | — | 32 | 3 |
| 1st Recheck | | | | | |
| 2nd Recheck | | | | | |

Additional spac

RC GEOT 0001 1/04

Hydro ID 708

SD EForm - 1621LD V1

# SOUTH DAKOTA WATER WELL COMPLETION REPORT

11-02

SW 3 7S

Location ¼ ~~NW~~ ¼ Sec ~~34~~ Twp ~~6S~~ Rg 1E

County ~~Custer County~~ Fall River

North

Please mark well location with an "X"

W E

|← 1 Mile →|

May 4, 2011

Well Completion Date ~~May 5, 2011~~

Distance to nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ft. from Unknown (identify source)

**PROPOSED USE:**
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test holes
☐ Irrigation ☐ Industrial ☐ Institutional ☑ Monitoring well

**METHOD OF DRILLING:**
4.25" HSA to ~~22.0'~~ 30'

**CASING DATA:** ☐ Steel ☑ Plastic ☐ Other
If other describe

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| LB/FT | 2.00 IN | 0.0 FT | ~~22.0~~ 20 FT | 4.25 IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA:**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| Cement | 1 | Lb/gal | ~~0.0~~ Ft | ~~8.0~~ Ft |
| Bentonite | 1 | Lb/gal | ~~8.0~~ Ft | ~~10.0~~ Ft |

0 to 15 ft
15 to 20 ft

Describe grouting procedure

**SCREEN:** ☐ Perforated pipe ☑ Manufactured
Diameter 2.00 Inches Length 10.0 Feet
Material Sch 40 PVC
Slot Size 0.010" Set From ~~12.0 Feet to 22.0 Feet~~ 20 to 30 Feet
Other information 12-20 Silica Sand from ~~10' to 22'~~ 20 to 30 Feet

**WAS A PACKER OR SEAL USED?** ☐ Yes ☑ No
If so, what material?
Describe packer(s) and location

**DISINFECTION:** Was well disinfected upon completion?
☐ Yes, How?
☑ No, Why Not? Monitoring well only.
Lab to which water quality sample sent for analysis

Well Owner: ...
Business Name: Powertech, Inc.
Address: 145 N Chicago Street
City, State, Zip: Hot Springs SD 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Topsoil - Silty Lean Clay with sand, brown, moist (CL) | 0 | 0.5' |
| Silty Lean Clay with sand, brn (CL) | 0.5' | 20' |
| Silty Gravel with sand, brn, wet (GM) | 20' | 22' |

sl silty CLAY, dry, roots 0 - 22'
silty, sandy, clayey, GRAVEL, wet 22-28'
competent SHALE 28-30'

STATIC WATER LEVEL FEET
If flowing: closed in pressure PSI
GPM flow through Inch pipe
Controlled by ☐ Valve ☐ Reducers ☐ Other
Reduced flow rate GPM
Can well be completely shut in?

**WELL TEST DATA:**
☐ Pumped Describe: NA
☐ Bailed
☐ Other
Pumping Level Below Land Surface
Ft. After Hrs. pumped GPM
Ft. After Hrs. pumped GPM
If pump installed, pump rate: GPM

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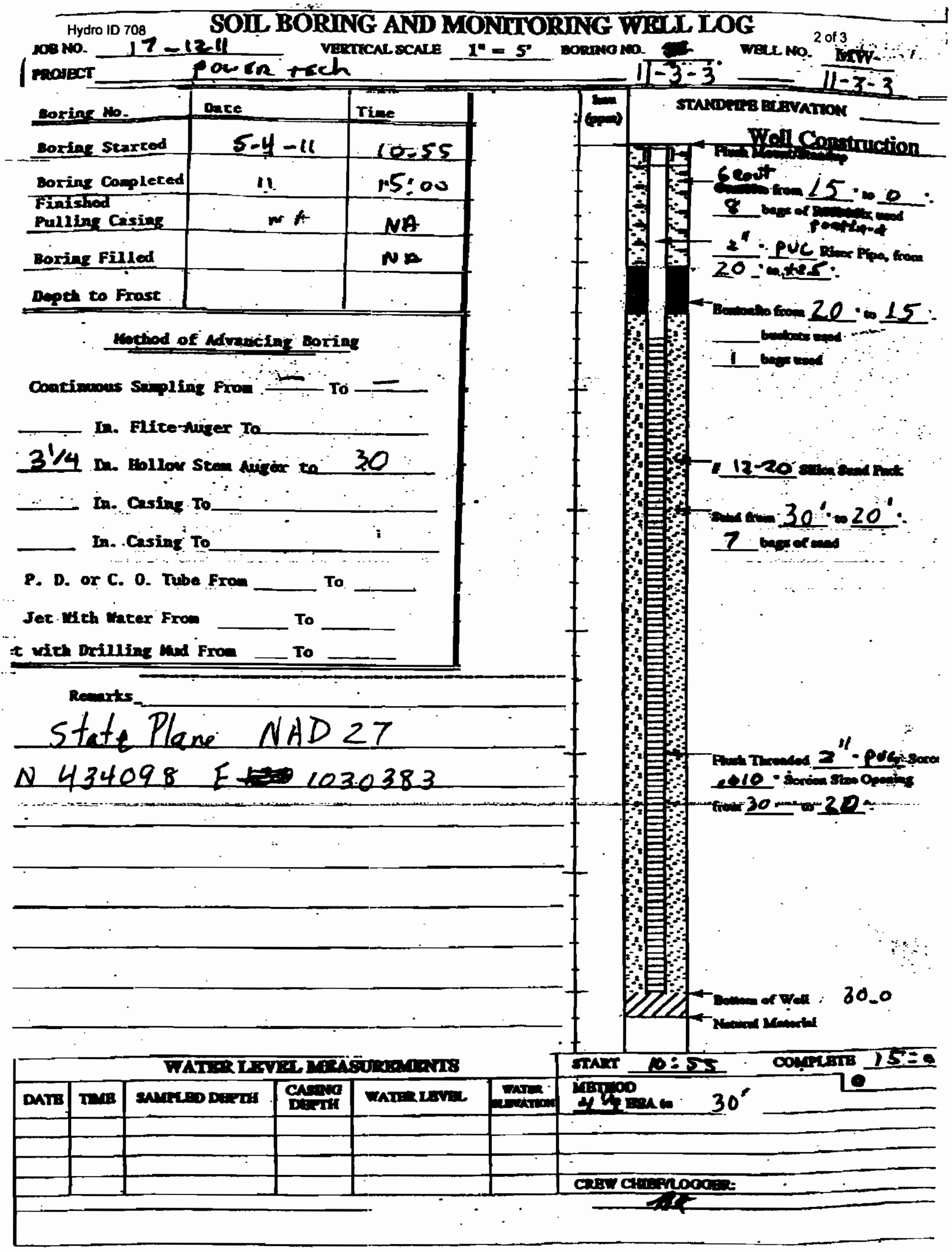
**REMARKS**
Monitoring well ~~11-3-2~~ 11-3-3

This well was drilled under license # 678 and this report is true and accurate.
Drilling firm: American Engineering Testing, Inc.
Signature of License Representative: B. B. H

Signature of Well Owner or Equitable Property Holder:

Date:



Hydro ID 708

# SOIL BORING AND MONITORING WELL LOG

2 of 3

JOB NO. 17-1211 VERTICAL SCALE 1" = 5' BORING NO. 11-3-3 WELL NO. MW-11-3-3

PROJECT Power tech

| Boring No. | Date | Time |
|---|---|---|
| Boring Started | 5-4-11 | 10:55 |
| Boring Completed | 11 | 15:00 |
| Finished Pulling Casing | NA | NA |
| Boring Filled |  | NA |
| Depth to Frost |  |  |

**Method of Advancing Boring**

Continuous Sampling From — To —

_____ In. Flite-Auger To _____

3 1/4 In. Hollow Stem Auger to 30

_____ In. Casing To _____

_____ In. Casing To _____

P. D. or C. O. Tube From _____ To _____

Jet With Water From _____ To _____

t with Drilling Mud From _____ To _____

Remarks

State Plane NAD 27

N 434098 E 1030383

Iso (ppm)

STANDPIPE ELEVATION _____

**Well Construction**

Flush Mount/Standup

Grout from 15' to 0'.

8 bags of Portland used

2" - PVC Riser Pipe, from 20' to +2.5'.

Bentonite from 20' to 15'.

_____ buckets used

1 bags used

# 12-20 Silica Sand Pack

Sand from 30' to 20'.

7 bags of sand

Flush Threaded 2" - PVC Screen

.010" Screen Size Opening

from 30' to 20'

Bottom of Well 30.0

Natural Material

**WATER LEVEL MEASUREMENTS**

| DATE | TIME | SAMPLED DEPTH | CASING DEPTH | WATER LEVEL | WATER ELEVATION |
|---|---|---|---|---|---|
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

START 10:55 COMPLETE 15:00

@

METHOD

4 1/4 HSA to 30'

CREW CHIEF/LOGGER:

Hydro ID 708

# PowerTech (USA) Inc.

3 of 3

DRILLED WITH: AIR ☐ WATER ☐ HOLE NO. DB11-3-ALLUV-3

T.D. 30 LOCATION: 434097.55, 1030382.506 State Plane NAD27

BIT SIZE 4" FA

SAMPLE LOG BY LE LEASE: (PROJECT) Dewey Burdock

DATE 5/4/11 COUNTY Fall River STATE SD

| DEPTH | LITHOLOGY | CARBON | PYRITE | OTHER ALTERATION | Alteration % Primary Oxidation | Reduction | Secondary Oxidation | SAMPLE DESCRIPTION (Amounts in Percent, %) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 0-22'<br>sl silty CLAY, orangish brown, dry, sat roots |
| 10 | | | | | | | | |
| 20 | | | | | | | | 22-28'<br>silty, sandy, clayey, GRAVEL, pinks/whites/grays, nickel sized angular qtzites & cherts, wet |
| 30 | | | | | | | | 28'-30<br>competent GRAVELS - gray |
| 40 | | | | | | | | TD @ 28' * drilled out to 8½" w/ 4¼" HSA & converted to mw. |
| 50 | | | | | | | | |
| 60 | | | | | | | | |

L = Limonite (Lim)
SOX Surf. Oxidation
Rd. Reduced
Rdt. Reduction
P = Pyrite (Pyr)
$P_T$ = Pyrite Tarnish
POX = Primary Oxid.
BSOX = Base of Surf. Oxid.
2OX = Secondary Oxid.
Tn = Transition Zone
fld = Feldspar
T = Trace
1 = Minor
2 = Moderate
3 = Abundant
C = Carbon
K = Kaolin
B = Bleached
Cht = Chert

Hydro ID 709

SD EForm - 1621LD V1
11- 02

# SOUTH DAKOTA WATER WELL COMPLETION REPORT

Location ¼ NW ¼ Sec ~~34~~ 15 Twp ~~6S~~ 7S Rg 1E

County ~~Custer County~~ Fall River

Please mark well location with an "X"

North

W E

|◄— 1 Mile —►|

Well Completion Date
May 9, 2011

Distance to nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)?
ft. from Unknown (identify source)

**PROPOSED USE:**
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test holes
☐ Irrigation ☐ Industrial ☐ Institutional ☑ Monitoring well

**METHOD OF DRILLING:**
4.25" HSA to 30.0'

**CASING DATA:** ☐ Steel ☑ Plastic ☐ Other
If other describe

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| LB/FT | 2.00 IN | 0.0 FT | ~~38.0~~ 28 FT FT | 4.25 IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

**GROUTING DATA:**

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| Cement | 7 | Lb/gal | 0.0 Ft | 24.0 Ft |
| Bentonite | 1 | Lb/gal | ~~24.0 Ft~~ | ~~26.0 Ft~~ |

26 to 28 Ft

Describe grouting procedure

**SCREEN:** ☐ Perforated pipe ☑ Manufactured
Diameter 2.00 Inches Length 10.0 Feet
Material Sch 40 PVC
Slot Size 0.010" Set From 28.0 Feet to 38.0 Feet
Other information 12-20 Silica Sand from ~~26' to 38'~~ ← 28 to 38'

**WAS A PACKER OR SEAL USED?** ☐ Yes ☑ No
If so, what material?
Describe packer(s) and location

**DISINFECTION:** Was well disinfected upon completion?
☐ Yes, How?
☑ No, Why Not? Monitoring well only.
Lab to which water quality sample sent for analysis

Well Owner: ...
Business Name: Powertech, Inc.
Address: 145 N Chicago Street
City, State, Zip: Hot Springs SD 57747

**WELL LOG:**

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Topsoil - Silty Lean Clay with sand, brown, moist (CL) | 0 | 0.5' |
| Silty Lean Clay with sand, brn (CL) | 0.5' | 35' |
| Silty Gravel with sand, brn, wet (GM) | 35' | 38' |
| | | |
| | | |
| | | |
| | | |
| | | |

**STATIC WATER LEVEL** FEET
If flowing: closed in pressure PSI
GPM flow through Inch pipe
Controlled by ☐ Valve ☐ Reducers ☐ Other
Reduced flow rate GPM
Can well be completely shut in?

**WELL TEST DATA:** NA

RECEIVED
NOV 09 2011
WATER RIGHTS PROGRAM

☐ Pumped Describe:
☐ Bailed
☐ Other
Pumping Level Below Land Surface
Ft. After Hrs. pumped GPM
Ft. After Hrs. pumped GPM
If pump installed, pump rate: GPM

**REMARKS**
Monitoring well 11-15-4

This well was drilled under license # 678 and this report is true and accurate.
Drilling firm: American Engineering Testing, Inc.
Signature of License Representative:

Signature of Well Owner or Equitable Property Holder:

Date:

# SOIL BORING AND MONITORING WELL LOG

NO. 17-12-11 VERTICAL SCALE 1" = 5' BORING NO. SB-11-15-4 WELL NO. 2 of MW-11-15-4

Hydro ID 709

ROJECT powertech

| Boring No. | Date | Time |
|---|---|---|
| Boring Started | 5-9-11 | 7:15 |
| Boring Completed | 11 | |
| Finished Pulling Casing | 11 | 12:30 |
| Boring Filled | | |
| Depth to Frost | | |

**Method of Advancing Boring**

Continuous Sampling From — To —

____ In. Flite-Auger To ____

4 1/4 In. Hollow Stem Auger to 35.0'

____ In. Casing To ____

____ In. Casing To ____

P. D. or C. O. Tube From ____ To ____

Jet With Water From ____ To ____

t with Drilling Mud From ____ To ____

Remarks

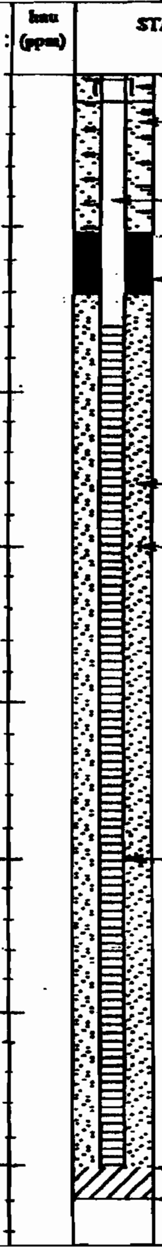
State Plane NAD 27

N 426 607 E 1029 415

hnu (ppm)

STANDPIPE ELEVATION ____

## Well Construction



~~Flush Mount/Standup~~

cement grout

~~Concrete~~ from 0' to 24.0'.

7 bags of Rodi-Mix used

2" pvc Riser Pipe, from 28' to +2'.

Bentonite from 28' to 26'.

____ buckets used

1 bags used

# 12-20 Silica Sand Pack

Sand from 38' to 28'.

6 bags of sand

Flush Threaded 2" pvc Screen

.010" Screen Size Opening

from 35' to 28'.

Bottom of Well 38.0'

Natural Material 35.0'

**WATER LEVEL MEASUREMENTS**

| DATE | TIME | SAMPLED DEPTH | CASING DEPTH | WATER LEVEL | WATER ELEVATION |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

START 9:25 COMPLETE 12:30

METHOD

4 1/4" HSA to

CREW CHIEF/LOGGER:

Hydro ID 709

3 of 3

# PowerTech (USA) Inc.

DRILLED WITH: AIR ☐ WATER ☐ HOLE NO. DBT-15-ALLUV-4

T.D. 40' LOCATION: 426606.639, 1029414.805 State Plane NAD27

BIT SIZE 4" FA

SAMPLE LOG BY LE LEASE: (PROJECT) Dewey Burdock

DATE 5/4/11 COUNTY Fall River STATE SD

DEPTH | LITHOLOGY | CARBON | PYRITE | OTHER Alteration | Alteration %: Primary Oxidation | Reduction | Secondary Oxidation

**SAMPLE DESCRIPTION**

(Amounts in Percent, %)

L = Limonite (Lmn)
SOX Surf. Oxidation
Rd. Reduced
Rdt. Reduction
P = Pyrite (Pyr)
$P_T$ = Pyrite Tarnish

POX = Primary Oxid.
BSOX = Base of Surf. Oxid.
2OX = Secondary Oxid.
Tz = Transition Zone
fld = Feldspar

T = Trace
1 = Minor
2 = Moderate
3 = Abundant

C = Carbon
K = Kaolin
B = Bleached
Cht = Chert

| Depth | Sample description |
|---|---|
| | 0-35' |
| | silty, sandy, CLAY, lt-med brown, dry, scat roots, (Alluv) |
| 10 | |
| 20 | |
| 30 | > 32' damp |
| | 35-40' |
| 40 | silty, sandy, clayey, GRAVEL, med brown, quartzite & chert pebbles, wet, (Alluv) |
| | weathered GRANEROS @ 40' = TD |
| 50 | * hole drilled out to 8¼" w/ 4¼ HSA & converted to MW. |
| 60 | |
| 70 | |

4-21-08

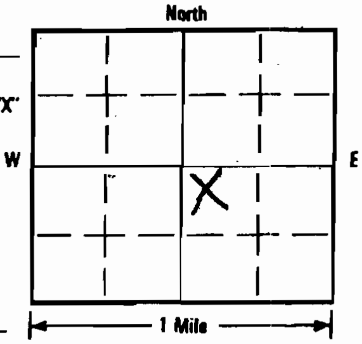
Hydro ID 3026

# SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NW ¼ SE ¼ Sec 1 Twp 7S Rg 1E
County Fall River

Please mark well location with an "X"



Well Completion Date 3-26-08

Well Owner: Power Tech
Business Name: Power Tech USA Inc
Address: P.O. Box 723
Hot Springs S.D 57747

WELL LOG:

| FORMATION | DEPTH FROM | DEPTH TO |
|---|---|---|
| Fall River | 0 | 55 |
| Fuson | 55 | 80 |
| Lakota | 80 | 166 |

LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from NONE Present (identify source).

PROPOSED USE:
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

METHOD OF DRILLING:
Mud + Rotary

CASING DATA: ☐ Steel ☒ Plastic ☐ Other
If other describe ______

| PIPEWEIGHT | DIAMETER | FROM | TO | HOLE DIAMETER |
|---|---|---|---|---|
| SDR21 LB/FT | 6 IN | 0 FT | 166 FT | 8¾ IN |
| LB/FT | IN | FT | FT | IN |
| LB/FT | IN | FT | FT | IN |

GROUTING DATA

| Grout Type | No. of Sacks | Grout Weight | From | To |
|---|---|---|---|---|
| CMT | 34 | 15.2 lb./gal | 0 ft. | 166 ft. |
| | | lb./gal | ft. | ft. |

Describe grouting procedure Pump

SCREEN: ☐ Perforated pipe ☒ Manufactured
Diameter 3 IN Length 30 FEET
Material PVC
Slot Size .020 Set From 166 Feet to 196 Feet
Other information Set K Packer

WAS A PACKER OR SEAL USED? ☒ YES ☐ NO
If so, what material? 6" X 3" K Packer
Describe packer(s) and location? Packer set at 156

DISINFECTION: Was well disinfected upon completion?
______YES, How: ______
X NO, Why Not? NA

Laboratory sent to for water quality analysis
Respec

STATIC WATER LEVEL 138 Feet
If flowing: closed in pressure ______ PSI
GPM flow ______ through ______ inch pipe
Controlled by ☐ Valve ☐ Reducers ☐ Other ______
Reduced Flowrate ______ GPM
Can well be completely shut in? Yes

WELL TEST DATA:
☐ Pumped Describe: Air lift at 150'
☐ Bailed
☐ Other

Pumping Level Below Land Surface
______ ft. After ______ Hrs. pumped ______ GPM
______ ft. After ______ Hrs. pumped ______ GPM
If pump installed, pump rate ______ GPM

RECEIVED
APR 28 2008
WATER RIGHTS PROGRAM

REMARKS
Dewey Burdock
8-1-6

This well was drilled under license # 745
And this report is true and accurate.
Drilling firm Davis Drilling
Signature of License Representative: Stan Davis
Signature of Well Owner or Equitable Property Holder:
Date: 4/22/08

## Hydro ID Cross Reference

| Count | Powertech ID | Hydro ID | Log Date |
|---|---|---|---|
| 1 | DB07-11-2 | 682 | 5/24/2007 |
| 2 | DB07-11-11C | 680 | 10/16/2007 |
| 3 | DB07-11-14C | 684 | 11/2/2007 |
| 4 | DB07-11-15 | 686 | 11/4/2007 |
| 5 | DB07-29-7 | 683 | 11/19/2007 |
| 6 | DB07-32-3C | 681 | 11/27/2007 |
| 7 | DB07-32-5 | 687 | 11/17/2007 |
| 8 | DB08-32-10 | 689 | 1/26/2008 |
| 9 | DB08-1-6 | 3026 | 3/24/2008 |
| 10 | DB08-1-7 | 703 | no date |
| 11 | DB08-2-1 | 698 | 3/21/2008 |
| 12 | DB08-5-1 | 704 | 4/19/2008 |
| 13 | DB08-11-17 | 688 | 3/25/2008 |
| 14 | DB08-11-18 | 690 | 4/1/2008 |
| 15 | DB08-11-19 | 692 | 4/4/2008 |
| 16 | DB08-15-2 | 696 | 3/11/2008 |
| 17 | DB08-15-3 | 694 | 3/19/2008 |
| 18 | DB07-32-4C | 685 | 12/4/2007 |
| 19 | DB08-32-9C | 691 | 1/15/2008 |
| 20 | DB08-32-11 | 693 | 2/8/2008 |
| 21 | DB08-32-12 | 697 | 2/26/2008 |
| 22 | DB08-32-13 | 695 | 3/7/2008 |
| 23 | DB09-21-1 | 705 | 11/19/2009 |
| 24 | DB09-21-2 | 706 | 11/24/2009 |
| 25 | DB-GW675 | 675 | n/a |
| 26 | DB-GW676 | 676 | n/a |
| 27 | DB-GW677 | 677 | n/a |
| 28 | DB-GW678 | 678 | n/a |
| 29 | DB-GW679 | 679 | n/a |
| 30 | DB-11-34-ALLUV-4 | 707 | n/a |
| 31 | DB-11-3-ALLUV-3 | 708 | n/a |
| 32 | DB-11-15-ALLUV-4 | 709 | n/a |

# SOURCE D

# SOUTH DAKOTA OIL AND GAS RECORDS

South Dakota
Department of Environment
& Natural Resources
Tomorrow... Today

| Oil and Gas Search for: *api_no_ like '40 047 20045'* | | |
|---|---|---|
| ***Page 1 of 1*** | ***Download Database***<br>(Excel spreadsheet format) | **Page:** 1 |

***Record 1 of 1***

## Well Information

| | | | |
|---|---|---|---|
| **API No:** | 40 047 20045 | **County:** | FALL RIVER |
| **Well Name:** | PETRO LEWIS 5-22 PETERSON | **Location:** | SWNW 22-7S-1E |
| **Permit No:** | 606 | **Total Depth:** | 2545 |
| **Operator Name:** | PETRO-LEWIS CORPORATION | **Bottom Hole:** | Minnelusa |
| **Permit Date:** | 10-21-1970 | **KB Elevation:** | 3542 |
| **Spud Date:** | 11-17-1970 | **Ground Elevation:** | 3534 |
| **Plug Date:** | 11-27-1970 | **Latitude:** | 43.429484 |
| | | **Longitude:** | -103.992869 |
| **Well Field** | WILDCAT | **Status** | P&A |
| **Class:** | DRY HOLE | **Type:** | DRY HOLE |

## Formation Tops

| Formation | Depth (ft.) |
|---|---|
| **Fall River** | **324** |
| **Lakota** | **452** |
| **Morrison** | **700** |
| **Sundance** | **848** |
| **Goose Egg** | **1441** |
| **Spearfish** | **1704** |
| **Minnekahta** | **1704** |
| **Opeche** | **1738** |
| **Minnelusa** | **1815** |
| **Converse** | **1838** |
| **Red Marker** | **2237** |
| **2nd Leo** | **2353** |

| | |
|---|---|
| ***Page 1 of 1*** (goto top) | **Page:** 1 |

| | |
|---|---|
| **COUNTY:** | **FALL RIVER** |
| **LEGAL LOCATION:** | **SWNW 22-7N-1E** |
| **API NO:** | **40 047 20045** |
| **PERMIT NO:** | **606** |
| **WELL NAME:** | **PETRO-LEWIS #5-22 PETERSON** |
| **OPERATOR:** | **PETRO-LEWIS CORPORATION** |
| **PERMIT ISSUED:** | **10/21/1970** |
| **PERMIT CLOSED:** | **12/29/1971** |
| **FILE LOCATION:** | **7N-1E-12 SWNW** |

**TARGET CODES:**

**WELL HISTORY / CHECKLIST**

**PERMIT TO DRILL / INTENT TO DRILL**

**WELL INSPECTION / SCOUT REPORTS**

**OPERATOR'S TECHNICAL REPORTS / MAPS**

**ADMINISTRATIVE / SUNDRY REPORTS**

**CORRESPONDENCE**

**SURETY**

**MISCELLANEOUS**

# WELL HISTORY / CHECKLIST

## Well History

**Well Name** Petro-Lewis #5-22 Peterson **Permit No.** 606

**Location** SWNW 22-7S-1E Fall River **Date of Permit** 10-21-70

**Elev.** 3534' Gr. **API No.** 40 047 20045

**Confidential** **From** **To**

**Logs Received** Dual Induction-Laterlog, Sonic-Gamma Ray

**Cuttings Received** **Cores Received**

**Drill Stem Records**

**Cap Plug and Marker Set**

**Surface Restored**

**Plugging Affidavit Signed** **Date**

**Bond Released** YES **Date** 12-29-71

**Summary of Scout Reports**

11-27-70 FVS Logging. Drilled to T.D.

6-21-71 RL Site approved.

# WELL HISTORY

Well Name Petro Lewis #5-22 Peterson Permit Number 606

Location SW NW 22-7S-1E Date of Permit Oct 22, 1970

Elevation 3542 KB API Number

Confidential Yes From 11-27-70 To 5-27-71

Logs Received Dual Ind, Sonic Gamma-Ray, Sample

Cuttings Received Yes Cores Received

Drill Stem Records Ran Dst - No Copy 12-8-70

Cap Plug and Marker Set Approved June 23, 1971

Surface Restored Approved June 23, 1971

Plugging Affidavit Signed Date

Bond Released Date

Summary of Scout Reports

No Cutting 29 Apr 1971

# PERMIT TO DRILL / INTENT TO DRILL

State Pub. Co., Pierre

# APPLICATION FOR PERMIT TO:

S. Dak. Oil & Gas Board
FORM 2

☒ DRILL ☐ DEEPEN ☐ PLUG BACK

☐ SINGLE ZONE

☐ OIL WELL ☐ GAS WELL ☐ MULTIPLE ZONE

FARM OR LEASE NAME: Peterson

WELL NO: 5-22

FIELD AND POOL, OR WILDCAT: Wildcat

NO. ACRES IN LEASE:

OPERATOR: PETRO-LEWIS CORPORATION

ADDRESS: 1224 Denver Club Building, Denver, Colorado, 80202

LOCATION (In feet from an established corner of the legal subdivision)*

1980' FNL, 660'FWL, SW-NW Section 22, T7S, RIE
Fall River County, South Dakota

[illegible]

¼ ¼ SEC. TWP. RGE: SW-NW Sec. 22, T7S, RIE

COUNTY: Fall River

NAME AND ADDRESS OF SURFACE OWNER: Mrs. M. Lenore Peterson

ELEVATION: 3534' Gr.

PROPOSED DEPTH: 2490'

NO. OF WELLS ETC.:

ROTARY OR CABLE TOOLS: Rotary

NAME AND ADDRESS OF CONTRACTOR: Will follow

APPROXIMATE DATE WORK WILL START: October 21, 1970

IF LEASE PURCHASED WITH ANY WELLS DRILLED, FROM WHOM PURCHASED (Name and address)

PROPOSED CASING AND CEMENTING PROGRAM

| SIZE OF HOLE | SIZE OF CASING | WEIGHT PER FOOT | NEW OR SECOND HAND | DEPTH | SACKS OF CEMENT |
|---|---|---|---|---|---|
| 12-1/4" | 8-5/8" | 24# | New | 165' Minimum | To Surface |

DESCRIBE PROPOSED OPERATIONS. IF PROPOSAL IS TO DEEPEN OR PLUG BACK, GIVE DATA ON PRESENT PRODUCTIVE ZONE AND PROPOSED NEW PRODUCTIVE ZONE. GIVE BLOW OUT PREVENTER PROGRAM IF ANY

We propose to drill this well with rotary tools to an approximate depth of 2490' to test the Leo Sand. If commercial production is encountered a 5-1/2" OD 14# oil string will be run and cemented with sufficient cement to displace 1000'.

Certified Surveyors plat attached (3 copies)
Blanket drilling bond #1672873

SIGNED R. J. Doubek
R. J. Doubek

TITLE Manager of Operations DATE 10/7/70

DO NOT WRITE BELOW THIS LINE

PERMIT NO. 66

CHECKED BY [illegible] School and Public Lands Date

APPROVAL DATE October [illegible]

[illegible] Secretary

CONDITIONS:

☐ COMPLETE SET OF SAMPLES, AND CORES IF TAKEN, MUST BE SUBMITTED.

☐ SAMPLES, AND CORES IF TAKEN, BELOW DEPTH, MUST BE SUBMITTED.

## INSTRUCTIONS

General: This form is designed for submitting proposals to perform certain well operations, as indicated, on all types of lands and leases for appropriate action by either a Federal or a State agency, or both, pursuant to applicable Federal and/or State laws and regulations. Consult applicable Federal or State regulations, or appropriate officials, concerning approval of the proposal before operations are started.

If the proposal is to redrill to the same reservoir at a different subsurface location or to a new reservoir, use this form with appropriate notations.

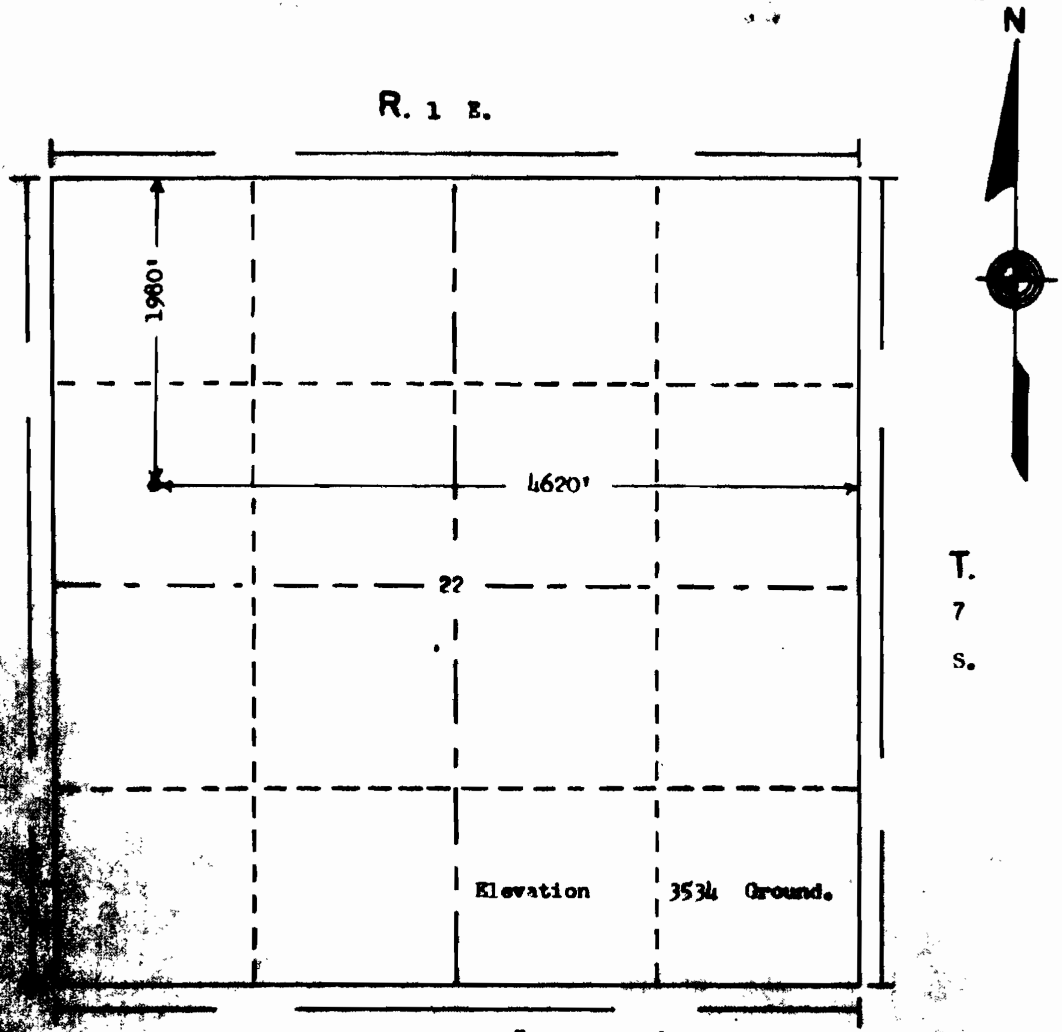
If the well is to be, or has been, directionally drilled, so state and show by attached sheets, if necessary, the coordinate location of the hole in any present or objective productive zones.

File 3 copies of this form with Secretary, Oil & Gas Board, Pierre.

(*Sample location: 660' South and 660' East of the Northwest Corner of Section 16.)

Hydro ID 3

8 of 80



Scale··· 1" = 1000'

[illegible] Elevation Company, Inc. of Denver, Colorado
[illegible] in accordance with a request from Owen Stevens
[illegible] Petro Lewis Corporation
[illegible] the location of #231 Driftwood Area
[illegible] 1980'FN & 4620'FE Section 22 Township 7 S.
[illegible] 1 E. of the Black Hills Meridian
Fall River County, South Dakota

I hereby certify that this plat is an accurate representation of a correct survey showing the location of #231 Driftwood Area

Date: 7-[illegible]-70

Licensed Land Surveyor No. 1212 PE
State of South Dakota

STATE PUB. CO., PIERRE

S. Dak. Oil & Gas Board
FORM 1

# ORGANIZATION REPORT

**Full Name of the Company, Organization, or Individual**
Petro-Lewis Corporation

Post Office Address (Box or Street Address)
1224 Denver Club Building, Denver, Colorado, 80202

Plan of Organization (State whether organization is a corporation, joint stock association, firm or partnership, or individual)
Corporation

If a reorganization, give name and address of previous organization

| (1) If foreign corporation, give State where incorporated | (2) Name and postoffice address of State agent | (3) Date of permit to do business in state |
|---|---|---|
| | | May 28, 1970 |

| Principal Officers or Partners (if partnership) NAME | TITLE | POSTOFFICE ADDRESS |
|---|---|---|
| SEE THE ATTACHED SHEET... | | |

| DIRECTORS NAME | POSTOFFICE ADDRESS |
|---|---|
| SEE THE ATTACHED SHEET | |

Executed this the 7th day of October 19 70

State of Colorado

County of Denver

R. J. Doubek
Signature of Affiant R. J. Doubek

Before me, the undersigned authority, on this day personally appeared R. J. Doubek known to me to be the person whose name is subscribed to the above instrument, who being by me duly sworn on oath states, that he is duly authorized to make the above report and that he has knowledge of the facts stated herein, and that said report is true and correct.

Subscribed and sworn to before me this 7th day of October 1970.

SEAL

My commission expires Nov. 3, 1971

Betty J. Burrows
Notary Public in and for Denver
County, Colorado

DO NOT WRITE BELOW THIS LINE

## PETRO-LEWIS CORPORATION

Attachment to Annual Corporate Report
Attachment dated May 15, 1970

Current Officers of the Corporation:

| Title: | Name: | Street Address: | City: | State: |
|---|---|---|---|---|
| President | Jerome A. Lewis | 3680 South Downing | Englewood | Colorado |
| Vice-President | Don E. Mettler | 5741 East Nassau Place | Englewood | Colorado |
| Vice-President | Dwight C. Moorhead | 1437 South Fairfax | Denver | Colorado |
| Vice-President | David A. Frawley | 7343 E. Jefferson Drive | Denver | Colorado |
| Vice-President | Hal H. Wolfe | 800 Lotus Way | Broomfield | Colorado |
| Vice-President | Herbert G. Allen | | | Colorado |
| Vice-President | Jim H. Hanlon | 2195 Urban Drive | Lakewood | Colorado |
| Secretary-Treasurer | Robert B. Huffman | 3162 South Gaylord | Englewood | Colorado |

Current Directors of the Corporation:

| Name: | Street Address: | City: | State: |
|---|---|---|---|
| Jerome A. Lewis | 3680 South Downing | Englewood | Colorado |
| Don E. Mettler | 5741 East Nassau Place | Englewood | Colorado |
| Ted P. Stockmar | 15 Cherry Street | Denver | Colorado |
| W. Dale Schouweiler | 5212 Indiana | Fort Wayne | Indiana |
| Cortlandt S. Dietler | 888 Logan Street | Denver | Colorado |
| Carl K. Erpf | 960 Park | New York | New York |
| James W. Vickers | 346 North | Wichita | Kansas |

# WELL INSPECTION / SCOUT REPORTS

JUN 2 5 1971

Number 2

## SCOUT REPORT
### South Dakota Geological Survey

Date Scouted 6-21-71

Operator Petro-Lewis

Permit Number 606

Farm/Lease Name #5-22 Peterson

API Number 40 047 20045

SWNW Sec. 22 , T. 7S , R. 1E , Fall River County

Elev. 3534 , Est. T.D. 2490 , Actual T.D. 2545 , Spudded 11-18-70

Contractor A. L. Schlaikier Geologist Al Nelson

**WORK IN PROGRESS:**

**DEVELOPMENTS SINCE LAST VISIT:**

**FORMATION TOPS:**

**PLUGGING RECORD:**

Date Plugged 11-27-70

**CASING RECORD:**

4 1/2 From 0 To 367 Feet ____ From ____ To ____ Feet

____ From ____ To ____ Feet ____ From ____ To ____ Feet

**REMARKS:**

Site approved. Converted to water well, good running well. Area restored and policed.

SCOUTED BY Ross Lamphere Fred V Steece

Ross Lamphere, Ass't. Geologist Fred V. Steece, Principal Geologist

Number 1

## SCOUT REPORT
### South Dakota Geological Survey

Date Scouted 11-27-70

**Operator** Petro-Lewis **Permit Number** 606

**Farm/Lease Name** # 5-22 Peterson **API Number** 40 047 20045

SWNW **Sec.** 22 , **T.** 7S , **R.** 1E , Fall River **County**

**Elev.** 3534 Gr. , **Est. T.D.** 2490 , **Actual T.D.** 2545 , **Spudded** 11-18-70

**Contractor** A. L. Schlaikjer **Geologist** Al Nelson

**WORK IN PROGRESS:**

Logging

**DEVELOPMENTS SINCE LAST VISIT:**

Drilled to T.D.

DST #1-2381-2395: IHP 1111, FH 1106, IF 20, FF20, IF 30, FF 75, SIP 963, SIP$_2$ 907, Flow, 15 min, SIP. 15 min, Flow$_2$ 45 min, SIP$_2$ 15 min, BHT 96°, mud wt. 9.5, visiosity 60; tool opened w/very weak blow and remained op 5 min, tool op w/very weak blow 1/4" under water, remained for 10 min, then intermittant blow. Rec: 140 fluid; 60' GCM w/sulfur smell, 80' water w/scum of oil and sulfur smelling gas; water flow throughout test; Resistivity: water 40.62 pf cl content 18,000ppm mud pit spl 2.6 @ 60 0f cl content 2,500 ppm.

**FORMATION TOPS:** (Al Nelson)

Fall River--------324
Fuson-------------452
Lakota------------469
Morrison----------700
Sundance----------848
Lak---------------966
Basal Sund Sd----1061
Spearfish--------1174

Goosegg------1441
ForelleLs----1599
Glendo-------1618
Minnekahta---1704
Opeche-------1738
Minnelusa----1815
1st Converse-1838
Massive Anhydrite 1911-1942

2nd Converse------1961-1991
3rd Converse------2076-2094
4th Converse------2154-2165
Red Marker--------2237-2247
2nd Leo-----------2353
Des Moines--------2416

**PLUGGING RECORD:** **Date Plugged** 11-27-70

40 sax--2410-2300 Leo
30 sax--1850-1750 Converse
30 sax--1130-1030 Basal Sand

**CASING RECORD:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | From | To | Feet | | From | To | Feet |
| | From | To | Feet | | From | To | Feet |

**REMARKS:**

Plugged back to Morrison, 4 1/2 casing ran to 367 and well completed as water well for Peterson farm; flows approx. 25.35 gal per min.

**SCOUTED BY** Fred V Steece

Fred V. Steece, Principal Geologist

Petro-Lewis # 5- 2 Peterson
SW NW 22-7S-1E Fall River
1980 FNL and 4620 FEL

PERMIT: 606 (10-21-70)
API: 40 047 20045
ELEV: 3534 Gr 3542 KB
CONTR: A.L. Schlaikjer 662-7244
GEOL: Al Nelson (Rambow Motel Edgemont
ENGR: W.J. McPeters
SPUD: 11-18-70 (1:15 AM)
EST T.D.: 2490
CASING: 8 5/8 - 167
CORES: None
DST'S: 2381-2395
LOGS: DIL & Sonic GR
T.D.: 2545 Drlr 2544 Log
PLUG: 11-27-70

10-29-70

No activity, location staked, but no work done.

11-19-70

Phone call from Al Nelson saying well was started and that he would let me know when ready to plug. Said, Petrolewis plans 3 tests in Edgemont area.

11-26-70

Nelson called saying would be logging late tonite ready to plug in A.M.

Plug Program:
40 sax — 2410-2300 Leo
30 sax — 1850-1750 Converse
30 sax — 1130-1030 Rand Sand

Plan to run 360 — 4½
Casing and convert to
water well. Schlaikjer w/
do this before they
tear down.

(2nd Leo Sand)
DST #1 — 2391-2395:
HHP 1111, FH 1106, IF 20
FF 20, IF 30, FF 75, SIP$_1$ 963,
SIP$_2$ 907, Flow 1-5 min,
SIP 1-15 min, Flow 2-45 min,
SIP$_2$-15 min, BHT 96°, mud
wt 9.5, viscosity 60; Tool
opened with a very weak
blow and remained —
op 5 min, tool op w/ very weak
blow ¼" under water,
remained for 10 min, then
intermittant blow. Bypassed
tool to see if plugged. Rec
140 fluid; 60' ~~gas~~ GCM
w/sulfur smell, 80' water w/
scum of oil & sulfur smelling
gas; Water flowed throughout test.

Resistivity: water .4 @ 62 °F Cl content 18,000 ppm
mud pit spl. 2.6 @ 60 °F
Cl content 2500 ppm

Hydro ID 3

Formation Tops

| | | |
|---|---|---|
| Kd | 324 | |
| Fuson | ~~447~~ 452 | |
| Lakota | ~~508~~ 469 | |
| Morr. | 700 | |
| Sund | 848 | |
| Lak | 966 | |
| Basal Sd. | 1061 | |
| Spear | 1174 | |
| Goosegg | 1441 | |
| Forelle Lime | 1599 | |
| Glendo Sh | 1618 | |
| Mk | 1704 | |
| Opeche | 1738 | |
| Minnelusa | 1815 | |
| 1st Converse | 1838 | |
| Massive Anhydrite | 1911 | |
| Base " | 1942 | |
| 2D Converse | 1961 | 1991 |

| | | |
|---|---|---|
| 3D Conv | 2076 | -2094 |
| 4th Conv | 2154 | -2165 |
| Basal Conv | 2226 | - |
| Red Marker | 2237 | -2247 |
| 2D Leo | 2353 | - |
| Des Moines | 2416 | |
| TD | 2540 | Drlr |
| | 2544 | Log |

Site Insp.
Converted to $H_2O$ well
is a good running well.
Area is restored
not real level. area
policed.

# OPERATOR'S TECHNICAL REPORTS / MAPS

PHONE 522-1206 AREA 303

**VIRG'S TESTERS, INC.**

BOX 712 STERLING, COLORADO

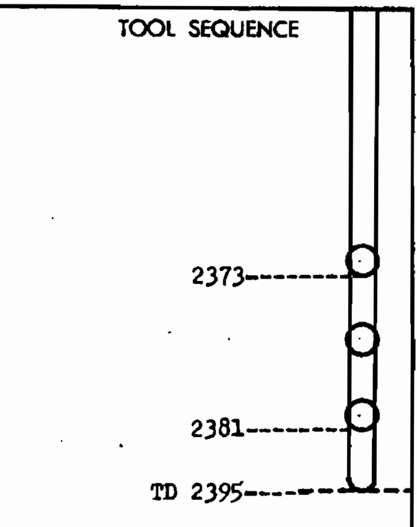
Operator Petro-Lewis Corp.
ADDRESS See Distribution

Contractor A. L. Schlaikjer, Inc.
Rig No. 4
Spot SW-NW
Sec. 22
Twp. 7 S
Rng. 1 E
Field Wildcat
County Fall River
State South Dakota
Elevation 3534' "Ground"
Formation "2nd Leo" Sand

Top Choke 1"
Bottom Choke 9/16"
Size Hole 7 7/8"
Size Rat Hole None
Size & Wt. D. P. 3½" 13.30
Size Wt. Pipe None
I. D. of D. C. 2¼"
Length of D. C. 542'
Total Depth 2395'
Interval Tested 2381-2395
Type of Test Straight

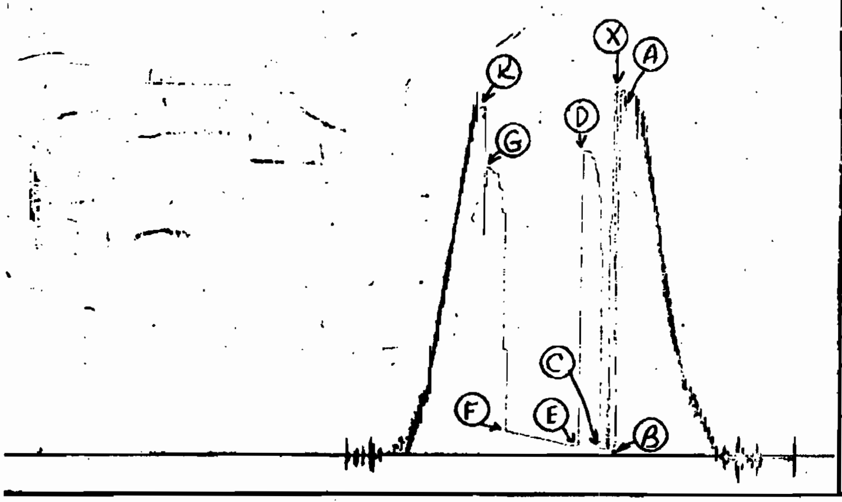
Tool Open @ 10:00 A M.
Flow #1 5 Min. SIP #1 15 Min. Flow #2 45 Min SIP #2 15 Min.
Flow #3 ___ Min. SIP #3 ___ Min. Flow #4 ___ Min. SIP #4 ___ Min.
B. H. T. 96°
Mud Wt. 9.0
Gravity
Viscosity 60

TOOL SEQUENCE



T- 0786

R- 4153-N



PRD Make Kuster AK-1
No. 4153 Cap. 2000 @ 2361

| Press | | Field | Corrected |
|---|---|---|---|
| IH | A | 1111 | 1102 ✓ |
| FH | K | 1106 | 1100 ✓ |
| Flow #1-IF | B | 20 | 4 ✓ |
| FF | C | 20 | 21 ✓ |
| SIP #1 | D | 963 | 969 ✓ |
| Flow #2-IF | E | 30 | 31 ✓ |
| FF | F | 75 | 76 ✓ |
| SIP #2 | G | 907 | 914 ✓ |
| Flow #3-IF | H | None | Taken |
| FF | I | " | " |
| SIP#3 | J | " | " |
| | | | |
| | | | |
| | | | |
| Pressure Below Bottom Packer Bled To | | | |

Our Tester: Lloyd Welty
Witnessed By: S. A. Nelson

Well Name and No. Peterson #5-22
Ticket No. 0786
Date 11-25-70
DST No. 1
No. Final Copies 10

RECOVERY IN PIPE

DID WELL FLOW - Gas No Oil No Water No

140' Total fluid
60' Gas-cut mud with a sulphur smell = .29 Bbl.
80' Water with a scum of oil & sulphur smelling gas = .39 Bbl.

REMARKS:

1st Flow - Very weak blow throughout period.
2nd Flow - Tool opened with a very weak blow (¼" under water), remained for 10 minutes, then decreased to intermittent blow for remainder of test.
By-passed tool after 50 minutes (point "X") to see if it was plugged.

Well had 3" to 4" water flow from anulus throughout test. 3' fillup on bottom.

Breakdown of Shut-in curves not practical because of very bad stair-stepping on Shut-in curves, caused by tight formation.

TIGHT HOLE

Phone 522-1206 **VIRG'S TESTERS, INC.** Box 712 - Sterling, Colo.

## Fluid Sample Report

Date 11-25-70 Ticket No. 0786

Company Petro-Lewis Corp.

Well Name & No. Peterson #5-22 DST No. 1

County Fall River State South Dakota

Sampler No. 02 Test Interval 2381-2395

Pressure in Sampler 11 PSIG BHT 96 °F

Total Volume of Sampler: 2150 cc.

Sample: 2150 cc.

Oil: 10 cc.

Water: 2140 cc.

Mud: None cc.

Gas: None cu. ft.

Other: None

### Resistivity

Water: .4 @ 62° of Chloride Content 17,200 ppm.

Mud Pit Sample 2.6 @ 60° of Chloride Content 2,550 ppm.

Gas/Oil Ratio Gravity °API @ °F

Where was sample drained Rig Floor

Remarks:

# DISTRIBUTION OF FINAL DST REPORTS

Company Operating Well Petro-Lewis Corp. Tkt. No. 0786

Lease Peterson Well No. 5-22 Field Wildcat

County Fall River State South Dakota Sec. 22 Twp. 7 S Rng. 1 E Spot SW-NW

DST. No. 1 Date of Test 11-25-70 Interval Tested 2381-2395

BE SURE AND SHOW CORRECT ADDRESS AND NUMBER OF COPIES. STATE ADDRESS TO WHICH ORIGINAL CHART WILL BE MAILED.

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Our Tester ________ Approved by ________

G. ALLAN NELSON
CONSULTING PETROLEUM GEOLOGIST
408
ROOM ~~[illegible]~~, MAJESTIC BLDG. CODE 303
~~[illegible]~~ 255-7750 Res. 322-0325
DENVER, COLORADO, 80202

1971

# GEOLOGICAL WELL REPORT

## PETRO-LEWIS
## #5-22 PETERSON

C SW NW SEC. 22, T. 7 S., R. 1 E.
FALL RIVER COUNTY, SOUTH DAKOTA

(Wildcat)

# INDEX

Page

# WELL DATA

| | |
|---|---|
| LOCATION: | 4620' from the East line and 1980' from the North line, C SW NW of Section 22, Township 7 South, Range 1 East, Fall River County, South Dakota. |
| ELEVATION: | 3534 ground (before and after grading).<br>3542 kelly bushing (7.6' from ground to K.B.).<br>(Surveyed by Powers, 7-24-70). |
| TYPE WELL: | Wildcat (Driftwood Canyon Prospect). |
| SPUD DATE: | 1:15 A. M., November 18, 1970. |
| COMPLETION DATE: | Approximately 5:00 P. M., November 27, 1970 (Finished plugging). |
| CASING RECORD: | Ran 4 joints of new 8 5/8" surface casing, totalling 167', 8 round, 20 pound. Cemented with 100 sax regular cement with 3% Calcium chloride (Plug down at 10:15 A. M., November 18, 1970. Cement circulated). Pipe set at 177 K. B. |
| TOTAL DEPTH: | 2545 Driller.<br>2544 Schlumberger. |
| DEEPEST FORMATION PENETRATED: | Pre-Second Leo Sand (Des Moines or older). |
| DEPTH DATUM: | 3542 K. B. |
| WELL STATUS: | Plugged and abandoned (Landowner ran pipe into Dakota Sand to complete as flowing water well from Dakota-Lakota). |
| MUD PROGRAM: | Mixed mud while drilling surface hole to combat lost circulation in river bed sands and gravels; mixed gel. Came out from under surface with native mud and gel and water and a 32-33 vis. Make-up water from nearby Beaver Creek. |

## WELL DATA (Continued)

Jetted pits at 953 in Sundance in order to convert to red bed type mud. Added 4 sacks of Caustic, 2 sacks of Soda Ash, and 6 sacks of Stabil-Vis. Requirements: 32-35 vis., wt. low as possible. On first trip below surface at 1086 in Sundance hole was flowing a 2" stream of water.

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|---|---|
| HOLE SIZE: | 12 1/4" from surface to 178.<br>7 7/8" from 178 to 2545 T. D. |
| CORES: | (None). |
| DRILL-STEM TEST: | D.S.T. #1 2379-93 P. D. (Second Leo Sand). |
| LOGS: | Ran Schlumberger Dual Induction-Laterolog first, running a logarithmic 5" and a logarithmic 2" from 2544 T. D. up above the Minnekahta. Then dropped back to bottom and came up to 1736 just above base of Opeche with another logarithmic 5" (repeat) and a linear 2". From above the Minnelusa ran a linear 2" and a linear 5" to base of surface casing at 177 K. B. |

Second logs run consisted of the Borehole Compensated Sonic Log with Gamma Ray-Caliper Logs. Ran 5" Sonic, etc., from 2544 T. D. up above Minnelusa to 1732. Then ran a 5" repeat over same interval to see if variance was above 2%. Sonic was repeating good in Minnelusa so continued all the way out to base of surface casing at 177 K. B., running a 5" and 2".

At approximately 1700 added 2 sacks of C.M.C. (Driscose) to lower water loss to 10 cc. or less going into Minnelusa Converse section. At 2206 in lower Converse added 1320 gallons of #2 Diesel to speed drilling and prevent drill column getting stuck in hole. At approximately 2150 added 2 sacks of C.M.C. to lower water loss to 5 cc. or less for drilling Leo Section of Minnelusa. In this part

## WELL DATA (Continued)

of section vis. was 38-40, wt. 9.9, Ph. 9.5 or more. Raised vis. to 72 for D.S.T. of Second Leo Sand.

Raised vis. with Gel and detergent for logging at 2545 T. D. Could not get vis. above 44 due to Dakota-Lakota water flow in upper hole; had no problems logging.

Mud furnished by American Mud Company, Gillette, Wyoming. Mud checks on location made every 1-2 days by engineer, Dick Myers, Gillette.

Est. mud bill at 2540, 5' above T. D.: $3,344.35.

Logging truck and personnel from Gillette, Wyoming. Engineer: Mr. Golas. (Calculations in rear of report).

**PLUGGING RECORD:**

40 sacks from 2420 to 2300 across Red Marker.
30 sacks from 1850 to 1750 across top of Converse.
30 sacks from 1130 to 1030 across Basal Sand of Sundance.
Cementing by Halco.
Finished plugging at approximately 5:00 P.M., November 27, 1970. (Left Dakota-Lakota open for flowing water well for landowner; contractor ran pipe into Dakota).

**CONTRACTOR AND RIG EQUIPMENT:**

Schlaikjer Drilling Company, Newcastle, Wyoming.
Pusher: C. W. McPeters, part owner.
Rig. No. 4.
Spencer-Harris 6000 - Made in 1969 (trailer-mounted rig).
Spencer-Harris 97' derrick (pulls doubles) and trailer.
Bethlehem S-45E with 15" double T. W. in Hydromatic.

## WELL DATA (Continued)

| | |
|---|---|
| 1 | 335 H.P. Cummins Diesel engine powering drawworks. |
| 1 | D-300 Emsco mud pump, 7 1/4" x 14", with 5 1/2" liners. |
| 2 | 6-71 (twins) G.M.C. engines with H.D. gear box, 300 H.P., powering mud pump. |
| | Space-Saver Cameron S.S. 8" blow-out preventer with 2 valve Cameron hydraulic closing unit. |
| 19 | 5 1/2" O.D. drill collars with 2 1/4" bore. |
| 6,000' | 3 1/2" I.F. Reed drill pipe with square shoulder tool joints. |
| | Caterpillar D-315 generator with 25 K.W. gas engine standby. |
| | 32' trailer house. |
| 1 | auxiliary 4 x 6 Gardner-Denver mud-mixing pump. |
| | New General Electric 2-way radio system on rig, in pusher's car, and in Newcastle office. |

SAMPLE STORAGE: Samples were shipped to American Stratigraphic in Casper where library cut will be made. Operator's complimentary cut will be sent to South Dakota Geological Survey as required.

DRILLING TIME RECORDS: Original copy of Geolograph 1' drilling time charts is on file in Denver office of G. A. Nelson.

# LOG FORMATION TOPS

All depths are measured from 3542 K. B.

| FORMATION | DEPTH | DATUM |
|---|---|---|
| LOWER CRETACEOUS | Surface | |
| MOWRY SHALE | Surface | |
| MUDDY SAND (NEWCASTLE) | (Behind pipe in surface hole) | |
| SKULL CREEK SHALE | (Behind pipe in surface hole) | |
| DAKOTA FORMATION (FALL RIVER FORMATION) | 324 | +3218 |
| FUSON SHALE (FUSON MEMBER OF LAKOTA FORMATION) | 452 | |
| LAKOTA SANDS | 469 | +3073 |
| UPPER JURASSIC | 700 | +2842 |
| MORRISON FORMATION | 700 | +2842 |
| SUNDANCE FORMATION | 832 | +2710 |
| REDWATER SHALE MEMBER | 832 | |
| LAK MEMBER | 966 | |
| TENTATIVE HULETT SAND | 1061 | |
| BASE OF SAND | 1092 | |
| TENTATIVE STOCKADE BEAVER SHALE | 1092 | |
| TENTATIVE TOP OF BASAL SAND | 1144 | |
| TRIASSIC | 1174 | +2368 |
| SPEARFISH FORMATION | 1174 | +2368 |
| PERMIAN | 1441 | +2101 |

## LOG FORMATION TOPS (Continued)

| FORMATION | DEPTH | DATUM |
|---|---|---|
| GOOSE EGG FORMATION | 1441 | +2101 |
| FORELLE LIME MEMBER | 1594 | |
| GLENDO SHALE MEMBER | 1618 | |
| MINNEKAHTA LIME MEMBER | 1704 | +1838 |
| OPECHE SHALE MEMBER | 1738 | |
| MINNELUSA FORMATION (REWORKED MINNELUSA) | 1815 | +1727 |
| UPPER MINNELUSA (PERMIAN) | 1815 | +1727 |
| FIRST CONVERSE SAND | 1838 | +1704 |
| MASSIVE ANHYDRITE | 1911 | |
| BASE ANHYDRITE | 1942 | |
| SECOND CONVERSE SAND | 1961 | |
| BASE OF SAND | 1991 | |
| TENTATIVE TOP OF THIRD CONVERSE SAND | 2089 | +1453 |
| BASE OF SAND | 2094 | |
| FOURTH CONVERSE SAND | 2154 | +1388 |
| BASE OF SAND | 2165 | |
| BASAL CONVERSE SAND | 2226 | |
| RED MARKER | 2237 | +1305 |
| BASE RED MARKER | 2247 | |
| PENNSYLVANIAN | 2247 | +1295 |
| MIDDLE MINNELUSA (LEO SECTION) | 2247 | +1295 |
| VIRGIL | 2247 | +1295 |
| MISSOURI | 2353 | +1189 |
| SECOND LEO SAND | 2354 | +1188 |

## LOG FORMATION TOPS (Continued)

| FORMATION | DEPTH | DATUM |
|---|---|---|
| BASE OF SANDS | 2396 | |
| DES MOINES (?) | 2416 | +1126 |
| TOTAL DEPTH DRILLER | 2545 | |
| TOTAL DEPTH SCHLUMBERGER | 2544 | |

## SAMPLE LITHOLOGIC DESCRIPTION

All depths are from 3542 K. B.

All sample depths following have been corrected for lag, and then matched to drilling time breaks wherever possible. *Sample lithology is then matched to log lithology so all lithology following matches log.

All shows are underlined with a solid line. Possible shows are shown with a dashed line.

| DEPTH | LITHOLOGY |
|---|---|
| Surface | LOWER CRETACEOUS |
| Surface | MOWRY SHALE |
| | (Surface pipe to 177 K. B.; Muddy Sand or Newcastle Sand probably behind surface pipe). |
| | (Samples below are caught and described every 30'). |
| 180-200 | Silty shale, steel gray, very soft Skull Creek; muddy cave: sandstone, gray, dark gray, shaly, dirty, limy, glauconitic, biotitic, very hard and tight; trace light gray inoceramus prism veinlet on same gray shale; trace sandstone, light gray, very fine, soft, porous; no fluorescence. |
| 200-32 | Same shale. |
| 232-64 | Same dark steel gray, very soft shale. |
| 264-324 | Same shale; trace light brown inoceramus prisms; trace loose pyrite. |
| 324 (+3218) | DAKOTA FORMATION (FALL RIVER FORMATION) |
| 324-28 | Abundant sandstone, light gray, lot of sandstone laminated with black silty shale, no show, slightly dirty, very fine to fine, well-cemented, poor visible porosity, hard to soft, also gray; sandstone, fine, soft, porous, no show, white, friable; loose pyrite, crystalline to sandy with embedded sand grains; all with no fluorescence. |

| | |
|---|---|
| 328-54 | Shaly siltstone, light gray with thin blackish shaly laminations; sandstone, fine, slightly sugary, visible porosity, some glauconite, no show, soft, also very fine, light gray, few carbonaceous spots; also dark gray, very shaly siltstone; sandstone has spotty white cementation; no fluorescence; in stoppered shell vial Dakota cuttings above 354 are cut in C. Tet. solution with no fluorescence in resulting solution; this indicates no oil in samples. |
| 354-78 | Abundant shaly siltstone, dark gray; some friable, porous sand as above, no show; first traces of waxy clay, tannish light gray, grayish brown and gray (possibly Fuson); lot of small black carbonaceous spots and streaks in siltstone, no visible porosity, no show, no fluorescence. |
| 378-452 | Same dark gray shaly siltstone and fine light gray sandstone as above with good porosity, soft, white clay spots, no show; limited same waxy clay, tannish gray mottled with black (Fuson?); very shaly siltstone, gray mottled blackish, hard, tight; gray waxy clay. |
| 452 | FUSON SHALE |
| 452-55 | Abundant very soft clay, waxy, light gray, tannish light gray, whitish; grayish light green, very waxy, very soft; part sandy where light gray. |
| 455-469 | Same whitish, light gray clay; also mostly grayish purple and red. |
| 469 (+3073) | LAKOTA SANDS |
| 469-98 | Abundant snow white sandstone, highly kaolinitic with abundant white waxy clay cementation, no show, non-calcareous, very fine to fine, no visible porosity, mushy soft, abundant pyrite, few fine grains (Lakota top marked by extremely fast drilling). |
| 498-522 | Same as above, mostly loose sand grains, clear, very fine to fine to fine-plus, unconsolidated, few medium grains; very abundant pyrite; limited light gray sandstone, no show, fine, cleaner, friable, porous; all with no fluorescence; shale breaks of very waxy clay, bluish white, very pale green; trace chert, smoky gray with tiny white spots, very coarse, subangular. |

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|---|---|
| 522-45 | Traces sandstone, slightly tannish light gray possibly stained, very fine to mostly fine, excellent visible porosity, friable, no fluorescence; abundant very sandy lime, grayish tan, very hard, dense, earthy; abundant loose pyrite, limited medium crystalline, mostly very sandy with embedded sand grains, very fine to fine, part all fine-plus; abundant chert, light gray translucent, tan; loose clear quartz sand grains, fine to medium to medium-plus. |
| 545-77 | All very dark gray shale (sand on log), slightly waxy, almost black, part slightly sandy; traces conglomeratic sandstone, clean, very sugary, fine to medium, no show; trace loose clear chert, coarse, angular, also frosted, milky white; ironstone (?) stringer, tannish brown, part very sandy, dense, very hard (Morrison-type shale). |
| 577-620 | Same greenish black shale, slightly waxy, very soft; trace chert, clear, angular, very coarse; traces brown sand, very fine, very well-cemented, no show, no visible porosity, very hard, tight, limy. |
| 620-48 | Abundant pebbles, mostly very coarse-plus, subangular, brown, milky white, clear angular; loose pyrite (pebbles surface cave?); same shale. |
| 648-62 | (Poor sample, mostly cave). |
| 662-700 | Loose chert, clear, pink opaque, yellow, subangular, very coarse to pebble size; loose sand grains, very poorly sorted very fine, fine, medium, coarse, very coarse, mostly clear; abundant loose pyrite. |
| 700 (+2842) | JURASSIC |
| 700 (+2842) | MORRISON FORMATION |
| 700-42 | Abundant pale green waxy clay, very soft, with embedded tan lime spots. |
| 742-74 | Same green clay; increasing tan dense lime. |
| 774-803 | Same green clay, becoming dark gray; limited limestone stringers, tan with green spots; traces sandstone, gray, light gray, very fine to fine, no show, no visible porosity, hard, tight, limy cementation. |
| 803-32 | Limestone, very light tan, cream, very dense, very hard; traces dark brown limestone, highly microfossiliferous, hard; trace sandstone, cream, very limy, very fine, very well-cemented, scat- |

tered orange grains, no visible porosity, hard, tight.

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| 832 (+2710) | SUNDANCE FORMATION |
| 832 | REDWATER SHALE MEMBER |
| 832-33 | Trace dark gray shaly siltstone, highly glauconitic with dark green grains, very soft; trace shaly siltstone, greenish gray, highly glauconitic, very fine and finer grains. |
| 833-86 | (Missing samples). |
| 886-920 | Silty shale, dark gray, very soft; very shaly sand to siltstone, dark gray, very, very fine where sand, very silty, highly biotitic and glauconitic, very soft, no porosity. |
| 920-40 | Waxy shale, pale green, very soft; dense limestone stringer, light gray, very hard; sandstone, light gray, very fine and finer, limy, scattered dark green glauconite grains, slightly soft. |
| 940-66 | Same waxy green shale; same very, very fine sandstone, cream, limited glauconite, no show, soft to slightly soft, no porosity. |
| 966 | LAK MEMBER OF SUNDANCE |
| 966-70 | Very shaly sand, dark orange, very fine and finer, excellent sorting, no visible porosity, no show, slightly soft; very silty shale, orange red, soft. |
| 970-98 | Same sand, orange brown, very fine, no show, soft. |
| 998-1002 | Waxy shale, dark gray to blackish. |
| 1002-52 | Black waxy shale, very soft. |
| 1052-61 | TENTATIVE HULETT SAND |
| 1061-76 | (Circulated 20" sample at 1076 before trip for bit in prospective zone). Traces light gray sandstone, very, very fine, excellent sorting, no show, friable, porous; also slightly greenish light gray sandstone, very fine to very, very fine, excellent sorting, no show, glauconitic, porous, soft to slightly soft where more cemented, no fluorescence. |
| 1076-92 | Same as above, becoming slightly shalier grayish; trace very pale green waxy shale laminations on sand; all with no show; trace light gray sandstone, very fine, excellent sorting, no show, well-cemented but porous, soft; all with no fluorescence. |

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|---|---|
| 1092 | TENTATIVE STOCKADE BEAVER SHALE |
| 1092-1144 | (Shale on log). |
| 1144 | TENTATIVE TOP OF BASAL SAND OF SUNDANCE |
| 1144-74 | Sandstone, clean, friable, excellent visible porosity; traces tannish light gray sandstone, very fine, excellent sorting, spotty clay cementation in part. |
| 1174 (+2368) | TRIASSIC |
| 1174 (+2368) | SPEARFISH FORMATION |
| 1174-1207 | Smooth shale, red, part silty, all soft. |
| 1207-37 | Abundant silty shale, brownish red, finely biotitic, few small light gray spots. |
| 1237-68 | Same silty shale, orange red, brownish red, finely biotitic, soft to slightly soft. |
| 1268-1304 | Same shale, traces sandy. |
| 1304-36 | Same shale, trace greenish gray large spot. |
| 1336-67 | Same shale and silty shale. |
| 1367-97 | Same shale; trace fibrous white anhydrite veinlet in shale. |
| 1397-1441 | Same silty shale, brownish red, orange red; traces loose white fibrous anhydrite; traces white anhydrite inclusions in shale. |
| 1441 (+2101) | PERMIAN |
| 1441 (+2101) | GOOSE EGG FORMATION |
| 1441-48 | (7' of slower drilling). (Probably anhydrite --none visible in samples). |
| 1448-61 | Silty shale, brick red; small round light green spots in smooth red shale. |
| 1461-81 | Silty shale, brick red. |
| 1481-96 | Anhydrite, white, orange white, dense, hard. |
| 1496-1524 | Silty shale, orange red, white anhydrite inclusions; anhydrite, white, grayish white, dense, hard; white fibrous anhydrite trace, veinlet. |
| 1524-94 | Same shale, orange red, few small round light green spots; anhydrite interbeds, white, gray, dense, as above. |
| 1594 | FORELLE LIME MEMBER OF GOOSE EGG |

| | |
|---|---|
| 1594-98 | Abundant anhydrite, white mottled violet dense, hard; trace dolomite, bright orange adjacent to cream, dense, hard. |
| 1598-1604 | Anhydrite, white mottled with purple, dense, hard, becoming very shaly dark purple. |
| 1604-14 | Trace tan lime, dense, flaky; traces pink dolomitic lime to limy dolomite. |
| 1614-18 | Traces limestone, dolomitic limestone, cream, dense, very hard; trace dark tan dense lime. |
| | |
| 1618 | GLENDO SHALE MEMBER OF GOOSE EGG |
| | |
| 1618-25 | Shale, silty, finely sandy, dark orange, soft to hard. |
| 1625-41 | Same shale, very silty, few anhydrite inclusions and streaks. |
| 1641-48 | Same shale. |
| 1648-59 | Same shale; trace whitish anhydrite inclusion. |
| 1659-67 | Same as above; few white anhydrite inclusions, few small light green round spots. |
| 1667-77 | Same orange red silty shale with few white anhydrite inclusions. |
| 1677-90 | Same as above, trace anhydrite as veinlet on shale. |
| 1690-1708 | (Missing due to no circulation for sample just before trip at 1708 in nonprospective zone). |
| | |
| 1704 (+1838) | MINNEKAHTA LIME MEMBER OF GOOSE EGG |
| | |
| 1708-13 | Limestone, cream to white chalky soft grading into tannish brown dense hard; trace light red slightly chalky limestone; trace dark orange anhydrite, very hard. |
| 1713-22 | Pink dense limestone, hard; tannish pink limestone, dense, hard; also lime, chalky white to dense tan. |
| 1722-38 | (Missing). |
| | |
| 1738 | OPECHE SHALE MEMBER OF GOOSE EGG |
| | |
| 1738-40 | Silty shale, brownish red, reddish brown. |
| 1740-49 | (Poor sample, mostly cave). |
| 1749-59 | Silty shale, orange, orange red, soft to slightly soft. |
| 1759-69 | Silty shale, brick red, soft. |
| 1769-79 | Silty shale, brick red, soft to slightly soft, few greenish gray spots. |

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| 1779-89 | Top 4' white anhydrite, microcrystalline, soft, to dense gray; bottom 6' same silty shale as above, few white anhydrite inclusions, small round green spots also; trace very sandy anhydrite to anhydritic sand trace, light gray, fine to fine-plus grains which powder under pressure. |
| 1789-1815 | Same brick red silty shale with few green small round spots; abundant white anhydrite, microcrystalline, part dense gray, hard. |
| 1815 (+1727) | MINNELUSA FORMATION (REWORKED MINNELUSA) |
| 1815 (+1727) | UPPER MINNELUSA (PERMIAN) |
| 1815-16 | Trace very shaly sand, fine, orange, soft, no show, no visible porosity; trace dark brown possibly stained sand, very quartzitic, very fine, excellent sorting, no visible porosity, very hard and tight, tiny pyrite specks, very well-cemented, to quartzite, no fluorescence. |
| 1816-27 | (No consolidated sand). Loose sand grains, light orange clear, poorly sorted very fine to fine to medium to medium-plus, also all clear, subround to round. |
| 1827-33 | Trace grayish tan possibly stained sand, very fine, well sorted, very well-cemented, no visible porosity, dolomitic cementation in part, trace pyrite speck; traces very anhydritic sandstone, conglomeratic, very poorly sorted very fine to fine to medium grains, light orange grains, * like those disintegrated just above, in white anhydrite matrix, no show, very well-cemented, no visible porosity, hard to slightly soft; all with no fluorescence. |
| 1833-38 | Trace same shaly sand as above, very fine to fine grains in orange red shaly matrix, no visible porosity, very well-cemented, no show, slightly soft, light orange clear grains when disintegrated, no fluorescence. |
| 1838 (+1704) | FIRST CONVERSE SAND |
| 1838-43 | (Fast drilling of 1+"/ft. suggests soft, porous sand). (Poor sample, mostly Sundance cave due to water-flow from Dakota-Lakota thinning mud or mudcake). Traces white anhydritic sandstone, very fine, clear grains, soft, no show, to fine, sugary, clean, excellent visible porosity, non- |

| | |
|---|---|
| | calcareous, loosely consolidated; traces dark red very shaly sandstone, very fine, well-cemented, less porous, no show, same as white sand but abundant red silty shale spots; all with no fluorescence. |
| 1843-52 | Same as above, mostly clean, white, light gray sugary sandstone, very anhydritic cementation, non-calcareous, fine to fine-plus, clear round to subround grains, excellent visible porosity, traces red shaly sandstone, very fine; all with no show, no fluorescence. |
| 1852-56 | (Slower drilling, tighter sand). (Poor sample due to abundant Sundance cave from water flow uphole). Traces same white sandstone, no show, fine, friable, no show, excellent visible porosity, no fluorescence. |
| 1856-70 | (Mostly very rapid drilling like very soft, porous sand). (Very poor sample, all cave, no visible sand or sand grains). |
| 1870-94 | (Same rapid drilling like very soft, porous sand). (Very poor sample, all cave, no visible sand nor sand grains). |
| 1894-1911 | (Top slower drilling like tight sand or anhydrite-dolomite; bottom fast drilling like soft, porous sand). |
| 1911 | MASSIVE ANHYDRITE |
| 1911-21 | Anhydrite, all hard, white finely crystalline to denser tannish cream, grading into very anhydritic dolomite, pinkish tan, and chalky white limestone; also white anhydrite mottled with orange to reddish denser anhydrite. |
| 1921-29 | Anhydrite, snow white, microcrystalline, slightly soft, to denser gray, hard, with tiny round white spots embedded; trace red silty shale on white anhydrite; trace white anhydrite with red shaly anhydritic dolomite. |
| 1929-42 | (Circulated 20" sample at 1945 just before trip for bit). Very dense hard anhydrite, white to denser orange red to purplish red; also chalky dolomite, dark pink, silty, limy where whiter, all purplish pink, slightly soft. |
| 1942 | BASE OF ANHYDRITE |
| 1942-45 | (Missing due to intentionally not circulating longer). |

| | |
|---|---|
| 1945-56 | (Poor sample, mostly cave following trip at 1945). Dolomite, anhydritic dolomite, tan, cryptocrystalline, distinctive tiny red silty shale spots scattered in part. |
| 1956-60 | (Missing). |
| 1960-61 | Tan anhydritic dolomite; mostly pink slightly silty anhydritic dolomite with light red shaly streaks, few small clear finely crystalline anhydrite spots. |
| 1961 | SECOND CONVERSE SAND |
| 1961-65 | Trace sandstone, light orange, very fine to fine, well-cemented but soft, no show, anhydritic cementation, light orange clear grains, no fluorescence, trace dolomitic cementation, porous, few small white spots. |
| 1965-85 | (1965 top of best porosity, breakdown to less than 1"/ft. from 1965 to 1968, same from 1970 to 1977, and from 1980 to 1985). (Very poor sample, mostly Sundance cave). Trace sandstone, white, very fine, friable, excellent visible porosity, no show; trace reddish orange sandstone, very fine, excellent sorting, shaly, no visible porosity, no show, silty; all with no fluorescence; trace same light orange sandstone; loose grains very fine to fine, light orange clear, subround.<br>Increasing sandstone, tannish light gray, possibly stained, as above, very fine, well-sorted, porous, friable, becoming less sorted very fine to fine, slightly dolomitic cementation, slightly yellowish, clear grains slightly yellowish, subround to round; trace pink silty well-cemented, soft; all with no fluorescence; sandstone, light orange white, very fine to fine, friable, soft, excellent visible porosity, no show, no fluorescence.<br>(Representative cuttings from Second Converse Sand were cut in C. Tet. in stoppered shell vial; resulting solution had no fluorescence, indicating no oil in cuttings). |
| 1985-88 | (Drills like sand but slower than above, suggesting less porous sand). (Poor sample, abundant cave). Trace sandstone, pinkish light gray, very fine, good sorting, porous, friable, no show, few tiny white spots like clay; traces sandstone, snow white with abundant clay cementation, no |

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| | porosity, no show, non-calcareous, very fine to fine-plus, clear grains, round, friable. |
| 1988-91 | Trace fairly clean light gray sandstone, sugary very fine to fine-plus, excellent visible porosity, friable, no show. |
| 1991 | BASE OF SECOND CONVERSE SAND |
| 1991-2006 | Trace very anhydritic dolomite to dolomitic lime, grayish brown, slightly cherty, with tiny black spots of possible microfossils; trace light brown limestone, hard, brittle, dense; trace chalky limestone, light brown, mottled with light green shale, highly microfossiliferous with tiny round "bugs." |
| 2006-18 | Limestone, silty, chalky, grayish tan to tannish gray with small blackish spots, also tannish light gray to whitish chalkier with same black spots, slightly soft to hard and brittle where grayer (* good pre-Second Converse Sand marker bed). |
| 2018-26 | (Slower drilling, harder). (Poor sample, unusable, all cave). |
| 2026-41 | (Poor sample, cave). Traces very anhydritic dolomite, light to dark greenish brown, cryptocrystalline, intermingled with snow white anhydrite, microcrystalline; trace dark brown limestone, cherty, dense, with trace round microfossil fragment. |
| 2041-46 | Silty dolomite to limestone, tan, light tan, grayish tan denser, part lighter tan anhydritic denser; trace very dense limestone, cherty, tannish brown, highly microfossiliferous with cream "bugs" in brown limestone matrix, with encrusting waxy; trace chalky limestone, green shaly. |
| 2046-59 | Silty limestone, dolomitic, chalky, dark tan, light tan, cream, slightly soft where chalky to hard where dark tan. |
| 2059-69 | Anhydrite, white to tannish white, finely crystalline, denser dark gray. |
| 2069-75 | Abundant orange red dolomite (?) with anhydrite inclusions; top anhydrite, white to brown; trace brown limestone, slightly silty, hard, brittle; bottom faster drilling possibly sandstone with some porosity: loose sand grains, very fine to fine, clear. |
| 2075-86 | Anhydritic dolomite, greenish dark tan, dense, cryptocrystalline, slightly limy on fresh surface, |

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| | hard, brittle, part siltier, greenish gray, slightly soft to soft. |
| 2086-89 | Snow white anhydrite. |
| 2089 | TENTATIVE THIRD CONVERSE SAND |
| 2089-94 | Abundant greenish white quartzite, also gray, grading into greenish white sandstone and white sandstone, very fine, excellent sorting, all very well-cemented, no visible porosity, very hard and tight where quartzitic to soft where greenish white silty to white silty; trace white sandstone, very fine to fine, anhydritic; all with no show; non-calcareous, anhydritic; less of shaly light red sandstone mottled with same white sandstone, few fine grains; all with no fluorescence. |
| 2094 | BASE OF THIRD CONVERSE SAND |
| 2094-2115 | Abundant anhydrite, snow white finely crystalline to denser tan to limited brown dolomitic; shale break, brick red; trace very shaly sand, light red with pale green spot, very silty, very soft, no show, no visible porosity, very fine sand grains in a silty shale matrix. |
| 2115-25 | Same brown and white anhydrite; shaly sandstone streaks as above, red and white mottled, very fine, hard, tight, no show, no visible porosity. |
| 2125-54 | Same white anhydrite with brown to gray denser parts. |
| 2154 (+1388) | FOURTH CONVERSE SAND |
| 2154-65 | Abundant well-cemented sand, 50% white, pinkish white, anhydritic-looking, very fine, excellent sorting, no visible porosity, no show, slightly soft to some hard; 50% same sand but light red to dark pink, no show; white more anhydritic spot in red sand; all possibly slightly dolomitic, no fluorescence; trace white sandstone, cleaner, very fine, soft, porous, no show. |
| 2165 | BASE OF FOURTH CONVERSE SAND |
| 2165-66 | Anhydrite, white, gray denser; silty limestone, pinkish tan, soft to hard, white anhydrite spot, few dark purple silty shale streaks; dense brown |

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| | dolomite grading into chalky limestone, tannish cream. |
| 2166-76 | Traces limestone to dolomite, creamy white, slightly soft to hard; silty dolomite to limy dolomite, pinkish cream, purplish shaly streaks, soft to slightly soft, becoming anhydritic dolomite, reddish purple, dense, hard. |
| 2176-89 | (Missing). |
| 2189-92 | Very anhydritic dolomite, few small limy spots, pink to light red with few small red silty shale spots, very cherty and hard, brittle, semi-crystalline, trace clear crystalline anhydrite veinlet on dolomite. |
| 2192-2201 | Abundant brick red shale, silty shale, smooth, with small round green spots; anhydrite, white, denser pink, light red; cream dolomite to limy dolomite, becoming very anhydritic dolomite as above, pink, light red, few yellow spots. |
| 2201-12 | Abundant anhydrite, snow white, finely crystalline. |
| 2212-24 | Anhydritic dolomite, tannish pink, small reddish spots, cherty, hard, brittle. |
| 2224-26 | Anhydrite, white to denser gray; abundant brick red shale with small green round spots, soft; anhydritic dolomite, pink, cherty, to limestone, hard, brittle. |
| 2226 | BASAL SAND OF CONVERSE |
| 2226-37 | Traces sandstone, white, pinkish white, very fine, few fine grains, no show, well-cemented, soft, anhydritic to traces of dolomitic cementation, no fluorescence, poor or less visible porosity, purplish part. |
| 2237 (+1305) | RED MARKER |
| 2237-47 | (All faster drilling 3"-4"/ft.). Shale, smooth, brick red, also silty; trace white anhydrite veinlet in shale; small round green spots in red shale.<br>Typical shiny, splintery Red Marker, platy, very soft. |
| 2247 | BASE OF RED MARKER |
| 2247 (+1295) | PENNSYLVANIAN |

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| 2247 (+1295) | MIDDLE MINNELUSA (LEO SECTION) |
| 2247 (+1295) | VIRGIL |
| 2247-56 | (Faster drilling from 2250 to 2256 like well-cemented sand). Trace light red sand (cave?), very fine to fine, no show, slightly soft, poor porosity, pinkish clear grains; remainder of interval anhydritic dolomite, cream chalky to hard tan dense, dolomite is slightly limy. Trace sand, brown possible staining, very fine, excellent sorting, friable, porous, very limy, no rainbows on acid, no fluorescence. |
| 2256-66 | (Dries like anhydrite and dolomite--poor sample). |
| 2266-77 | (Poor sample, mostly Red Marker cave; drills slow like anhydrite and dolomite). Traces very well-cemented sand, purplish white, very fine, few fine grains, no show; trace snow white sandstone (cave?), very well-cemented, very fine, white clay cementation, slightly soft, no show; trace tannish gray possibly stained sandstone, very fine to fine to fine-plus, friable, porous, clear grains, clay cementation; all with no fluorescence. (All sand may be cave). |
| 2277-79 | Traces anhydritic dolomite, tan, cherty, hard, dark tan; traces sandstone, white, cream-white, very fine, silty, soft, no show, possibly porous, no fluorescence, few fine grains, anhydritic cementation. |
| 2279-81 | (Missing due to no circulation for sample at 2281 just before trip for bit in slow drilling). |
| 2281-85 | Silty dolomite, gray, very silty, limy, some black spots; sandstone streaks, white, light gray, very fine, well-cemented, few black shale spots, no show, no visible porosity, soft. |
| 2285-90 | (Slightly faster drilling like sand). Traces white sandstone, very fine, good sorting, well-cemented, poor to no visible porosity, no show, slightly salt and pepper with few blackish grains scattered, soft; trace cleaner white sandstone, less cemented, no show, porous, friable, very fine, excellent sorting; all with no fluorescence (shale break on log). |
| 2290-93 | Dolomite, part slightly limy, tan to brown, flaky, no show, no porosity. |
| 2293-2302 | (Slightly faster drilling). Trace chalky cream dolomite, slightly soft to soft, limy. |

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| 2302-05 | Same dark tan dolomite as 2290 to 2293, limy. |
| 2305-10 | (Slightly faster drilling, like sand). Traces sandstone, white, very anhydritic-looking, abundant white cementation, silty, very fine, few fine grains, angular to subround, few purplish shaly spots, no show, soft; traces white sand, very fine, few fine grains, no show, silty, white, possibly some porosity. |
| 2310-16 | Same dark tan dolomite as 2290 to 2293. |
| 2316-26 | (Very poor unusable sample, almost all cave, not screened). (All drills very slow like hard dolomite, possibly anhydrite also). |
| 2326-36 | Dolomite, anhydritic dolomite, brown where more anhydrite, also dark gray dense to dark gray siltier. |
| 2336-47 | (Very poor sample, almost all cave). (All drills slow like dolomite above). Traces white sandstone, probably in streaks, light gray, no show, well-cemented, very fine; part less cemented very fine to fine friable with porosity (cave?). |
| 2347-51 | (Circulated 20" sample at 2351 before trip for bit). Anhydrite, white to tan, finely crystalline, grading into dark tan dolomite and limy dolomite. |
| 2351-53 | Same as above. |
| 2353 (+1189) | MISSOURI |
| 2353-54 | (Highly radioactive shale on log). |
| 2354 (+1188) | SECOND LEO SAND |
| 2354-57 | Loose sand grains, very fine, clear, also fine; trace clean sandstone, light gray, very fine, good visible porosity, friable, no show. |
| 2357-60 | (Drills 4" to 5"/ft.). Traces well-cemented sand, very fine, no show, poor visible porosity, soft, light gray, white, slightly silty, no fluorescence; loose sand grains, very fine, fine, clear grains, round to subround. |
| 2360-64 | (Circulated 20" sample at 2365). Limited sandstone, white, light gray, well-cemented, shaly, very fine, no show; part less cemented with some porosity, friable, no show; 2% light brown possibly stained, cleaner less cemented, very fine, soft, porous; all with no fluorescence (5±"/ft.). |
| 2364-65 | (Circulated 30" sample at 2365). Same well-cemented sand, very fine, no show, few fine grains, anhy- |

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| | dritic-looking cementation; trace same cleaner sand, very fine, very light brownish possibly stained, porous, friable.<br>* All above sand from 2354 to 2365 has no hydrocarbon cut nor fluorescence after cutting representative cuttings in C. Tet. in stoppered shell vial. |
| 2365-66 | Traces clean sandstone (probably above 2365), friable, excellent visible porosity, no show, light gray, so soft disintegrates when picked up with tweezers; trace friable white sandstone, abundant white cementation like clay, very fine to abundant fine, porous, clear grains, no show, loosely consolidated, non-calcareous; trace same well-cemented sand, very fine sand as above; all with no fluorescence; trace white sandstone, very fine, excellent sorting, well-cemented, no show, soft; trace light tan possibly stained sandstone, fine to very fine, limy, porous, friable. |
| 2366-73 | Dolomite stringer, grayish dark tan; greenish gray anhydritic dolomite to dolomitic lime; trace sandstone, light tan possibly stained, no live oil on freshly broken surface, friable, excellent visible porosity, salt and pepper with scattered dark gray shale grains, clear to slightly frosted grains, non-calcareous. |
| 2373-75 | (Circulated 20" sample at 2378). 75% jet black shale, coaly, strong hydrocarbon odor. |
| 2375-78 | 25% gray chalky dolomite.<br>* Representative sand cuttings from 2354 to 2373 were cut in C. Tet. with no fluorescence in resulting solution, indicating no live oil in cuttings. |
| 2378-82 | (Top 2' are 2"/ft., bottom 2' are 1"/ft.). Abundant sandstone, light to medium tan oil staining when wet, dries to fair or better tan stain, definite abundant tiny brown live oil spots scattered, 80% fair yellowish fluorescence to 20% with good bright yellow fluorescence, anhydritic to dolomitic cementation, silty, very fine, good visible porosity, friable. |
| 2382-93 | (Circulated 20" sample at 2393). Abundant sandstone, light gray with tannish cast plus tiny dark brown live oil spots scattered, limy cementation, very fine to fine more sugary, friable, excellent visible porosity, acid cuts immediate rainbows, clear subround quartz grains; sandstone soaked with tan oil stain in very fine, cemented sand- |

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| | stone, some spotty white cementation like clay, tiny dark brown live oil stains scattered, acid brings out tiny dark brown oil bubbles, fair or better visible porosity, soft to slightly soft. * Representative cuttings of show zone were cut in C. Tet. in cork stoppered shell vial: there was no fluorescence in solution until several hours later when it was a faint grayish to yellowish. |
| 2393-96 | (Sand on log). |
| 2396 | BASE OF SECOND LEO SANDS |
| 2396-2404 | Chalky limy dolomite to dolomitic lime, cream-tan, denser tan also, few grayish streaks; limited associated anhydrite, finely crystalline white. |
| 2404-15 | Slightly silty dolomite, very finely sandy, grayish dark tan, minute pyrite specks. |
| 2415-17 | Coaly black shale, hard, brittle (probably a radioactive shale marker on log). |
| 2416 | DES MOINES (?) |
| 2417-26 | Abundant red shale in fast drilling breaks, orange red, silty to finely sandy, abundant small round light green spots in shale, with few anhydrite inclusions; remainder anhydritic dolomite, gray, few small limy streaks, part dark gray very shaly with few dark green spots; limited very sandy dolomite, limy, gray, flaky; limited sand streaks, gray, very well-cemented, no show, no porosity, hard, tight, very fine to fine; trace white sandstone, lot cleaner, very fine to fine, well-cemented, no show, possibly porous, soft (cave?). |
| 2426-29 | (Fast drilling shale break at 2429 to 2430). Same anhydritic dolomite, light grayish tan with dark gray shaly spots, minute pyrite specks, also dark tan with blackish spots, trace gray very sandy. |
| 2429-30 | Possibly jet black coaly shale (highly radioactive shale on log). |
| 2430-35 | Same as from 2426 to 2429. |
| 2435-46 | Shale break from 2440 to 2441, orange red smooth plain to silty; same anhydritic dolomite, gray to tan, less of silty limy dolomite, light gray, chalky; few sandstone streaks, grayish brown, slightly quartzitic-looking, very fine, very well-cemented, no show, poor to no visible poros- |

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| | ity, part slightly soft; trace gray sandstone, very shaly and well-cemented, no show, no visible porosity, very fine to fine. |
| 2446-53 | Dolomite, limy dolomite, grayish tan to tan, cryptocrystalline, some associated white anhydrite, hard, brittle, few pyrite specks. |
| 2453-55 | Faster drilling plus shale on log. |
| 2455-56 | Sandstone stringer, white, fine, no show, very well-cemented, no visible porosity, same but shalier tannish gray, soft where white. |
| 2456-59 | Abundant sandstone, (possibly Third Leo Sand), snow white, very fine, fine, good sorting, no show, porous, anhydritic-looking, dolomitic to anhydritic cementation, part hard and tight, grayish yellow to yellow fluorescence, probably from dolomitic cementation, soft, part all fine grained. |
| 2459-73 | No odor in fresh sackfull, same sandstone as above; part softer, cleaner, more porous, trace more porous with slight tannish possible staining, same fair or better fluorescence; trace fine sandstone, sugary, friable, excellent visible porosity; becoming gray slightly quartzitic, poorly sorted fine to few medium grains, hard, tight. |
| 2473-85 | Abundant anhydrite, snow white, grayish where denser; abundant red shale, orange red, plain, silty, soft to slightly soft, few small light gray round spots. |
| 2485-91 | (Missing due to no circulation for sample before trip at 2491). |
| 2491-2501 | Mostly shaly dolomite, gray, dark gray, tannish dark gray, part limy, with abundant associated snow white anhydrite, finely crystalline; thin sand beds, white, light gray, fine, fairly clean, good visible porosity, no show, slightly soft, some black carbonaceous streaks; also dark gray shaly sand, soft, fine, porous to nonporous, black carbonaceous streaks; all with no fluorescence. |
| 2501-10 | Faster drilling sand, traces sand, white, very well-cemented, no show, very fine, no visible porosity to limited porosity, soft to slightly soft, possible faint grayish fluorescence. |
| 2510-14 | Limy dolomite to dolomitic lime, tannish brown, silty, blackish spots in part, also light gray; tan dense dolomitic lime to limy dolomite, hard, brittle. |

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| 2514-18 | (Missing due to no circulation for sample just before trip at 2518). |
| 2518-26 | * First chert, trace, smoky gray translucent, very coarse and angular, also light brown translucent; sandstone, white, light gray, very well-cemented, poor visible porosity, very fine, well-sorted, slightly soft, part light gray less cemented; part white hard and tight; all limy, all with no show; limy dolomite, very light tan, cherty, hard, brittle, also dark tan limy dolomite, cryptocrystalline; white anhydrite; sand in top 7'. |
| 2526-31 | Brick red shale break with few small round light green spots; dolomite, sandy dolomite, gray, dark gray, mottled blackish in part, part limy dolomite; same chert; sandstone streaks, shaly, quartzitic, light gray to gray, very well-cemented, no show, no visible porosity, slightly soft. |
| 2531-38 | Chert, tan, milky white, angular, coarse; same quartzitic sandstone streaks, brownish gray; finely sandy limy dolomite to dolomitic lime, tannish brown. |
| 2538-43 | (Circulated 30" sample at 2543 T. D.). Chert, angular, very coarse, tan to light gray milky; limy dolomite to limestone, tannish brown, dense plain to cryptocrystalline; sandstone, white, very fine, very well-cemented, no show, no visible porosity, light gray, tannish light gray tighter, slightly limy, becoming brown quartzitic, good yellow fluorescence from limy mineralization. |
| 2545 | TOTAL DEPTH DRILLER |
| 2544 | TOTAL DEPTH SCHLUMBERGER |

Samples examined and described on location by G. Allan Nelson.

# DRILL-STEM TEST

D.S.T. #1 2379-2393 P. D. * (Corrected uphole 2' by matching lithology and drilling time to log).
(2381-2395 drillers depths at time test was run).
Zone tested: Lower of 2 Second Leo Sand benches.
November 25, 1970. Open hole conventional test.
Top packer at 2371 corrected.
Bottom packer at 2379 corrected.
Top choke 1". Bottom choke 9/16".
Hole size 7 7/8". 3 1/2" drill pipe.
2 1/4" I.D. of drill collars; 542' of drill collars.
Mud wt. 9.5. Vis. 60.
Packers held and did not leak. No cushion.

Tool opened with a very weak blow and remained open 5"; very weak blow throughout period. Tool reopened with a very weak blow (1/4" under water); remained for 10", then intermittent blow throughout rest of test. (By-passed tool after 50" to see if it was plugged--before opening. Well had 3" to 4" water flow from annulus throughout test--from Dakota-Lakota. 3' fillup on bottom).

Recovered:
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|---|---|
| 60' | gas-cut mud with a sulfur smell=.29 bbl. |
| 80' | water with scum of oil and sulfur smelling gas=.39 bbl. |
| 140' | Total Fluid |

Pressures following are office-corrected:

| | | |
|---|---|---|
| | Initial hydrostatic | 1102 |
| | Final hydrostatic | 1100 |
| 5" | Initial flow | 4 to 21 |
| 45" | Final flow | 31 to 76 |
| 15" | Initial shut-in | 969 |
| 15" | Final shut-in | 914 |

Fluid Sample Report:

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|---|---|
| Pressure in sampler | 11 psig |
| BHT | 96° F. |
| Total volume of sampler | 2150 cc. |
| Sample | 2150 cc. |
| Oil | 10 cc. |
| Water | 2140 cc. |

(No mud or gas)

-27-

## DRILL-STEM TEST (Continued)

Resistivity -
Water - .4 @ 62° = 17,200 ppm chlorides
Mud pit sample - 2.6 @ 60° = 2,550 ppm chlorides

Testing done by Virg's Testers, Gillette, Wyoming.
Tester: Lloyd Welty.

Checked periodically during test for combustability; would not burn. No gas to surface.

## SCHLUMBERGER LOG CALCULATIONS

Calculations were performed by Mike Golas, Schlumberger engineer on location.

| DEPTH | Rt | POROSITY (from Sonic) | Rw | Sw | FORMATION |
|---|---|---|---|---|---|
| 1062 | 29 | 22% | 1.6 @ 80° | 100% | Tentative Hulett Sand |
| 1074 | 33 | 23 | " | " | " |
| 1078 | 31 | 23 | " | " | " |
| 1866 | 50 | 18 | 1.3 @ 88° | 78% | First Converse Sand |
| 1871 | 45 | 17 | " | 90 | " |
| 1878 | 55 | 16 | " | " | " |
| 1885 | 40 | 18 | " | " | " |
| 1966 | 45 | 15 | " | 100% | Second Converse Sand |
| 1970 | 35 | 17 | " | " | " |
| 1980 | 35 | 17 | " | " | " |
| 2376 | 35 | 6 | .34 @ 88° | " | Second Leo Sand |
| 2378 | 26 | 25 | ("way too high") | 42 | " |
| 2380 | 35 | 10 | .34 @ 88° | 92 | " |
| 2382 | 42 | 5 | " | 100 | " |
| 2384 | 30 | 6 | " | " | " |
| 2386 | 21 | 6 | " | " | " |
| 2388 | 25 | 9 | " | " | " |
| 2458 | 6.5 | 11 | " | " | Pre-Second Leo |
| 2460 | 5.5 | 14 | " | " | " |
| 2462 | 6.5 | 8 | " | " | " |
| 2464 | 6.0 | 7 | " | " | " |
| 2466 | 5.0 | 15 | " | " | " |
| 2468 | 6.5 | 10 | " | " | " |

## HOLE DEVIATION SURVEYS

Surveys were made using a TOTCO instrument with a 7° maximum.

| DEPTH | DEVIATION | FORMATION |
|---|---|---|
| 178 | 1/4° | Skull Creek |
| 1086 | 1 | Tentative Hulett Sand |
| 1691 | 1 | Glendo Shale |
| 1939 | 1 | Massive Anhydrite |
| 2188 | 1 | Pre-Fourth Converse |
| 2282 | 1 (?) | Upper Leo |
| 2352 | 1 | Basal Virgil |

# BIT RECORD

12 1/4" bit from surface to 178. All bits below 178 are 7 7/8".

| RUN NO. | MAKE | TYPE | FROM | TO | FEET | HOURS | FORMATION AT BASE OF RUN |
|---|---|---|---|---|---|---|---|
| 1A | HTC | OSC3 (RR) | 0 | 178 | 178 | 5 1/2 | Skull Creek |
| 1 | " | OSC1GJ | 178 | 1086 | 908 | 18 | Tentative Hulett |
| 2 | " | " | 1086 | 1707 | 621 | 14 | Minnekahta |
| 3 | " | OSC1G | 1707 | 1939 | 232 | 11 1/4 | Massive Anhydrite |
| 4 | Reed | YS1G | 1939 | 2091 | 152 | 12 1/2 | Third Converse |
| 5 | - | - | 2091 | 2189 | 98 | 13 1/4 | Pre-Fourth Converse |
| 6 | HTC | OWV | 2189 | 2282 | 93 | " | Upper Leo |
| 7 | Reed | YMG | 2282 | 2352 | 70 | 13 | Basal Virgil |
| 8 | " | " | 2352 | 2395 | 43 | 5 1/2 | Second Leo Sand |
| 9 | - | - | 2395 | 2493 | 98 | 14 | Pre-Second Leo |
| 10 | - | - | 2493 | 2520 | 27 | 3 | " |
| 11 | - | - | 2520 | 2545<br>T.D. | 25 | 3 1/4 | " |

## DRILLING PROGRESS SUMMARY

Drilling depths as of 7 A. M. each date.

| DATE | NO. OF DAYS | P.D. DEPTH | FORMATION AT P. D. | STATUS |
|---|---|---|---|---|
| Nov. 17, 1970 | - | - | - | Rigging up rotary tools. |
| 18 | 1/2 | 105 | Skull Creek | Drilling surface hole. |
| 19 | 1 1/2 | 821 | Morrison | Drilling. |
| 20 | 2 1/2 | 1681 | Goose Egg | " |
| 21 | 3 1/2 | 2040 | Upper Minnelusa | " |
| 22 | 4 1/2 | 2189 | " | Trip for bit. |
| 23 | 5 1/2 | 2284 | Middle Minnelusa | Drilling. |
| 24 | 6 1/2 | 2374 | " | " |
| 25 | 7 1/2 | 2395 | " | Starting out to put tool on -- D.S.T. #1. |
| 26 | 8 1/2 | 2493 | " | Trip for bit. |
| 27 | 9 1/2 | 2545 T.D. | " | Logging. |

(Finished plugging at 5:00 P. M., November 27).

Respectfully submitted,

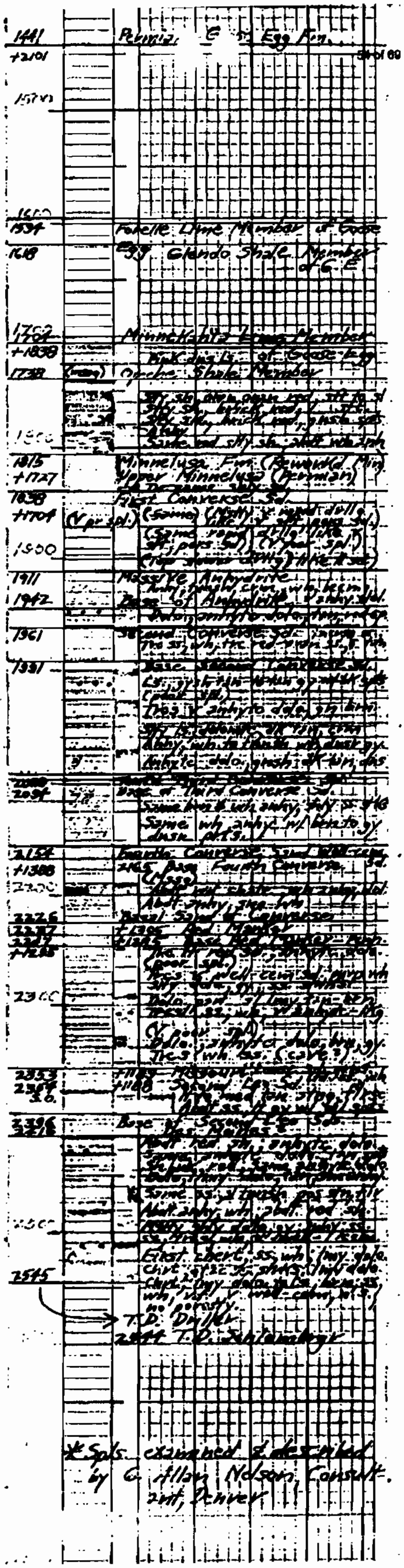
G. Allan Nelson

G. Allan Nelson, Consultant
Denver, Colorado
January 26, 1971

WELL NO. 5-22

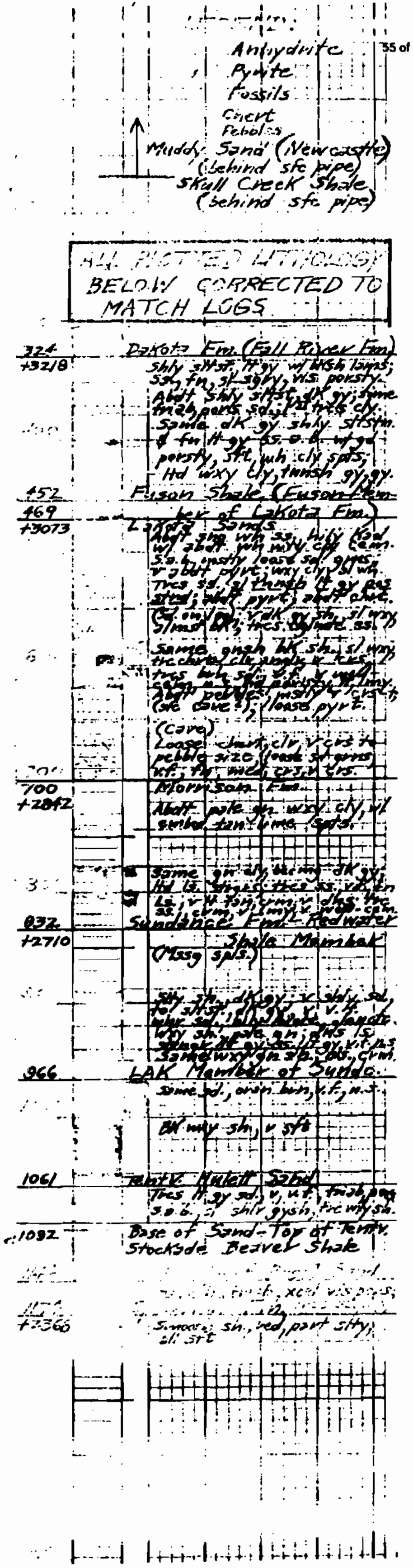
STATE South Dak COMPANY Petro-Lewis
COUNTY Fall River FARM Peterson WELL NO. # 5-22
1620' FEL & 1980' FNL, C SW NW
SEC. 22
T. 7S. R. 1E.
2544 Schlum.
Schlaikjer
Nov. 18, 1970
Nov. 27, 1970
Wildcat - Drift- wood Canyon Prospect.
3542 K.B.
D & A.
Ran 4 jts. of [illegible] 8 5/8" sfc casg, totaling [illegible], 8 rd., 20# Cem w/ [illegible] regular [illegible]
[illegible]
Nelson

Petro-Lewis Peterson



1441 Permia. [illegible] Egg Fm.
+2101
1500
1600
1534 Forelle Lime Member of Goose
1618 Egg Glendo Shale Member of G. E.
1702
1704 Minnekahta Lime Member
+1838 Pink [illegible] Ls. of Goose Egg
1738 Opeche Shale Member
[illegible]
1800
1815 Minnelusa Fm. (Reworked Min)
+1727 Upper Minnelusa (Permian)
1838 First Converse Sd.
+1704 [illegible]
1900
1911 Massive Anhydrite
1942 Base of Anhydrite
1961 Second Converse Sd.
1991 Base Second Converse Sd.
[illegible]
2094 Base of Third Converse Sd.
[illegible]
2154 Fourth Converse Sand
+1388 2165 Base Fourth Converse Sd.
2200
2226 Basal Sand of Converse
2237 +1305 Red Marker
2247 +1295 Base Red Marker
2300
[illegible]
2353 +1189 [illegible]
2364 +1178 Second Leo Sd.
2396 Base of Second Leo Sd.
[illegible]
2500
First [illegible]
2545 → T.D. Driller
2544 T.D. Schlumberger

* Spls. examined & described by G. Allan Nelson, Consultant, Denver



Anhydrite
Pyrite
Fossils
Chert
Pebbles

Muddy Sand (Newcastle)
(behind sfc pipe)
Skull Creek Shale
(behind sfc pipe)

ALL PLOTTED LITHOLOGY
BELOW CORRECTED TO
MATCH LOGS

324
+3218
Dakota Fm. (Fall River Fm.)
Shly sltst, lt gy w/ blk sh lams;
ss, fn, sl sgry, v.s. porsty.
Abdt shly sltst, dk gy; some
[illegible] parts sdy; [illegible] trcs cly.
Same dk gy shly sltstn.
& fn lt gy ss. a.b. w/ gd
porsty, sft, wh cly spts;
Hd wxy cly, tnnsh gy, gy.

452
Fuson Shale (Fuson Mem-
469
ber of Lakota Fm.)
+3073
Lakota Sands
Abdt [illegible] wh ss, hily kaol
w/ abdt wh wxy cly cem.
S.a.b. porsty loose sd grns,
v abdt pyrt; wxy cly, sl wh.
Trcs ss, sl [illegible] lt gy [illegible]
[illegible]; abdt pyrt; abdt chrt.
Sd only [illegible], v dk gy sh, sl wxy,
sl [illegible]; trcs [illegible] ss.
Same gnsh blk sh, sl wxy,
trc chrt, clr, angly & [illegible],
trcs [illegible] sd [illegible]
[illegible] slty.
Abdt pebbles, mstly v crs [illegible]
(sfc cave?); loose pyrt.
(Cave)
Loose chrt, clr, v crs to
pebble size; loose sd grns
v.f., fn, med, crs, v crs.

700
+2842
Morrison Fm.
Abdt pale gn wxy cly, w/
[illegible] tan lime spts.

Same gn cly, bcmg dk gy,
Hd ls. [illegible] trcs ss, v.f., [illegible]
Ls, v lt tan, crm, v dns. trc
ss, crm, v lmy, v [illegible] cem.

832
+2710
Sundance Fm. - Redwater
Shale Member
(Mssg spls.)

Slty sh, dk gy, v slty, sd,
to sltst, dk gy, v. lt
[illegible] sd, [illegible] glauc.
wxy sh, pale gn; dns ls,
[illegible] lt gy ss, lt gy, v.f. [illegible]
Same wxy gn sh. [illegible] crm.

966
LAK Member of Sundc.
Same sd., orsn brn, v.f., [illegible]

Brk wxy sh, v sft

1061
Entr. Hulett Sand
Trcs lt gy sd, v, v.f., [illegible]
s.a.b., sl shly gysh, trc wxy sh.

c.1092
Base of Sand - Top of Entr.
Stockade Beaver Shale

[illegible] Sand
[illegible], xcel vis prs;
[illegible]
+2366
Same, sh., red, part slty,
sl. sft

# ADMINISTRATIVE / SUNDRY REPORTS

lcc

S. Dak. Oil & Gas Board
FORM 7

# PLUGGING RECORD

| | | |
|---|---|---|
| Operator<br>Petro-Lewis Corporation | Address<br>1224 Denver Club Building, Denver, Colorado, 80202 | |
| Name of Lease<br>Peterson | Well No.<br>5-22 | Field & Reservoir<br>Wildcat |
| Location of Well<br>1980' FNL and 660' FWL, SW-NW Section 22, T7S, R1E | Sec-Twp-Rge or Block & Survey | County<br>Fall River |

| | | | | |
|---|---|---|---|---|
| Application to drill this well was filed in name of<br>Petro-Lewis Corporation | Has this well ever produced oil or gas<br>No | Character of well at completion (initial production): Oil (bbls/day)<br>---- | Gas (MCF/day)<br>---- | Dry?<br>Yes |
| Date plugged:<br>11/27/70 | Total depth<br>2544' Logger | Amount well producing when plugged: Oil (bbls/day)<br>---- | Gas (MCF/day)<br>---- | Water (bbls./day)<br>--- |

| Name of each formation containing oil or gas. Indicate which formation open to well-bore at time of plugging | Fluid content of each formation | Depth interval of each formation | Size, kind & depth of plugs used indicate zones squeeze cemented, giving amount cement. |
|---|---|---|---|
| | | | |

## CASING RECORD

| Size pipe | Put in well (ft.) | Pulled out (ft.) | Left in well (ft.) | Give depth and method of parting casing (shot, ripped etc) | Packers and shoes |
|---|---|---|---|---|---|
| 8-5/8" | 167' | None | 167' | | |

Was well filled with mud-laden fluid, according to regulations?

Indicate deepest formation containing fresh water.

In addition to other information required on this form, if this well was plugged back for use as a fresh water well, give all pertinent details of plugging operations to base of fresh water sand, perforated interval to fresh water sand, name and address of surface owner, and attach letter from surface owner authorizing completion of this well as a water well and agreeing to assume full liability for any subsequent plugging which might be required.

USE REVERSE SIDE FOR ADDITIONAL DETAIL

Executed this the 15th day of February, 19 71

State of Colorado

County of Denver

R. J. Doubek
R. J. Doubek Signature of Affiant

Before me, the undersigned authority, on this day personally appeared R. J. Doubek known to me to be the person whose name is subscribed to the above instrument, who being by me duly sworn on oath states, that he is duly authorized to make the above report and that he has knowledge of the facts stated therein, and that said report is true and correct.

Subscribed and sworn to before me this 15th day of February 19 71.

SEAL

Elsie J. Stone Elsie J. Stone

My commission expires September 24, 1974

Notary Public in and for Denver

County, Colorado

DO NOT WRITE BELOW THIS LINE

Approved December 29, 1971
Date

OIL AND GAS BOARD OF THE STATE OF SOUTH DAKOTA

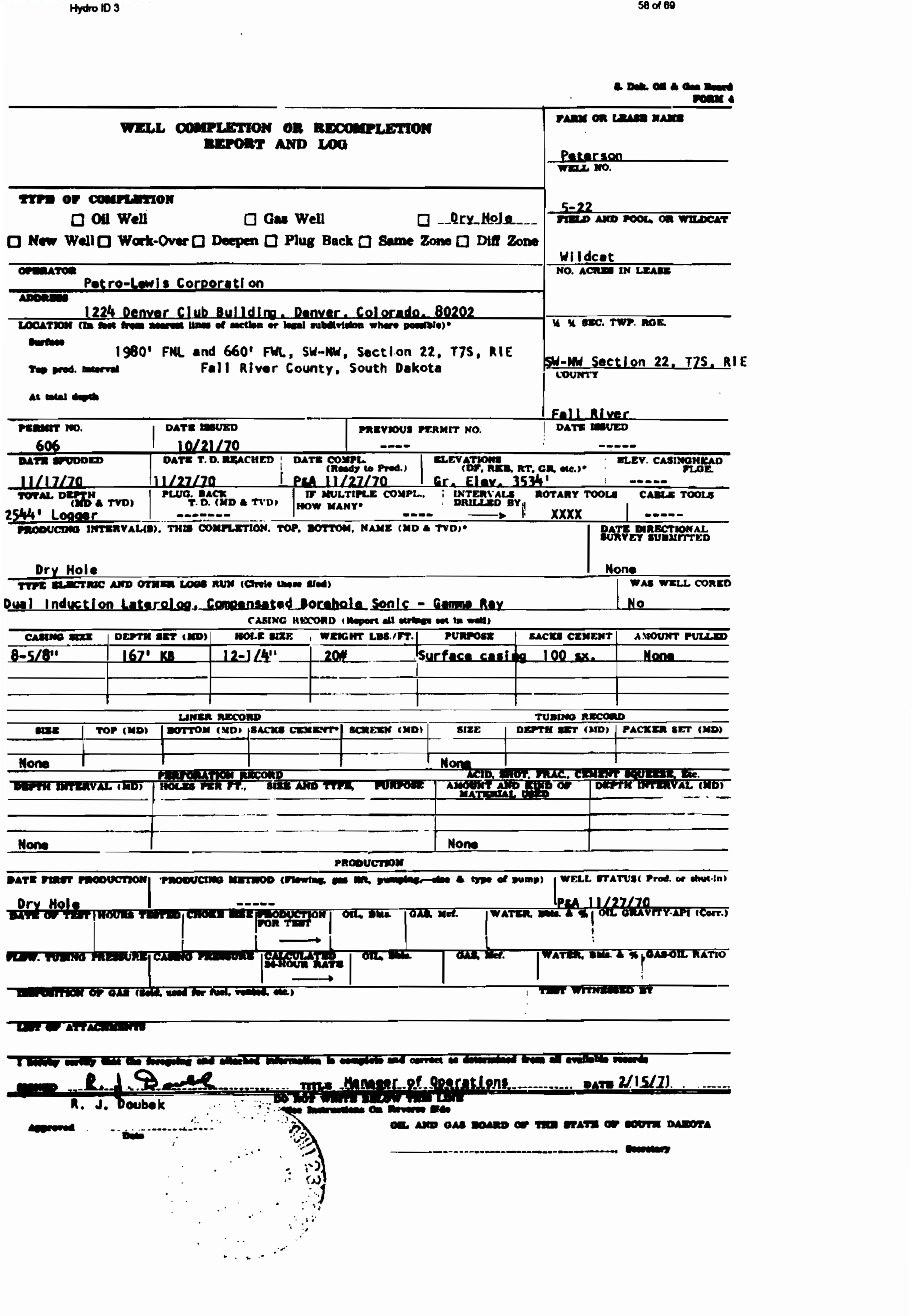
Secretary

Date Dec. 28, 1971

Duncan J. McGregor
State Geologist

Note: File 2 copies of this form with Secretary, Oil & Gas Board, Pierre.

FEB 1971



S. Dak. Oil & Gas Board
FORM 4

## WELL COMPLETION OR RECOMPLETION REPORT AND LOG

FARM OR LEASE NAME: Peterson

WELL NO.: 5-22

FIELD AND POOL, OR WILDCAT: Wildcat

NO. ACRES IN LEASE:

¼ ¼ SEC. TWP. RGE.: SW-NW Section 22, T7S, R1E

COUNTY: Fall River

TYPE OF COMPLETION

☐ Oil Well ☐ Gas Well ☐ Dry Hole

☐ New Well ☐ Work-Over ☐ Deepen ☐ Plug Back ☐ Same Zone ☐ Diff Zone

OPERATOR: Petro-Lewis Corporation

ADDRESS: 1224 Denver Club Building, Denver, Colorado, 80202

LOCATION (In feet from nearest lines of section or legal subdivision where possible)*

Surface: 1980' FNL and 660' FWL, SW-NW, Section 22, T7S, R1E
Fall River County, South Dakota

Top prod. interval

At total depth

| | | | |
|---|---|---|---|
| PERMIT NO.<br>606 | DATE ISSUED<br>10/21/70 | PREVIOUS PERMIT NO.<br>---- | DATE ISSUED<br>----- |

| | | | | |
|---|---|---|---|---|
| DATE SPUDDED<br>11/17/70 | DATE T. D. REACHED<br>11/27/70 | DATE COMPL. (Ready to Prod.)<br>P&A 11/27/70 | ELEVATIONS (DF, RKB, RT, GR, etc.)*<br>Gr. Elev. 3534' | ELEV. CASINGHEAD FLGE.<br>----- |

| | | | | | |
|---|---|---|---|---|---|
| TOTAL DEPTH (MD & TVD)<br>2544' Logger | PLUG. BACK T. D. (MD & TVD)<br>-------- | IF MULTIPLE COMPL., HOW MANY*<br>---- | INTERVALS DRILLED BY ⟶ | ROTARY TOOLS<br>XXXX | CABLE TOOLS<br>----- |

PRODUCING INTERVAL(S), THIS COMPLETION, TOP, BOTTOM, NAME (MD & TVD)*: Dry Hole

DATE DIRECTIONAL SURVEY SUBMITTED: None

TYPE ELECTRIC AND OTHER LOGS RUN (Circle those filed): Dual Induction Laterolog, Compensated Borehole Sonic - Gamma Ray

WAS WELL CORED: No

CASING RECORD (Report all strings set in well)

| CASING SIZE | DEPTH SET (MD) | HOLE SIZE | WEIGHT LBS./FT. | PURPOSE | SACKS CEMENT | AMOUNT PULLED |
|---|---|---|---|---|---|---|
| 8-5/8" | 167' KB | 12-1/4" | 20# | Surface casing | 100 sx. | None |
| | | | | | | |
| | | | | | | |

| LINER RECORD | | | | | TUBING RECORD | | |
|---|---|---|---|---|---|---|---|
| SIZE | TOP (MD) | BOTTOM (MD) | SACKS CEMENT* | SCREEN (MD) | SIZE | DEPTH SET (MD) | PACKER SET (MD) |
| None | | | | | None | | |

| PERFORATION RECORD | | | | ACID, SHOT, FRAC., CEMENT SQUEEZE, Etc. | |
|---|---|---|---|---|---|
| DEPTH INTERVAL (MD) | HOLES PER FT., | SIZE AND TYPE, | PURPOSE | AMOUNT AND KIND OF MATERIAL USED | DEPTH INTERVAL (MD) |
| | | | | | |
| | | | | | |
| None | | | | None | |

PRODUCTION

| | | |
|---|---|---|
| DATE FIRST PRODUCTION<br>Dry Hole | PRODUCING METHOD (Flowing, gas lift, pumping,—size & type of pump)<br>------ | WELL STATUS( Prod. or shut-in)<br>P&A 11/27/70 |

| DATE OF TEST | HOURS TESTED | CHOKE SIZE | PRODUCTION FOR TEST ⟶ | OIL, Bbls. | GAS, Mcf. | WATER, Bbls. & % | OIL GRAVITY-API (Corr.) |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

| FLOW. TUBING PRESSURE | CASING PRESSURE | CALCULATED 24-HOUR RATE ⟶ | OIL, Bbls. | GAS, Mcf. | WATER, Bbls. & % | GAS-OIL RATIO |
|---|---|---|---|---|---|---|
| | | | | | | |

DISPOSITION OF GAS (Sold, used for fuel, vented, etc.)

TEST WITNESSED BY

LIST OF ATTACHMENTS

I hereby certify that the foregoing and attached information is complete and correct as determined from all available records

SIGNED R. J. Doubek TITLE Manager of Operations DATE 2/15/71

R. J. Doubek

DO NOT WRITE BELOW THIS LINE
*See Instructions On Reverse Side

Approved ................ Date

OIL AND GAS BOARD OF THE STATE OF SOUTH DAKOTA

................................ Secretary

[illegible]

S. Dak. Oil & Gas Board
FORM 6

# SUNDRY NOTICES AND REPORT ON WELLS

FARM OR LEASE NAME: Peterson

WELL NO.: 5-22

FIELD AND POOL, OR WILDCAT: Wildcat

NO. ACRES IN LEASE:

¼ ¼ SEC. TWP. RGE.: SW-NW Section 22, T7S, R1E

COUNTY: Fall River

☐ OIL WELL ☐ GAS WELL ☐ ---------------- ☒ DRY

OPERATOR: Petro-Lewis Corporation

ADDRESS: 1224 Denver Club Building, Denver, Colorado, 80202

LOCATION (In feet from nearest lines of section or legal subdivision, where possible)
1980' FNL and 660' FWL, SW-NW Section 22, T7S, R1E
Fall River County, South Dakota

ELEVATIONS (DF., R.K.B., R.T., GRD., etc.; how determined)
Gr. Elev. 3534'

INDICATE BELOW BY CHECK MARK NATURE OF REPORT, NOTICE OR OTHER DATA

| NOTICE OF INTENTION TO: | | | | SUBSEQUENT REPORT OF: | | | |
|---|---|---|---|---|---|---|---|
| TEST WATER SHUT-OFF | ☐ | SHOOT OR ACIDIZE | ☐ | WATER SHUT-OFF | ☐ | SHOOTING OR ACIDIZING | ☐ |
| FRACTURE TREAT | ☐ | REPAIR WELL | ☐ | FRACTURE TREATMENT | ☐ | REPAIRING WELL | ☐ |
| MULTIPLE COMPLETE | ☐ | PULL OR ALTER CASING | ☐ | | | ALTERING CASING | ☐ |
| ABANDON | XXX | | | | | | |

(Note: Report results of multiple completion on Well Completion or Recompletion and Log Form—Form 4)

DESCRIBE PROPOSED OR COMPLETED OPERATIONS (Clearly state all pertinent details, and give pertinent dates, including estimated date of starting any proposed work)

T. D. 2544' Logger

Date of Work 11/27/70

We propose to plug and abandon this well as follows:

40 sx. cement from 2300'-2420'
30 sx. cement from 1750'-1850'
30 sx. cement from 1030'-1130'

(Contractor will run pipe to complete as water well for landowner. Pipe will be set at 350'. (Dakota).

I hereby certify that the foregoing as to any work or operation performed is a true and correct report of such work or operation.

SIGNED R. J. Doubek TITLE Manager of Operations DATE 2/15/71
R. J. Doubek

DO NOT WRITE BELOW THIS LINE

Approved ................................
Date

OIL AND GAS BOARD OF THE STATE OF SOUTH DAKOTA

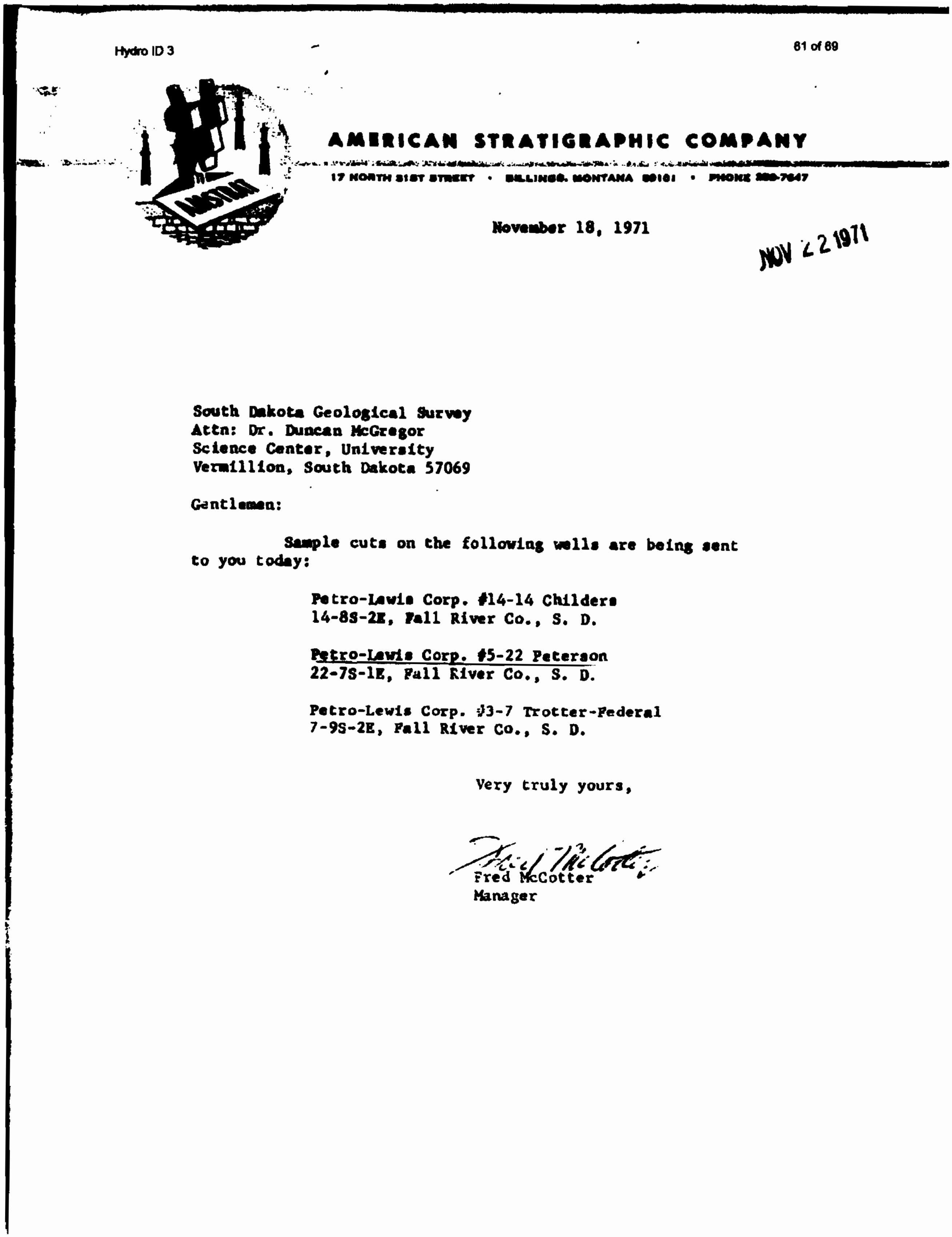
CONDITIONS, IF ANY:

................................................, Secretary

See Instructions On Reverse Side

FEB 1971

# CORRESPONDENCE



AMERICAN STRATIGRAPHIC COMPANY
17 NORTH 31ST STREET • BILLINGS, MONTANA 59101 • PHONE 259-7647

November 18, 1971

NOV 22 1971

South Dakota Geological Survey
Attn: Dr. Duncan McGregor
Science Center, University
Vermillion, South Dakota 57069

Gentlemen:

Sample cuts on the following wells are being sent to you today:

Petro-Lewis Corp. #14-14 Childers
14-8S-2E, Fall River Co., S. D.

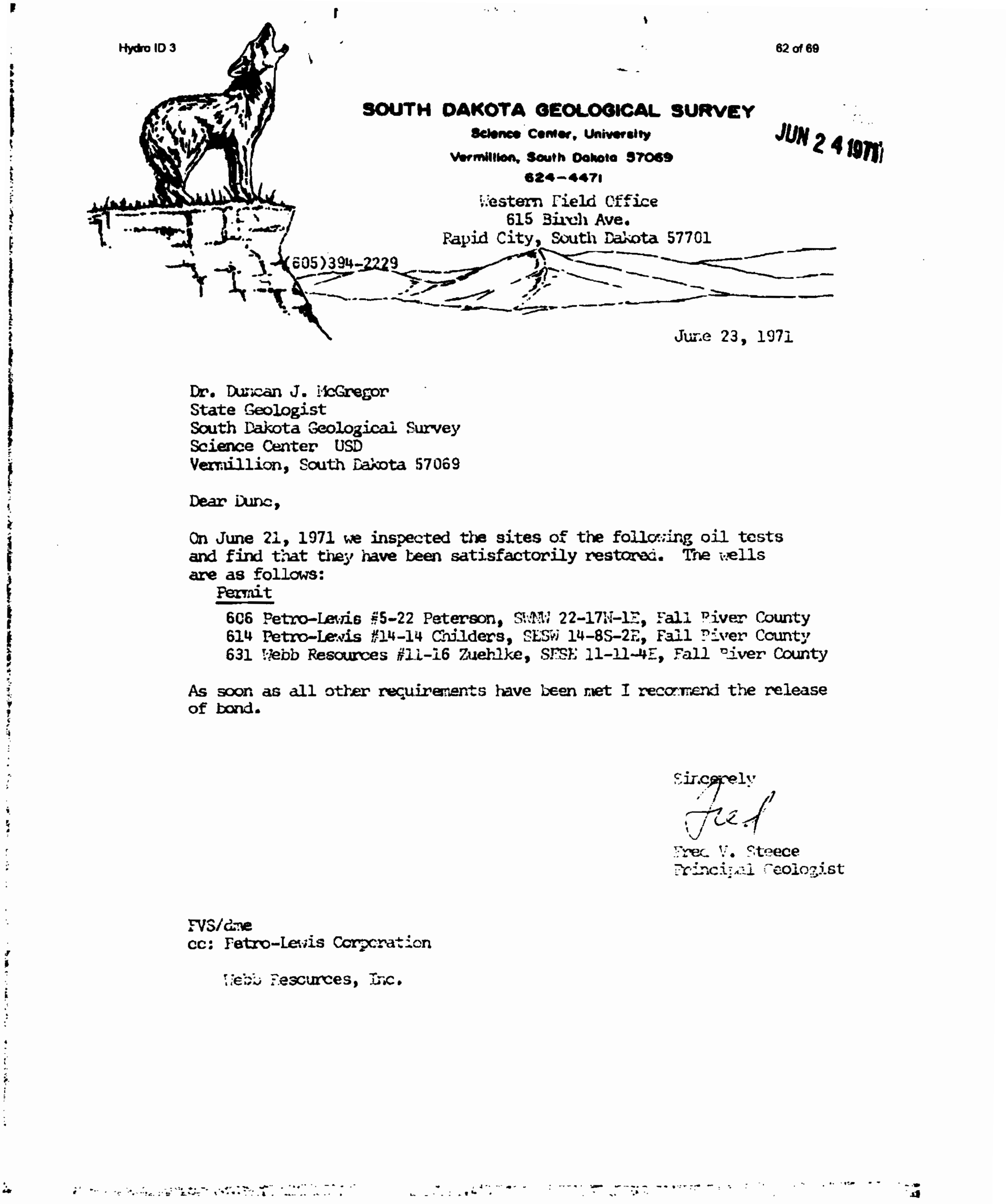
Petro-Lewis Corp. #5-22 Peterson
22-7S-1E, Fall River Co., S. D.

Petro-Lewis Corp. #3-7 Trotter-Federal
7-9S-2E, Fall River Co., S. D.

Very truly yours,

Fred McCotter

Fred McCotter
Manager



Hydro ID 3

62 of 69

SOUTH DAKOTA GEOLOGICAL SURVEY
Science Center, University
Vermillion, South Dakota 57069
624-4471
Western Field Office
615 Birch Ave.
Rapid City, South Dakota 57701
(605)394-2229

JUN 24 1971

June 23, 1971

Dr. Duncan J. McGregor
State Geologist
South Dakota Geological Survey
Science Center USD
Vermillion, South Dakota 57069

Dear Dunc,

On June 21, 1971 we inspected the sites of the following oil tests and find that they have been satisfactorily restored. The wells are as follows:

Permit

606 Petro-Lewis #5-22 Peterson, SWNW 22-17N-1E, Fall River County
614 Petro-Lewis #14-14 Childers, SESW 14-8S-2E, Fall River County
631 Webb Resources #11-16 Zuehlke, SESE 11-11-4E, Fall River County

As soon as all other requirements have been met I recommend the release of bond.

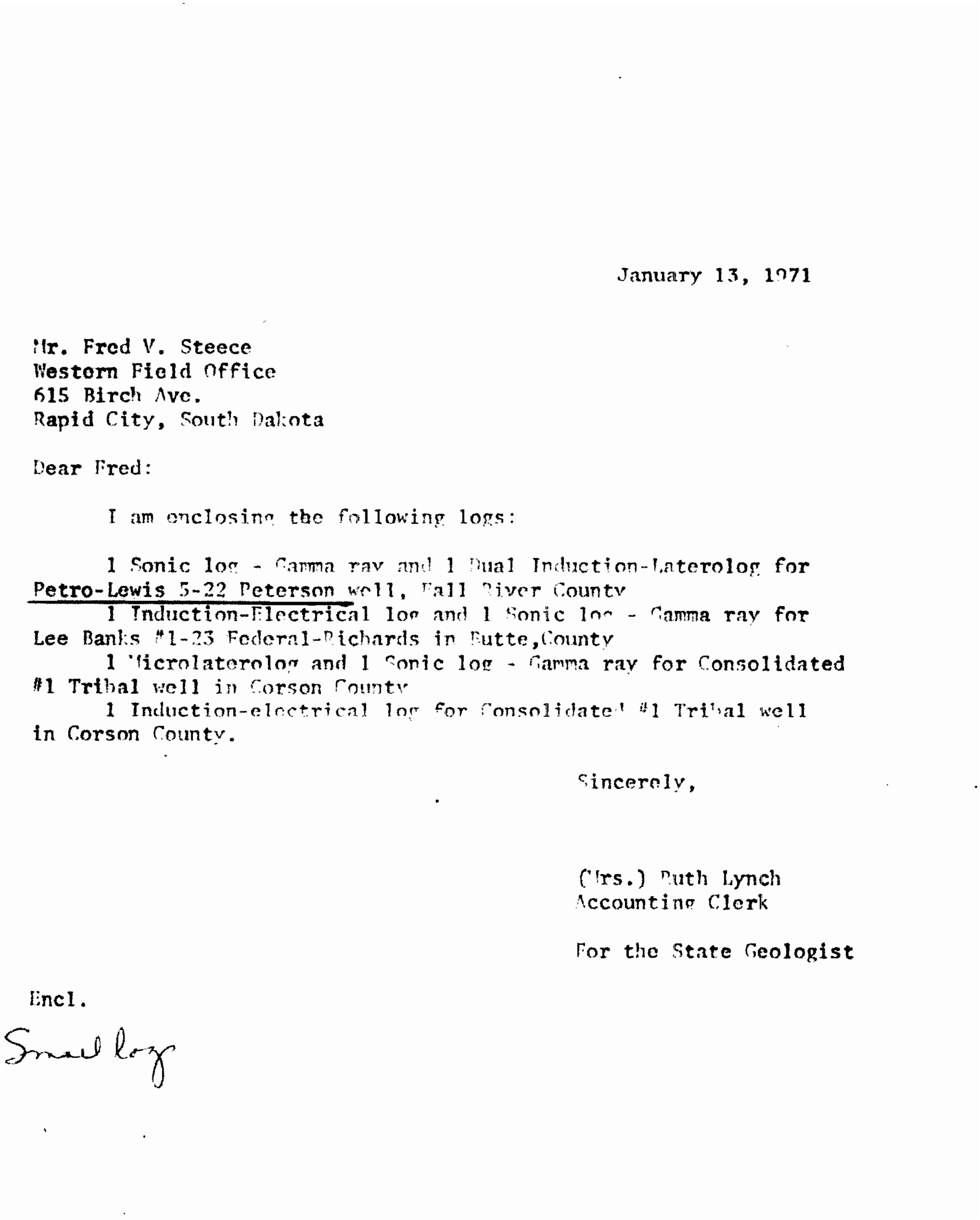
Sincerely

Fred

Fred V. Steece
Principal Geologist

FVS/dme
cc: Petro-Lewis Corporation

Webb Resources, Inc.



January 13, 1971

Mr. Fred V. Steece
Western Field Office
615 Birch Ave.
Rapid City, South Dakota

Dear Fred:

I am enclosing the following logs:

1 Sonic log - Gamma ray and 1 Dual Induction-Laterolog for Petro-Lewis 5-22 Peterson well, Fall River County

1 Induction-Electrical log and 1 Sonic log - Gamma ray for Lee Banks #1-23 Federal-Richards in Butte,County

1 Microlaterolog and 1 Sonic log - Gamma ray for Consolidated #1 Tribal well in Corson County

1 Induction-electrical log for Consolidated #1 Tribal well in Corson County.

Sincerely,

(Mrs.) Ruth Lynch
Accounting Clerk

For the State Geologist

Encl.

Small log

DEC 16 1970

Western Field Office
615 Birch Avenue
Rapid City, South Dakota 57701
((605)394-2229

December 15, 1970

Mrs. M. Lenore Peterson
Star Route
Edgemont, South Dakota

Dear Mrs. Peterson,

Thank you for your letter of December 11, 1970 regarding the Webb Resources #5-22 Peterson oil test, located on your land in SW 1/4 NW 1/4 Sec. 22, T. 7S., R. 1E., Fall River county, South Dakota. The letter is fine as far as it goes, however it is incomplete.

I have enclosed the original and three carbon copies of a suggested substitution to your letter. If you approve of this please date and sign the original and two carbon copies and send them to:

South Dakota Oil and Gas Board, Capitol Office Building, Pierre, South Dakota 57501

Mr. J. W. Grimes, Chief Engineer, South Dakota Water Resources Comm., Capitol Office Building, Pierre, South Dakota 57051

Fred V. Steece, Principal Geologist, Geological Survey, Western Field Office, 615 Birch Avenue, Rapid City, South Dakota 57701

The other copy is for your files.

Sincerely

Fred V. Steece
Principal Geologist

FVS/dme
cc: Dr. Duncan J. McGegor
State Geologist

DEC 15 1970

Western Field Office
615 Birch Avenue
Rapid City, South Dakota 57701
(605) 394-2229

December 14, 1970

Mr. J. W. Grimes
Chief Engineer
South Dakota Water Resource Comm.
Capitol Office Building
Pierre, South Dakota 57501

Dear Joe,

Friday, December 11, 1970, I spoke with Don Driscol on the telephone with regard to an oil test in Fall River county that has recently been converted to a water well. The well is the Petro-Lewis #5-22 Petersen located in SWNW 22-7S-1E Fall River (permit 608). The well was drilled from November 18 to November 27, 1970 and completed as a water well in the Fall River Formation on November 28, 1970. The well has 167 feet of 8 5/8 surface casing cemented from top to bottom and was completed with 389 feet of 4 1/2 inch casing suspended inside the larger casing. The original depth of the well was 2545 feet and was plugged back to 1030, which plugs through the Basal Sundance sand and allows the well to take advantage of the maximum sand development of the Fall River and Lakota. The plugging record is as follows:

40 sax--2410-2300 across the Leo sand
30 sax--1860-1750 across the Converse sand
30 sax--1130-1030 across the Basal Sundance sand

If there is further information you need on this well, please let me know.

Sincerely

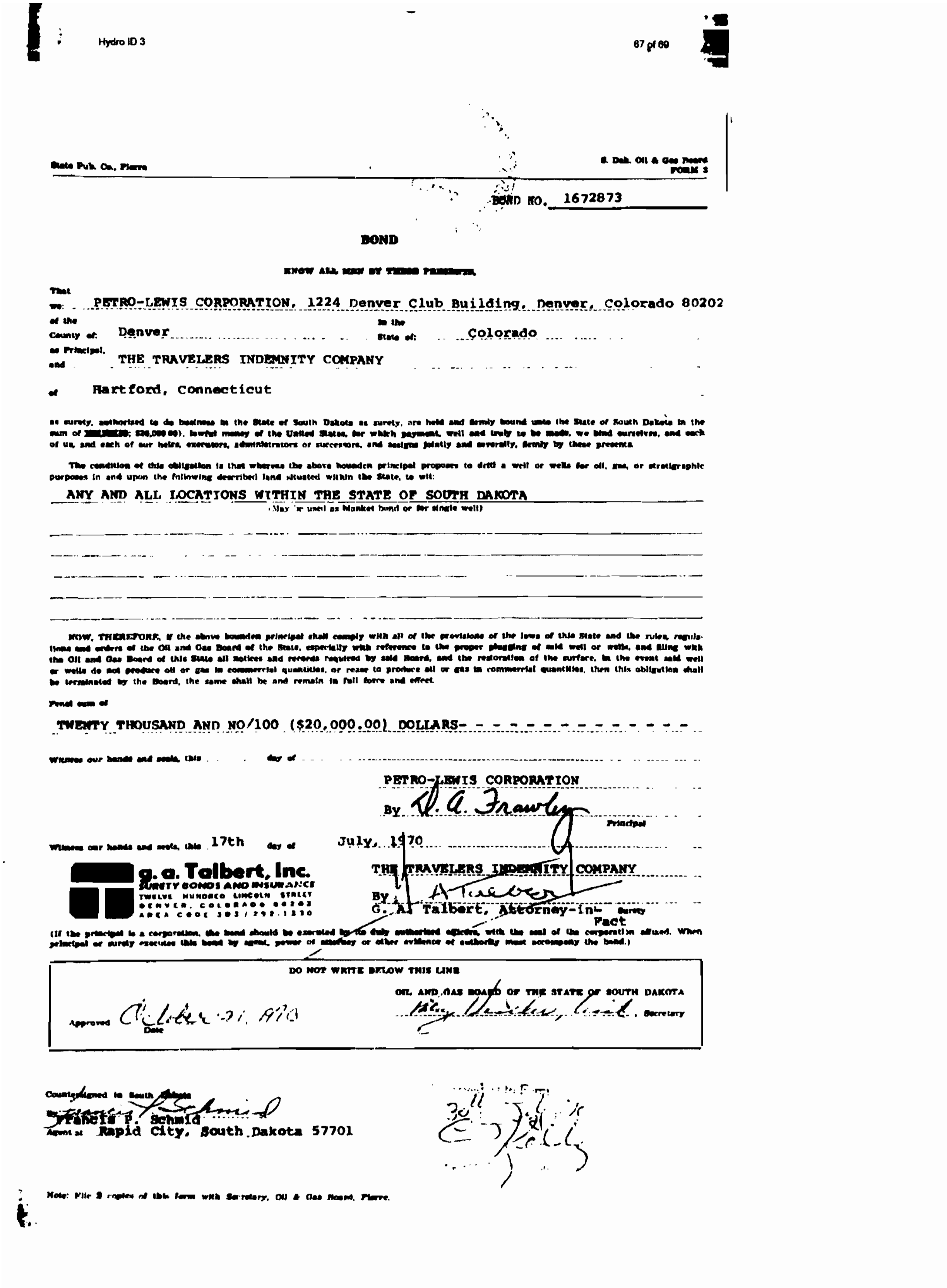
Fred V. Steece

Fred V. Steece
Principal Geologist

FVS/cms
cc: Dr. Duncan J. McGregor
State Geologist

Miss Alma Larson
Secretary, Oil and Gas Board

# SURETY



State Pub. Co., Pierre

S. Dak. Oil & Gas Board
FORM 3

BOND NO. 1672873

## BOND

KNOW ALL MEN BY THESE PRESENTS,

That we: PETRO-LEWIS CORPORATION, 1224 Denver Club Building, Denver, Colorado 80202

of the County of: Denver in the State of: Colorado

as Principal, and THE TRAVELERS INDEMNITY COMPANY

of Hartford, Connecticut

as surety, authorized to do business in the State of South Dakota as surety, are held and firmly bound unto the State of South Dakota in the sum of [redacted]; $20,000.00), lawful money of the United States, for which payment, well and truly to be made, we bind ourselves, and each of us, and each of our heirs, executors, administrators or successors, and assigns jointly and severally, firmly by these presents.

The condition of this obligation is that whereas the above bounden principal proposes to drill a well or wells for oil, gas, or stratigraphic purposes in and upon the following described land situated within the State, to wit:

ANY AND ALL LOCATIONS WITHIN THE STATE OF SOUTH DAKOTA

(May be used as blanket bond or for single well)

NOW, THEREFORE, if the above bounden principal shall comply with all of the provisions of the laws of this State and the rules, regulations and orders of the Oil and Gas Board of the State, especially with reference to the proper plugging of said well or wells, and filing with the Oil and Gas Board of this State all notices and records required by said Board, and the restoration of the surface, in the event said well or wells do not produce oil or gas in commercial quantities, or cease to produce oil or gas in commercial quantities, then this obligation shall be terminated by the Board, the same shall be and remain in full force and effect.

Penal sum of

TWENTY THOUSAND AND NO/100 ($20,000.00) DOLLARS- - - - - - - - - - - - - -

Witness our hands and seals, this day of

PETRO-LEWIS CORPORATION
By W. A. Frawley
Principal

Witness our hands and seals, this 17th day of July, 1970

g. a. Talbert, Inc.
SURETY BONDS AND INSURANCE
TWELVE HUNDRED LINCOLN STREET
DENVER, COLORADO 80203
AREA CODE 303/292-1330

THE TRAVELERS INDEMNITY COMPANY
By A Talbert
G. A. Talbert, Attorney-in-Fact
Surety

(If the principal is a corporation, the bond should be executed by its duly authorized officers, with the seal of the corporation affixed. When principal or surety executes this bond by agent, power of attorney or other evidence of authority must accompany the bond.)

DO NOT WRITE BELOW THIS LINE

Approved October 21, 1970
Date

OIL AND GAS BOARD OF THE STATE OF SOUTH DAKOTA
Secretary

Countersigned in South Dakota
By Francis P. Schmid
Francis P. Schmid
Agent at Rapid City, South Dakota 57701

Note: File 2 copies of this form with Secretary, Oil & Gas Board, Pierre.

# MISCELLANEOUS

NO MISCELLANEOUS
INFORMATION FOR THIS WELL
AS OF 5/18/2011

Department of Environment & Natural Resources
...Tomorrow...Today

| Oil and Gas Search for: *api_no_ like '40 047 05093'* | | |
|---|---|---|
| ***Page 1 of 1*** | ***Download Database***<br>(Excel spreadsheet format) | **Page:** 1 |

## ***Record 1 of 1***

### Well Information

| | | | |
|---|---|---|---|
| **API No:** | 40 047 05093 | **County:** | FALL RIVER |
| **Well Name:** | SUPERIOR OIL 1 PETERSON 44-15 | **Location:** | SESE 15-7S-1E |
| **Permit No:** | 382 | **Total Depth:** | 2264 |
| **Operator Name:** | SUPERIOR OIL COMPANY | **Bottom Hole:** | Minnelusa |
| **Permit Date:** | 02-18-1965 | **KB Elevation:** | 3585 |
| **Spud Date:** | 02-20-1965 | **Ground Elevation:** | 3576 |
| **Plug Date:** | 03-05-1965 | **Latitude:** | 43.436899 |
| | | **Longitude:** | -103.977905 |
| **Well Field** | WILDCAT | **Status** | P&A |
| **Class:** | DRY HOLE | **Type:** | DRY HOLE |

### Formation Tops

| Formation | Depth (ft.) |
|---|---|
| **Dakota Mud** | **185** |
| **Lakota** | **371** |
| **Morrison** | **471** |
| **Sundance** | **670** |
| **Minnekahta** | **1518** |
| **Opeche** | **1557** |
| **Minnelusa** | **1645** |
| **Red River** | **2108** |

| | |
|---|---|
| ***Page 1 of 1*** (goto top) | **Page:** 1 |

| | |
|---|---|
| **COUNTY:** | **FALL RIVER** |
| **LEGAL LOCATION:** | **SESE 15-7N-1E** |
| **API NO:** | **40 047 05093** |
| **PERMIT NO:** | **382** |
| **WELL NAME:** | **SUPERIOR OIL #1 PETERSON (44-15)** |
| **OPERATOR:** | **THE SUPERIOR OIL COMPANY** |
| **PERMIT ISSUED:** | **02/18/1965** |
| **PERMIT CLOSED:** | **10/21/1966** |
| **FILE LOCATION:** | **7N-1E-15 SESE** |

**TARGET CODES:**

**WELL HISTORY / CHECKLIST**

**PERMIT TO DRILL / INTENT TO DRILL**

**WELL INSPECTION / SCOUT REPORTS**

**OPERATOR'S TECHNICAL REPORTS / MAPS**

**ADMINISTRATIVE / SUNDRY REPORTS**

**CORRESPONDENCE**

**SURETY**

**MISCELLANEOUS**

# WELL HISTORY / CHECKLIST

## WELL HISTORY

Well Name Superior Oil #1 Peterson 44-15 Permit No. 382

Location SESE 15-7S-1E - Fall River Date of Permit 2-18-65

Elev. 3576 Gr. API No.

Confidential From To

Logs Received

Cuttings Received Cores Received

Drill Stem Records

Cap Plug and Marker Set

Surface Restored

Plugging Affidavit Signed Date

Bond Released Date 10-21-66

Summary of Scout Reports

| | |
|---|---|
| 2-19-65 | First report |
| 2-24-65 | Spudded 2-20-65 |
| 3-4-65 | Plugged |
| 3-5-65 | Planned to convert test to water well |
| 4-9-65 | Pits not filled - Rig still on location |
| 5-25-65 | Mud pits not filled - Rig moved from location |
| 7-30-65 | Pits not filled |
| 7-1-66 | Pits not filled |

Hydro ID 4

Superior #1 (44-15) Peterson
660 FSL, 660 FEL
SE SE, -15-7S-1E
Fall River Co.

Surface + mineral owner.
E.A. Peterson
Edgemont, So.Dak.

Contractor: Barnhart Drilling Co.
Casper, Wyo.

Elev: 3576 gr
3585 K.B.

Est T.D. 2500 1st Leo.

Permit: 2-18-65 #382.

Plan to Set 500' 8⅝, Core + test
1st Leo. + Run Dual Induction-Laterlog
+ GRS

water flowed about 400

Evans #7 Reinbow.
971' 8⅝

March 2, 1965

Coring at 2175'
@ 2179

986.54 of 8⅝
w/ 450 sx + Circ.
+ 125 sack
Cemented 971.

Dave Benson - Geol.

2-19-65
John Ryan of P.I.
Called + Said Barnhart
was Contractor + they were
on location.

2-20-65
Dykes Called at 11:00
A.M. Said Barnhart was
Contractor + had spudded
at 1:30 AM 2-20-65
~~Dick Wagner Geols~~
Don ~~Brause~~ - Eng. pusher.
(Wayne will not be out until
reach Minnelusa

Not Tite
nothing will be tite.

Feb 24, 1965

@ 974
~~[illegible]~~ by E. Peterson [illegible]

ML
~~Tops~~ log E.
Dak 185
Lak 371
Mor 471
Sun 670
L 771. top Sundance.

Sample tops

Mk. - 1527
Ml - 1652

Lak + Sun flowed.

1st Leo being Cored.

est. T.D. 2500

# PERMIT TO DRILL / INTENT TO DRILL

State Pub. Co., Pierre

# APPLICATION FOR PERMIT TO:

S. Dak. Oil & Gas Board
FORM 2

☒ DRILL ☐ DEEPEN ☐ PLUG BACK

☐ SINGLE ZONE

☒ OIL WELL ☐ GAS WELL ☐ MULTIPLE ZONE

FARM OR LEASE NAME: Peterson

WELL NO.: #1 (44-15)

FIELD AND POOL, OR WILDCAT:

OPERATOR: The Superior Oil Company

ADDRESS: P. O. Box 200, Casper, Wyoming

NO. ACRES IN LEASE: 2846.03

LOCATION (In feet from an established corner of the legal subdivision)*: 660' FSL & 660' FEL Sec. 15-7S-1E

¼ ¼ SEC. TWP. RGE.: SE SE 15-7S-1E

COUNTY: Fall River

NAME AND ADDRESS OF SURFACE OWNER:
F. A. Peterson
Edgemont, South Dakota

ELEVATION: 3576 G.L.

PROPOSED DEPTH: 2500'

NO. OF WELLS ETC:

ROTARY OR CABLE TOOLS: Rotary

NAME AND ADDRESS OF CONTRACTOR: Unknown

APPROXIMATE DATE WORK WILL START: 2-22-65

IF LEASE PURCHASED WITH ANY WELLS DRILLED, FROM WHOM PURCHASED (Name and address):

PROPOSED CASING AND CEMENTING PROGRAM

| SIZE OF HOLE | SIZE OF CASING | WEIGHT PER FOOT | NEW OR SECOND HAND | DEPTH | SACKS OF CEMENT |
|---|---|---|---|---|---|
| 12-1/4" | 8-5/8" | 24# | New | 500 | 300 |

DESCRIBE PROPOSED OPERATIONS. IF PROPOSAL IS TO DEEPEN OR PLUG BACK, GIVE DATA ON PRESENT PRODUCTIVE ZONE AND PROPOSED NEW PRODUCTIVE ZONE. GIVE BLOW OUT PREVENTER PROGRAM IF ANY

(1) The Superior Oil Company proposes to drill a 2500' 1st Leo Sand test at the above location.
(2) Will set 8-5/8" csg. at 500' & cmt. to surface.
(3) Will drill 7-7/8" hole to total depth.
(4) Will catch 10' samples from base of surface to TD.
(5) Expect to core & test the 1st Leo Sand plus any other zones that have significant shows.
(6) Will run Dual Induction-Laterolog & GRS logs from TD to base of surf. csg.
(7) Should commercial production be encountered, 5-1/2" casing will be cemented through the productive zone.

SIGNED J. P. Dujka TITLE District Engineer DATE 2-11-65

DO NOT WRITE BELOW THIS LINE

PERMIT NO. [illegible]

CHECKED BY Bernard Linn School and Public Lands Date 2/17/65

APPROVAL DATE [illegible] [illegible] Secretary

CONDITIONS:

☐ COMPLETE SET OF SAMPLES, AND CORES IF TAKEN, MUST BE SUBMITTED.

☐ SAMPLES, AND CORES IF TAKEN, BELOW ...... DEPTH, MUST BE SUBMITTED.

## INSTRUCTIONS

General: This form is designed for submitting proposals to perform certain well operations, as indicated, on all types of lands and leases for appropriate action by either a Federal or a State agency, or both, pursuant to applicable Federal and/or State laws and regulations. Consult applicable Federal or State regulations, or appropriate officials, concerning approval of the proposal before operations are started.

If the proposal is to redrill to the same reservoir at a different subsurface location or to a new reservoir, use this form with appropriate notations.

If the well is to be, or has been, directionally drilled, so state and show by attached sheets, if necessary, the coordinate location of the hole in any present or objective productive zones.

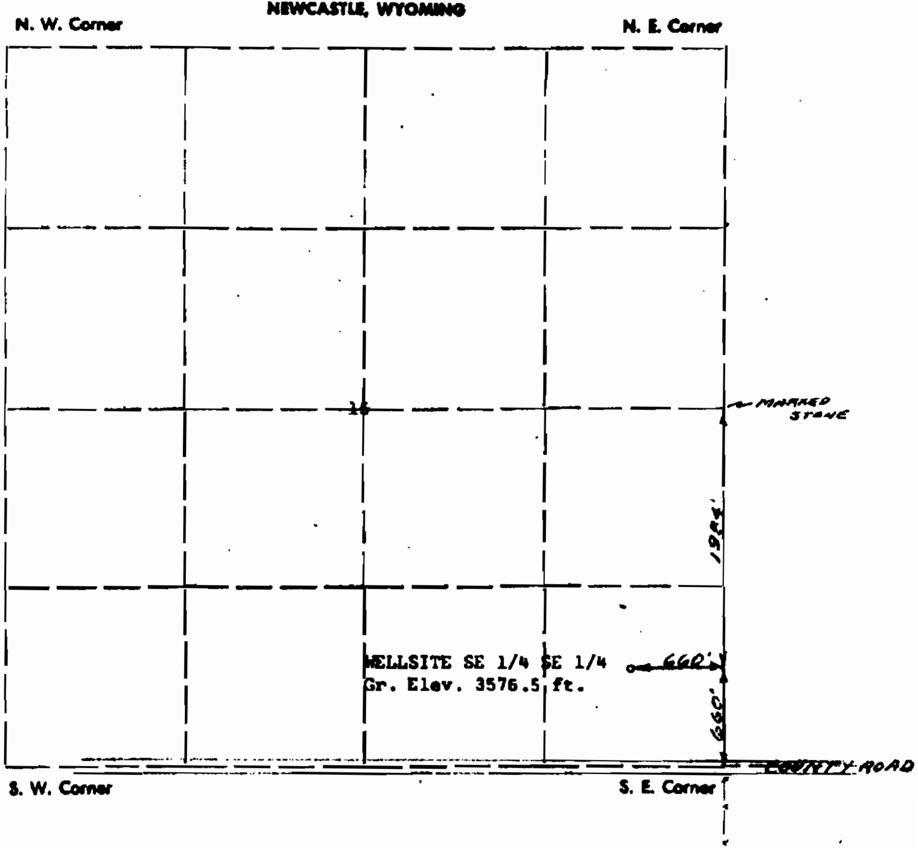
File 3 copies of this form with Secretary, Oil & Gas Board, Pierre.

(*Sample location: 660' South and 600' East of the Northwest Corner of Section 16.)

# TRI-STATE COMPANY

X 797 746-47

NEWCASTLE, WYOMING



I, Lawrence T. Price, of Newcastle, Wyoming, Certify

that in accordance with a request from J. P. Dujka

of Casper, Wyoming, for The Superior Oil Company

P. O. Box 200, Casper, Wyoming

I made a survey (date) February 9 19 65

for the location and elevation of the Peterson No. 1 (44-15) oil

wellsite

As shown on above map, the well site is in center SE 1/4 SE1/4

Section 15, Township 7 South XXXXX Range 1 East XXXXX

Fall River County, ~~Wyoming~~ South Dakota. Elevation is 3576.5 feet

above mean sea level before dozing.

Lawrence T. Price

Licensed Surveyor No. 1311

# WELL INSPECTION / SCOUT REPORTS

Permit No. 382 10 of 63

STATE GEOLOGICAL SURVEY

Scout Report

Date Scouted 7/1/66

Owner Superior Oil Company

**Designation of well** #1 Peterson (44-15)

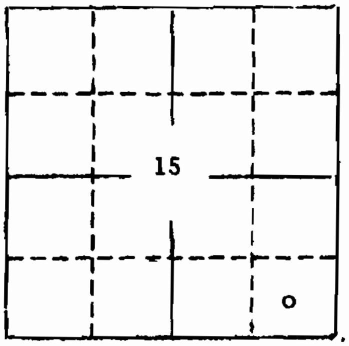
**Location:** Sec. 15 T. 7 N. S. R. 1 E. W.

Fall River County, S. D. **Total depth** 2264 **feet**

**Casing Record:**

8 5/8 971 Ft. ______ Ft.

______ Ft. ______ Ft.



**Work in progress at time of visit:**

None

**Developments since last visit:**

None

**Remarks and recommendations:**

Pits not filled

**Scouted by** Earl Cox, Geologist

**Approved by** Duncan J. McGregor

Duncan J. McGregor, State Geologist

Permit No. 382

## STATE GEOLOGICAL SURVEY

## Scout Report

Date Scouted July 30, 1965

**Owner** Superior Oil Company

**Designation of well** #1 Peterson (44-15)

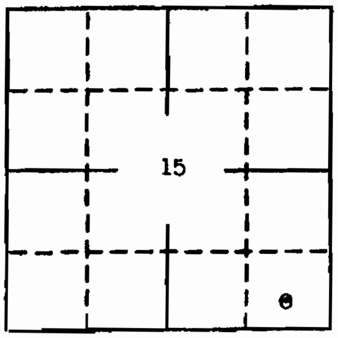
**Location:** Sec. 15 T. 7 N. S. R. 1 E.W.

Fall River County, S. D. **Total depth** 2264 feet

**Casing Record:**

8 5/8 971 Ft. Ft.

Ft. Ft.



**Work in progress at time of visit:**

None

**Developments since last visit:**

None

**Remarks and recommendations:**

Pits not filled

**Scouted by** Earl Cox, Geologist

**Approved by**
Duncan J. McGregor, State Geologist

Permit No. 382

# STATE GEOLOGICAL SURVEY

## Scout Report

Date Scouted May 25, 1965

Owner Superior Oil Company

Designation of well #1 Peterson (44-15)

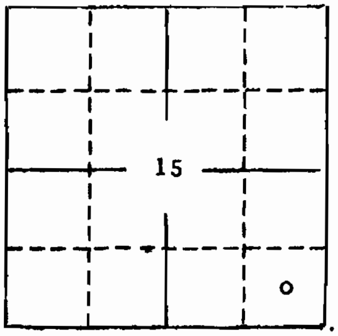
Location: Sec. 15 T. 7 ~~N~~. S. R. 1 E. ~~W~~.

Fall River County, S. D. Total depth 2,264 feet

**Casing Record:**

8 5/8 971 Ft. ______ Ft.

______ Ft. ______ Ft.



**Work in progress at time of visit:**

None

**Developments since last visit:**

Rig moved from location

**Remarks and recommendations:**

Mud pits not filled

Scouted by Earl Cox, Geologist

Approved by Duncan J. McGregor, State Geologist

Hydro ID 4

13 of 63

Permit No. 382

# STATE GEOLOGICAL SURVEY

## Scout Report

Date Scouted April 9, 1965

Owner Superior Oil Company

Designation of well #1 Petersen (44-15)

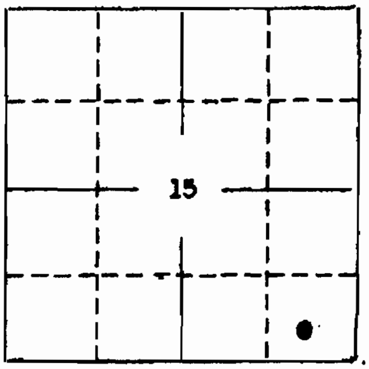
Location: Sec. 15 T. 7 ~~N~~. S. R. 1 E. ~~W~~.

Fall River County, S. D. Total depth 2264 feet

Casing Record:

8 5/8 971 Ft. Ft.

Ft. Ft.



Work in progress at time of visit:

None, well is flowing at about 10 gpm

Developments since last visit:

A three-inch control valve is in place on the well head.

Remarks and recommendations:

Pits have not been filled.
Rig is still over location.

Scouted by Earl Cox, Geologist

Approved by Duncan J. McGregor
Duncan J. McGregor, State Geologist

Permit No. 382

STATE GEOLOGICAL SURVEY

Scout Report

Date Scouted March 5, 1965

Owner Superior Oil Company

Designation of well #1 Peterson (44 - 15)

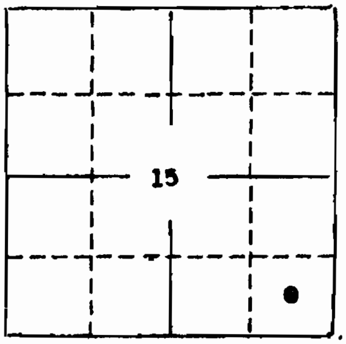
Location: Sec. 15 T. 7 ~~N~~. S. R. 1 E. ~~W~~.

Fall River County, S. D. Total depth 2264 feet

**Casing Record:**

8 5/8 971 Ft. Ft.

Ft. Ft.



**Work in progress at time of visit:**

An artesian flow at the base of the surface casing flushed out the top of the cement plug resulting in a 20-30 gpm flow of fresh water.

**Developments since last visit:**

**Remarks and recommendations:**

The flow is contained by a valve at the surface and it is planned to convert the test to a water well.

Scouted by Earl Cox, Geologist

Approved by Duncan J McGregor

Duncan J. McGregor, State Geologist

Permit No. 382

# STATE GEOLOGICAL SURVEY

## Scout Report

Date Scouted March 4, 1966

Owner Superior Oil Company

Designation of well #1 Peterson (44 - 15)

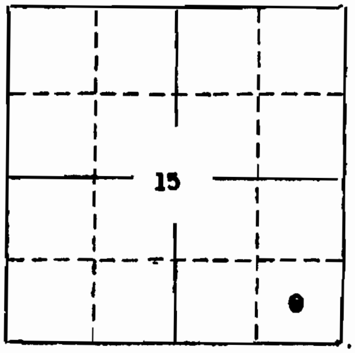
Location: Sec. 15 T. 7 ~~N~~. S. R. 1 E. ~~W~~.

Fall River County, S. D. Total depth 2264 feet

Casing Record:

8 5/8 971 Ft. ____ Ft.

____ Ft. ____ Ft.



Work in progress at time of visit:
Plugged as follows:

| | | |
|---|---|---|
| 25 sacks | 1970-1920 | 3rd Converse sand |
| 35 sacks | 1715-1645 | Top Minnelusa |
| 30 sacks | Base surface casing | 1020-950 |

Developments since last visit:
Core #1 2175-2221 anhydrite, Core #2 2221-22644, anhydrite essentially. Leo Sand very tight. No permeability or porosity. Run sonic-gamma ray log and dual induction laterolog (971-T.D.). Run E-log and micro-log prior to setting surface casing. Water flow of about 40 gpm at 890-905 and also a flow after drilling out from under surface casing.

Remarks and recommendations:
Tentative log tops:

| | | | |
|---|---|---|---|
| Minnekahta | - 1518 | 3rd converse | - 1942 |
| Opeche | - 1557 | Red marker | - 2108 |
| Minnelusa | - 1645 | Base of 1st Leo | - 2254 |
| 2nd Converse | - 1777 | T. D. | - 2264 |

Scouted by Earl Cox, Geologist

Approved by Duncan J. McGregor
Duncan J. McGregor, State Geologist

Permit No. 392

# STATE GEOLOGICAL SURVEY

## Scout Report

Date Scouted March 2, 1965 ?

Owner Superior Oil Co.

Designation of well #1 Peterson

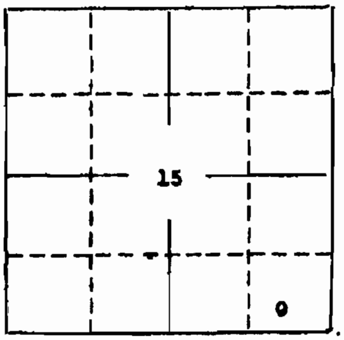
Location: Sec. 15 T. 7 ~~N~~. S. R. 1 E. ~~W~~

Fall River County, S. D. Total depth 2179 feet

Casing Record:

8 5/8 971 Ft. Ft.

Ft. Ft.



Work in progress at time of visit:

Coring at 2179 (1st Leo Sand)

Developments since last visit:

Set 971' of 8 5/8" surface casing with 375 sacks.
Drilled from 974-2175.
Cored from 2175-2179.

Artesian flows were encountered in the Lakota and Sundance.

Remarks and recommendations:

| | | |
|---|---|---|
| **E log tops:** | | **Sample Tops:** |
| Dakota - 185 | Sundance - 670 | Minnekahta - 1527 |
| Lakota - 371 | Top Sundance Sand - 771 | Minnelusa - 1652 |
| Morrison - 471 | | |

Scouted by Earl Cox, Geologist

Approved by Duncan J. McGregor
Duncan J. McGregor, State Geologist

Elevations: 3576 gd; 3585 K.B.

Hydro ID 4

17 of 63

Permit No. 382

# STATE GEOLOGICAL SURVEY

## Scout Report

Date Scouted Feb. 24, 1965

Owner Superior Oil Co.

Designation of well #1 Peterson (44-15)

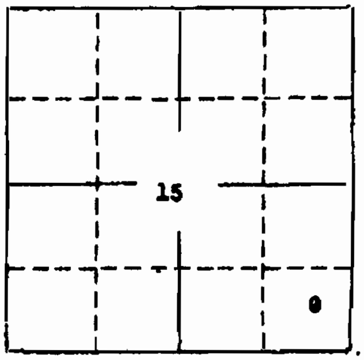
Location: Sec. 15 T. 7 ~~N~~. S. R. 1 E. ~~W~~.

Fall River County, S. D. Total depth 974 feet

Casing Record:

________ Ft. ________ Ft.

________ Ft. ________ Ft.



Work in progress at time of visit:

Drilling at 974'.

Developments since last visit:

Spudded 2-20-65.
Drilled from 0 - 974.
Run electric log to locate water sands.

Remarks and recommendations:

Over 900 feet of surface casing will be set to case off artesian flows.

Scouted by Earl Cox, Geologist

Approved by Duncan J. McGregor
Duncan J. McGregor, State Geologist

Permit No. 382

STATE GEOLOGICAL SURVEY

Scout Report

FIRST REPORT

Date Scouted Feb. 19, 1965

Owner Superior

Designation of well #1 (44-15) Peterson

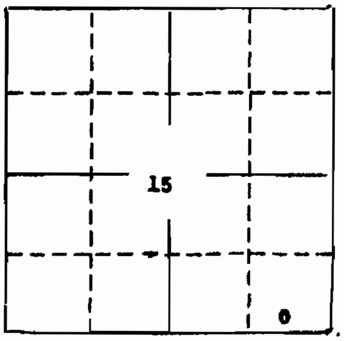
Location: Sec. 15 T. 7 ~~N~~. S. R. 1 E. ~~W~~.

Fall River County, S. D. Total depth 0 feet

Casing Record:

______ Ft. ______ Ft.

______ Ft. ______ Ft.



Work in progress at time of visit:

Petroleum Information informed me by phone that Barnhart Drilling Company was the contractor and they were on location.

Developments since last visit:

Remarks and recommendations:

Scouted by Earl Cox, Geologist

Approved by Duncan J. McGregor, State Geologist

8:45 AM
March 4, 1965

Don Brause Called. Had Reached 2264 + found the sand very tite + no Shows. Plan to log + then plug

Petroleum phone 662-6222

Sonic log · Gamma Ray Neutron
IES + Microlog or cuttings,
Dual induction Laterolog.

Formation log tops
mk - 1518
Gyp - 1557
mnl - 1645
2nd Cannon 1777
3rd " 1942
Red marker - 2108
Base of Lakota 2254
T.D. 2264

3rd Cann / 1970 - 1920

3rd Conc. 1970 - 1920 25 sx
T. Mnl 1715 - 1645 35 sx
Fox Lagune 1020 - 950 30 sx
90 sx

~~7:30 - 8:00~~
7:45 A.M to Church
plug.

462 - 7244
Room 7.
Don Brause

Core #1 2175 - 2228
Only Butts. Rec 44'

Core #2 2228 - 2264
Only Butt essentially

Good water at
890 - 905 or 925
1st flow 1 bbl/min

plug
Fox Lagune Con

970
45
25

45

30 sx - ~~[illegible]~~
1020 - ~~935~~ 950
25 sx 3rd Cannon 1970 - 1920
35 sx top Mnl 1645 - 1715

970 Cem stut will preserve Samples

March 5, 1965
Brause called in at 10:00 AM
I finally got hold of him at about 7:00 P.M. ~~He~~ Got a flow of water ~~[illegible]~~ ~~[illegible]~~ flowing a 2" stream at an estimated 20 g/m. Had put valve at surface + shut in.
A sand zone immediately below surface had apparently broke loose. (A flow was of land ~~[illegible]~~ when drilled out from under surface!) Rig had been torn down + part hauled off for repair. We decided to put steel Baker plug at base of casing + put 10 ft. Cement on top of it.

March 6, 1[illegible]

Called Brown @ 8:30 AM
He said he was quite
some water was coming
from base of surface. Said
rancher wants to save from
flow. I said couldn't
be done but would
see McGregor about it.
Brown said an alternative
that would save them
money would be to pump
60 sx down hole and
shut in after reaching
the sand. This would
leave about 100' of
cement in casing & the
rancher would have
to drill it out. I
said this would be
a satisfactory alternative.
~~[illegible]~~ work would be
done in week or 10 days
after they evaluate well.

Apr 19, 19[illegible]

Most laid down. Nothing
removed. Pits not filled or
fenced. Lead-valve was
on well head + was
flowing about 5-10 gpm

May 25, 1965

Rig gone from location
pits not filled

July 30, 1965

no change

Sept. 2, 1965

No change. Water from
well running into
mud pits.

July 1, 1966

No change

9-9-66

No change

using cement would cost
about 500.# using steel
plug about 1000.

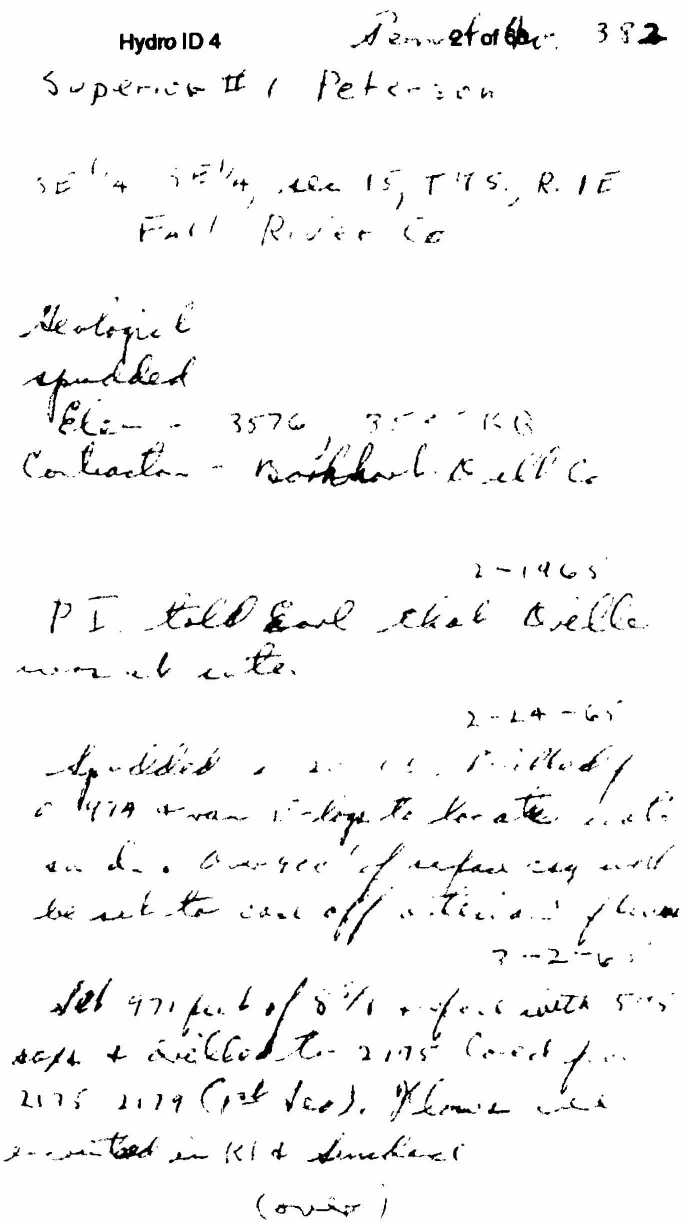
Duyka - pronounced Dika

3-8-65

Called McGregor, Don [illegible],
Francis Peterson, and Mr
Duyka and all agreed to
convert flow to a water well.
I would get letter from
Peterson that he request
a conversion

3-17-65

Called Peterson as he had
not sent back signed letter
saying he wants to convert to
a water well. He said had
reduced [illegible] + put valve on
+ run it for a week + then
had dropped to 6 gpm. He
was going to sign letter + return.



Hydro ID 4 [illegible] 21 of 66 382

Superior #1 Peterson

SE 1/4 SE 1/4, sec 15, T 7 S., R. 1 E
Fall River Co

Geological
spudded
Elev - 3576, 35[illegible] KB
Contractor - [illegible] Drill Co

2-1965

P.I. told Earl that drilling [illegible] at site.

2-24-65

Spudded [illegible]. Drilled to 474 & ran E-logs to locate [illegible] sand. Over 900' of surface csg will be set to case off artesian flow

3-2-65

Set 971 feet of 8 5/8 surface with 500 sacks & drilled to 2175. Cored from 2175 2179 (1st [illegible]). Flows were encountered in K1 & [illegible]

(over)

[illegible] Hydro ID 4 18N, R1- 22 of 63 [illegible]
471, [illegible] 670,
sample tops - Minnekahta 15[illegible]
Minnelusa - 1652

3-4-6[illegible]

Plugged. Core #1 2211-2221
Core #2 2221-2264 anhydrite
anhydrite, essentially [illegible] [illegible] [illegible]
no porosity [illegible] [illegible] [illegible] +
[illegible] [illegible] (971 TD). [illegible] [illegible]
+ [illegible] [illegible] [illegible] [illegible]
at [illegible] flow of about 4 gpm at 870-
905 + also a flow after drilling out
from under surface csg
Tops:
Minnekahta 1515 2nd Converse 1942
Opeche - 1557 red marker 2108
Minnelusa - 1645 base of 1st Leo 22[illegible]
2nd Converse - 1777 TD 2264

3-5-64

Artesian flow at base of surface csg flowed
out cement plug resulting in a flow of 20-30
gpm. Flow contained by valve + will convert
to water well.

3-10-64

Letter from [illegible] to [illegible] [illegible] to
convert to water well

- - 5

Received 2 copies of letter from Vernon Peterson with [illegible] to [illegible] [illegible] plug out of hole so well could be converted to water well

Also 2 copies of core analyses

4-9-65

Well flowing at about 10 gpm Control valve is in place. Pits are filled & rig is still on location

5-10-65

Letter from [illegible] saying don't release bond because pits not filled even though [illegible] has assumed responsibility for well.

5-25-65

Rig moved from location. Pits not filled.

7-30-65

Pits not filled

10-?-65

Letter from [illegible] to [illegible] saying valve was opened and water running into pits

Letter from Earl [illegible] saying a release from Peterson is needed

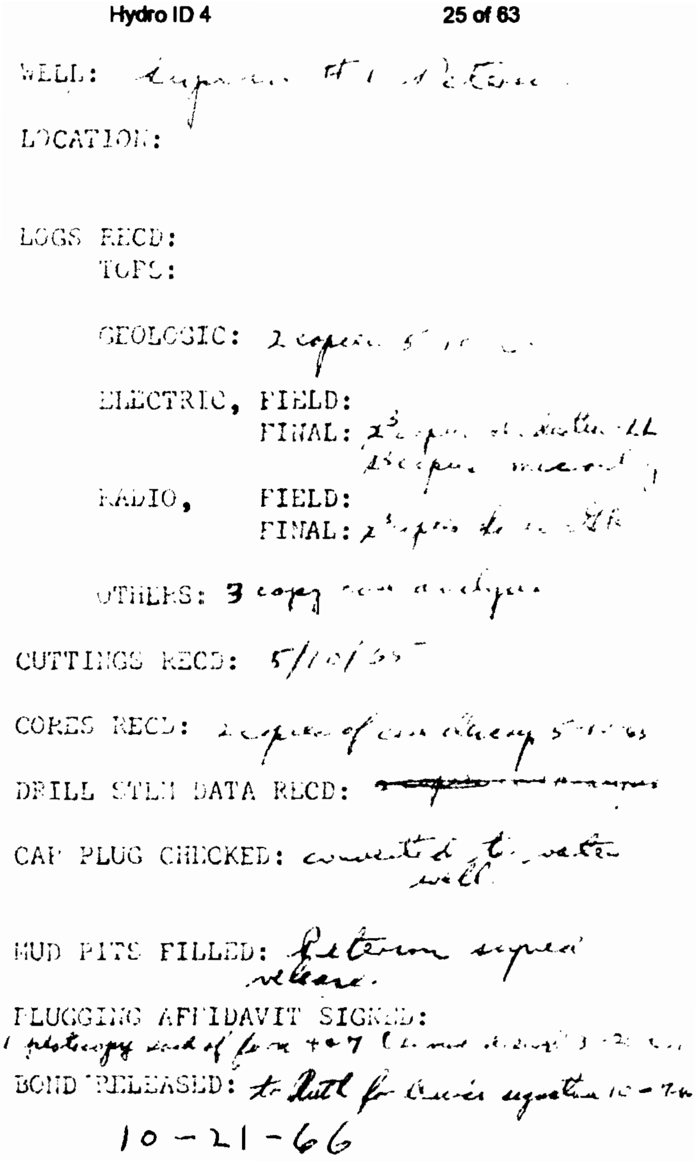
Pits not filled 7-1-66

9-28-66

Received release signed by Peterson for pits

9-30-66

Letter from Earl saying OK to release bond



**Hydro ID 4** **25 of 63**

WELL: Dupree #1 [illegible] Peterson

LOCATION:

LOGS RECD:

TOPS:

GEOLOGIC: 2 copies 5-10-[illegible]

ELECTRIC, FIELD:

FINAL: 2 copies [illegible]
2 copies [illegible]

RADIO, FIELD:

FINAL: 2 copies [illegible]

OTHERS: 3 copy core analyses

CUTTINGS RECD: 5/10/55

CORES RECD: 2 copies of core analyses 5-10-65

DRILL STEM DATA RECD: ~~[illegible]~~

CAP PLUG CHECKED: converted to water well.

MUD PITS FILLED: Peterson signed release.

PLUGGING AFFIDAVIT SIGNED:
1 photocopy each of form 4 & 7 [illegible]

BOND RELEASED: to Ruth for Dave's signature 10-7-[illegible]

10-21-66

# OPERATOR'S TECHNICAL REPORTS / MAPS

Hydro ID 4

**Preliminary Report**

CORE LABORATORIES, INC.
*Petroleum Reservoir Engineering*
DALLAS, TEXAS

THE SUPERIOR OIL COMPANY
MAR 1 1 1965
ENGINEERING
CASPER

Page No. ______

# CORE ANALYSIS RESULTS

Company SUPERIOR OIL COMPANY Formation MINNELUSA File RP-4-1363
Well NO. 1 PETERSON Core Type DIAMOND CONV. Date Report 3-4-65
Field WILDCAT Drilling Fluid WATER BASE Analysts JMM
County FALL RIVER State S. DAKOTA 3576 Gr Location SE SE 15-7S-1E

## Lithological Abbreviations

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SAND-SD | DOLOMITE-DOL | ANHYDRITE-ANHY | SANDY-SDY | FINE-FN | CRYSTALLINE-XLN | BROWN-BRN | FRACTURED-FRAC | SLIGHTLY-SL/ |
| SHALE-SH | CHERT-CH | CONGLOMERATE-CONG | SHALY-SHY | MEDIUM-MED | GRAIN-GRN | GRAY-GY | LAMINATION-LAM | VERY-V/ |
| LIME-LM | GYPSUM-GYP | FOSSILIFEROUS-FOSS | LIMY-LMY | COARSE-CSE | GRANULAR-GRNL | VUGGY-VGY | STYLOLITIC-STY | WITH-W/ |

| SAMPLE NUMBER | DEPTH FEET | PERMEABILITY MILLIDARCYS | POROSITY PER CENT | RESIDUAL SATURATION PER CENT PORE OIL | RESIDUAL SATURATION PER CENT PORE TOTAL WATER | SAMPLE DESCRIPTION AND REMARKS |
|---|---|---|---|---|---|---|
| 1 | 2217-18 | 0.16 | 2.7 | 7.4 | 63.1 | SD, GRY, V/FN-FN, CALC. |
| 2 | 18-19 | 0.24 | 2.6 | 0.0 | 65.5 | SD, GRY, V/FN-FN, CALC. |
| 3 | 2183 | 0.10 | 2.2 | 0.0 | 77.2 | SD, GRY, V/FN-FN, SL/DOL. |
| 4 | 2212 | 0.10 | 1.3 | 0.0 | 84.5 | SD, GRY, V/FN-FN, SL/DOL. |
| 5 | 2221 | <0.1 | 0.5 | 0.0 | 40.0 | SD, GRY, V/FN-FN, SL/CALC. |
| 6 | 2239 | 0.10 | 2.8 | 0.0 | 68.0 | SD, GRY, FN-MED, SL/CALC. |
| 7 | 2249 | 0.10 | 1.9 | 0.0 | 47.3 | SD, GRY, FN-MED, SL/CALC. |

Superior Oil Company, 44-15 Petersen Description by: D. A. Bentzin
C SE SE Section 15, T 7 S, R 1 E
Fall River County, South Dakota

Elevation: 3576G, 3585KB

| | |
|---|---|
| 974- 980 | Shaly siltstone, dark reddish brown, calc, NS. |
| 980- 990 | Siltstone, aa, NS. |
| 990-1000 | Siltstone, aa, NS. |
| 1000-1010 | Siltstone, dark reddish brown, calc, NS. |
| 1010-1020 | Siltstone, dark reddish brown, calc, NS. |
| 1020-1030 | Siltstone, dark reddish brown, calc, NS. |
| 1030-1040 | Shaly siltstone, dark reddish brown, calc, NS. |
| 1040-1050 | Shaly siltstone, dark reddish brown, calc, NS. |
| 1050-1060 | Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS. |
| 1060-1070 | Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS. |
| 1070-1080 | Shaly siltstone, dark reddish brown, calc, NS. |
| 1080-1090 | Shaly siltstone, dark reddish brown, calc, NS. |
| 1090-1100 | Shaly siltstone, dark reddish brown, calc, NS. |
| 1100-1110 | Shaly siltstone, dark reddish brown, calc, NS. |
| 1110-1120 | Shaly siltstone, dark reddish brown, calc, NS. |
| 1120-1130 | Shaly siltstone, dark reddish brown, calc, NS. |
| 1130-1140 | Shaly siltstone, dark reddish brown, calc, NS. |
| 1140-1150 | Shaly siltstone, dark reddish brown, calc, NS. |
| 1150-1160 | Shaly siltstone, dark reddish brown, calc, NS. |
| 1160-1170 | Shaly siltstone, dark reddish brown, calc, NS. |
| 1170-1180 | Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS. |
| 1180-1190 | Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS. |
| 1190-1200 | Shaly siltstone, dark reddish brown, calc, NS. |
| 1200-1210 | Shaly siltstone, dark reddish brown, calc, NS. |
| 1210-1220 | Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS. |
| 1220-1230 | Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS. |
| 1230-1240 | Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS. |
| 1240-1250 | Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS. |

**Superior Oil Company, 44-15 Petersen**
**C SE SE Section 15, T 7 S, R 1 E**
**Fall River County, South Dakota**
**Page 2**

| | |
|---|---|
| 1250-1260 | Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS. |
| 1260-1270 | Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS. |
| 1270-1280 | Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS. |
| 1280-1290 | Shaly siltstone, dark reddish brown, calc, with 10% anhydrite, NS. |
| 1290-1300 | Shaly siltstone, dark reddish brown, calc, with 10% anhydrite, NS. |
| 1300-1310 | Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS. |
| 1310-1320 | Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS. |
| 1320-1330 | Shaly siltstone, dark reddish brown, calc, with 25% anhydrite, NS. |
| 1330-1340 | Shaly siltstone, dark reddish brown, slightly calc, with 30% anhydrite, NS. |
| 1340-1350 | Anhydrite, white, crystalline with shaly siltstone aa, NS. |
| 1350-1360 | Anhydrite, white, crystalline with shaly siltstone aa, NS. |
| 1360-1370 | Anhydrite, white, crystalline, decreasing with siltstone as above, NS. |
| 1370-1380 | Shaly siltstone, dark reddish brown, calc, with 25% anhydrite, NS. |
| 1380-1390 | Shaly siltstone, dark reddish brown, calc, with 25% anhydrite, NS. |
| 1390-1400 | Shaly siltstone, dark reddish brown, calc, with 10% anhydrite, NS. |
| 1400-1410 | Anhydrite, white, crystalline with shaly siltstone aa, NS. |
| 1410-1420 | Anhydrite and shaly siltstone, aa, 50-50, NS. |
| 1420-1430 | Anhydrite and shaly siltstone, aa, 50-50, NS. |
| 1430-1440 | Shaly siltstone, dark reddish brown, slightly calc, with minor anhydrite, NS. |
| 1440-1450 | Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS. |
| 1450-1460 | Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS. |
| 1460-1470 | Shaly siltstone, dark reddish brown, slightly calc, with minor anhydrite, NS. |

Superior Oil Company, 44-15 Petersen
C SE SE Section 15, T 7 S, R 1 E
Fall River County, South Dakota
Page 3

| | |
|---|---|
| 1470-1480 | Shaly siltstone, dark reddish brown, slightly calc, with minor anhydrite, NS. |
| 1480-1490 | Shaly siltstone, dark reddish brown, slightly calc, with minor anhydrite, NS. |
| 1490-1500 | Shaly siltstone, dark reddish brown, slightly calc, with minor anhydrite, NS. |
| 1500-1510 | Shaly siltstone, dark reddish brown, slightly calc, with minor anhydrite, NS. |
| 1510-1520 | Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS. |
| 1520-1530 | 40% Shaly siltstone, aa, with 10% white anhydrite and 20% dolomite, pink, very fine granular to dense, slow effervescence, NS. |
| 1530-1540 | Shaly siltstone, anhydrite and dolomite, aa, in equal parts. The dolomite is varicolored - white, pink, tan, NS. |
| 1540-1550 | Sample aa, with minor calcareous purple shale, NS. |
| 1550-1560 | Sample aa, with minor calcareous purple shale, NS. |
| 1560-1570 | Sample aa, with no purple shale, NS. |
| 1570-1580 | Sample aa, NS. |
| 1580-1590 | Sample aa, NS. |
| 1590-1600 | Sample aa, NS. |
| 1600-1610 | Silty shale to siltstone, reddish brown, slightly calc, with minor anhydrite, NS. |
| 1610-1620 | Silty shale to siltstone, reddish brown, slightly calc, with minor anhydrite, NS. |
| 1620-1630 | Silty shale to siltstone, reddish brown, slightly calc, with minor anhydrite, NS. |
| Note | The Opeche lithology is similar to the pre-Minnekahta with the exception that the silt grains seem generally smaller. |
| 1630-1640 | Shaly siltstone, reddish brown, calc, with minor anhydrite, NS. |
| 1640-1650 | Sample aa, with sandy siltstone, reddish brown, slightly calc, soft and sandstone, gray to pink, fine grained, non-calc poor porosity, NS. |
| 1650-1660 | Sample aa, with sandstone, pink to white, fine to medium grained, fair sorting, slightly calc, poor porosity, grains appear to have secondary overgrowths, NS. |
| 1660-1670 | Sandy siltstone, reddish brown, and sandstone aa, NS. |
| 1670-1680 | Sample aa, with sandy siltstone predominant, NS. |
| 1680-1690 | Sample aa, with sandstone increasing to 30%, NS. |

Superior Oil Company, 44-15 Petersen
C SE SE Section 15, T 7 S, R 1 E
Fall River County, South Dakota
Page 4

| | |
|---|---|
| 1690-1700 | Sample aa, with sandstone increasing to 30%, with minor anhydrite, NS. |
| 1700-1710 | Sample aa, with sandstone increasing to 30%, with minor anhydrite, NS. |
| 1710-1720 | Sample aa, with sandstone increasing to 30%, with minor anhydrite, NS. |
| 1720-1730 | 60% Anhydrite, white, crystalline with silty shale, reddish brown and minor sandstone, NS. |
| 1730-1740 | Sample aa, NS. |
| 1740-1750 | Dolomite, white to pink, dense, with anhydrite aa, NS. |
| 1750-1760 | Dolomite, white to pink to gray, dense, with anhydrite aa, NS. |
| 1760-1770 | Sandy siltstone, reddish brown, calc, with minor anhydrite, NS. |
| 1770-1780 | Sandy siltstone, reddish brown, calc, with minor anhydrite, NS. |
| 1780-1790 | Sandy siltstone, reddish brown, calc, with minor sandstone, white to pink, fine grained, angular, well sorted, poor porosity anhydrite cement, NS. |
| 1790-1800 | Sandy siltstone and sandstone aa, with anhydrite, NS. |
| 1800-1810 | Shale, reddish brown with siltstone and anhydrite aa, NS. |
| 1810-1820 | Limestone, mottled gray, dense, with lithology aa, NS. |
| 1820-1830 | Limestone, mottled gray, dense, with lithology aa, NS. |
| 1830-1840 | Shaly siltstone, reddish brown, slightly calc, with limestone and anhydrite aa, NS. |
| 1840-1850 | Sample aa, NS. |
| 1850-1860 | Sample aa, with minor white sandstone, fine grained, poor porosity, NS. |
| 1860-1870 | Limestone aa, with shaly siltstone and anhydrite aa, NS. |
| 1870-1880 | Limestone aa, with shaly siltstone and anhydrite aa, NS. |
| 1880-1890 | Limestone aa, with shaly siltstone and anhydrite aa, NS. |
| 1890-1900 | Shaly siltstone increasing in proportion to limestone and anhydrite with minor sandstone, white very fine grained, angular, no porosity, grains are anhydrite encased, NS. |
| 1900-1910 | Sample aa, NS. |
| 1910-1920 | Shaly siltstone to silty shale, reddish brown, soft calc, and anhydrite, white, granular with minor limestone, pink, dense, NS. |
| 1920-1930 | 60% Shaly siltstone aa, 30% anhydrite aa, 10% limestone aa, NS. |

**Superior Oil Company, 44-15 Petersen**
**C SE SE Section 15, T 7 S, R 1 E**
**Fall River County, South Dakota**
**Page 5**

| | |
|---|---|
| 1930-1940 | Sample aa, NS. |
| 1940-1950 | Silty shale, reddish brown, slightly calc, soft with minor anhydrite, NS. |
| 1950-1960 | Silty shale, reddish brown, slightly calc, soft with minor anhydrite and sandstone, white, very fine grained, non-calc, tight, NS. |
| 1960-1970 | Silty shale and minor anhydrite aa, no sandstone, NS. |
| 1974 | Lost circulation - No sample 1970-1980. |
| 1980-1990 | 75% cave, 25% sample aa, NS. |
| 1990-2000 | 75% cave, 25% sample aa, NS. |
| 2000-2010 | 75% cave, 25% sample aa, NS. |
| 2010-2020 | 30% cave and silty shale, reddish brown, non-calc, soft with minor anhydrite and limestone, NS. |
| 2020-2030 | Sample aa, with sandstone, pink, fine to very fine grained, sub-angular, fair sorting dolomite cement, poor porosity, NS. |
| 2030-2040 | Sandstone aa, NS. |
| 2040-2050 | Sandstone aa, except very fine to medium grained sub-rounded poor sorting, poor porosity, NS. |
| 2050-2060 | Sandstone aa. |
| 2060-2070 | Anhydrite, white, with minor dolomite, pink and gray, dense and sandstone aa, with one chip shaly siltstone, red, slightly calc, hard, NS. |
| 2070-2080 | Sample aa, with 10% siltstone aa, NS. |
| 2080-2090 | Sample aa, with 10% siltstone aa, NS. |
| 2090-2100 | Anhydrite and limestone aa, NS. |
| 2100-2110 | Anhydrite and limestone aa, with sandstone white to lavender, very fine to fine grained, poor sorting, slightly calc to non-calc, NS. |
| 2110-2120 | Dolomite, tan to grey, dense; anhydrite, white, crystalline, shale, red, soft; sandstone white to levender, very fine to fine grained, poor sorting, slightly calc to non-calc, tight, NS. |
| 2120-2130 | Sample aa, with sandstone white, very fine to fine grained, fair sorting, rounded, slight effervescence, fair porosity, NS. |
| 2130-2140 | Dolomite and shale aa, with white sandstone aa, NS. |
| 2140-2150 | Increasing white sandstone with shale aa, NS. |
| 2150-2160 | Shale aa, with dolomite aa and decreasing sandstone aa, with minor black shale, soft, slightly calc, NS. |
| 2160-2170 | Sample aa, with increasing black shale and limestone, NS. |
| 2170-2175 | Sample aa, NS. |
| 2175-2221 | Core #1, see detailed description. |
| 2221-2264 | Core #2, see detailed description. |
| | Total Depth 2264'. |

The Superior Oil Company, #44-15 Peterson
C SE SE Section 15, T 7 S, R 1 E
Fall River County, South Dakota

CORE #1 2175-2221 Cored 46 feet, Recovered 44 feet.

| | |
|---|---|
| 2175-76 | Dolomite, black, finely crystalline, tight, NS. |
| 2176-77 | Anhydrite and dolomite, mottled light and dark gray, coarsely crystalline, tight, NS. |
| 2177-78 | Anhydrite, light to dark gray, tight, NS. |
| 2178-79 | Anhydrite, aa, with reddish-brown dolomite mottling, tight, NS. |
| 2179-80 | Dolomite, light gray, finely crystalline with minor clear anhydrite crystals and black shale mottling, NS. |
| 2180-81 | Dolomite, light gray, dense, mottled with clear anhydrite and red spots, NS. Some of the anhydrite has the curved shape of shell fragments. |
| 2181-82 | Sample aa, NS. |
| 2182-83 | Sandstone, gray, very fine-grained, subrounded, dolomitic and anhydritic cement, hard and tight, NS. |
| 2183-84 | Sample aa, NS. |
| 2184-85 | Anhydrite, mottled white and gray, tight, NS. |
| 2185-86 | Shale, dark gray, anhydritic, NS. |
| 2186-87 | Anhydrite, gray, very finely crystalline, dolomitic and very silty, NS. |
| 2187-88 | Anhydrite, light gray, sandy, very fine grained, NS. |
| 2188-89 | Sandstone, light gray, very fine to medium-grained, poorly sorted, dolomitic and anhydritic, tight, NS. |
| 2189-90 | Sandstone, light gray, very fine to medium-grained, poorly sorted, dolomitic and anhydritic, tight, NS. |
| 2190-91 | Sandstone, light gray, very fine to medium-grained, poorly sorted, dolomitic and anhydritic, tight, NS. |
| 2191-92 | Sandstone, light gray, very fine to medium-grained, poorly sorted, dolomitic and anhydritic, tight, NS. |
| 2192-93 | Sandstone, light gray, very fine to fine-grained, anhydritic cement, tight, NS. |
| 2193-94 | Anhydritic, gray with white dolomite mottling, tight, NS. |
| 2194-95 | Anhydrite, gray and white mottled, NS. |
| 2195-96 | Anhydrite, gray and white mottled, NS. |
| 2196-97 | Anhydrite, gray and white mottled, NS. |

**Superior, #44-15 Peterson**
**Core #1**
**Page 2**

| | |
|---|---|
| 2197-98 | Anhydrite, gray and white mottled, NS. |
| 2198-99 | Anhydrite, gray and white mottled, NS. |
| 2199-2200 | Anhydrite, gray and white mottled, NS. |
| 2200-01 | Anhydrite, gray and white mottled, NS. |
| 2201-02 | Anhydrite, gray and white mottled, NS. |
| 2202-03 | Anhydrite, aa, mottled with reddish-brown dolomite, tight, NS. |
| 2203-04 | Sample aa, NS. |
| 2204-05 | Sample aa, NS. |
| 2205-06 | Anhydrite, mottled light and dark gray, NS. |
| 2206-07 | Anhydrite, mottled light and dark gray, NS. |
| 2207-08 | Anhydrite, mottled light and dark gray, with minor dolomite, NS. |
| 2208-09 | Anhydrite, mottled light and dark gray and black, with minor dolomite, NS. |
| 2209-10 | Anhydrite, aa, with ¼-inch tan dolomite layers, no dip, tight, NS. |
| 2210-11 | Dolomite, gray, finely crystalline, with veinlets of black anhydrite, tight, NS. |
| 2211-12 | Thin laminae of black anhydrite and light gray sandy dolomite, tight, NS. |
| 2212-13 | Sandstone, black, very fine-grained, with anhydrite cement, tight, NS. |
| 2213-14 | Anhydrite, mottled light and dark gray with tan dolomite mottling, NS. |
| 2214-15 | Dolomite, tan to light gray, mottled with dark gray anhydrite, tight, NS. |
| 2215-16 | Black shale, anhydritic with gray anhydrite laminae, NS. |
| 2216-17 | Black shale, anhydritic, NS. |
| 2217-18 | Dolomite, light gray, very finely crystalline, very sandy, very fine to fine-grained, NS. |
| 2218-19 | Sandstone, light gray, very fine to medium-grained, subrounded, fair sorting, dolomite cement, tight, NS. |

The Superior Oil Company, #44-15 Peterson
C SE SE Section 15, T 7 S, R 1 E
Fall River County, South Dakota

**CORE #2 2221-2264 Cored 43 feet, Recovered 43 feet.**

| | |
|---|---|
| 2221-22 | Sandstone, gray, very fine to medium-grained, subrounded, fair sorting, dolomitic and anhydritic cement, tight, NS. |
| 2222-23 | Sandstone, dark gray, very fine to fine-grained, good sorting, anhydritic cement, tight, NS. |
| 2223-24 | Anhydrite, mottled gray, NS. |
| 2224-25 | Anhydrite, mottled gray, NS. |
| 2225-26 | Anhydrite, mottled gray, NS. |
| 2226-27 | Anhydrite, mottled gray, NS. |
| 2227-28 | Anhydrite, mottled gray, NS. |
| 2228-29 | Anhydrite, mottled gray, NS. |
| 2229-30 | Anhydrite, mottled gray, NS. |
| 2230-31 | Anhydrite, mottled gray, NS. |
| 2231-32 | Anhydrite, mottled gray, NS. |
| 2232-33 | Anhydrite, mottled gray, NS. |
| 2233-34 | Dolomite, gray, dense with spots of anhydrite; yellow fluorescence in hairline fractures; very slight and very slow cut with acetone. Strong sulfur odor. |
| 2234-35 | Dolomite, aa, tight, NS. Sulfur odor. |
| 2235-36 | Dolomite, aa, tight with increasing amount of anhydrite, NS. |
| 2236-37 | Anhydrite, gray, dense, NS. |
| 2237-38 | Dolomite and anhydrite, gray, very finely crystalline, very sandy, fine to very fine grains, slight porosity, NS. |
| 2238-39 | Sandstone, fine to medium-grained, rounded to subrounded, fair sorting, dolomitic and anhydritic cement. Trace of porosity. NS. |
| 2239-40 | Anhydrite, gray, very sandy, tight, NS. |
| 2240-41 | Anhydrite, gray, very sandy, tight, NS. |
| 2241-42 | Anhydrite, gray, very sandy, tight, NS. |
| 2242-43 | Anhydrite, gray, very sandy, tight, NS. |
| 2243-44 | Sandstone, gray, very fine to fine-grained, subrounded, fair sorting, dolomitic and anhydritic cement, tight, NS. |

**Superior, #44-15 Peterson**
**Core #2**
**Page 2**

| | |
|---|---|
| 2244-45 | Sandstone, aa, tight, NS. |
| 2245-46 | Sandstone, gray, fine to medium-grained, anhydritic cement, tight, NS. |
| 2246-47 | Anhydrite, black, silty, tight, NS. |
| 2247-48 | Anhydrite, black, silty, tight, NS. |
| 2248-49 | Anhydrite, gray, dolomitic, tight, NS. |
| 2249-50 | Sandstone, gray, very fine to fine-grained, subrounded, anhydritic cement, tight, NS. |
| 2250-51 | Sandstone, gray, very fine to fine-grained, subrounded, anhydritic cement, tight, NS. |
| 2251-52 | Sandstone, gray, very fine to fine-grained, subrounded, anhydritic cement, tight, NS. |
| 2252-53 | Sandstone, gray, very fine to fine-grained, subrounded, anhydritic cement, tight, NS. |
| 2253-54 | Sandstone, gray, very fine to fine-grained, subrounded, anhydritic cement, slight porosity, NS. |
| 2254-55 | Anhydrite, mottled gray, dense, with streaks of tan dolomite and very fine-grained pyrite, tight, NS. |
| 2255-56 | Anhydrite, mottled gray, dense with streaks of tan dolomite, tight, NS. |
| 2256-57 | Sample aa, NS. |
| 2257-58 | Sample aa, NS. |
| 2258-59 | Sample aa, NS. |
| 2259-60 | Dolomite, light gray, dense, tight, NS. |
| 2260-61 | Dolomite, light gray, dense, tight with small spots of anhydrite, NS. |
| 2261-62 | Sample aa, NS. |
| 2262-63 | Sample aa, with minor spots of very finely crystalline pyrite, NS. |
| 2263-64 | Sample aa, NS. |

Hydro ID 4

37 of 63

FILE ..................

# SOUTH DAKOTA STATE GEOLOGICAL SURVEY

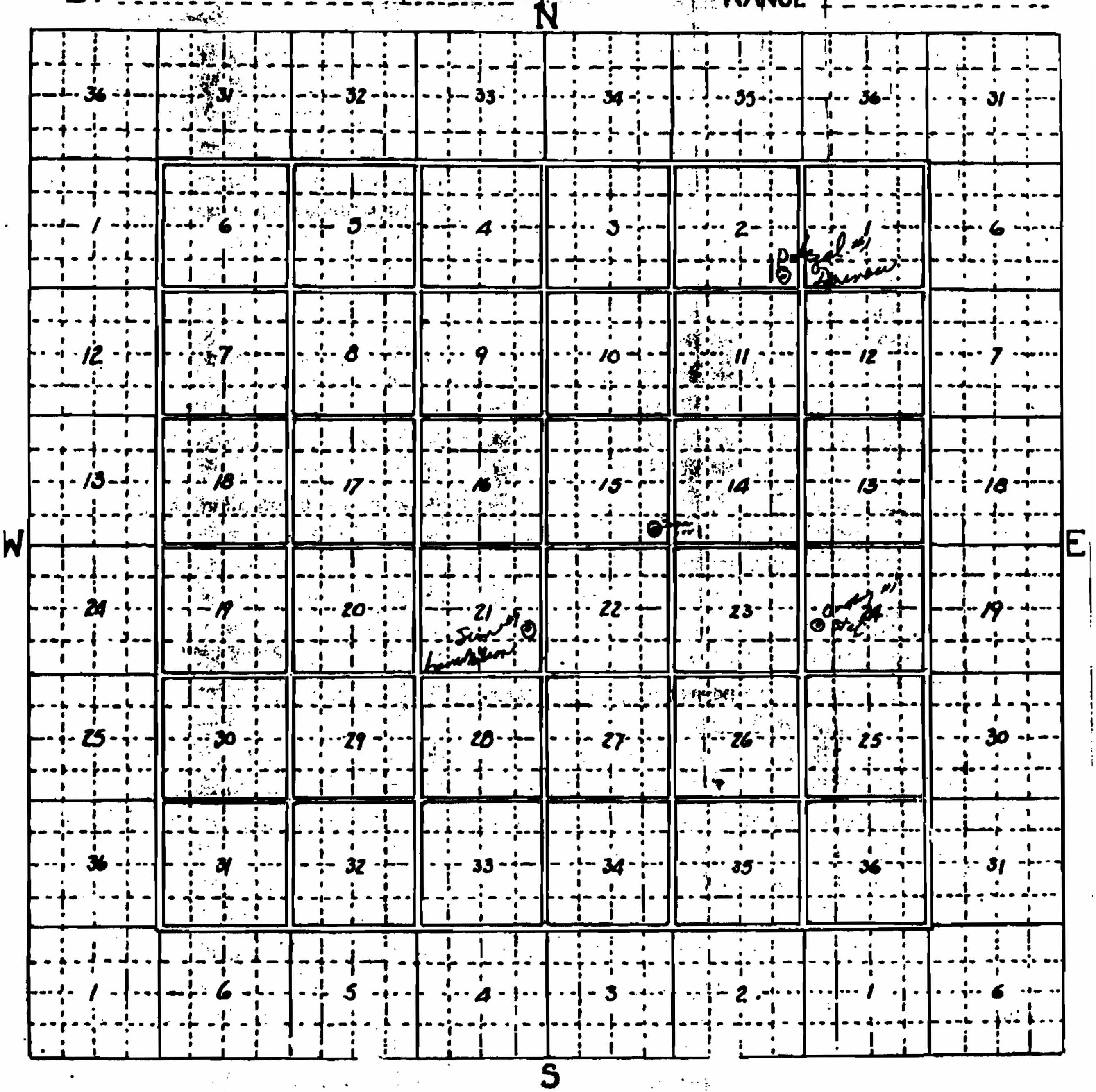
COUNTY ..................

DATE ..................

BY ..................

TOWNSHIP 7S

RANGE 1E



# ADMINISTRATIVE / SUNDRY REPORTS

MAR 25 1965

STATE PUB. CO., PIERRE

S. Dak. Oil & Gas Board
FORM 7

# PLUGGING RECORD

| | |
|---|---|
| **Operator**<br>The Superior Oil Company | **Address**<br>P. O. Box 200, Casper, Wyoming |

| | | |
|---|---|---|
| **Name of Lease**<br>Peterson | **Well No.**<br>1 (44-15) | **Field & Reservoir**<br>Wildcat |

| | | |
|---|---|---|
| **Location of Well**<br>660' FSL & 660' FEL C SE SE 15-7S-1E | **Sec-Twp-Rge or Block & Survey** | **County**<br>Fall River |

| | | | | |
|---|---|---|---|---|
| **Application to drill this well was filed in name of**<br>The Superior Oil Co. | **Has this well ever produced oil or gas**<br>No | **Character of well at completion (initial production):**<br>Oil (bbls/day) | Gas (MCF/day) | Dry?<br>Yes |
| **Date plugged:**<br>March 5, 1965 | **Total depth**<br>2264' | **Amount well producing when plugged:**<br>Oil (bbls/day) | Gas (MCF/day) | Water (bbls/day) |

| Name of each formation containing oil or gas. Indicate which formation open to well-bore at time of plugging | Fluid content of each formation | Depth interval of each formation | Size, kind & depth of plugs used. Indicate zones squeeze cemented, giving amount cement |
|---|---|---|---|
| | | | |

CASING RECORD

| Size pipe | Put in well (ft.) | Pulled out (ft.) | Left in well (ft.) | Give depth and method of parting casing (shot, ripped etc.) | Packers and shoes |
|---|---|---|---|---|---|
| 8-5/8" | 971 | None | 971 | | Guide shoe @ 971, float collar @ 937 & basket @ 688'. |

| | |
|---|---|
| Was well filled with mud-laden fluid, according to regulations?<br>Yes | Indicate deepest formation containing fresh water<br>Bsl. Sundance Sd. |

In addition to other information required on this form, if this well was plugged back for use as a fresh water well, give all pertinent details of plugging operations to base of fresh water sand, perforated interval to fresh water sand, name and address of surface owner, and attach letter from surface owner authorizing completion of this well as a water well and agreeing to assume full liability for any subsequent plugging which might be required.

Mr. Earl J. Cox of the State Geological Survey supervised the plugging operations.
This well was plugged & abandoned in the following manner:
Plug #1 - Equalized through open end DP 25 sx reg. cmt. from 1970' to 1920'
Plug #2 - Equalized through open end DP 35 sx reg. cmt. from 1715' to 1645'
Plug #3 - Equalized through open end DP 30 sx reg. cmt. w/2% $CaCl_2$ from 1020' to 950'
Removed csg. head & capped well as requested by land owner in attached letter.
The pits have been fenced and the location will be cleaned & leveled when the pits dry up.

USE REVERSE SIDE FOR ADDITIONAL DETAIL

Executed this the 18th day of March, 19 65

State of Wyoming

County of Natrona

J. P. Dujka, Signature of Affiant

Before me, the undersigned authority, on this day personally appeared J. P. Dujka known to me to be the person whose name is subscribed to the above instrument, who being by me duly sworn on oath states, that he is duly authorized to make the above report and that he has knowledge of the facts stated therein, and that said report is true and correct.

Subscribed and sworn to before me this 18th day of March, 19 65

SEAL

My commission expires [illegible] 18, 1967

Notary Public in and for [illegible]

County, [illegible]

DO NOT WRITE BELOW THIS LINE

Approved 11-21-66
Date

OIL AND GAS BOARD OF THE STATE OF SOUTH DAKOTA

, Secretary

Approved for release of bond

Date Oct 10, 1966

Duncan J McGregor
State Geologist

Dist: State Board (2)
State Geologist (1)

Note: File 2 copies of this form with Secretary, Oil & Gas Board, Pierre.

S. Dak. Oil & Gas Board
FORM 4

# WELL COMPLETION OR RECOMPLETION REPORT AND LOG

FARM OR LEASE NAME: Peterson

WELL NO.: 1 (44-15)

FIELD AND POOL, OR WILDCAT: Wildcat

NO. ACRES IN LEASE: 2846.03

¼ ¼ SEC. TWP. RGE.: C SE SE 15-7S-1E

COUNTY: Fall River

TYPE OF COMPLETION

☐ Oil Well ☐ Gas Well ☒ Dry Hole

☐ New Well ☐ Work-Over ☐ Deepen ☐ Plug Back ☐ Same Zone ☐ Diff Zone

OPERATOR: The Superior Oil Company

ADDRESS: P. O. Box 200, Casper, Wyoming

LOCATION (In feet from nearest lines of section or legal subdivision where possible)*

Surface: 660' FSL & 660' FEL Sec. 15.

Top prod. interval:

At total depth: 660' FSL & 660' FEL Sec. 15

| PERMIT NO. | DATE ISSUED | PREVIOUS PERMIT NO | DATE ISSUED |
|---|---|---|---|
| [illegible] | 2-18-65 | | |

| DATE SPUDDED | DATE T. D. REACHED | DATE COMPL. (Ready to Prod.) | ELEVATIONS (DF, RKB, RT, GR, etc.)* | ELEV. CASINGHEAD FLGE |
|---|---|---|---|---|
| 2-20-65 | 3-3-65 | P & A 3-5-65 | 3585' KB | |

| TOTAL DEPTH (MD & TVD) | PLUG. BACK T. D. (MD & TVD) | IF MULTIPLE COMPL., HOW MANY* | INTERVALS DRILLED BY → | ROTARY TOOLS | CABLE TOOLS |
|---|---|---|---|---|---|
| 2264' MD | | | | 0' to 2264' | |

PRODUCING INTERVAL(S), THIS COMPLETION, TOP, BOTTOM, NAME (MD & TVD)*

DATE DIRECTIONAL SURVEY SUBMITTED

TYPE ELECTRIC AND OTHER LOGS RUN (Circle those filed): IES, Microlog, Dual Induction - LL & GRS (All filed)

WAS WELL CORED: Yes

CASING RECORD (Report all strings set in well)

| CASING SIZE | DEPTH SET (MD) | HOLE SIZE | WEIGHT LBS./FT. | PURPOSE | SACKS CEMENT | AMOUNT PULLED |
|---|---|---|---|---|---|---|
| 8-5/8" | 971 | 12-1/4" | 24# | Surface | 625 | None |
| | | | | | | |
| | | | | | | |

LINER RECORD

| SIZE | TOP (MD) | BOTTOM (MD) | SACKS CEMENT* | SCREEN (MD) |
|---|---|---|---|---|
| | | | | |

TUBING RECORD

| SIZE | DEPTH SET (MD) | PACKER SET (MD) |
|---|---|---|
| | | |

PERFORATION RECORD

| DEPTH INTERVAL (MD) | HOLES PER FT. | SIZE AND TYPE | PURPOSE |
|---|---|---|---|
| | | | |
| | | | |

ACID, SHOT, FRAC., CEMENT SQUEEZE, Etc.

| AMOUNT AND KIND OF MATERIAL USED | DEPTH INTERVAL (MD) |
|---|---|
| | |
| | |

PRODUCTION

| DATE FIRST PRODUCTION | PRODUCING METHOD (Flowing, gas lift, pumping—size & type of pump) | WELL STATUS (Prod. or shut in) |
|---|---|---|
| | | |

| DATE OF TEST | HOURS TESTED | CHOKE SIZE | PRODUCTION FOR TEST → | OIL, Bbls. | GAS, Mcf. | WATER, Bbls. & % | OIL GRAVITY-API (Corr.) |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

| FLOW TUBING PRESSURE | CASING PRESSURE | CALCULATED 24-HOUR RATE → | OIL, Bbls. | GAS, Mcf. | WATER, Bbls. & % | GAS-OIL RATIO |
|---|---|---|---|---|---|---|
| | | | | | | |

DISPOSITION OF GAS (Sold, used for fuel, vented, etc.)

TEST WITNESSED BY

LIST OF ATTACHMENTS

1 copy all E-Logs, 1copy Core Analysis, 1copy ltr. from land owner

I hereby certify that the foregoing and attached information is complete and correct as determined from all available records

SIGNED J. P. Dujka TITLE District Engineer DATE 3-15-65

DO NOT WRITE BELOW THIS LINE
*See Instructions On Reverse Side

Approved
Date

OIL AND GAS BOARD OF THE STATE OF SOUTH DAKOTA
Secretary

Dist: State Board (3) w/1 copy all attachments.
State Geologist (1) w/2 copies all attachments.

## INSTRUCTIONS

General: This form is designed for submitting a complete and correct well completion report and log on all types of lands and leases to either a Federal agency or a State agency, or both, pursuant to applicable Federal and/or State laws and regulations. Supplemental instructions by local Federal and/or State offices will govern the use of this form.

If not filed prior to the time this summary record is submitted, copies of all currently available logs (drillers, geologists, sample and core analysis, all types electric, etc.), formation and pressure tests, and directional surveys, should be attached hereto, to the extent required by applicable Federal and/or State laws and regulations. All attachments should be listed on this form, see last blank.

If this well was directionally drilled, show both the location at the surface and at total depth from nearest lines, where possible; also show the locations at the top and at the bottom of any zone for which production data are reported in space 33, and any zone open for injection or disposal. Use this reverse side if more space is needed. (MD-Measured Depth, TVD-True Vertical Depth)

*Indicate which elevation is used as reference (where not otherwise shown) for depth measurements given in other spaces on this form and in any attachments.

If this well is completed for separate production from more than one zone (multiple-zone completion), so state in the correct space and show the producing interval, or intervals, top(s), bottom(s) and name(s) (if any) for only the zone reported in the blanks under PRODUCTION. Submit a separate completion report on this form for each interval (zone) to be separately produced.

"Sacks Cement": Attached supplemental records for this well should show the details of any multiple stage cementing and the location of the cementing tool.

File 3 copies of this form with Secretary, Oil and Gas Board, Pierre.

SUMMARY OF WATER ZONES AND NON-COMMERCIAL OIL OR GAS ZONES

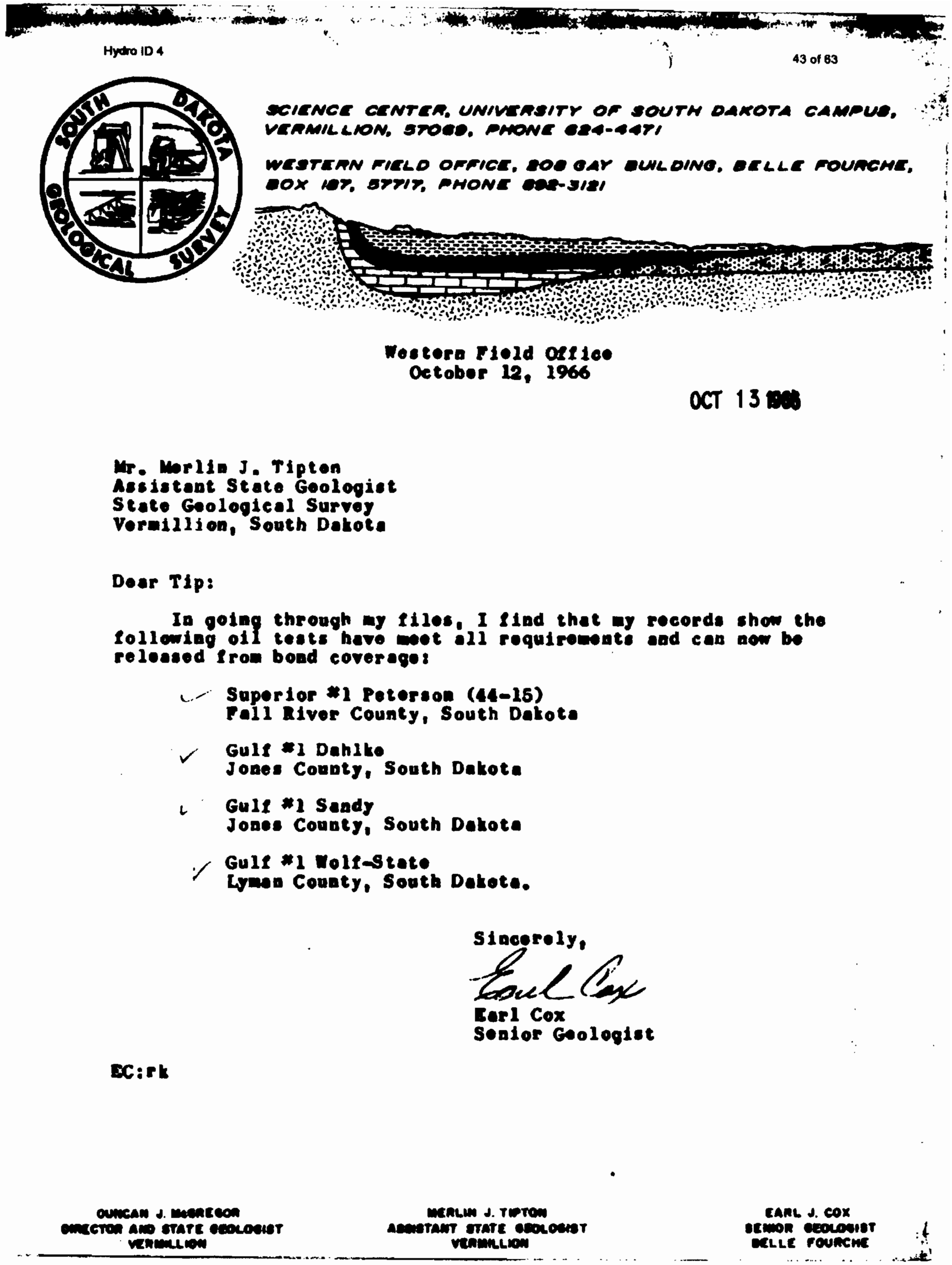
(Note: If well was directionally drilled, show both measured and true vertical depths for zones and markers listed)

| KIND OF FORMATION | DEPTH TO TOP | | DEPTH TO BOTTOM | | CONTENTS; PRODUCTIVE RATE, IF KNOWN |
|---|---|---|---|---|---|
| | MEAS. DEPTH | TRUE VERT. DEPTH | MEAS. DEPTH | TRUE VERT. DEPTH | |
| Lakota Sd. | 371 | | 425 | | 30 bbls. wtr./hr. |
| Sundance Sd. | 771 | | 905 | | 25 bbls. wtr./hr. |
| Bsl. Sundance Sd. | 966 | | 1007 | | 15 bbls. wtr./hr. |

GEOLOGIC MARKERS

| NAME | DEPTH TO TOP | |
|---|---|---|
| | MEAS. DEPTH | TRUE VERT. DEPTH |
| Dakota | 185' | |
| Lakota | 371' | |
| Morrison | 471' | |
| Sundance | 670' | |
| Sundance Sd. | 771' | |
| Minnekahta | 1518' | |
| Opeche | 1557' | |
| Minnelusa | 1845' | |
| Red Marker | 2108' | |

# CORRESPONDENCE



SOUTH DAKOTA GEOLOGICAL SURVEY

SCIENCE CENTER, UNIVERSITY OF SOUTH DAKOTA CAMPUS,
VERMILLION, 57069, PHONE 624-4471

WESTERN FIELD OFFICE, 208 GAY BUILDING, BELLE FOURCHE,
BOX 187, 57717, PHONE 892-3121

Western Field Office
October 12, 1966

OCT 13 1966

Mr. Merlin J. Tipton
Assistant State Geologist
State Geological Survey
Vermillion, South Dakota

Dear Tip:

In going through my files, I find that my records show the following oil tests have meet all requirements and can now be released from bond coverage:

Superior #1 Peterson (44-15)
Fall River County, South Dakota

Gulf #1 Dahlke
Jones County, South Dakota

Gulf #1 Sandy
Jones County, South Dakota

Gulf #1 Wolf-State
Lyman County, South Dakota.

Sincerely,

Earl Cox

Earl Cox
Senior Geologist

EC:rk

DUNCAN J. McGREGOR
DIRECTOR AND STATE GEOLOGIST
VERMILLION

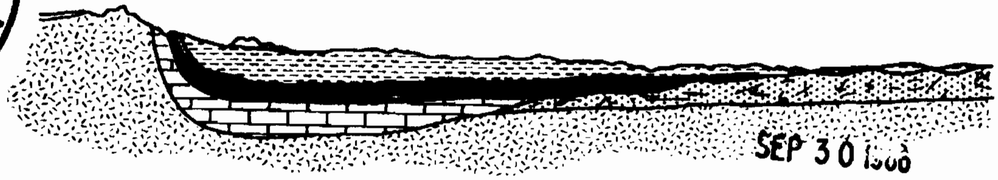
MERLIN J. TIPTON
ASSISTANT STATE GEOLOGIST
VERMILLION

EARL J. COX
SENIOR GEOLOGIST
BELLE FOURCHE

SOUTH DAKOTA GEOLOGICAL SURVEY

SCIENCE CENTER, UNIVERSITY OF SOUTH DAKOTA CAMPUS,
VERMILLION, 57069, PHONE 624-4471

WESTERN FIELD OFFICE, 208 GAY BUILDING, BELLE FOURCHE,
BOX 187, 57717, PHONE 892-3121



SEP 30 1966

Western Field Office
September 29, 1966

Dr. Duncan McGregor
State Geologist
State Geological Survey
Vermillion, South Dakota

Re: Superior #1 Peterson (44-15)
SESE-15-7S-1E
Fall River County, South Dakota
Permit No. 382

Dear Duncan:

I have received a copy of the RELEASE, signed by Francis Peterson, and the letter showing two copies of the RELEASE has been sent you by Superior Oil Company.

My records show all required samples, logs and records have been received by your office. The RELEASE, completes all requirements and it is recommended the bond covering this location be terminated.

Sincerely,

Earl Cox

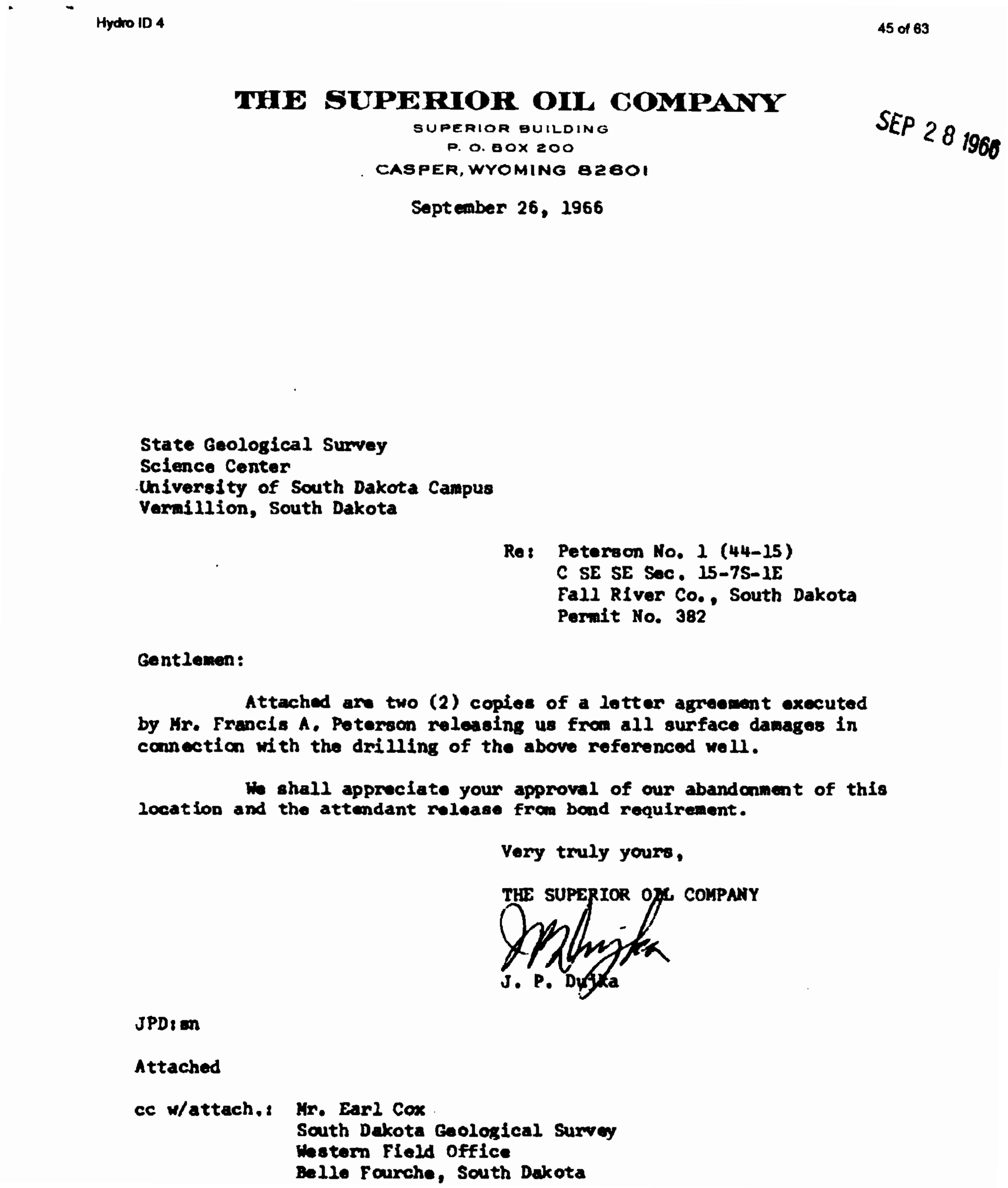
Earl Cox
Engineering-Petroleum Geologist

EC:rk

DUNCAN J. McGREGOR
DIRECTOR AND STATE GEOLOGIST
VERMILLION

MERLIN J. TIPTON
ASSISTANT STATE GEOLOGIST
VERMILLION

EARL J. COX
SENIOR GEOLOGIST
BELLE FOURCHE



Hydro ID 4

45 of 63

**THE SUPERIOR OIL COMPANY**
SUPERIOR BUILDING
P. O. BOX 200
CASPER, WYOMING 82601

SEP 28 1966

September 26, 1966

State Geological Survey
Science Center
University of South Dakota Campus
Vermillion, South Dakota

Re: Peterson No. 1 (44-15)
C SE SE Sec. 15-7S-1E
Fall River Co., South Dakota
Permit No. 382

Gentlemen:

Attached are two (2) copies of a letter agreement executed by Mr. Francis A. Peterson releasing us from all surface damages in connection with the drilling of the above referenced well.

We shall appreciate your approval of our abandonment of this location and the attendant release from bond requirement.

Very truly yours,

THE SUPERIOR OIL COMPANY

J. P. Dujka

JPD:sn

Attached

cc w/attach.: Mr. Earl Cox
South Dakota Geological Survey
Western Field Office
Belle Fourche, South Dakota

**THE SUPERIOR OIL COMPANY**
SUPERIOR BUILDING
P. O. BOX 200
CASPER, WYOMING 82601

September 20, 1966

RST ____
JCS ____
EJW ____
FILE ____

THE SUPERIOR OIL COMPANY
SEP 26 1966
ENGINEERING
CASPER

THE SUPERIOR OIL COMPANY
SEP 26 1966
LAND DEPARTMENT
CASPER, WYOMING

Mr. Francis A. Peterson
Edgemont, South Dakota

Re: Peterson #1 (44-15)
C SE SE 15-7S-1E
Fall River County, South Dakota
Permit #382

Dear Mr. Peterson:

Reference is made to Assignment and Agreement dated March 16, 1965 whereby we assigned to you the well in the SE SE 15-7S-1E and you assumed the responsibility for the well.

Regarding the reserve mud pit used in connection with said well, you have informed us that you wish to use it for a reservoir and will take it over, relieving us of any further clean up work or concern about surface damages of any kind arising out of the drilling of the well mentioned above.

If you agree with the foregoing, please sign in the space provided below and return one copy of this letter to us in the enclosed self-addressed envelope.

Very truly yours,

THE SUPERIOR OIL COMPANY

R. S. Troost
District Landman

RST/b
enc.

ACCEPTED AND AGREED TO
THIS 23 DAY OF Sept., 1966.

Francis A. Peterson
FRANCIS A. PETERSON

SEP 13 1966

SOUTH DAKOTA GEOLOGICAL SURVEY

SCIENCE CENTER, UNIVERSITY OF SOUTH DAKOTA CAMPUS,
VERMILLION, 57069, PHONE 624-4471

WESTERN FIELD OFFICE, 208 GAY BUILDING, BELLE FOURCHE,
BOX 187, 57717, PHONE 892-3121

Western Field Office
September 12, 1966

Mr. Robert Schoon
Geologist
State Geological Survey
Vermillion, South Dakota

Dear Bob:

Would you check the file on the Superior #1 Peterson, in Fall River County, and see if Superior has sent us a copy of the RELEASE, signed by the land owner.

Sincerely,

Earl Cox

Earl Cox
Engineering-Petroleum Geologist

EC:rk

PS. Also have you rec'd samples from the Texaco #1-X Martinson, Perkins County

E. Cox

205

DUNCAN J. McGREGOR
DIRECTOR AND STATE GEOLOGIST
VERMILLION

MERLIN J. TIPTON
ASSISTANT STATE GEOLOGIST
VERMILLION

EARL J. COX
SENIOR GEOLOGIST
BELLE FOURCHE

NOV 1 1965

Western Field Office
October 29, 1965

Mr. J. P. Dujka
Superior Oil Company
P. O. Box 200
Casper, Wyoming

Re: Superior #1 Peterson (44-15)
SESE-15-7S-1E
Fall River County, So. Dakota
Permit No. 382

Dear Mr. Dujka:

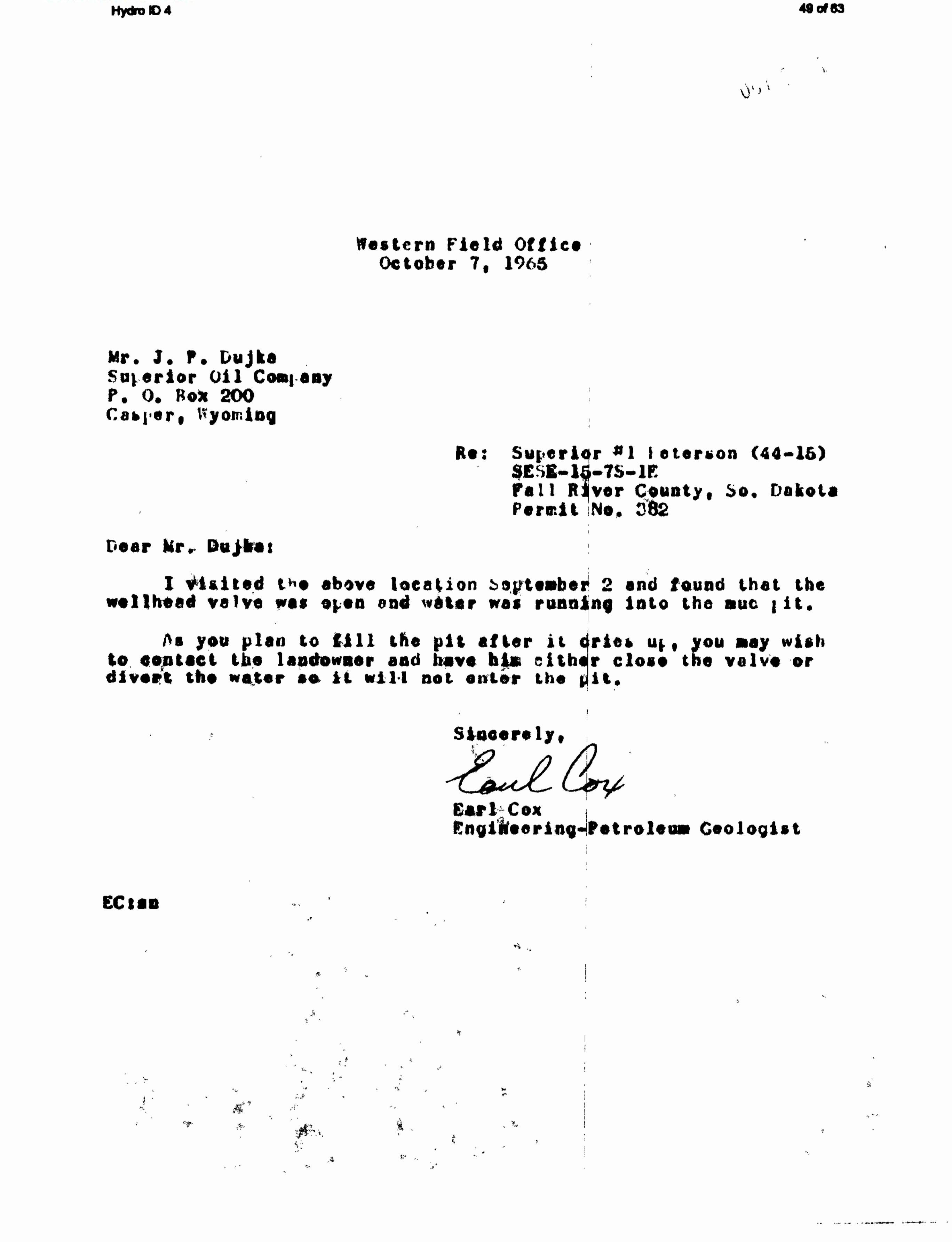
Thank you for your October 27 letter. A release from Mr. Peterson will meet all requirements covering cleaning up of the above location. If a copy of the release is sent to me, it will expedite bond termination.

Sincerely,

Earl Cox

Earl Cox
Engineering-Petroleum Geologist

EC:sm



Western Field Office
October 7, 1965

Mr. J. P. Dujka
Superior Oil Company
P. O. Box 200
Casper, Wyoming

Re: Superior #1 Peterson (44-15)
SESE-15-7S-1E
Fall River County, So. Dakota
Permit No. 382

Dear Mr. Dujka:

I visited the above location September 2 and found that the wellhead valve was open and water was running into the mud pit.

As you plan to fill the pit after it dries up, you may wish to contact the landowner and have him either close the valve or divert the water so it will not enter the pit.

Sincerely,

Earl Cox

Earl Cox
Engineering-Petroleum Geologist

EC:an

July 13, 1965

Mr. Earl Cox
State Geological Survey
P. O. Box 187
Belle Fourche, South Dakota 57717

Dear Earl:

I am enclosing the electric log and dual induction laterolog on the Superior Peterson #1 (44-15) well in Fall River County, and carbon copies of the scout reports that Bob Schoon turned in last week.

Sincerely yours,

Janet J. McDonough
Senior Stenographer

Enclosures

MAY 13 1965

SOUTH DAKOTA
**State Water Resources Commission**
STATE OFFICE BUILDING
PIERRE, SOUTH DAKOTA

May 12, 1965

Mr. Francis A. Peterson
Edgemont, South Dakota 57735

Re: Superior #1 Peterson (44-15)
SE¼ SE¼ 15-7S-1E
Fall River County, S.D.
Permit No. 38[illegible]

Dear Mr. Peterson:

In as much as the requirements for converting your oil test well to a water well have been done, as specified by the State Geological Survey, the Water Resources Commission hereby assumes jurisdiction of the well as a water well.

Sincerely,

J. W. GRIMES

JWG/BM/bw
cc: ✓Dr. Duncan McGregor, State Geologist, Vermillion, S.D.
Mr. Earl Cox, Belle Fourche, S.D.
Oil and Gas Board, Pierre, S.D.

MAY 11 1965

Western Field Office
Belle Fourche, South Dakota
May 10, 1965

Mr. Joe Grimes
Water Resources Commission
State Office Building
Pierre, South Dakota

Re: Superior #1 Peterson (44-15)
SE SE-15-7S-1E
Fall River County, South Dakota
Permit No. 382

Dear Mr. Grimes:

The above oil test is on land owned by Francis A. Peterson. He made arrangements to convert the test to a water well. The well has 971 feet of 8 5/8 inch surface casing, cemented with 575 sacks of cement. The base of the casing is just above the lowest Sundance sand. Immediately below the sand is a cement plug. Additional plugs were placed so as to isolate the Minnelusa sands in the hole. A three inch control valve is in place on the wellhead and when last visited, the well was flowing about 10 gpm of fresh water.

Enclosed is a letter from Mr. Peterson asking that conversion of the oil test to a water well be approved. Petersen agrees to assume full liability for any subsequent plugging that might be required.

If the Water Resources Commission will accept jurisdiction of this test as a water well, please so inform the Oil and Gas Board with a copy of your letter to the State Geologist.

Sincerely,

Earl Cox

Earl Cox
Engineering-Petroleum Geologist

EC:sm

cc: Secretary, Oil and Gas Board w/enc.
State Geologist w/enc.

P.S. to Duncan: Even though the Water Resources Commission accepts jurisdiction the pits have not been filled at this location and it is suggested that we not approve the bond release until they have been filled. Earl

Hydro ID 4

MAY 10 1965

53 of 63

**THE SUPERIOR OIL COMPANY**
SUPERIOR BUILDING
P. O. BOX 200
CASPER, WYOMING 82602

May 7, 1965

State Geological Survey
Science Center
University of South Dakota Campus
Vermillion, South Dakota

Re: Peterson #1 (44-15)
C SE SE 15-7S-1E
Fall River County
South Dakota
Permit #382

Gentlemen:

Attached are two copies each of the core and sample description on the above test.

Today we received a copy of the transmittal letter from American Stratigraphic Company showing they have sent you the samples for this well. As stated on the plugging record, the mud pits have been fenced and will be filled and leveled when they dry up.

If you need any further information or reports, please let us know.

Yours very truly,

THE SUPERIOR OIL COMPANY

J. P. Dujka

RLH/jr

cc: Mr. Earl Cox
South Dakota State Geological Survey
Western Field Office
Belle Fourche, South Dakota

MAY 7 1965

AMERICAN STRATIGRAPHIC COMPANY
17 NORTH 31ST ST. • BILLINGS, MONTANA • ALPINE 9-7647

May 4, 1965

State of South Dakota Geological Survey
Science Center
Vermillion, South Dakota

Attention: Dr. Duncan McGregor
State Geologist

Gentlemen:

We are shipping you today via motor freight samples on the following well:

✓ Superior, #1 Peterson
15-7S-1E
Fall River County, South Dakota.

Very truly yours,

AMERICAN STRATIGRAPHIC COMPANY

Fred McCotter

Fred McCotter be
Manager

FMc/be
cc: Mr. Jerry Davis, Superior Oil Company, Box 200, Casper, Wyoming.

SOUTH DAKOTA
STATE GEOLOGICAL SURVEY
SCIENCE CENTER
University of South Dakota Campus
VERMILLION 57069
Phone 624-4471

DUNCAN J. McGREGOR
Director and State Geologist
MERLIN J. TIPTON
Assistant State Geologist

Western Field Office
Belle Fourche, South Dakota

April 15, 1965

Mr. J. P. Dujka
Superior Oil Company
P.O. Box 200
Casper, Wyoming

Re: Superior #1 Petersen (44-15)
SE¼SE¼-15-7S-1E
Fall River County, So. Dakota
Permit No. 382

Dear Mr. Dujka:

In checking our files, at Vermillion, I find we still need two copies each of the core and sample description on the above test. These records should be sent in within thirty days of completion of the test.

Before the bond can be released, the rig must be removed from the location, the samples sent in and the mud pits either filled or a release obtained from Mr. Peterson.

This letter is merely to inform you of the status of our files and to outline our requirements. It is hoped Superior will see fit to do additional work in South Dakota and be assured of our future cooperation.

Sincerely,

Earl Cox

Earl Cox
Engineering-Petroleum Geologist

EC:sn

Edgemont, South Dakota
March 10, 1965

Mr. Joe Grimes
Water Resource Commission
Pierre, South Dakota

Re: Superior #1 Peterson(44-15)
SE¼SE¼-15-7S-1E
Fall River County, So. Dakota
Permit No. 382

Dear Mr. Grimes:

I wish to convert the above oil test, on my land, to a water well. The water to be used will come from the sand zone immediately below the surface casing. A cement plug is in place, immediately below the water zone. The lower portion of the hole has been plugged according to specifications of the State Geological Survey.

Should conversion of the oil test to a water well be approved, I agree to assume full liability for any subsequent plugging that might be required.

Sincerely,

Francis A. Peterson

Francis A. Peterson

MAR 10 1965

SOUTH DAKOTA
STATE GEOLOGICAL SURVEY
SCIENCE CENTER
University of South Dakota Campus
VERMILLION 57069
Phone 624-4471

DUNCAN J. McGREGOR
Director and State Geologist

MERLIN J. TIPTON
Assistant State Geologist

Western Field Office
Belle Fourche, South Dakota
March 9, 1965

Mr. Francis A. Peterson

Edgemont, South Dakota

Re: Superior #1 Peterson(44-15)
SE¼SE¼-15-7S-1E
Fall River County, So. Dakota
Permit No. 382

Dear Mr. Peterson:

Enclosed is a letter and three copies made out to Mr. Grimes, of the Water Resource Commission, stating you wish to convert the above oil test to a water well. Please sign the original and all copies, and return to me in the stamped, addressed envelope.

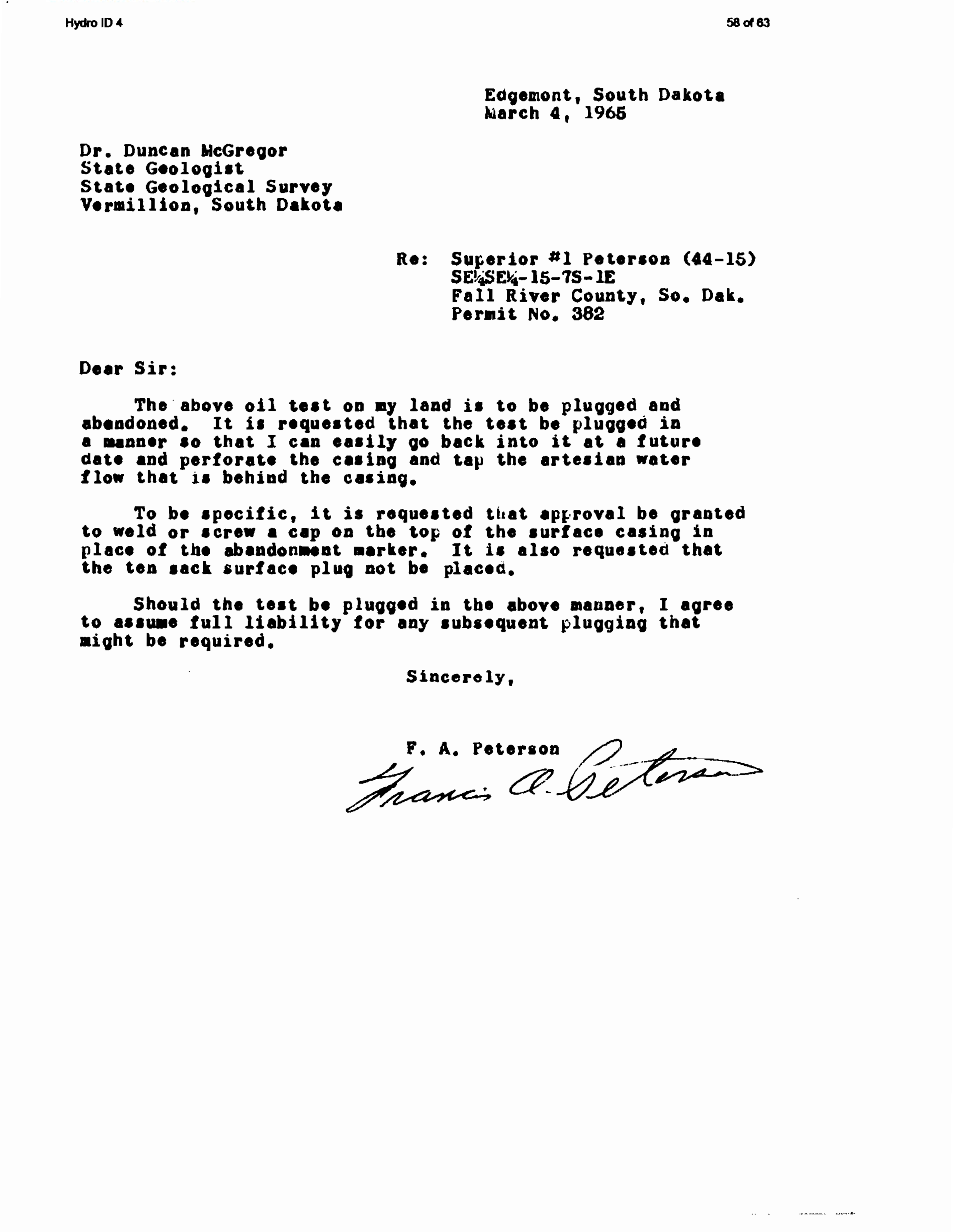
As soon as you get the valve in place, at the wellhead, please let me know so it can be inspected. An envelope is enclosed for your use.

Sincerely,

Earl Cox

Earl Cox
Engineering-Petroleum Geologist

EC:sn



Edgemont, South Dakota
March 4, 1965

Dr. Duncan McGregor
State Geologist
State Geological Survey
Vermillion, South Dakota

Re: Superior #1 Peterson (44-15)
SE¼SE¼-15-7S-1E
Fall River County, So. Dak.
Permit No. 382

Dear Sir:

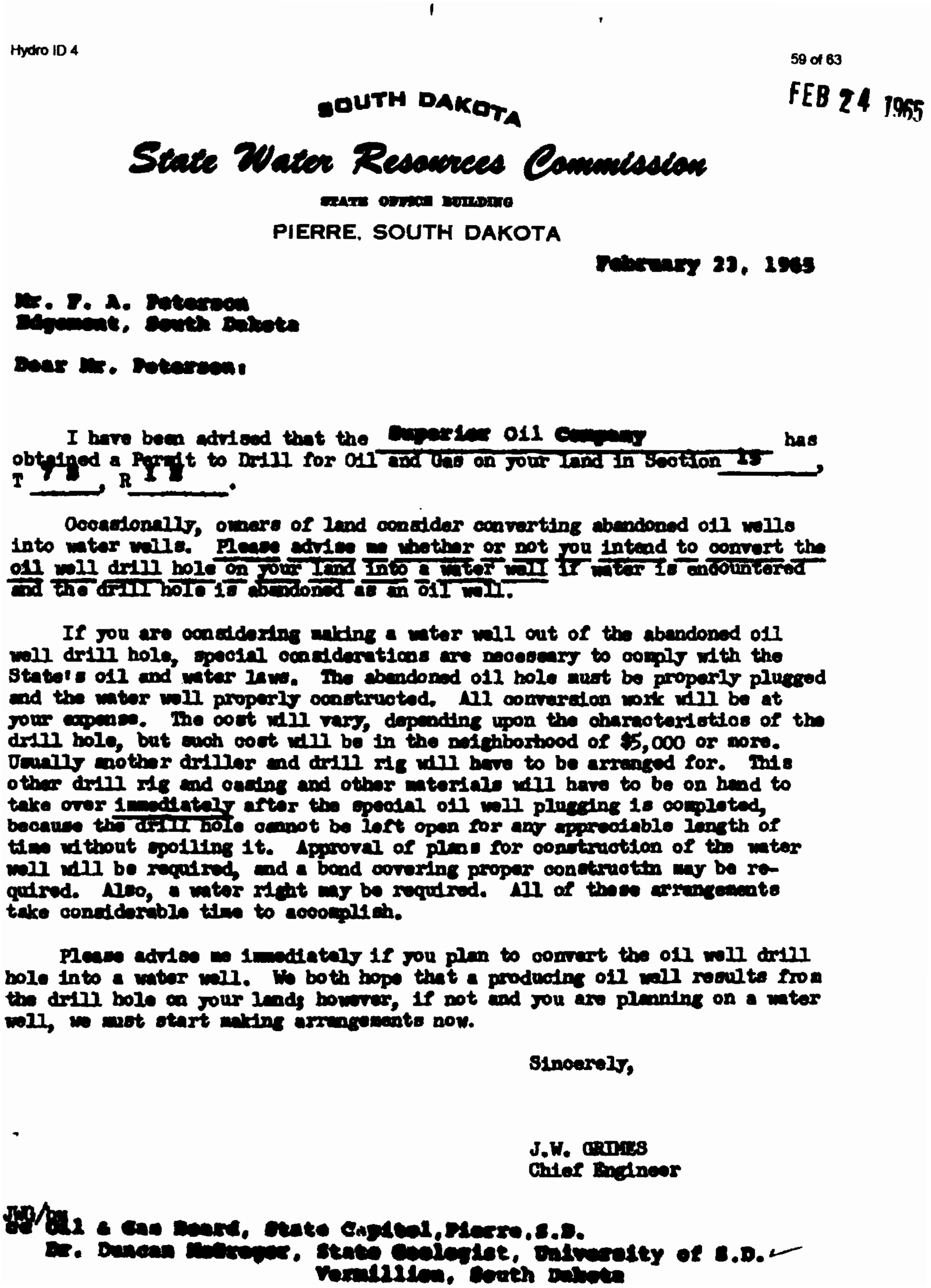
The above oil test on my land is to be plugged and abandoned. It is requested that the test be plugged in a manner so that I can easily go back into it at a future date and perforate the casing and tap the artesian water flow that is behind the casing.

To be specific, it is requested that approval be granted to weld or screw a cap on the top of the surface casing in place of the abandonment marker. It is also requested that the ten sack surface plug not be placed.

Should the test be plugged in the above manner, I agree to assume full liability for any subsequent plugging that might be required.

Sincerely,

F. A. Peterson
Francis A. Peterson



Hydro ID 4

59 of 63

FEB 24 1965

SOUTH DAKOTA
**State Water Resources Commission**
STATE OFFICE BUILDING
PIERRE, SOUTH DAKOTA

February 23, 1965

Mr. F. A. Peterson
Edgemont, South Dakota

Dear Mr. Peterson:

I have been advised that the Superior Oil Company has obtained a Permit to Drill for Oil and Gas on your land in Section 13, T 7 S, R 1 E.

Occasionally, owners of land consider converting abandoned oil wells into water wells. Please advise me whether or not you intend to convert the oil well drill hole on your land into a water well if water is encountered and the drill hole is abandoned as an oil well.

If you are considering making a water well out of the abandoned oil well drill hole, special considerations are necessary to comply with the State's oil and water laws. The abandoned oil hole must be properly plugged and the water well properly constructed. All conversion work will be at your expense. The cost will vary, depending upon the characteristics of the drill hole, but such cost will be in the neighborhood of $5,000 or more. Usually another driller and drill rig will have to be arranged for. This other drill rig and casing and other materials will have to be on hand to take over immediately after the special oil well plugging is completed, because the drill hole cannot be left open for any appreciable length of time without spoiling it. Approval of plans for construction of the water well will be required, and a bond covering proper constructin may be required. Also, a water right may be required. All of these arrangements take considerable time to accomplish.

Please advise me immediately if you plan to convert the oil well drill hole into a water well. We both hope that a producing oil well results from the drill hole on your land; however, if not and you are planning on a water well, we must start making arrangements now.

Sincerely,

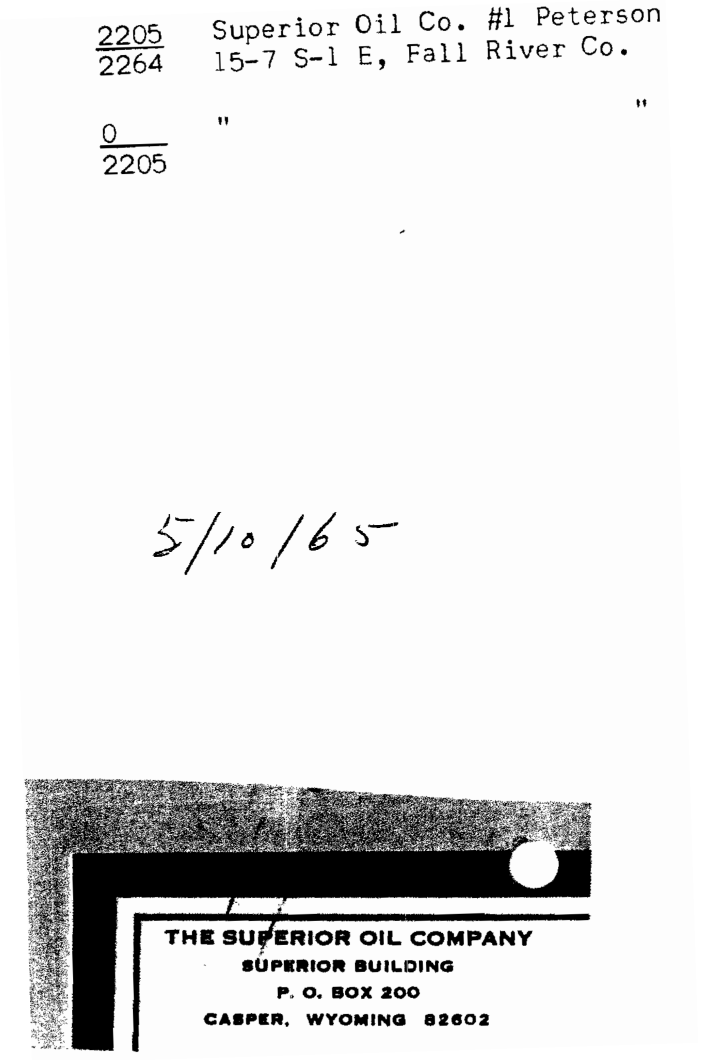
J.W. GRIMES
Chief Engineer

JWG/bm
cc Oil & Gas Board, State Capitol, Pierre, S.D.
Dr. Duncan McGregor, State Geologist, University of S.D.
Vermillion, South Dakota

# SURETY

# NO SURETY INFORMATION FOR THIS WELL AS OF 5/18/2011

# MISCELLANEOUS



2205/2264 Superior Oil Co. #1 Peterson
15-7 S-1 E, Fall River Co.

0/2205 " "

5/10/65

**THE SUPERIOR OIL COMPANY**
SUPERIOR BUILDING
P. O. BOX 200
CASPER, WYOMING 82602

South Dakota
Department of Environment
& Natural Resources
...Today

| | | |
|---|---|---|
| **Oil and Gas Search for:** *api_no_ like '40 047 20065'* | | |
| ***Page 1 of 1*** | Export Options<br>(temporarily unavailable) | **Page:** 1 |

***Record 1 of 1***

## Well Information

| | | | |
|---|---|---|---|
| **API No:** | 40 047 20065 | **County:** | FALL RIVER |
| **Well Name:** | PRC 21-14 PETERSON | **Location:** | NENW 14-7S-1E |
| **Permit No:** | 741 | **Total Depth:** | 2266 |
| **Operator Name:** | POWER RESOURCES CORPORATION | **Bottom Hole:** | Minnelusa |
| **Permit Date:** | 12-03-1975 | **KB Elevation:** | 3647 |
| **Spud Date:** | 12-11-1975 | **Ground Elevation:** | 3639 |
| **Plug Date:** | 12-26-1975 | **Latitude:** | 43.447765 |
| | | **Longitude:** | -103.968121 |
| **Well Field** | WILDCAT | **Status** | P&A |
| **Class:** | DRY HOLE | **Type:** | DRY HOLE |

## Formation Tops

| Formation | Depth (ft.) |
|---|---|
| **Morrison** | 322 |
| **Spearfish** | 890 |
| **Goose Egg** | 1178 |
| **Minnekahta** | 1425 |
| **Opeche** | 1465 |
| **Minnelusa** | 1569 |
| **Red Marker** | 1984 |
| **2nd Leo** | 2100 |

| | |
|---|---|
| ***Page 1 of 1*** (goto top) | **Page:** 1 |

| | |
|---|---|
| **COUNTY:** | **FALL RIVER** |
| **LEGAL LOCATION:** | **NENW 14-7N-1E** |
| **API NO:** | **40 047 20065** |
| **PERMIT NO:** | **741** |
| **WELL NAME:** | **PRC #21-14 PETERSON** |
| **OPERATOR:** | **POWER RESOURCES CORPORATION** |
| **PERMIT ISSUED:** | **12/03/1975** |
| **PERMIT CLOSED:** | **01/23/1976** |
| **FILE LOCATION:** | **7N-1E-14 NENW** |

**TARGET CODES:**

**WELL HISTORY / CHECKLIST**

**PERMIT TO DRILL / INTENT TO DRILL**

**WELL INSPECTION / SCOUT REPORTS**

**OPERATOR'S TECHNICAL REPORTS / MAPS**

**ADMINISTRATIVE / SUNDRY REPORTS**

**CORRESPONDENCE**

**SURETY**

**MISCELLANEOUS**

# WELL HISTORY / CHECKLIST

## BOND RELEASE CHECKLIST

**Well Name & Location**

PRC #21-14 Peterson
NENW 14-7S-1E, Fall River County

Permit # 741

API #40 047 20065

Bond # 4288541

Date Issued Dec. 3, 1975

Date released Aug. 25, 1976

**Surface Restoration**

✓ Pits filled

✓ Site level

✓✓ — Site policed

— Dry-hole marker solid, sealed, correctly inscribed

— No dry-hole marker desired, letter in WFO files from surface owner

✓✓ (Converted to water well, owner's responsibility) FK

**Paperwork Filed**

— Form 4 (Completion or Recompletion Report)

— Form 6 (Sundry Notices and Report on Wells)

✓ Form 7 (plugging Report)

**Geological Information Filed**

✓ Well Logs: IES, SNP, [✓ DIL], GR, NEUT, CALIP, Cement Bond, Temp, Micro, Laterlog, SM Dens. BCSL

— DST charts and reports

✓ Geologist's Report

— Results of coring and core analyses

✓ Set of 10-foot sample cuttings (check with Bob Schoon)

have been received at Vermillion 1-15-76

DATE 8-25-76 CHECKED BY

2

# PERMIT CHECKLIST

Well Name and Location:

PRC #21-14 Peterson
NENW 14-7S-1E, Fall River

Permit # 741
API #40 047 20065
Bond # 4288541

## Paperwork Filed with WFO

✓ Organization Report
✓ Application
✓ Bond
✓ Permit fee

## The Following Papers sent to Operator:

✓ Permit (Form 2a)
✓ Receipt for $100 permit fee
✓ Cover letter explaining material sent

## Permit Fee Filed:

✓ Permit fee w/Cash Receipts Transmittal Form sent to State Treasurer

## Notification of New Permit sent to:

✓ Dr. Duncan J. McGregor
✓ Mr. Vern W. Butler
✓ Dr. Allyn Lockner
✓ Mr. George Kane

DATE Dec. 3, 1975 CHECKED BY Jean Miller

# PERMIT TO DRILL / INTENT TO DRILL

3

State Pub. Co., Pierre

## APPLICATION FOR PERMIT TO:

S. Dak. Oil & Gas Board
FORM 2

☒ DRILL ☐ DEEPEN ☐ PLUG BACK

☐ SINGLE ZONE

☒ OIL WELL ☐ GAS WELL ☐ MULTIPLE ZONE

FARM OR LEASE NAME: M. Lenore Peterson

WELL NO: ~~12-14~~ # 21-14 [illegible]

FIELD AND POOL, OR WILDCAT: Wildcat

NO. ACRES IN LEASE: 971.32

¼ ¼ SEC. TWP. RGE.: NENW 14-7S-1E

COUNTY: Fall River

OPERATOR: Power Resources Corporation

ADDRESS: 1660 S. Albion St. Suite 827 Denver, Colorado 80222

LOCATION (In feet from an established corner of the legal subdivision.*):
660 ft. NORTH
1983 ft. West
Section 14-7S.-1E

NAME AND ADDRESS OF SURFACE OWNER:
M. Lenore Peterson
Star Route, Edgemont, So. Dakota 57735

ELEVATION: 3639 GR

PROPOSED DEPTH: 2500

NO. OF WELLS, ETC.: None

ROTARY OR CABLE TOOLS: Rotary

NAME AND ADDRESS OF CONTRACTOR:
Farnsworth and Keiser
P.o. Box 940
Newcastle, Wyoming

APPROXIMATE DATE WORK WILL START: December 3, 1975

IF LEASE PURCHASED WITH ANY WELLS DRILLED, FROM WHOM PURCHASED (Name and address): — NO —

### PROPOSED CASING AND CEMENTING PROGRAM

| SIZE OF HOLE | SIZE OF CASING | WEIGHT PER FOOT | NEW OR SECOND HAND | DEPTH | SACKS OF CEMENT |
|---|---|---|---|---|---|
| 12¼" | 8⅝" | 28 | Second hand | 150 | 150 |

DESCRIBE PROPOSED OPERATIONS. IF PROPOSAL IS TO DEEPEN OR PLUG BACK, GIVE DATA ON PRESENT PRODUCTIVE ZONE AND PROPOSED NEW PRODUCTIVE ZONE. GIVE BLOW OUT PREVENTER PROGRAM IF ANY.

Drill a 7⅞" hole from bottom of surface casing to estimated total depth of 2500. Will test ~~[illegible]~~ the Leo zones of Minnelusa formation. Drill stem test any zones with shows of oil & gas. If commercial production indicated will set 5½" casing 100 feet below prospective pay zone, perforate, and complete.

SIGNED Richard A. Benham TITLE Vice President-Land DATE Nov. 28 1975

DO NOT WRITE BELOW THIS LINE

PERMIT NO.: 741

APPROVAL DATE: December 3, 1975

CHECKED BY: Fred V. Steece — School and Public Lands — Date
Supervisor

CONDITIONS:
COMPLETE SET OF SAMPLES, AND CORES IF TAKEN MUST BE SUBMITTED.
SAMPLES, AND CORES IF TAKEN, BELOW DEPTH, MUST BE SUBMITTED.

SOUTH DAKOTA
STATE GEOLOGICAL SURVEY
WESTERN FIELD OFFICE

DEC 1975
RECEIVED
WESTERN FIELD OFFICE

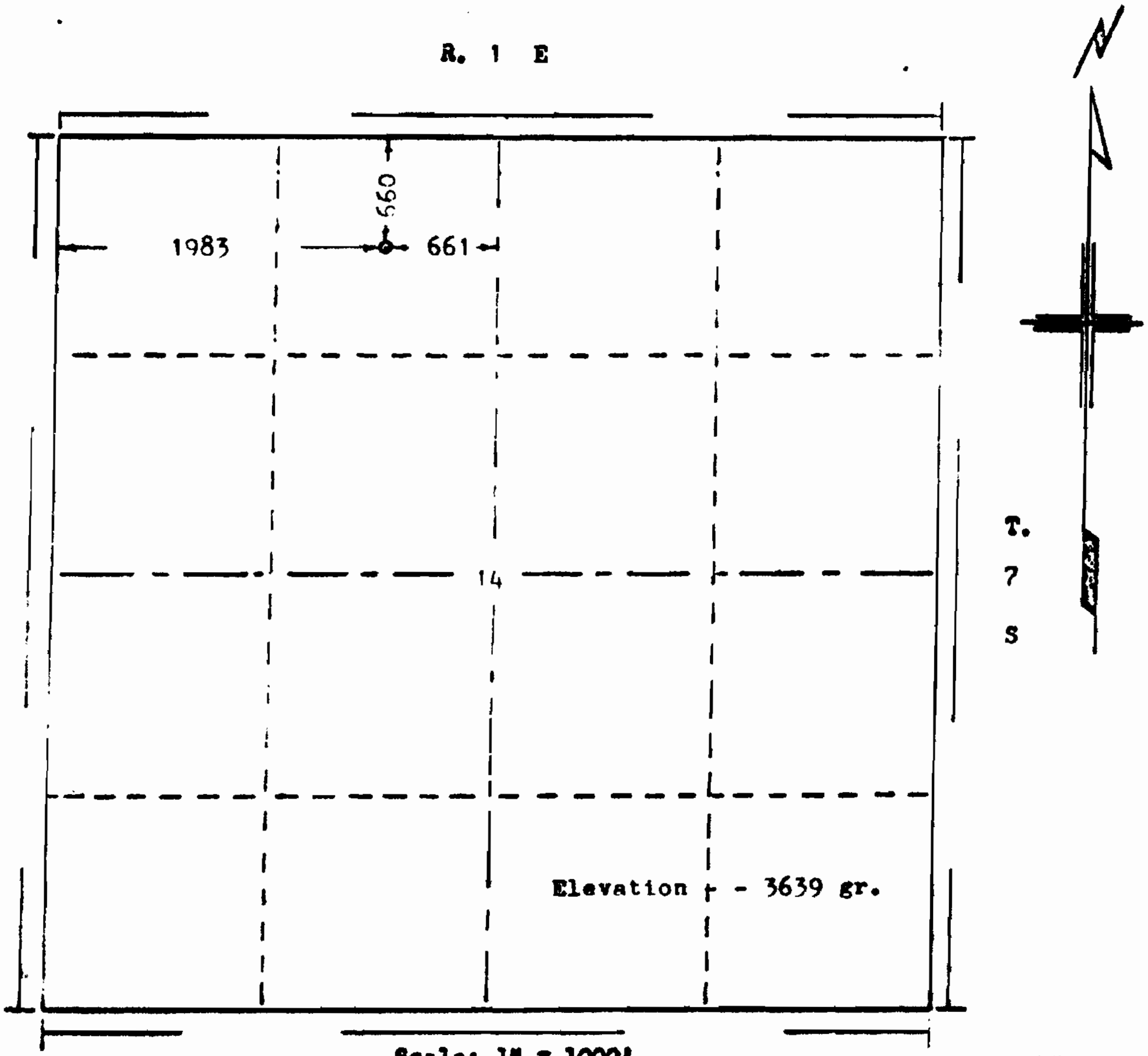
### INSTRUCTIONS

General: This form is designed for submitting proposals to perform certain well operations, as indicated, on all types of lands and leases for appropriate action by either a Federal or a State agency, or both, pursuant to applicable Federal and/or State laws and regulations. Consult applicable Federal or State regulations, or appropriate officials, concerning approval of the proposal before operations are started.

If the proposal is to redrill to the same reservoir at a different subsurface location or to a new reservoir, use this form with appropriate notations.

If the well is to be, or has been, directionally drilled, so state and show by attached sheets, if necessary, the coordinate location of the hole in any present or objective productive zones.

(*Sample location: 660' South and 660' East of the Northwest Corner of Section 16.)



Scale: 1" = 1000'

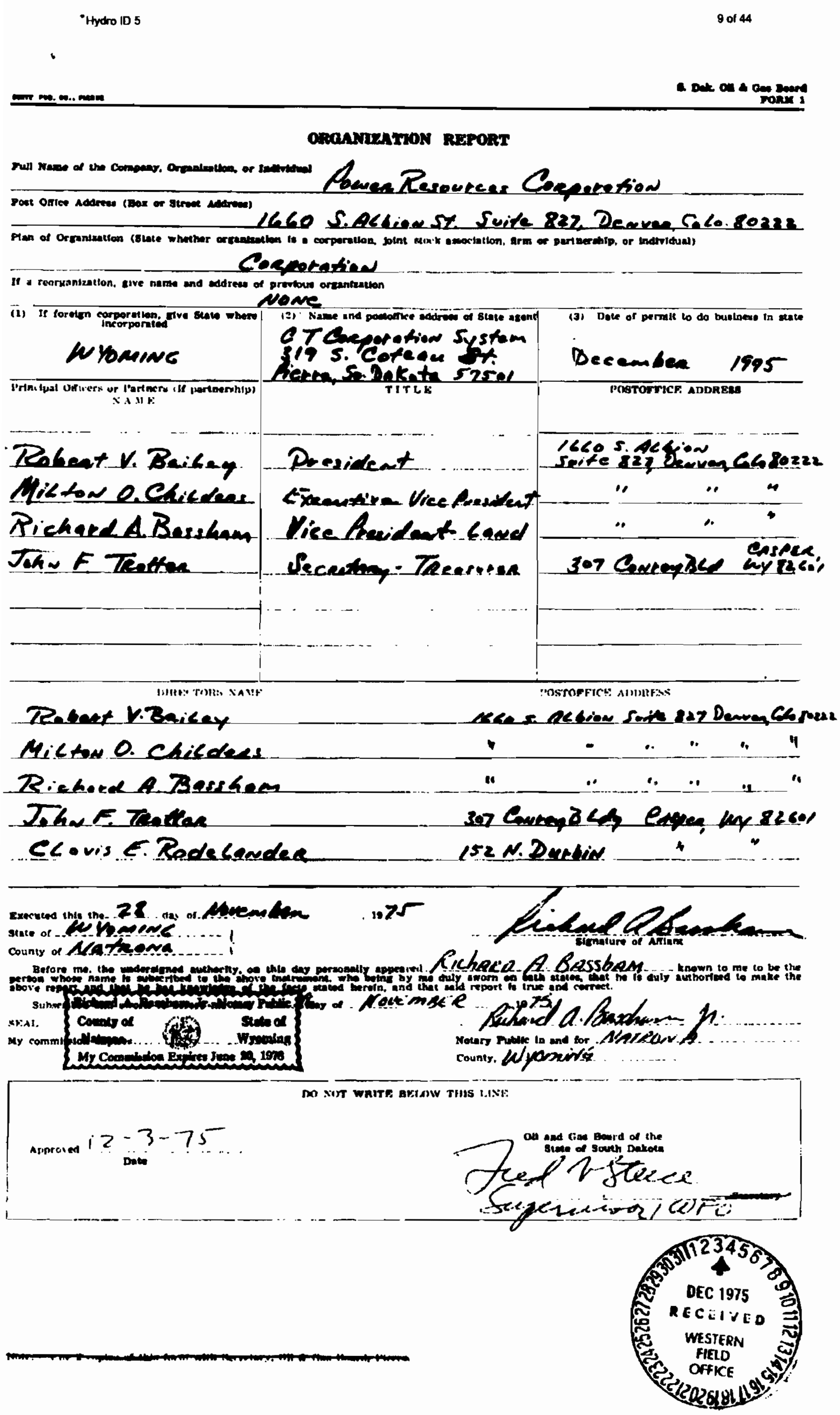
#21-14 Jus

Thomas E. Nelson, of Casper, Wyoming
has in accordance with a request from Mr. Bassham
for Power Resources Corporation
determined the location of ~~#12-14~~ M. Lenore Peterson
to be C NE NW Section 14, Township 7 South
Range 1 East of the Black Hills Meridian
Fall River County, South Dakota

I hereby certify that this plat is an
accurate representation of a correct
survey showing the location of
~~#12-14~~ #21-14 Jus M. Lenore Peterson

Date: 11-29-75

Licensed Land Surveyor No. 1200
State of South Dakota



*Hydro ID 5

9 of 44

S. Dak. Oil & Gas Board
FORM 1

## ORGANIZATION REPORT

Full Name of the Company, Organization, or Individual: Power Resources Corporation

Post Office Address (Box or Street Address): 1660 S. Albion St. Suite 827, Denver, Colo. 80222

Plan of Organization (State whether organization is a corporation, joint stock association, firm or partnership, or individual): Corporation

If a reorganization, give name and address of previous organization: NONE

| (1) If foreign corporation, give State where incorporated | (2) Name and postoffice address of State agent | (3) Date of permit to do business in state |
|---|---|---|
| WYOMING | C T Corporation System<br>319 S. Coteau St.<br>Pierre, So. Dakota 57501 | December 1995 |

| Principal Officers or Partners (if partnership) NAME | TITLE | POSTOFFICE ADDRESS |
|---|---|---|
| Robert V. Bailey | President | 1660 S. Albion Suite 827 Denver Colo 80222 |
| Milton O. Childers | Executive Vice President | " " " |
| Richard A. Bassham | Vice President Land | " " " |
| John F. Trotter | Secretary - Treasurer | 307 Conroy Bld Casper, Wy 82601 |

| DIRECTORS NAME | POSTOFFICE ADDRESS |
|---|---|
| Robert V. Bailey | 1660 S. Albion Suite 827 Denver, Colo 80222 |
| Milton O. Childers | " " " " " " |
| Richard A. Bassham | " " " " " " |
| John F. Trotter | 307 Conroy Bldg Casper, Wy 82601 |
| Clovis E. Rodelander | 152 N. Durbin " " |

Executed this the 28 day of November, 1975

State of WYOMING

County of NATRONA

Richard A Bassham
Signature of Affiant

Before me, the undersigned authority, on this day personally appeared Richard A. Bassham known to me to be the person whose name is subscribed to the above instrument, who being by me duly sworn on oath states, that he is duly authorized to make the above report and that he has knowledge of the facts stated herein, and that said report is true and correct.

Subscribed and sworn to before me this day of November, 1975

SEAL

Richard A. Bassham Jr. — Notary Public — County of Natrona — State of Wyoming — My Commission Expires June 20, 1976

My commission expires

Richard A. Bassham Jr.
Notary Public in and for NATRONA County, WYOMING

DO NOT WRITE BELOW THIS LINE

Approved 12-3-75
Date

Oil and Gas Board of the State of South Dakota

Fred V Steece
Supervisor / WFO

Secretary

DEC 1975
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WESTERN FIELD OFFICE

# WELL INSPECTION / SCOUT REPORTS

SOUTH DAKOTA GEOLOGICAL SURVEY
Western Field Office

# SCOUT REPORT

Number 2

Date Scouted 7-27-76

Operator Power Resources Corporation

Permit Number 741

Farm/Lease Name #21-14 Peterson

API Number 40 047 20065

NENW Sec. 14 T. 7S R. 1E County Fall River

Elev. 3638 Est. T.D. - Actual T.D. 2284 Spudded 12-11-75

Contractor Farnsworth & Kaiser Geologist Al Nelson

SCOUT'S OBSERVATION:

Open pipe at surface with mud all around it remains at site. Bags of cement and other refuse strewn about. No indication of completion as water well.

DST RECORD:

FORMATION TOPS:

PLUGGING RECORD:

DATE PLUGGED/COMPLETED

CASING RECORD:

From To

From To

SITE INSPECTION:

Approved X

Not Approved

REMARKS: No open mud pits. Water well piping is probably subsurface. Mess probably belongs to the rancher.

SCOUTED BY James E Ellithorpe Fred V Steece

James E. Ellithorpe, Field Assistant Fred V. Steece, Supervisor

'J PRC #21-14 Peterson 12-26-75

NENW 14-7S-1E Fall River

660 FNL & 1983 FWL

PERMIT: 741 (12-3-75)

API: 40 047 20065

ELEV: 3639 Gr.

CONTR: Farnsworth & Newell & Kaiser

GEOL: Al Nelson

ENGR:

SPUD: 12-11-75

EST T.D.: 2500 (Leo)

CASING: 8 5/8 - 160 (@ 152)

CORES: None

DST'S: None

LOGS: BCSL, DIL

T.D.: 2269 (Drl) 2267 (Log)

PLUG: 12-26-75

Al Nelson called for plugging approval we worked out following plug program

40 sax: 2020-1900 Red marker

40 sax: 1600-1500 Top Fall

30 sax: 950-850 Basal Sundance

no surface plug as well will be completed as a water well.

Formation Tops (Nelson)

| | |
|---|---|
| Fuson | 178 |
| Morrison | 339 |
| Sundance | 571 |
| Basal Sd | 862 |

'J Power Resources Corp, Denver
John Trotter & George Wolff, principals

| | |
|---|---|
| Spearfish | 877 |
| Goose Egg | 1180 |
| Minnekahta | 1428 |
| Minnelusa | 1571 |
| $ 1st Conv. | 1571 |
| massive Anhydr. | 1648 |
| 2D Conv. | 1696 |
| $ Red Marker | 1988 |
| 2D Leo | 2099 |
| TD | 2269 |

7-27-76

Visited site to see if converted to water well. Impossible to tell. Site is a mess.

# OPERATOR'S TECHNICAL REPORTS / MAPS

G. ALLAN NELSON
CONSULTING PETROLEUM GEOLOGIST
ROOM 408, MAJESTIC BUILDING
(303) 623-7760 RES. 322-0325
DENVER, COLORADO 80202

JAN 1976
RECEIVED
WESTERN
FIELD
OFFICE

# GEOLOGICAL WELL REPORT

**POWER RESOURCES CORPORATION**
**#21-14 LENORE PETERSON**
**NE NW SEC. 14, T.7S., R.1E.,**
**FALL RIVER COUNTY, SOUTH DAKOTA**

**Wildcat**

# WELL DATA

**Location:** 1983' from the West line and 660' from the North line, C NE NW Sec. 14, Township 7 South, Range 1 East, Fall River County, South Dakota.

**Elevation:** 3639 ground.
3647 K.B.

**Type Well:** Wildcat.

**Spud Date:** 10:00 P.M., December 11, 1975.

**Completion Date:** 9:00 P.M., December 26, 1975.

**Casing Record:** Ran 8 5/8" surface casing. Set at 152 ground. Cemented with 125 sacks of regular cement with 3% Calcium chloride. Pipe set at 152 ground. 24# casing.

**Total Depth:** 2269 Driller.
2267 Schlumberger.

**Deepest Formation Penetrated:** Lower Leo Section.

**Depth Datum:** 3647 K.B.

**Well Status:** Plugged and abandoned(left as water well for landowner).

**Mud Program:** Drilled out from under surface with water. Continued drilling with native mud down to 1070 in Spearfish red beds. Converted to a red bed between between 1070 and 1283 in the Goose Egg formation after getting stuck at 1283. Added 1 sack of soda ash, 5 Rayvan, 4 caustic soda, 1 can suf-drill, and 25 sacks of gel. Above 1283 a water-flow was continually thinning mud, particularly when mud pump was shut down on trips for bit.
Between 1625 in the Converse Massive Anhydrite and 1729 in middle Converse tourly treatment was Gel, 1 sack caustic soda, 1 soda ash, 1 Rayvan, and mud weight was 9.4-9.6 and vis. was 36 to 37.
At 2045 to 2078 in upper Leo wt. was 9.7 and vis. was 46, with tourly treatments of 1 sack of soda ash, 1 Rayvan, 1 caustic soda, and 4 CMC to get water loss down to 5 cc. or less before Second Leo was reached at approximately 2100.
At 2105 in Second Leo Sand main objective wt. was 10.0, vis. 36, and water loss 6.0 . Water flow from up the hole continued to create problems in maintain- good quality mud.
Logs were run without any hole trouble. Wt. was 10.3, vis. 85, and water loss 7.2.
Mud furnished by Pro-Mud, Casper; Phil Hogan, engineer.

# WELL DATA (Con.)

**Hole Size:** 12¼" from surface to 168.
7 7/8" from 168 to 2269 T.D. Driller.

**Cores:** (None).

**Drill-Stem Tests:** (None).

**Logs:** Schlumberger Borehole Compensated Sonic Log was run from T.D. up to base of surface casing on a 5" scale 40-70-100, and on a 5" scale 40-90-140 from T.D. up to 1400 above Minnekahta. Gamma Ray Log and Caliper Log were also run with Sonic Log. Two repeats were run from T.D. up to 1980 first and then from T.D. up to 1400 on a 40-90-140 scale.
Dual Induction Laterolog was run second and did not work. 8 hours were spent waiting for a second tool to arrive. A 2" scale was run from T.D. to base of surface pipe, and a 5" scale over same interval was also run, with a repeat from T.D. up to 1900.
Engineer: Don Marquez, Gillette.

**Plugging Record:** 40 sacks from 2020 to 1900 across the Red Marker.
30 sacks from 1600 to 1500 across top of the First Converse Sand.
30 sacks from 950 to 850 acorss Basal Sand of the Sundance.
Cementing by Halco, Gillette
(No plug in surface pipe since left as water well).

**Contractor and Rig Equipment:** Farnsworth & Kaiser, Newcastle, Wyoming.
U-34 rig.
3½" IF drill pipe.
5½" drill collars totaling 341'.
Mud pump GD FXQ with 6" liners and 16" stroke.
Radios on rig and at Newcastle base plus in pusher's pickup.
Mud pump trailer-mounted.
Rig trailer-mounted.
Buzz Farnsworth, pusher-owner.

**Sample Storage:** One cut of samples were sent to American Stratigraphic in Casper.
sent
One cut of damples were to the South Dakota Geologic Survey in Vermillion.

**Drilling Time Records:** Original copy of Star Recording 1' drilling time charts is on file in Denver office of G.A. Nelson.

## LOG FORMATION TOPS

All depths are measured from 3647 K.B.

| FORMATION | DEPTH | DATUM |
|---|---|---|
| LOWER CRETACEOUS | (In first samples at 184 K.B.) | |
| TENTATIVE FUSON SHALE (LAKOTA TOP INDETERMINATE) | 178 | |
| UPPER JURASSIC | 339 | |
| MORRISON FORMATION | 339 | |
| SUNDANCE FORMATION | 571 | |
| REDWATER SHALE MEMBER | 571 | |
| LAK MEMBER | 690 | |
| TENTATIVE HULETT SAND | 795 | |
| STOCKADE BEAVER SHALE | 817 | |
| BASAL SAND OF SUNDANCE | 862 | |
| TRIASSIC | 877 | |
| SPEARFISH FORMATION | 877 | |
| PERMIAN | 1180 | |
| GOOSE EGG FORMATION | 1180 | |
| FORELLE LIME MEMBER | 1320 | |
| GLENDO SHALE MEMBER | 1338 | |
| MINNEKAHTA LIME MEMBER | 1428 | |
| OPECHE SHALE MEMBER | 1471 | |
| MINNELUSA FORMATION | 1571 | -2076 |
| UPPER MINNELUSA(PERMIAN) | 1571 | -2076 |
| FIRST CONVERSE SAND | 1571 | -2076 |
| BASE OF SAND | 1648 | |
| MASSIVE ANHYDRITE | 1648 | |
| BASE OF ANHYDRITE | 1696 | |
| SECOND CONVERSE SAND | 1696 | |
| BASE OF SECOND CONVERSE SAND | 1722 | |
| RED MARKER | 1988 | -1659 |
| BASE OF RED MARKER | 1992 | |

# LOG FORMATION TOPS

| FORMATION | DEPTH | DATUM |
|---|---|---|
| PENNSYLVANIAN | 1992 | -1663 |
| MIDDLE MINNELUSA (LEO SECTION) | 1992 | -1663 |
| SECOND LEO SAND | 2099 | -1548 |
| BASE OF SAND | 2130 | |
| TOTAL DEPTH DRILLER (STRAP) | 2269 | |
| TOTAL DEPTH SCHLUMBERGER | 2267 | |

# SAMPLE LITHOLOGIC DESCRIPTION

All depths are from 3647 K.B.

All sample depths following have been corrected for lag, and then matched to drilling time breaks wherever possible. **Sample li ology is then matched to log lithology so that all lithology following matches log.

All shows are underlined with a solid line. Possible shows are underlined with a dashed line.

| DEPTH | LITHOLOGY |
|---|---|
| LOWER CRETACEOUS | (In first samples caught below surface pipe at 184 K.B.) |
| TENTATIVE FUSON | 178 (LAKOTA TOP INDETERMINATE)<br>(In first samples caught below surface pipe at 184 K.B.) |

(Samples following are caught at 10' intervals)

| | |
|---|---|
| 184-86 | Abundant variegated clay, red, maroon, dark gray, purple, light green; limited sand, white, no show, no porosity, very well-cemented, very fine to fine, limy, poorly sorted, slightly soft, abundant white clay-fill. |
| 186-97 | Same variegated clay; very shaly sand, very silty, very fine, abundant clay cementation, part very fine to fine with poor sorting, no porosity, very soft. |
| 197-204 | Same red, maroon, purple waxy clay, also light green, noticeable brownish gray; purple very sandy clay; limited very shaly sand as above. |
| 204-10 | (Very fast drilling) Traces pale green sand with abundant waxy clay cementation, very fine, silty, very soft, no show, also white. |
| 210-30 | Same as above (fast drilling). |
| 230-34 | (Very slow drilling like hard formation) Trace tannish brown very shaly sand, hard, tight, very fine, excellent sorting, no porosity, noncalcareous. |
| 234-41 | (Fast drilling) Waxy clay, red, maroon, violet, tan, pale green. |
| 241-52 | Same clay, also distinctive very dark chocolate brown; loose sand grains, poorly sorted very fine to fine to medium, subround. |
| 252-59 | Same red, violet waxy clay, some dark gray; same loose sand grains, clear, poorly sorted. |
| 259-70 | Same clay; traces green shaly sand, very fine to fine, very soft, silty, trace angular med grained orange quartz grain. |
| | Same clay; abundant light red very shaly sand, waxy cly cementation, very fine, verynsoft; first trace chert, whitish, light gray, very coarse and coarser, subangular. |
| 270-88 | (Top 12' very, very fast drilling like high porosity) Purplish maroon waxy shale, clay, light to dark gray; abundant very shaly sand, light red, very silty, clay cementation, very fine, soft. |

## SAMPLE LITHOLOGIC DESCRIPTION(Con.)

288-99 (Top 6' very fast drilling) Same as above.

299-311 (Basal 4' hard drilling) Shaly sand, dark green, very hard and tight, very well-cemented, no porosity, ver fine, well-sorted.

311-18 Abundant clay-filled sand, light red, very fine, silty, mushy soft; shale breaks, waxy clay, light green, red.

318-39 Same; green sand, shaly, very fine to fine, tight, no porosity.

339 MORRISON

339-50 Abundant dark gray silty shale, shale, slightly waxy in part.

350-61 Same blackish shale, clay; loose calcite like from veinlet, white, gray, dark gray, in abundance.

361-66 Same shale.

366-78 Same shale, also dark green waxy, few streaks quartzitic sand, shaly, dark green, hard, very well-cemented, very fine, soft in part.

378-92 Increasing greenish dark gray shale, clay, also very dark gray.

Clay, slightly waxy, very dark gray to greenish dark gray, soft.

392-? Same waxy clay, grayish green to greenish dark gray, traces red.

?-414 Same, also very dark gray clay; intermingled with sandy lime stringer(s), white to gray(Very slow drilling in basal part like lime).

414-19 Same clay, very dark gray to greenish dark gray.

419-28 (Fast drilling) Waxy clay, dark gray, greenish gray, soft, grayish green.

428-34 Waxy clay, mostly grayish green, very soft.

434-44 (Very fast drilling) Same.

444-59 Same, also dark gray.

459-69 Waxy clay, dark gray to greenish dark gray.

469-79 Same, with trace white kaolinitic sand, very soft, very fine, no show, excellent sorting.

571 SUNDANCE FORMATION

571 REDWATER SHALE MEMBER
699 LAK MEMBER

699

699-710 Waxy clay, grayish green to greenish gray, dark gray, platy, very soft; sand streaks, greenish light gray, very silty, very, very fine, very soft, poor porosity, scattered fine glauconite.

710-16 Same clay and sand; also light tan sand, very fine, silty, soft, no show, porous, excellent sorting.

716-30 Same gray to green waxy clay, very soft; limited sand, light tan, very fine and finer, soft, porous, excellent sorting, no show.

730-37 Very waxy clay, dark gray, greenish gray, grayish green, very soft; same soft tan sand, very fine, silty, no show; limited orange sand, very fine, well-sorted, shaly, soft, no show.

## SAMPLE LITHOLOGIC DESCRIPTION (Con.)

795 TENTATIVE HULETT SAND

817 STOCKADE BEAVER SHALE

823-31 Sandstone, grenish white, very fine, excellent sorting, no show, no porosity, fine glauconite scattered, abundant tiny white spots of clay scattered, soft to very soft, also tiny black specks scattered, limy (Hulett cave).

831-46 Shale, silty shale, gray, greenish gry, platy, very soft, also darker gray; sand streaks, same sand as above, no show, part yellow limonite stained (Hulett cave).

846-57 Same soft waxy shale, grayish green to greenish gray; sand streaks, greenish gray, light gray, no show, poor porosity, very well-cemented, silty, bery soft, very fine, excellent sorting, fine glauconite, limy.

857-62 Same alternating shale and sand as above, no show,

862 BASAL SAND OF SUNDANCE

862-72 (Very rapid drilling of 7' in 4") Basal sand of Hulett: sandstone, light greenish gray to yellowish greenish gray, no show, very fine, excellent sorting, porous, very soft, fine glauconite and black specks scattered, no fluorescence.

872-77 Dark gray very waxy shale, very soft; trace also black with pyrite spot; trace tannish gray mottled purplish maroon.

877 TRIASSIC

877 SPEARFISH FORMATION

877-99 (Samples up at 900 in less than 22"; red bed top marked by faster drilling from 2½"/ft. above red bed top to 2"/ft. below red bed top) Abundant brick red silty shale, very silty, very soft, fine black biotite specks scattered; limited smooth red shale; trace white medium crystalline to coarsely crystalline anhydrite.

## SAMPLE LITHOLOGIC DESCRIPTION (Con.)

1528-34 Plain shale to silty shale, brick red, soft in lower part; top 4' anhydr ite, white, tan, microcrystalline.
1534-44 (Missing).
1544-49 Same red silty shale, soft.
Anhydrite, white, to tan denser to limited orange.
1549-56 Siltyshale, light red, brick red, soft.
1556-71 Same shale.
1571(-2076 MINNELUSA FORMATION
1571(-2076 UPPER MINNELUSA (PERMIAN)

1571-90 (Samplessurfacing off bottom at 1590 in more than 15" and less than 45") (Top 10' very fast drilling like high porosity and bottom 5' fast drilling like good porosity) Abundant sandstone, light yellow, pinkish yellow, soft, no show, good visible porosity, poorly sorted very fine to fine to fine-lpus, anhydritic-looking, clear grains, subround.
1590-93 Anhydrite stringer, white to tan to gray denser, crypto crystalline.
1593-1602 (Fast drilling like very porous sand) Same sand as above, light yellow, pinkish possible from red bed mud contamination, poorly sorted very fine to fine to fine-plus, porous, no show, no fluorescence, friable.
1602-07 (Slower drilling like tight or hard streak) Possible anhydrite stringer, tan denser to white.
1607-15 (Very fast drilling of 1"/ft. like high porosity) Sandstone, light yellow, fair sorting, very fine to fine, clear grains, soft, good visible porosity, no show, anhydritic-looking, trace limy; trace light red shaly sandstone, very fine to mostly fine, abundant tiny red shale specks.
1615-35 Abundant loose sand grains, very poorly sorted, very fine to fine to few medium grains, clear grains, mostly light yellowish to less of light orange coloration(Slower drilling like more cemented, less porosity); sand is cave; white anhydrite, finely crystalline.
Same as above; anhydrite is in top 17' and sand is in bottom 3' of Fast drilling.
1635-45 (Continued fast drilling)Same loose sand grains as above.
1645-48 (Slightly slower drilling like sand is transitional to anhydrite below)
1648 BASE OF FIRST CONVERSE SAND
1648 MASSIVE ANHYDRITE

1648-60 (Slower drilling 11"/ft.) Anhydrite, tannish light gray, finely crystalline.
1696 BASE OF MASSIVE ANHYDRITE

1696 SECOND CONVERSE SAND

1696-98 Abundant sandstone, light orange, orange, very fine, good sorting, porous, soft, no show, traces whitish clay-fill scattered, clear grains but light orange, subround.
1698-1702 Increasingly abundant light orang sand, no show, soft, porous, very fine, well-sorted, anhydritic cementation.

## SAMPLE LITHOLOGIC DESRIPTION (Con.)

1702-1722 (Below top 3' very fast drilling begins: 1"/ft.) Same light orange sandstone, very fine to fine, soft, porous, no show, anhydritic cementation, clear light orange grains, fair sorting, noncalcareous.

1722 BASE OF SECOND CONVERSE SAND

1806-13 Snow white sand, no show, well-cemented, poor porosity, very fine to fine, fair sorting, anhydritic-looking cementation, clear grains, soft to slightly soft, no fluorescence.

1813-24 Same white sand as above, no show, poor porosity due to being very well-cemented, abundant white clay-fill, soft.

## SAMPLE LITHOLOGIC DESCRIPTION (Con.)

1988(-1659) RED MARKER

| | |
|---|---|
| 1988-92 | (At 1990 samples coming off bottom in less than 38") (Red Marker marked by typical faster drilling from 10"/ft. above Marker to 2,4,3"/ft. in it) Abundant shale, shiny, splintery, platy, red, maroon, purplish red, very soft. |

1992 BASE OF RED MARKER

1992(-1663) PENNSYLVANIAN

1992(-1663) MIDDLE MINNELUSA (LEO SECTION)

| | |
|---|---|
| 1992-2002 | Abundant dolomite, tan to dark tan, anhydritic dolomite, less of red, lighter tan slightly chalky softer, darker tan and reddenser, harder; associated white anhydrite in 20%. |
| 2002-12 | (4'bblow top is 4' of faster drilling like possible shale break) Abundant silty shale, brick red, orange red, very soft; same dolomite and anhydritic dolomite and white anhydrite, with dolomite becoming violet to tan with purple shale spots in part; sand streaks, white, very well-cemented, no show, limited, no visible porosity, very fine to fine, clear grains, anhydritic cementation, noncalcareous, soft, possibly a granular anhydrite fast drilling is sd. |
| 2012-22 | Dolomite, tan, pink, violet, dense, hard, becoming anhydritic dolomite, tan, finely crystalline; sand streak(s), white, very fine, well-sorted, no show, no porosity, tight, few fine grains, trace mostly fine grained. |
| 2022-32 | Very distinctive blackish brown to greenish brown dolomite with tiny blacksih spots which in part are embedded clear sand grains, slightly chalky-looking, noncalcareous, hard; 20% finely crystalline snow white anhydrite with dark greenish brown dolomite and tan dense anhydrite. |
| 2032-41 | Same dolomite as above, becoming mostly snow white anhydrite with part tan denser and few brown sandy streaks with no porosity, tight. |
| 2041-52 | Same as above. |
| 2052-62 | Hard snow white to denser gray anhydrite; hard, dense tan to tannish brown to brown mottled red dolomite and anhydritic dolomite, part slightly crystalline; tannish gray very,very finely sandy dolomite, silty, with dark maroon to purplish maroon shaly spots. |
| 2062-71 | Anhydritic dolomite, dark tan, dense, very hard, cryptocrystalline, with anhydrite, snow white, very finely crystalline. |
| 2071-84 | Dolomite, anydritic dolomite, tan with purplish tan in part, few purplish red tiny shale spots in part; associated white anhydrite as above; limited violet chalky dolomite. |
| 2084-92 | Tan to dark tan anhydritic dolomite, dense, hard, cryptocrystalline, also purplish to maroon shale spots in part; 5% sandstone, light gray to tannish gray, poorly sorted very fine to fine, very well-cemented, no porosity, tight, mostly dolomitic, trace limy, soft to hard, scattered purplish tiny shale spots. |

## SAMPLE LITHOLOGIC DESCRIPTION (Con.)

| | |
|---|---|
| 2092-99 | Anhydritic dolomite, tannish brown, very finely sandy, hard, with associated snow white anhydrite, microcrystalline, limited gray denser. |
| 2099(-1548) SECOND LEO SAND | (Very slow drilling like hard formation)(Drills at 19" to 28"/ft. in sand versus 16"/ft. above and below sand) |
| 2099-2113 | Abundant sandstone, light gray, very silty, very well-cemented, no show, no visible porosity, tight, poorly sorted, part mostly very fine, part mostly fine with few medium grains, limy to dolomitic; two out of 25 cuttings with traces of yellow fluorescence on each end only, two other cuttings with golden yellow fair fluorescence throughout opposite tan staining in all of of one cutting and tan staining in 50% of other cutting, subround grains, tiny possible oil droplets not detectable after crushing, good yellow fluorescence in 2 stained pieces after crushing. |
| 2113-21 | Trace first chert in Leo, light gray, translucent, angualr, very coarse and coarser; same light gray sand, no show, very silty, very well-cemented, also gray more cemented, mostly very fine, few fine grained streaks, limited same sand grayer slightly quartzitic, no fluorescence. |
| 2121-30 | Sandstone, very silty, light gray, very fine, excellent sorting, very well-cemented, no show, no porosity, soft, in 40-50%; sandstone, 30-40%, grayish tan staining, very fine to mostly fine, well-cemented, poor or less porosity, soft, noncalcareous; limited gray denser sand, slightly quartzitic, very fine, hard, tight; limited fine to fine-plus sand, white, soft, porous, no show; all with no fluorescence. |
| *2130 BASE OF SECOND LEO SAND | **First jet black coaly shale, coal, mostly brownish black firm to hard, blocky; from 2121 to 2124. |
| 2130-42 | All tan dense dolomite, anhydritic dolomite, hard, brittle, tle, with few white anhydrite spots and veinlets, cryptocrystalline. |
| 2142-52 | Same as above but darker brown, greenish brown, dense, cryptocrystalline, with 10% snow white anhydrite; trace round white anyhdrite spots in tan dolomite matrix. |
| 2152-63 | Same dolomite and minor amounts of anhydrite as above; also silty dolomite to lime, grennish tan, soft. |
| 2163-69 | Silty shale, orange redbrick red, soft; abundant very shaly siltstone, medium gray, no show, no porosity, dolomitic to limy, soft to limited hard; white anhydrite veinlet intersecting siltstone, medium crystalline. |
| 2169-82 | Second jet black coaly shale, coal, brownish black, firm, slightly soft; silty red shale break(s) as above, soft; mostly dolomite to anhydritic dolomite, tan, gray, dark gray, some brown, mostly dense to cryptocrystalline, anhydrite is from 2171 to 2182. |
| 2182-93 | Dolomite, anhydritic dolomite, tan, grayish tan, very cherty, dense, cryptocrystalline in part; grading into very sandy dolomite to very dolomitic sand, tan to grayish tan, very poorly sorted very fine to fine to few medium grains, very well-cemented, no porosity. |

## SAMPLE LITHOLOGIC DESCRIPTION (Con.)

2193-2202 Same dolomite and anhydritic dolomite, becoming darker brown cryptocrystalline; also chalky dolomite tolime, cream, light tan grayish, light gray; abundant shale, orange red, silty, soft; minor amount of anhydrite, white to brownish denser; shale probaly in faster drilling lower few feet.

2202-12 Same dolomite and abundant red shale as above; increasing snow white anhydrite, very finely crystalline; traces quartzitic sand, white to gray where tighter, very fine, excellent sorting, very well-cemented, no porosity, hard, tight.

2212-21 Abundant snow white anhydrite, part gray denser; abundant orange red silty shale as above, very soft; minority

2221-32 Dolomite to limestone, graysh tan, cryptocrystalline, hard, brittle, trace dark gray irregular streaks, trace fine pyrite specks.
20% brick red shale, orange red, soft, silty; very finely sucrosic silty limy dolomite to limestone, tan, grayish tan, tannish gray, hard; minority snow white anhydrite, microcrystalline to gray denser.

2132-40 Very finely sucrosic dolomite, dark gray, less of brown; 15% white anhydrite; 5% or less limited streak of sand, white, light gray, gray, quartzitic, very well-cemented, no show, no porosity, tight.

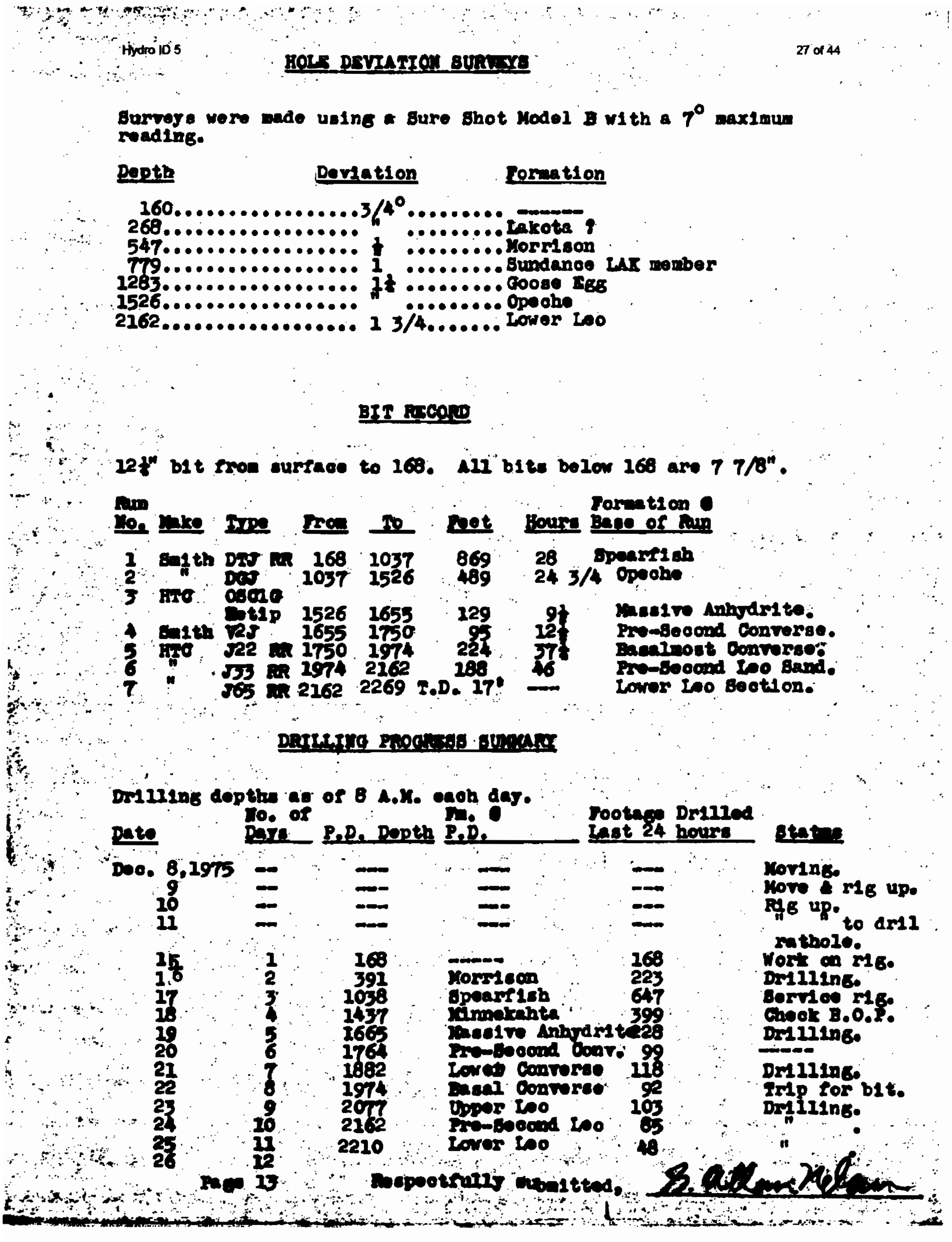
2140-54 Sucrosic limestone, dolomitic lime, ver, very finely sandy lime, tan, greenish tan; traces anhydritic sand, white, light gray, no show, no porosity, very well-cemented. very fine, well-sorted; 15% white anhydrite.

2154-63 Same as above, with limestone, becoming same white sand, very fine, well-sorted, very well-cemented, no show, no porosity, anhydritic-looking.

2163- 68½ (Missing because when 45" circulated samples were caught at T.D. no more cuttings were coming since hole was all cleaned out.

2269 TOTAL DEPTH DRILLER(STRAP)

2267 TOTAL DEPTH SCHLUMBERGER



## HOLE DEVIATION SURVEYS

Surveys were made using a Sure Shot Model B with a 7° maximum reading.

| Depth | Deviation | Formation |
|---|---|---|
| 160 | 3/4° | ------ |
| 268 | " | Lakota ? |
| 547 | ½ | Morrison |
| 779 | 1 | Sundance LAK member |
| 1283 | 1½ | Goose Egg |
| 1526 | " | Opeche |
| 2162 | 1 3/4 | Lower Leo |

## BIT RECORD

12¼" bit from surface to 168. All bits below 168 are 7 7/8".

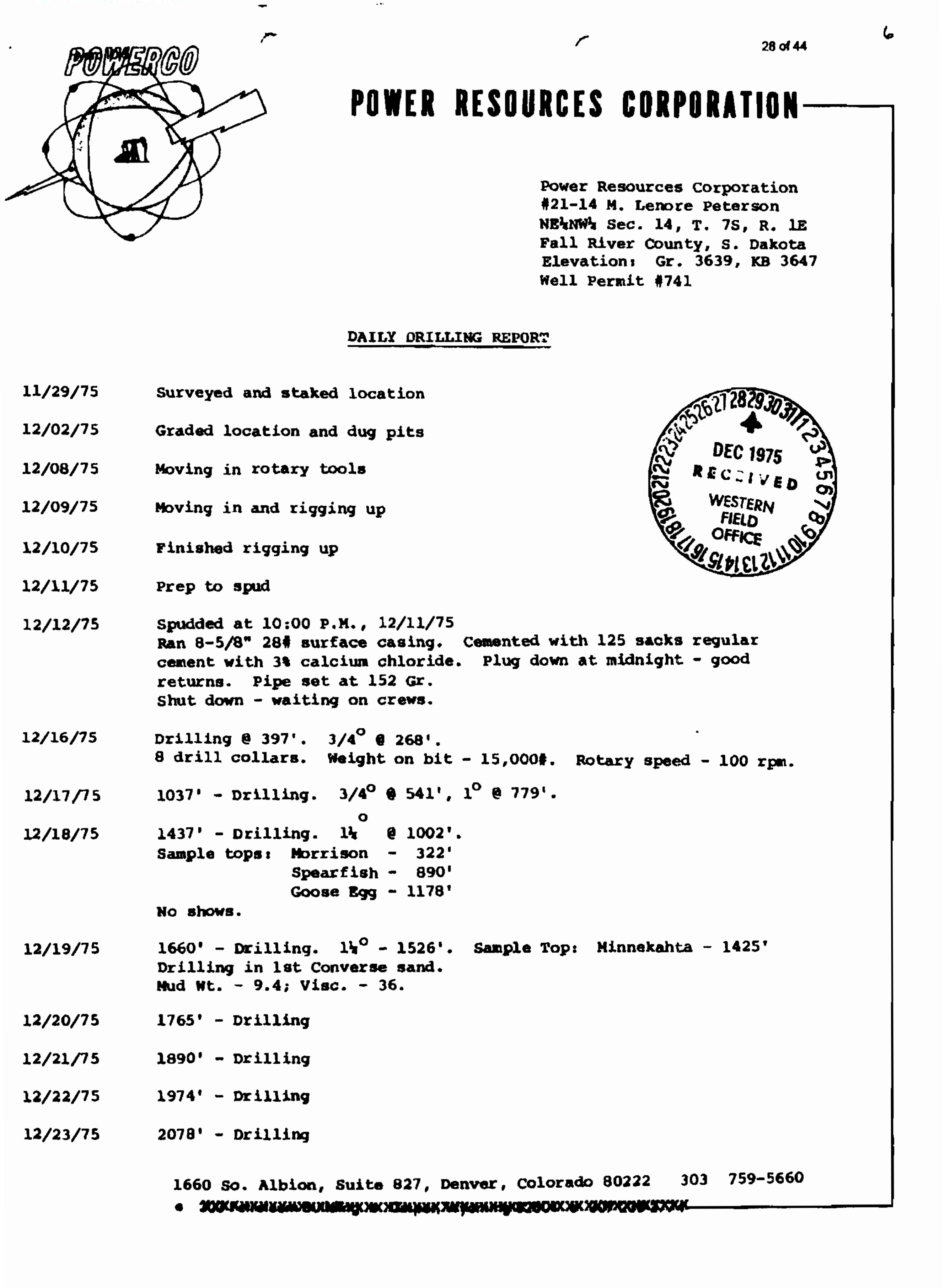
| Run No. | Make | Type | From | To | Feet | Hours | Formation @ Base of Run |
|---|---|---|---|---|---|---|---|
| 1 | Smith | DTJ RR | 168 | 1037 | 869 | 28 | Spearfish |
| 2 | " | DGJ | 1037 | 1526 | 489 | 24 3/4 | Opeche |
| 3 | HTC | OSC1G<br>Rrtip | 1526 | 1655 | 129 | 9½ | Massive Anhydrite. |
| 4 | Smith | V2J | 1655 | 1750 | 95 | 12½ | Pre-Second Converse. |
| 5 | HTC | J22 RR | 1750 | 1974 | 224 | 37½ | Basalmost Converse. |
| 6 | " | J33 RR | 1974 | 2162 | 188 | 46 | Pre-Second Leo Sand. |
| 7 | " | J65 RR | 2162 | 2269 T.D. | 17' | ---- | Lower Leo Section. |

## DRILLING PROGRESS SUMMARY

Drilling depths as of 8 A.M. each day.

| Date | No. of Days | P.D. Depth | Fm. @ P.D. | Footage Drilled Last 24 hours | Status |
|---|---|---|---|---|---|
| Dec. 8,1975 | -- | ---- | ---- | ---- | Moving. |
| 9 | -- | ---- | ---- | ---- | Move & rig up. |
| 10 | -- | ---- | ---- | ---- | Rig up. |
| 11 | -- | ---- | ---- | ---- | " " to dril rathole. |
| 15 | 1 | 168 | ------ | 168 | Work on rig. |
| 16 | 2 | 391 | Morrison | 223 | Drilling. |
| 17 | 3 | 1038 | Spearfish | 647 | Service rig. |
| 18 | 4 | 1437 | Minnekahta | 399 | Check B.O.P. |
| 19 | 5 | 1665 | Massive Anhydrite | 228 | Drilling. |
| 20 | 6 | 1764 | Pre-Second Conv. | 99 | ----- |
| 21 | 7 | 1882 | Lower Converse | 118 | Drilling. |
| 22 | 8 | 1974 | Basal Converse | 92 | Trip for bit. |
| 23 | 9 | 2077 | Upper Leo | 103 | Drilling. |
| 24 | 10 | 2162 | Pre-Second Leo | 85 | " . |
| 25 | 11 | 2210 | Lower Leo | 48 | " |
| 26 | 12 | | | | |

Page 13 Respectfully submitted, B. Allen [illegible]



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6

POWERCO

# POWER RESOURCES CORPORATION

Power Resources Corporation
#21-14 M. Lenore Peterson
NE¼NW¼ Sec. 14, T. 7S, R. 1E
Fall River County, S. Dakota
Elevation: Gr. 3639, KB 3647
Well Permit #741

DEC 1975
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WESTERN
FIELD
OFFICE

## DAILY DRILLING REPORT

| | |
|---|---|
| 11/29/75 | Surveyed and staked location |
| 12/02/75 | Graded location and dug pits |
| 12/08/75 | Moving in rotary tools |
| 12/09/75 | Moving in and rigging up |
| 12/10/75 | Finished rigging up |
| 12/11/75 | Prep to spud |
| 12/12/75 | Spudded at 10:00 P.M., 12/11/75<br>Ran 8-5/8" 28# surface casing. Cemented with 125 sacks regular cement with 3% calcium chloride. Plug down at midnight - good returns. Pipe set at 152 Gr.<br>Shut down - waiting on crews. |
| 12/16/75 | Drilling @ 397'. 3/4° @ 268'.<br>8 drill collars. Weight on bit - 15,000#. Rotary speed - 100 rpm. |
| 12/17/75 | 1037' - Drilling. 3/4° @ 541', 1° @ 779'. |
| 12/18/75 | 1437' - Drilling. 1¼° @ 1002'.<br>Sample tops: Morrison - 322'<br>Spearfish - 890'<br>Goose Egg - 1178'<br>No shows. |
| 12/19/75 | 1660' - Drilling. 1¼° - 1526'. Sample Top: Minnekahta - 1425'<br>Drilling in 1st Converse sand.<br>Mud Wt. - 9.4; Visc. - 36. |
| 12/20/75 | 1765' - Drilling |
| 12/21/75 | 1890' - Drilling |
| 12/22/75 | 1974' - Drilling |
| 12/23/75 | 2078' - Drilling |

1660 So. Albion, Suite 827, Denver, Colorado 80222   303 759-5660

POWERCO

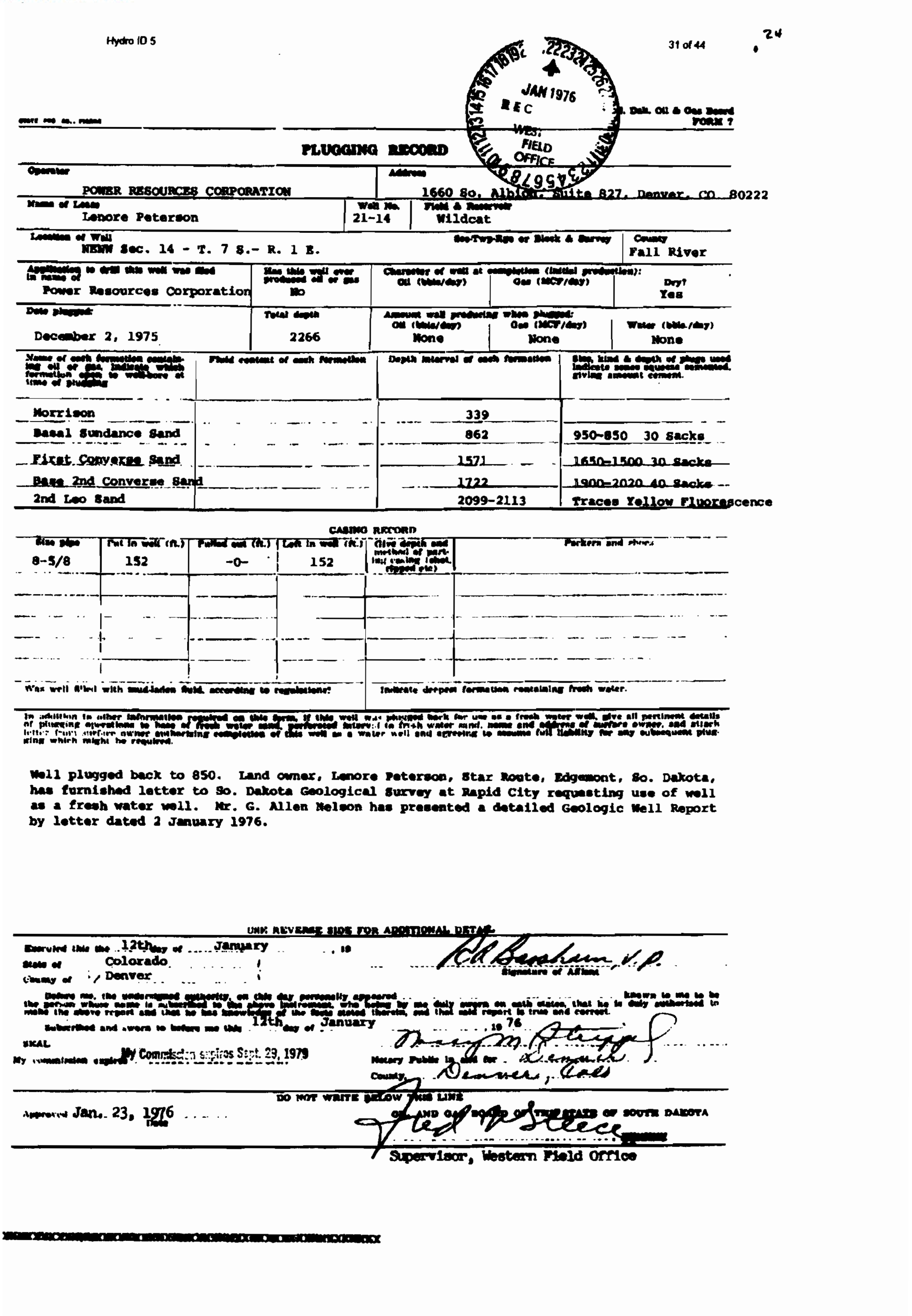
POWER RESOURCES CORPORATION

Power Resources Corporation
#21-14 M. Lenore Peterson
NE¼NW¼ Sec. 14, T. 7S, R. 1E
Fall River County, S. Dakota
Elevation: Gr. 3639, KB 3647
Well Permit #741

## DAILY DRILLING REPORT cont'd.

| | |
|---|---|
| 12/24/75 | 2162' - drilling. Sample Top: 2nd Leo - 2100' (+1547)<br>ss, tite, some oil stn, poor P&P<br>Drilling to est. total depth of 2285' and log. |

# ADMINISTRATIVE / SUNDRY REPORTS



Hydro ID 5

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24

JAN 1976
REC
WEST
FIELD
OFFICE

S. Dak. Oil & Gas Board
FORM 7

## PLUGGING RECORD

| | | |
|---|---|---|
| Operator<br>POWER RESOURCES CORPORATION | Address<br>1660 So. Albion, Suite 827, Denver, CO 80222 | |
| Name of Lease<br>Lenore Peterson | Well No.<br>21-14 | Field & Reservoir<br>Wildcat |
| Location of Well<br>NENW Sec. 14 - T. 7 S.- R. 1 E. | Sec-Twp-Rge or Block & Survey | County<br>Fall River |

| Application to drill this well was filed in name of | Has this well ever produced oil or gas | Character of well at completion (initial production): Oil (bbls/day) | Gas (MCF/day) | Dry? |
|---|---|---|---|---|
| Power Resources Corporation | No | | | Yes |

| Date plugged: | Total depth | Amount well producing when plugged: Oil (bbls/day) | Gas (MCF/day) | Water (bbls./day) |
|---|---|---|---|---|
| December 2, 1975 | 2266 | None | None | None |

| Name of each formation containing oil or gas. Indicate which formation open to well-bore at time of plugging | Fluid content of each formation | Depth interval of each formation | Size, kind & depth of plugs used. Indicate zones squeeze cemented, giving amount cement. |
|---|---|---|---|
| Morrison | | 339 | |
| Basal Sundance Sand | | 862 | 950-850 30 Sacks |
| First Converse Sand | | 1571 | 1650-1500 30 Sacks |
| Base 2nd Converse Sand | | 1722 | 1900-2020 40 Sacks |
| 2nd Leo Sand | | 2099-2113 | Traces Yellow Fluorescence |

CASING RECORD

| Size pipe | Put in well (ft.) | Pulled out (ft.) | Left in well (ft.) | Give depth and method of parting casing (shot, ripped etc) | Packers and shoes |
|---|---|---|---|---|---|
| 8-5/8 | 152 | -0- | 152 | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

| | |
|---|---|
| Was well filled with mud-laden fluid, according to regulations? | Indicate deepest formation containing fresh water. |

In addition to other information required on this form, if this well was plugged back for use as a fresh water well, give all pertinent details of plugging operations to base of fresh water sand, perforated interval to fresh water sand, name and address of surface owner, and attach letter from surface owner authorizing completion of this well as a water well and agreeing to assume full liability for any subsequent plugging which might be required.

Well plugged back to 850. Land owner, Lenore Peterson, Star Route, Edgemont, So. Dakota, has furnished letter to So. Dakota Geological Survey at Rapid City requesting use of well as a fresh water well. Mr. G. Allen Nelson has presented a detailed Geologic Well Report by letter dated 2 January 1976.

USE REVERSE SIDE FOR ADDITIONAL DETAIL

Executed this the 12th day of January, 19

State of Colorado

County of Denver

R.A. Bessham, V.P.
Signature of Affiant

Before me, the undersigned authority, on this day personally appeared ........ known to me to be the person whose name is subscribed to the above instrument, who being by me duly sworn on oath states, that he is duly authorized to make the above report and that he has knowledge of the facts stated therein, and that said report is true and correct.

Subscribed and sworn to before me this 12th day of January, 1976

SEAL

My commission expires My Commission expires Sept. 29, 1979

Notary Public in and for Denver
County, Denver, Colo

DO NOT WRITE BELOW THIS LINE

Approved Jan. 23, 1976
Date

OIL AND GAS BOARD OF THE STATE OF SOUTH DAKOTA

Fred V. Steece
Supervisor, Western Field Office

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

# CORRESPONDENCE

Peterson and Son, Inc.
Edgemont, South Dakota 57735
April 21, 1976

Mr. Fred Steece
South Dakota Geological Survey
308 West Boulevard
Rapid City, South Dakota 57701

Dear Sir:

I am writing in regard to your letter of February 26, 1976, concerning the well converted to our use. We are using the well as a flowing well to water livestock. The well was completed by adding a 8 5/8 inch pipe to the existing casing and reducing this pipe to 4 inches with a one inch outlet. Approximately 100 feet of plastic pipe carries the water to the tank. We have not had the water analyzed.

If you have any further questions, feel free to contact us.

Sincerely,

Debrah Peterson

Debrah Peterson
Secretary

APR 1976
RECEIVED
WESTERN
FIELD
OFFICE

January 7, 1976

JAN 1976
RECEIVED
WESTERN
FIELD
OFFICE

Fred Steece
South Dakota Geologocal Survey
308 West Blvd.
Rapid City, South Dakota 57701

Dear Sir:

I, M. Lenore Peterson, accept full responsibility for the oil test well known as #21-14 Peterson located on my land in NENW¼ Section 14 Township 7S. Range 1E. Fall river County, South Dakota as it is being left for a water well. Relieving Power Resources of their responsibilities with their bond.

The top of the highest plug is 850 feet and it has an 8 5/8" casing to 152 feet below ground level.

Sincerely,

M. Lenore Peterson

M. Lenore Peterson
Star Route
Edgemont, S.D. 57735

cc: John Trotter

December 3, 1975

Mr. R. A. Bassham, Vice President
Power Resources Corporation
1660 S. Albion, Suite 827
Denver, Colorado 80222

Dear Mr. Bassham:

Enclosed is your copy of Permit #741 (form 2a) and approved application to drill (form 2) covering the Power Resources Corporation #21-14 Peterson oil test in Fall River County, South Dakota. A copy of the permit should be posted at the well site. Also enclosed is a receipt for your $100 permit fee. Please make drilling progress reports to the Western Field Office at least weekly.

May I wish you success in your drilling venture and if there is anything I can do to be of help, please let me know.

Sincerely,

Fred V. Steece
Supervisor, Western Field Office

FVS/jlm
cc: Dr. Duncan J. McGregor
Enc. 3

December 3, 1975

Mr. David Volk
State Treasurer
Capitol Office Building
Pierre, S. D. 57501

Dear Mr. Volk:

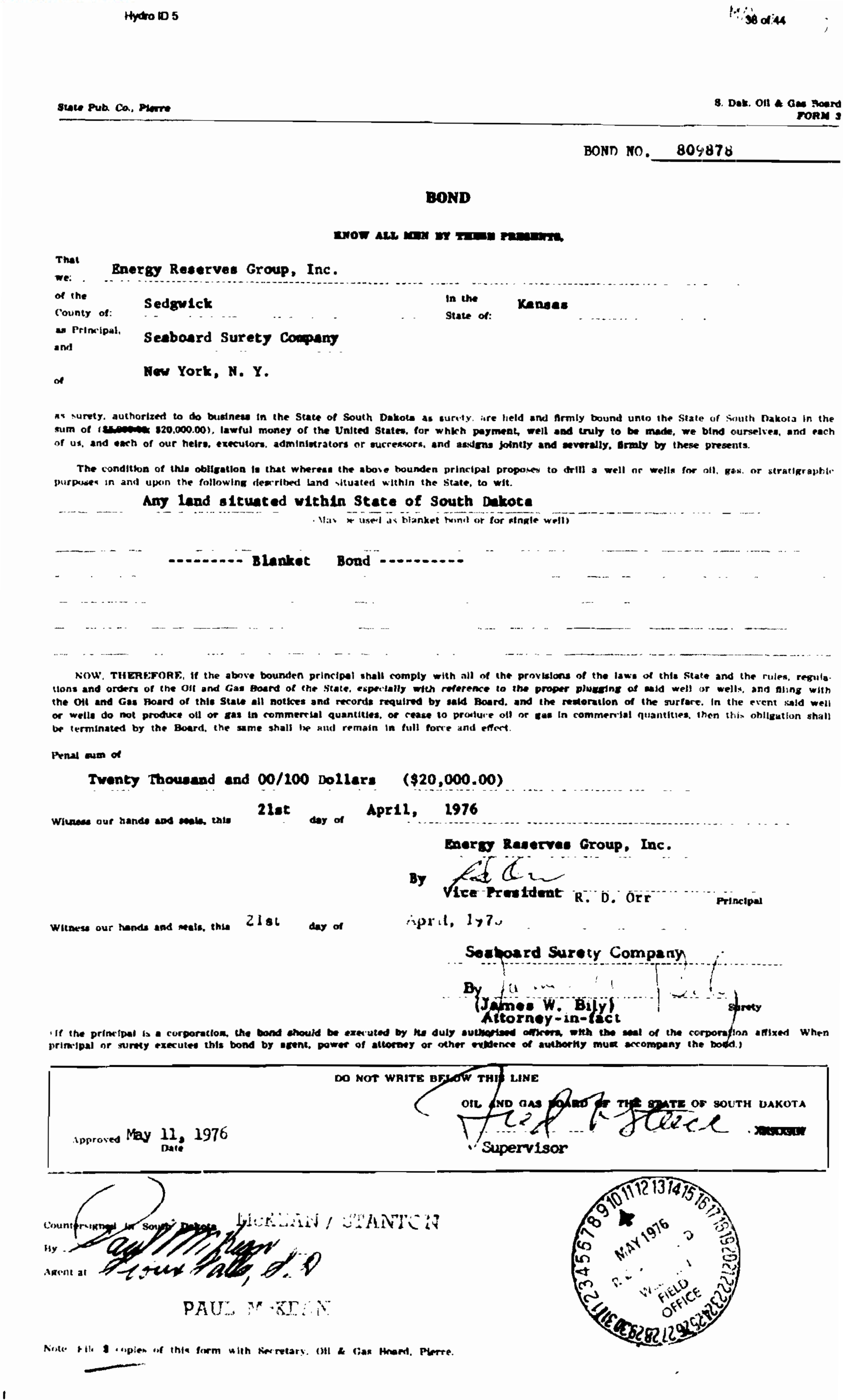
Enclosed is a check in the amount of $100 from Power Resources Corporation to cover the drilling fee for permit #741 for an oil test in Fall River County. This check is for deposit in the general fund and a Cash Receipts Transmittal form is enclosed for the same amount.

Sincerely,

Fred V. Steece
Supervisor, Western Field Office

FVS/jlm
Enc. 2
cc: Dr. Duncan J. McGregor

# SURETY



State Pub. Co., Pierre

S. Dak. Oil & Gas Board
FORM 3

BOND NO. 809878

## BOND

KNOW ALL MEN BY THESE PRESENTS,

That we: Energy Reserves Group, Inc.

of the County of: Sedgwick in the State of: Kansas

as Principal, and Seaboard Surety Company

of New York, N. Y.

as surety, authorized to do business in the State of South Dakota as surety, are held and firmly bound unto the State of South Dakota in the sum of (~~[illegible]~~ $20,000.00), lawful money of the United States, for which payment, well and truly to be made, we bind ourselves, and each of us, and each of our heirs, executors, administrators or successors, and assigns jointly and severally, firmly by these presents.

The condition of this obligation is that whereas the above bounden principal proposes to drill a well or wells for oil, gas, or stratigraphic purposes in and upon the following described land situated within the State, to wit.

Any land situated within State of South Dakota

(May be used as blanket bond or for single well)

---------- Blanket Bond ----------

NOW, THEREFORE, if the above bounden principal shall comply with all of the provisions of the laws of this State and the rules, regulations and orders of the Oil and Gas Board of the State, *especially with reference to the proper plugging of said well or wells*, and filing with the Oil and Gas Board of this State all notices and records required by said Board, and the restoration of the surface, in the event said well or wells do not produce oil or gas in commercial quantities, or cease to produce oil or gas in commercial quantities, then this obligation shall be terminated by the Board, the same shall be and remain in full force and effect.

Penal sum of

Twenty Thousand and 00/100 Dollars ($20,000.00)

Witness our hands and seals, this 21st day of April, 1976

Energy Reserves Group, Inc.

By
Vice President R. D. Orr Principal

Witness our hands and seals, this 21st day of April, 1976

Seaboard Surety Company

By
(James W. Bily)
Attorney-in-fact Surety

(If the principal is a corporation, the bond should be executed by its duly authorized officers, with the seal of the corporation affixed. When principal or surety executes this bond by agent, power of attorney or other evidence of authority must accompany the bond.)

DO NOT WRITE BELOW THIS LINE

OIL AND GAS BOARD OF THE STATE OF SOUTH DAKOTA

Approved May 11, 1976
Date

~~XXXXXX~~ Supervisor

Countersigned in South Dakota McKEAN / STANTON
By
Agent at Sioux Falls, S.D

PAUL McKEON

MAY 1976
FIELD OFFICE

Note: File 2 copies of this form with Secretary, Oil & Gas Board, Pierre.

# SEABOARD SURETY COMPANY

HOME OFFICE

No.

NEW YORK, NEW YORK

## POWER OF ATTORNEY

**KNOW ALL MEN BY THESE PRESENTS:** That SEABOARD SURETY COMPANY, a corporation of the State of New York, has made, constituted and appointed and by these presents does make, constitute and appoint A. C. Arbrecia or A. C. Biebert or James A. Bevan or Robert C. Brost or Evelyn Houchin or James W. Bily or Bill Hall or Donald E. Gragg or Leonard A. Colagrossi--------------------------------------------------------

of Wichita, Kansas

its true and lawful Attorney-in-Fact, to make, execute and deliver on its behalf insurance policies, surety bonds, undertakings and other instruments of similar nature as follows: Without Limitations

Such insurance policies, surety bonds, undertakings and instruments for said purposes, when duly executed by the aforesaid Attorney-in-Fact, shall be binding upon the said Company as fully and to the same extent as if signed by the duly authorized officers of the Company and sealed with its corporate seal; and all the acts of said Attorney-in-Fact, pursuant to the authority hereby given, are hereby ratified and confirmed.

This appointment is made pursuant to the following By-Laws which were duly adopted by the Board of Directors of the said Company on December 8th, 1927, and are still in full force and effect:

ARTICLE VIII, SECTION 1:

"Policies, bonds, recognizances, stipulations, consents of surety, underwriting undertakings and instruments relating thereto. [illegible] bonds, recognizances, stipulations, consents of surety and underwriting undertakings of the Company, and [illegible] and other writings relating in any way thereto or to any claim or loss thereunder, shall be signed in the name and on behalf of the Company

(a) by the Chairman of the Board, the President, a Vice-President or a Resident Vice-President and by the Secretary, an Assistant Secretary, a Resident Secretary or a Resident Assistant Secretary; or

(b) by an Attorney-in-Fact for the Company appointed and authorized by the Chairman of the Board, the President or a Vice-President to make such signature; or

(c) by such other officers or representatives as the Board may from time to time determine.

The seal of the Company shall if appropriate be affixed thereto by any such officer, Attorney-in-Fact or representative."

**IN WITNESS WHEREOF,** SEABOARD SURETY COMPANY has caused these presents to be signed by one of its Vice-Presidents, and its corporate seal to be hereunto affixed and duly attested by one of its Assistant Secretaries, this 13th day of August, 1975.

Attest:

SEABOARD SURETY COMPANY,

(Seal) Joan Lynch
Assistant Secretary

By John C. Whiteside
Vice-President

STATE OF NEW YORK
COUNTY OF NEW YORK } ss.:

On this 13th day of August 19 75, before me personally appeared John C. Whiteside a Vice-President of SEABOARD SURETY COMPANY, with whom I am personally acquainted, who, being by me duly sworn, said that he resides in the State of New Jersey; that he is a Vice-President of SEABOARD SURETY COMPANY, the corporation described in and which executed the foregoing instrument; that he knows the corporate seal of the said Company; that the seal affixed to said instrument is such corporate seal; that it was so affixed by order of the Board of Directors of said Company; and that he signed his name thereto as Vice-President of said Company by like authority.

State of New York
No. 43-4508755 Qualified in Richmond County
Certificate filed in New York County
(Seal) Commission Expires March 30, 1977

Karen Gavrity
Notary Public

## CERTIFICATE

I, the undersigned Assistant Secretary of SEABOARD SURETY COMPANY do hereby certify that the original Power of Attorney of which the foregoing is a full, true and correct copy, is in full force and effect on the date of this Certificate and I do further certify that the Vice-President who executed the said Power of Attorney was one of the officers [illegible] by the Board of Directors to appoint an attorney-in-fact as provided in Article VIII, Section 1, of the By-Laws of SEABOARD SURETY COMPANY.

This Certificate may be signed and sealed by facsimile under and by authority of the following resolution of the [illegible] of SEABOARD SURETY COMPANY at a meeting duly called and held on the 25th day of [illegible]

"RESOLVED: (2) That the use of a printed facsimile of the corporate seal of the company and of the signature of an Assistant Secretary on any certification of the correctness of a copy of an instrument executed by the President or a Vice-President pursuant to Article VIII, Section 1, of the By-Laws appointing and authorizing an attorney-in-fact to sign in the name and on behalf of the company surety bonds, underwriting undertakings or other instruments described in said Article VIII, Section 1, with like effect as if such seal and such signature had been manually affixed and made, hereby is authorized and approved."

**IN WITNESS WHEREOF,** I have hereunto set my hand and affixed the corporate seal of the Company to these presents this 21st day of April 19 76

1927

State Pub. Co., Pierre

S. Dak. Oil & Gas Board
FORM 3

BOND NO. [illegible]

# BOND

KNOW ALL MEN BY THESE PRESENTS,

That
we POWER RESOURCES CORP.
of the
County of DENVER in the State of: COLORADO
as Principal,
and HARTFORD ACCIDENT AND INDEMNITY COMPANY

of HARTFORD, CONN.

as surety, authorized to do business in the State of South Dakota as surety, are held and firmly bound unto the State of South Dakota in the sum of ($5,000.00, ~~$20,000.00~~) lawful money of the United States, for which payment, well and truly to be made, we bind ourselves, and each of us, and each of our heirs, executors, administrators or successors and assigns jointly and severally, firmly by these presents

The condition of this obligation is that whereas the above bounden principal proposes to drill a well or wells for oil, gas, or stratigraphic purposes in and upon the following described land situated within the State to wit

[illegible] South, R. 1 East, Fall River County, South Dakota
(May be used as blanket bond or for single well)

Sec. 14: C NE NW
Well Name #21-14 M. Lenore Petersen

NOW, THEREFORE, if the above bounden principal shall comply with all of the provisions of the laws of this State and the rules, regulations and orders of the Oil and Gas Board of the State, especially with reference to the proper plugging of said well or wells, and filing with the Oil and Gas Board of this State all notices and records required by said Board, and the restoration of the surface, in the event said well or wells do not produce oil or gas in commercial quantities, or cease to produce oil or gas in commercial quantities, then this obligation shall be terminated by the Board, the same shall be and remain in full force and effect

Penal sum of

Five Thousand and no/100------------ ------------- -------($5,000.00)

Witness our hands and seals, this 1st day of December 1975

Attest:
[illegible] Secretary
[illegible] F. Trotter, Secretary

POWER RESOURCES CORP.
Richard A. Basham, Vice president
Richard A. Basham, V. P.
Principal

Witness our hands and seals, this 1st day of December 1975

Hartford Accident and Indemnity Co.
Walt Forbes
Walt Forbes, attorney-in-fact Surety
130 South Wolcott, Casper, Wyo. 82601

(If the principal is a corporation, the bond should be executed by its duly authorized officers, with the seal of the corporation affixed. When principal or surety executes this bond by agent, power of attorney or other evidence of authority must accompany the bond.)

DO NOT WRITE BELOW THIS LINE

Approved 12-3 75
Date

OIL AND GAS BOARD OF THE STATE OF SOUTH DAKOTA
[illegible]
~~Secretary~~
Supervisor [illegible]

Countersigned in South Dakota
By [illegible] Agency, Inc.
[illegible], S. Dak.

Note: File 2 copies of this form with Secretary, Oil & Gas Board, Pierre

# Hartford Accident and Indemnity Company

HARTFORD, CONNECTICUT

## POWER OF ATTORNEY

**Know all men by these Presents,** That the HARTFORD ACCIDENT AND INDEMNITY COMPANY, a corporation duly organized under the laws of the State of Connecticut, and having its principal office in the City of Hartford, County of Hartford, State of Connecticut, does hereby make, constitute and appoint

**WALT FORBES, W. W. BUTLER, SHIRLEY L. McPHERSON, and THOMAS L. MYERS, of CASPER, WYOMING,**

its true and lawful Attorney(s)-in-fact, with full power and authority to each of said Attorneys-in-fact, in their separate capacity if more than one is named above, to sign, execute and acknowledge any and all bonds and undertakings and other writings obligatory in the nature thereof on behalf of the company in its business of guaranteeing the fidelity of persons holding places of public or private trust; guaranteeing the performance of contracts other than insurance policies; guaranteeing the performance of insurance contracts where surety bonds are accepted by states and municipalities, and executing or guaranteeing bonds and undertakings required or permitted in all actions or proceedings or by law allowed

**in penalties not exceeding the sum of FIVE HUNDRED THOUSAND DOLLARS ($500,000.00) each,** ————————————————

and to bind the HARTFORD ACCIDENT AND INDEMNITY COMPANY thereby as fully and to the same extent as if such bonds and undertakings and other writings obligatory in the nature thereof were signed by an Executive Officer of the HARTFORD ACCIDENT AND INDEMNITY COMPANY and sealed and attested by one other of such officers, and hereby ratifies and confirms all that its said Attorney(s)-in-fact may do in pursuance hereof.

This power of attorney is granted under and by authority of the following By-Law adopted by the Stockholders of the HARTFORD ACCIDENT AND INDEMNITY COMPANY at a meeting duly called and held on the 10th day of February, 1943.

ARTICLE IV

SECTION 8. The President or any Vice-President, acting with any Secretary or Assistant Secretary, shall have power and authority to appoint, for purposes only of executing and attesting bonds and undertakings and other writings obligatory in the nature thereof, one or more Resident Vice-Presidents, Resident Assistant Secretaries and Attorneys-in-fact and at any time to remove any such Resident Vice-President, Resident Assistant Secretary, or Attorney-in-fact, and revoke the power and authority given to him.

SECTION 11. Attorneys-in-fact shall have power and authority, subject to the terms and limitations of the power of attorney issued to them, to execute and deliver on behalf of the Company and to attach the seal of the Company thereto any and all bonds and undertakings, and other writings obligatory in the nature thereof, and any such instrument executed by any such Attorney-in-fact shall be as binding upon the Company as if signed by an Executive Officer and sealed and attested by one other of such Officers.

This power of attorney is signed and sealed by facsimile under and by the authority of the following Resolution adopted by the Directors of the HARTFORD ACCIDENT AND INDEMNITY COMPANY at a meeting duly called and held on the 13th day of March, 1956.

RESOLVED, that, whereas the President or any Vice-President, acting with any Secretary or Assistant Secretary, has the power and authority to appoint by a power of attorney, for purposes only of executing and attesting bonds and undertakings and other writings obligatory in the nature thereof, one or more Resident Vice-Presidents, Assistant Secretaries and Attorneys-in-fact,

Now, therefore, the signatures of such officers and the seal of the Company may be affixed to any such power of attorney or to any certificate relating thereto by facsimile, and any such power of attorney or certificate bearing such facsimile signatures or facsimile seal shall be valid and binding upon the Company and any such power so executed and certified by facsimile signatures and facsimile seal shall be valid and binding upon the Company in the future with respect to any bond or undertaking to which it is attached.

**In Witness Whereof,** the HARTFORD ACCIDENT AND INDEMNITY COMPANY has caused these presents to be signed by its Vice-President, and its corporate seal to be hereto affixed, duly attested by its Secretary, this 17th day of January, 1968.

Attest:

HARTFORD ACCIDENT AND INDEMNITY COMPANY

*Secretary*

John F. Beardsley
*Vice President*

STATE OF CONNECTICUT, }
} ss
COUNTY OF HARTFORD, }

On this 17th day of January, A. D. 1968, before me personally came John F. Beardsley, to me known, who being by me duly sworn, did depose and say, that he resides in the County of Hartford, State of Connecticut, that he is the Vice-President of the HARTFORD ACCIDENT AND INDEMNITY COMPANY, the corporation described in and which executed the above instrument, that he knows the seal of the said corporation, that the seal affixed to the said instrument is such corporate seal, that it was so affixed by order of the Board of Directors of said corporation and that he signed his name thereto by like order.

*Notary Public*
*My commission expires March 31, 1977*

STATE OF CONNECTICUT, }
} ss
COUNTY OF HARTFORD, }

**CERTIFICATE**

I, the undersigned, Assistant Secretary of the HARTFORD ACCIDENT AND INDEMNITY COMPANY, a Connecticut Corporation, DO HEREBY CERTIFY that the foregoing and attached POWER OF ATTORNEY remains in full force and has not been revoked; and furthermore, that Article IV, Sections 8 and 11, of the By-Laws of the Company, and the Resolution of the Board of Directors, set forth in the Power of Attorney, is now in force.

Signed and sealed at the City of Hartford. Dated the 14 day of December 1975.

Form [illegible]

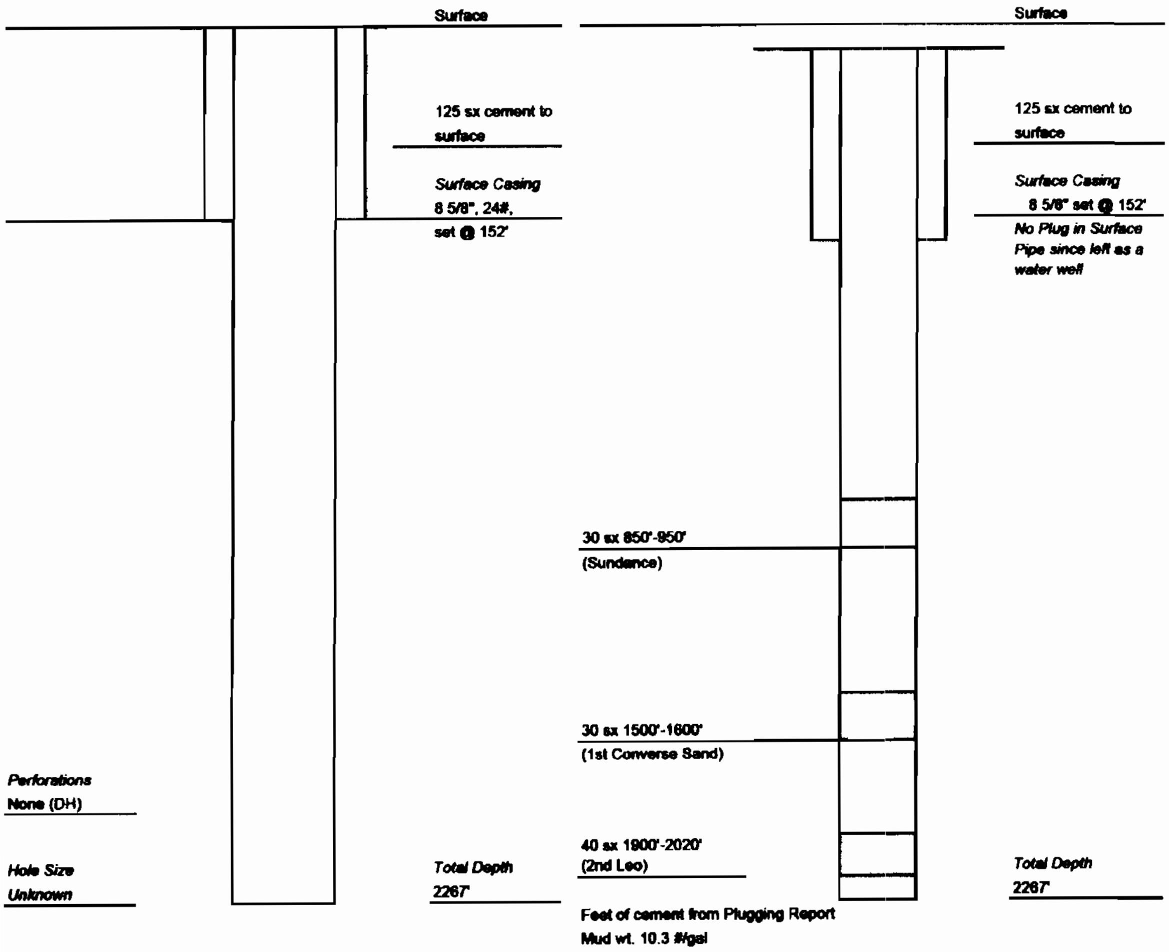
*Assistant Secretary*

# MISCELLANEOUS

# NO MISCELLANEOUS INFORMATION FOR THIS WELL AS OF 5/18/2011

**ORIGINAL WELL CONSTRUCTION DURING OPERATION** **PLUGGING AND ABANDONMENT CONSTRUCTION**

API No. 4004720065
14-7S-1E



SOURCE E

DEWEY-BURDOCK GROUNDWATER WELL REPORT

2010 & 2011 FIELD WORK COMPLETED

(Mike Beshore, Powertech (USA) Inc., October 4, 2011)

POWERTECH (USA) INC.
By Mike Beshore, Powertech (USA) Inc.

October 4, 2011

## Dewey Burdock Groundwater Well Report (2010 & 2011 – Field Work Completed):

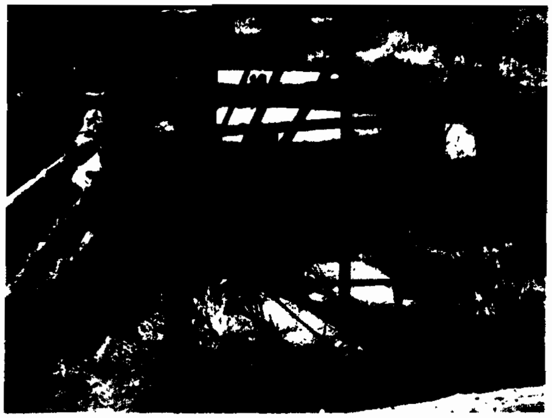
During the field seasons of 2010 and 2011, Powertech personnel conducted groundwater well work at the Dewey Burdock project area. This work consisted of locating groundwater wells within the Area of Review (AOR), monitoring water levels of selected wells, measuring flow rates of artesian wells, and determining groundwater well construction information by running the down-hole camera and geophysical logging tools. Groundwater wells within the AOR are shown in **Map 1**. The conducted field work is detailed below.

### Groundwater Level Measurements:

Groundwater levels were monitored by Powertech personnel on selected groundwater wells, in order to construct groundwater potentiometric surfaces for various aquifers. Standard operating procedures (SOP) for water level measurements under artesian and sub-surface conditions are shown in **Attachment 1**. Groundwater elevation data from the monitoring program are contained within **Table 1**. It should be noted that a significant amount of work had to be completed on many groundwater well surface casings in order to obtain accurate measurements. This was particularly the case for artesian groundwater wells that needed to be fully sealed up and shut in, in order to obtain accurate pressure measurements. Below is a photograph showing an example of well head work completed in order to accurately obtain artesian pressure measurements.

### Artesian/Windmill Groundwater Well Flow Rates:

Groundwater wells that free-flow at the ground surface under artesian pressure and by the use of a windmill and their associated flow rates are shown in **Table 2**. This information was provided to Petrotek to incorporate into the project area groundwater flow model. Flow rates of free flowing groundwater wells was obtained by using a 5-gallon bucket, and noting the amount of time it took to fill the bucket, which yielded an estimate of the flow rate. Below are photographs of a typical artesian groundwater well and a flowing windmill within the project area, that are allowed to free-flow to the ground surface.



**Groundwater Well Work Completed:**

Below is a well by well summary of work completed on groundwater wells during the field season of 2011. Several tasks were completed in order to determine the construction details of many groundwater wells. A tabulated summary of groundwater well status as of September 30, 2011 is included in **Table 3**.

Hydro ID 5 is former oil test well API 40 047 20065

***Groundwater Well Hydro ID 5:***

Groundwater well number 5 is located about 0.5 miles south of the Powertech Burdock pump test location. The well is artesian and consists of a 4-inch casing. Originally the well was expected to produce water from the Chilson aquifer, however further investigations utilizing the down-hole camera and geophysical tool actually revealed that the well is screened within the lower Fall River aquifer. The geophysical log and the screened interval were sent to Powertech geologists for sub-surface geologic interpretations. The well consists of 4-inch casing to a depth of 155 feet below the ground surface, and is open hole from 155 to 175 feet.

***Groundwater Well Hydro ID 6:***

Groundwater well number 6 is located within the project AOR and about 1-mile south of the Powertech Burdock pump test location. This well is non-flowing and consists of a 12-inch steel casing. The static water level in the well is at about 20 feet below ground surface.

The 2-inch down-hole camera was run down the well casing in order to determine the well construction details. As with many groundwater wells in the area, it was very difficult to see the screened interval of the well due to mineralization on the inner casing walls. It appeared from the video that the steel well casing ended at a depth of 135 feet below the ground surface, below which was open bore hole to a total depth of 200 feet below ground surface. These depths correspond to other Fall River wells in the area. The geophysical logging tool was also run down the well casing to its total depth. The logs suggest that sandy facies with good porosity exists from the ground surface to 200 feet below the ground surface.

***Groundwater Well Hydro ID 9:***

Groundwater well number 9 is located within the AOR and south of the Powertech Burdock pump test area. The status of this well was unknown, and was identified at the ground surface by the presence of upwelling water flow from what was hypothesized to be a broken-off casing (see photo below). Historical documents from TVA identify this well as being screened within the Fall River Aquifer. Conversations with the landowner also help validate that well number 9 is screened within the Fall River Aquifer.

Powertech personnel excavated a small portion of the area near the upwelling water in an attempt to locate the groundwater well. After much effort, the broken off 2-inch groundwater well casing was located about 6 feet below the ground surface. A pipe was then attached to the casing to ensure that artesian pressure would lift the groundwater to the ground surface before repairing the well-head, but water did not flow to the ground surface.

Powertech personnel then constructed a 6-foot long 1-inch drill bit. This tool was used to ream out sulfide mineralization that had accumulated on the inner walls of the well casing. This process increased artesian flow from the well to about 1.0 gallon/minute at the ground surface.

After verifying flow from the well at the ground surface, a 2-inch pipe was placed inside the existing well casing and penetrated into the well about 2-feet. A protective riser was then placed around the 2-inch pipe, and cement was added to the space between the 2-inch well head and the protective riser. Artesian flow of 1 gallon/minute was observed at the ground surface. Below is a photograph of the final well-head configuration.

The excavated area around the well was then replaced and smoothed out to match the existing topography. The landowner can now utilize the groundwater well for stock watering purposes.

Powertech personnel were unable to run a down-hole camera on the well due to mineralization on the inner casing walls. A one inch camera, once obtained, may penetrate into the water well and allow construction details to be ascertained. This effort resulted in verifying the presence of a groundwater well and is now set up so water level measurements can be obtained.

***Groundwater Well Hydro ID 37:***

Groundwater well number 37 is located outside of the project boundary but within the AOR, about 0.75 miles south-east of the south-east corner of the project boundary. This groundwater well is not artesian and produces stock water by a windmill. The windmill was disassembled by Powertech personnel so access to the well could be obtained.

This groundwater well originally produce water from an unknown aquifer, but further investigations reveal that it produces from the upper Fall River aquifer according to Powertech geologists who interpreted the geophysical log and screened interval obtained from the down-hole camera. The down-hole camera revealed that the well is cased at the surface, but is open-hole from a depth of 93-145 feet below the ground surface.

***Groundwater Well Hydro ID 49:***

Groundwater well number 49 is located within the Powertech Dewey aquifer pump test area. This well has a construction report associated with it, is screened from a depth of 475-540 feet, and is known to be screened within the upper Fall River aquifer. The total depth of the well was verified to be 540 feet by Powertech personnel.

This groundwater well is artesian, and when first visited had a leaky surface casing. In order to be able to measure artesian pressure and groundwater levels with a high degree of accuracy, the leak in the surface casing had to be fixed, and fitted with valves to isolate the pressure gauge. Below is a photograph of surface casing work completed. There are no leaks at the ground surface, and measured water levels now correlate very well with other surrounding upper Fall River wells.

***Groundwater Well Hydro ID 106:***

Groundwater well number 106 is located within the AOR just north of the town of Dewey, and north of the Dewey Fault zone. The status of this 7-inch was unknown, and expected to produce from Inyan Kara aquifers. The well is artesian and flows about 0.1 gallons/minute.

The 2-inch down-hole camera was run down the well casing to determine well construction details. The casing walls were very difficult to see due to mineralization and algae growth. It appeared from the video that the steel casing ended at 160 feet below the ground surface, below which was open bore hole to a depth of 196 feet below ground surface. The geophysical logging tool was then run down the well casing to its total depth. The logs show a zone of good porosity below about 175 feet to 196 feet below the ground surface.

***Groundwater Well Hydro ID 220:***

Groundwater well number 220 is an existing stock well located about 1.5 miles north north-west of the Powertech Dewey pump test location, consisting of a 6-inch surface casing. Flow from the groundwater well is artesian and produces about 0.2 gallons of water per minute to a nearby stock tank. Below is a photograph of well number 220.

The down-hole camera and geophysical logging tool was used by Powertech personnel to investigate the groundwater well. The well was initially screened within an unknown aquifer. Through the use of the down-hole camera, it was determined that the well is screened from at least 463-523 feet below the ground surface. This corresponds to the upper Fall River aquifer according to Powertech geologists. However as can be seen from the down-hole video, the screened interval extends below 523 feet to an unknown depth. At 523 feet the camera could not go any deeper as the casing was broken and caved in.

### *Groundwater Well Hydro ID 270:*

Groundwater well number 270 has been found and is located about 1.5 miles north and west of the Powertech Dewey pump test location. This groundwater well is artesian and produces about 12 gallons/minute from a 2-inch steel casing. Currently the construction details of the groundwater well are unknown, but is expected to produce from the Inyan Kara aquifers.

Powertech personnel excavated the area around the groundwater well to fix the leaky well-head and prepare it for down-hole tools. A new well-head riser pipe was installed and fitted with a valve for artesian water level measurements. The well-head is no longer leaky.

An attempt was made to run a down-hole camera in the well in order to obtain construction details. Due to mineralization on the inner casing walls, the down-hole camera would not enter the well casing. A 1-inch camera must be obtained to penetrate the well casing and obtain construction details.

### *Groundwater Well Hydro ID 605:*

The original groundwater well database provided to Powertech from their consultants identified a ground water well hydro ID 605, which was suppose to be located about 1500 feet east of the TVA Burdock aquifer pump test well 668. There is in fact no groundwater well at this location. There is a vertical 1-inch pipe that comes up from the ground and provides water to a livestock tank. However this pipe comes from groundwater well Hydro ID 668, which provide water to this location via artesian flow from 668. There is no evidence that groundwater well 605 exists.

### *Groundwater Wells Hydro ID's 622 and 623:*

The status of groundwater wells 622 and 623 are known as TVA construction reports exist, and were utilized in the TVA Dewey pump test as observation wells. Powertech personnel verified in the field each of these wells using a tag line to determine well depth, and most maps that show the screened interval are incorrect. Groundwater well 622 is the southern well and is the lower Chilson, as defined by the well depth being 780 feet below the ground surface. Groundwater well 623 is the northern well and is the lower Fall River, as defined by the tag line going to a depth of 580 feet below the ground surface. Furthermore, groundwater levels obtained from surrounding wells correlate perfectly with the above conclusions. Most maps that have been generated to date are labeled incorrectly, and the well symbols need to be revised to show the verified aquifer. Groundwater well 622 is Chilson and well 623 is Fall River.

***Groundwater Well Hydro ID 635:***

It was originally thought that Hydro ID 635 was an Sundance groundwater well located near the stock reservoir about 750 feet east of groundwater well Hydro ID 5. However, it has been confirmed that this is actually a discharge point from groundwater well Hydro ID 5. Any groundwater quality samples obtained that are labeled as Hydro ID 635 are actually from Hydro ID 5.

According to well construction reports, there was once a Sundance groundwater well in this area. The construction report shows that an oil test well was plugged back and perforated in the Sundance aquifer. Powertech personnel found a solid steel pipe sticking out of the ground about 2000 feet north of the reservoir where the Hydro ID 5 discharge point is located. It is thought that this is the location of the oil test well. The steel pipe needs to be excavated to check if the well has been plugged back to the ground surface.

This is a different oil test, API 40 047 20071, which was plugged and the dry hole marker placed. Excavation is not required. L.S. 3/12/2012

***Groundwater Well Hydro ID 642:***

Groundwater well number 642 is located in the extreme south-east corner of the project boundary, and was originally hooked up to a windmill for livestock watering purposes. The well is currently not being used for any purpose except for groundwater monitoring. The photograph below shows the windmill structure below which groundwater well 642 is located.

Well number 642 consists of a 5-inch steel surface casing that is in good condition. Groundwater level measurements completed by Powertech personnel yield a water level of about 5-feet below the ground surface. Below is a close up photograph of groundwater well 642.

The construction details of groundwater well 642 were initially unknown. Powertech personnel ran down-hole tools on the well to determine construction information. The down-hole camera shown that the 5-inch surface casing extends to a depth of 12 feet below the ground surface, below which is an open hole to a total well depth of 33 feet. Location and geophysical log information was provided to Powertech geologists, and they interpreted the well to be producing water from surface alluvial sediments. However while running the camera down the hole, it was noted that the walls of the borehole consisted of solid-rock. The geophysical log from the hole should be re-examined to make sure the well is not completed in a sandstone formation such as the Fall River or Chilson.

***Groundwater Well Hydro ID 651:***

The original groundwater well database provided to Powertech from its consultants identified a groundwater well Hydro ID 651. Powertech personnel inspected this area, and confirmed that there is no groundwater well at this location. There is a stock tank at the location, but it originally received water from groundwater well Hydro ID 6 via a trenched pipeline. Inspection of an aerial photograph of this location clearly shows that a pipeline exists from well number 6 to the location of the stock tank, which was originally thought to be a stand-alone well. From conversations with the current landowner, the groundwater well 6 at one time would provide water to the stock tank, but following TVA pumping of aquifers, the well failed to deliver water to the stock tank location.

***Groundwater Well Hydro ID 668:***

Groundwater well number 668 is located within the project area and within the proposed groundwater aquifer exemption boundary at the location of the TVA Burdock groundwater pumping test.

As can be seen from the above photograph, this groundwater well is in excellent condition and consists of a 10-inch casing. The groundwater well is artesian and provides livestock water for the landowner. This groundwater well was used as the pumping well during the TVA Burdock aquifer test, and so there is a lot of construction information available. The TVA well construction report shows that the well produces groundwater from both the Fall River and Chilson aquifers, but Powertech personnel thought it was important to verify that information by running the down-hole camera and geophysical logging tool.

Powertech personnel ran the down-hole camera on the water well and confirmed that the well is screened at multiple intervals. The upper screen of the well extends from 300 feet to 350 feet below the ground surface. A solid, unscreened interval exists from 350 feet to 495 feet below the ground surface. From 495 feet to 550 feet below the ground surface is the lower screened interval of the well. The total depth of the well is 550 feet.

The geophysical logs ran by Powertech personnel were provided to Powertech geologists for geologic interpretation. It was confirmed that the upper screened interval of the well (300-350 feet) is in fact within the lower Fall River Formation aquifer. The lower screen of the well from 495 to 550 feet intersects the Lower Chilson Member of the Lakota aquifer. The solid casing that runs between the two screened intervals intersects the Fuson Member confining layer.

During the summer of 2011 Powertech personnel installed an inflatable packer within the groundwater well 668, in an attempt to isolate the two screened intervals of the groundwater well and conduct monitoring of the artesian pressures of each screened aquifer. That task and monitoring details are contained within a stand-alone report provided to Powertech engineering.

**Dewey Burdock Groundwater Potentiometric Surface Measurements - Collected by Beshore and VanEaton**

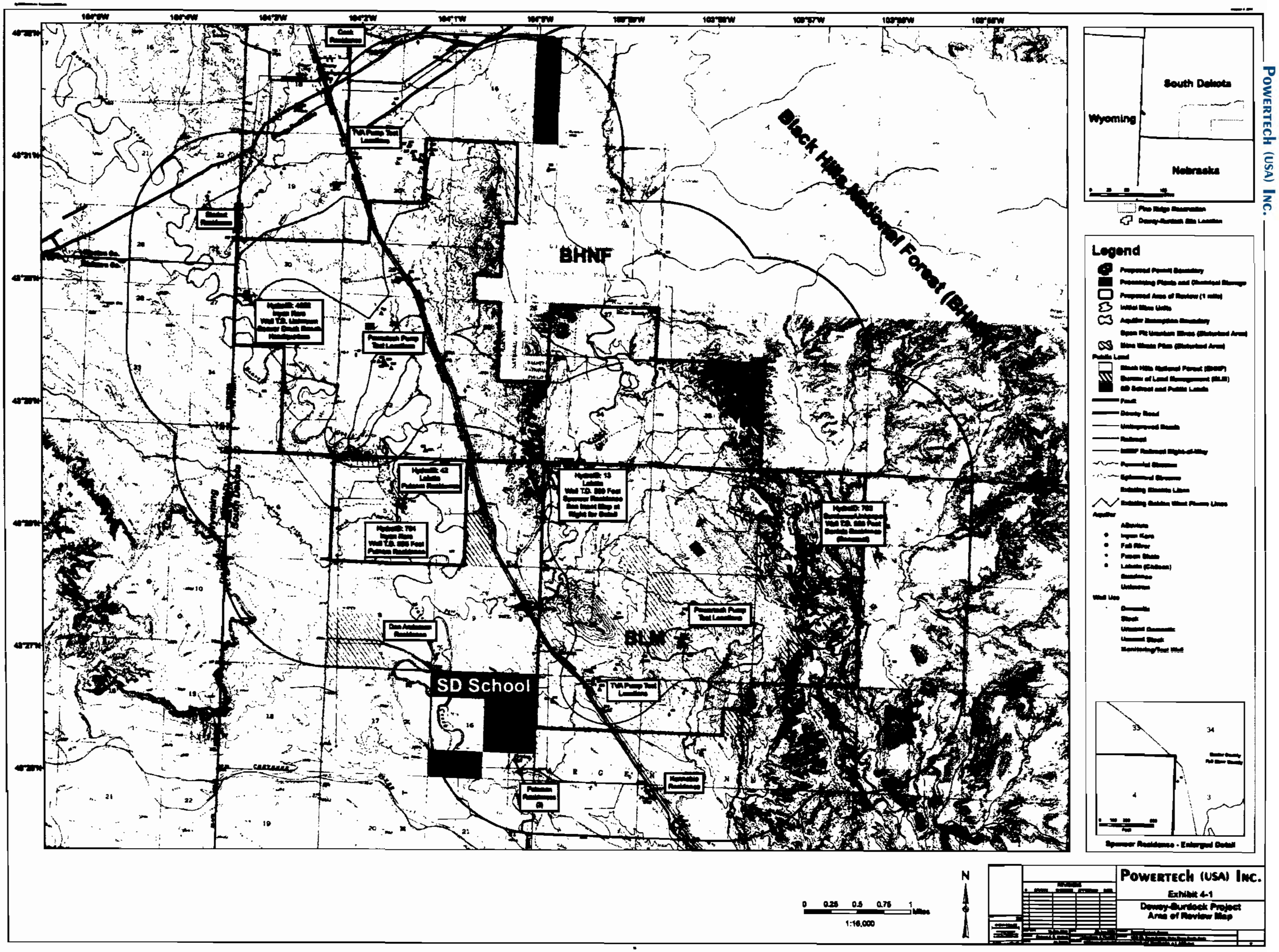
| Hydro ID or Hydro Code | SD State Plane 1983 East (Feet) | SD State Plane 1983 North (Feet) | Screened Formation | Total Depth (Feet) | TOC Elevation (Feet) | Measuring Point Elevation (Feet) | Water Level Elevation (Feet) - Week of 8/30/2010 | Water Level Elevation (Feet) - Week of 12/13/2010 | Water Level Elevation (Feet) - Week of 1/17/2011 | Water Level Elevation (Feet) - Week of 2/21/2011 | Water Level Elevation (Feet) - Week of 3/21/2011 | Water Level Elevation (Feet) - Week of 4/25/2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 995376.8 | 434378.5 | Lakota | 805 | 3641.14 | 3641.51 | 3653.19 | 3653.46 | 3654.06 | 3654.26 | 3654.09 | 3654.55 |
| 14 | 1002103.3 | 434723.34 | Fall River | 300 | 3669.88 | 3669.88 | Not Measured | 3662.91 | 3663.07 | 3663.02 | 3663.05 | 3663.15 |
| 38 | 992726.9 | 442289.6 | Fall River | 494 | 3638.75 | 3639.63 | 3644.96 | 3646.23 | 3644.76 | 3646.61 | 3646.75 | 3647.01 |
| 49 | 987330.6 | 444022.8 | Fall River | 600 | 3620.86 | 3621.27 | 3648.59 | 3642.36 | 3642.34 | Not Measured | 3644.64 | 3645.47 |
| 436 | 989848.68 | 454700.89 | Fall River | 590 | 3739.85 | 3739.85 | Not Measured | 3707.48 | 3707.56 | 3707.31 | 3707.36 | 3707.31 |
| 609 | 990133.3 | 447808.3 | Lakota | 1000 | 3700.67 | 3700.67 | 3688.5 | 3688.85 | 3686.81 | 3687.76 | 3687.75 | 3688.05 |
| 610 | 989998 | 447969.6 | Fall River | 680 | 3704.85 | 3704.85 | 3691.75 | 3691.74 | 3691.51 | 3691.45 | 3691.33 | 3691.52 |
| 611 | 990233.96 | 453965.33 | Lakota | 804 | 3737.36 | 3737.36 | Not Measured | 3691.99 | 3690.77 | 3691.03 | 3691.32 | 3691.26 |
| 612 | 990153.49 | 454128.57 | Lakota | 800 | 3732.34 | 3732.34 | Not Measured | 3694.04 | 3692.69 | 3692.9 | 3693.17 | 3693.15 |
| 613 | 990523.4 | 453775.8 | Fall River | 580 | 3736.93 | 3736.93 | 3700.03 | 3700.2 | 3700.25 | 3700.02 | 3700 | 3700.03 |
| 615 | 990571 | 453708.9 | Lakota | 800 | 3741 | 3741 | 3689.31 | 3689.79 | 3688.49 | 3688.72 | 3688.99 | 3688.99 |
| 616 | 990530.63 | 453135.16 | Lakota | 835 | 3751.04 | 3751.04 | Not Measured | 3693.43 | 3692.16 | 3692.4 | 3692.63 | 3692.6 |
| 617 | 989425.25 | 453583.39 | Lakota | 810 | 3725.55 | 3725.55 | Not Measured | 3692.35 | 3691.11 | 3691.33 | 3691.58 | 3691.53 |
| 622 | 991174.5 | 454033.8 | Lakota | 780 | 3754.91 | 3754.91 | 3692.85 | 3693.33 | 3692.03 | 3692.24 | 3692.5 | 3692.47 |
| 623 | 991084.6 | 454311.84 | Fall River | 580 | 3753.28 | 3753.28 | 3708.51 | 3708.64 | 3708.65 | 3708.5 | 3708.53 | 3708.55 |
| 628 | 990894.7 | 449719.2 | Fall River | 520 | 3731.99 | 3731.99 | 3694.78 | 3694.93 | 3694.77 | 3694.69 | 3694.42 | 3694.68 |
| 631 | 1002575.7 | 449309.8 | Fall River | 80 | 3745.37 | 3745.37 | 3716.86 | 3716.95 | 3716.92 | 3717.11 | 3717.37 | 3717.41 |
| 657 | 989882.27 | 454729.93 | Lakota | 800 | 3747.58 | 3747.58 | Not Measured | 3693.34 | 3692.06 | 3692.28 | 3692.48 | 3692.53 |
| 680 | 1003476.6 | 429969.1 | Lakota | 436 | 3701.94 | 3701.94 | 3661.02 | 3660.69 | 3661.06 | 3661.09 | 3661.07 | 3661.45 |
| 681 | 988728.3 | 443725.3 | Fall River | 600 | 3626.99 | 3630.31 | 3649.22 | 3643.89 | 3644.21 | Not Measured | 3646.05 | 3646.63 |
| 682 | 1003538.2 | 431257.9 | Lakota | 460 | 3718.24 | 3718.24 | 3665.4 | 3665.14 | 3665.49 | 3665.54 | 3665.45 | 3665.75 |
| 683 | 988610.5 | 446104.7 | Fall River | 650 | 3663.66 | 3666.64 | 3662.67 | 3659.52 | 3658.88 | Not Measured | 3660.21 | 3660.57 |
| 684 | 1003590.38 | 429744.24 | Lakota | 423 | 3689.04 | 3689.04 | Not Measured | 3661.57 | 3661.96 | 3661.96 | 3661.95 | 3662.34 |
| 685 | 988088.4 | 443409.7 | Fall River | 595 | 3627.85 | 3630.35 | **3666.88** | 3642.12 | 3642.58 | Not Measured | 3645.51 | 3646.14 |
| 686 | 1003368.77 | 429749.56 | Lakota | 428 | 3692.06 | 3692.06 | Not Measured | 3661.23 | 3661.52 | 3661.56 | 3661.48 | 3661.96 |
| 687 | 988480.18 | 443724.72 | Fall River | 608 | 3623.84 | 3624.79 | Not Measured | 3641.48 | 3641.58 | Not Measured | 3643.99 | 3644.39 |
| 688 | 1003425.8 | 429974.4 | Fall River | 255 | 3701.26 | 3701.26 | 3663.36 | 3662.81 | 3663.09 | 3663.08 | 3663.06 | 3663.37 |
| 689 | 988715 | 443789.2 | Lakota | 730 | 3627.27 | 3629.69 | 3684.72 | 3684.1 | **3678.86** | Not Measured | 3684.23 | 3683.99 |
| 691 | 988762.9 | 443698.4 | Fall River | 505 | 3628.88 | 3630.29 | 3646.65 | 3643.51 | 3643.58 | Not Measured | Not Measured | 3646.12 |
| 692 | 1003474.48 | 430014.33 | Lakota | 335 | 3704.98 | 3704.98 | Not Measured | 3663.21 | 3663.54 | 3663.57 | 3663.54 | 3663.83 |
| 694 | 997116.1 | 426836.1 | Fall River | 392 | 3598.29 | 3600.69 | **3660.25** | 3640.12 | 3641.29 | 3641.2 | 3641.28 | 3641.64 |
| 695 | 990783.4 | 439312.5 | Fall River | 508 | 3597.8 | 3599.12 | **3638.98** | 3634.18 | 3633.64 | 3634.95 | 3634.42 | 3634.95 |
| 696 | 996936.6 | 427141.5 | Lakota | 587 | 3597.96 | 3599.91 | **3641.09** | 3649.16 | 3649.78 | 3649.6 | 3649.58 | 3650.74 |
| 697 | 990748.4 | 439347.4 | Lakota | 682 | 3597.69 | 3600.3 | 3679.68 | 3675.76 | 3670.51 | 3678.16 | 3672.58 | 3672.69 |
| 698 | 1004307.8 | 435651.1 | Fall River | 205 | 3714.25 | 3714.25 | 3679.28 | 3679.45 | 3679.38 | 3679.22 | 3679.21 | 3679.35 |
| 705 | 997022.63 | 453314.89 | Lakota | 460 | 3826.42 | 3826.42 | Not Measured | 3709.77 | 3709.62 | 3709.41 | 3709.53 | 3709.64 |
| 706 | 996887.91 | 453276.44 | Fall River | 316 | 3824.32 | 3824.32 | Not Measured | 3725.19 | 3725.32 | 3725.1 | 3725.29 | 3725.15 |
| 3026 | 1012037.4 | 432833.2 | Lakota | 196 | 3820.48 | 3820.48 | 3680.3 | 3680.89 | 3680.78 | 3680.38 | 3680.46 | 3680.58 |

BOLD = OUTLIERS

| Hydro ID | Township | Range | Section | 1/4 - 1/4 Location | Coordinates East | Coordinates North | Screened Location | Well Use | Status | Flow Rate (GPM) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7 | 1 | 9 | SESE | 1027696 | 429227 | Chilson | Stock | Flowing | 1.5 | |
| 2 | 7 | 1 | 16 | SESE | 1026724 | 423922 | Chilson | Domestic | | 4.11 | |
| 3 | 7 | 1 | 22 | SWNW | 1028593 | 421104 | Chilson | Stock | Flowing | 3 | |
| 4 | 7 | 1 | 15 | SESE | 1032516 | 423080 | Unknown | Stock | Flowing | 5 | |
| 5 | 7 | 1 | 14 | NENW | 1035181 | 427284 | Chilson | Stock | Flowing | 1.5 | |
| 6 | 7 | 1 | 14 | NESE | 1037218 | 425012 | Unknown | Stock | | | |
| 7 | 7 | 1 | 23 | NWNW | 1033304 | 422417 | Fall River | Domestic | | 0.056 | 2 X 40 GPD (Est) |
| 8 | 7 | 1 | 23 | SWSE | 1036052 | 418515 | Fall River | Domestic | | 0.14 | 5 X 40 GPD (Est) |
| 9 | 7 | 1 | 23 | NENE | 1038003 | 421806 | Fall River | Stock | Flowing | 3 | |
| 12 | 7 | 1 | 4 | SESE | 1026978 | 434378 | Chilson | Stock | Flowing | 3.3 | |
| 13 | 7 | 1 | 3 | NWNW | 1028360 | 438470 | Chilson | Domestic | | 0.085 | 1 X 123 GPD (Est) |
| 14 | 7 | 1 | 2 | NWSW | 1033704 | 434723 | Fall River | Stock | | | |
| 15 | 7 | 1 | 2 | NENW | 1035304 | 438317 | Chilson | Stock | | | |
| 16 | 7 | 1 | 1 | NESW | 1041428 | 434446 | Chilson | Domestic | | | Not In Use |
| 17 | 7 | 1 | 12 | SENW | 1040223 | 431329 | Fall River | Stock | | | Windmill - Not In Use |
| 18 | 7 | 1 | 9 | SWSW | 1022812 | 428960 | Fall River | Domestic | | 6 | |
| 37 | 7 | 2 | 18 | NWSW | 1044183 | 423947 | Unknown | Stock | | 2.5 | |
| 38 | 6 | 1 | 33 | SWNW | 1024328 | 442289 | Fall River | Stock | Flowing | 1.5 | |
| 40 | 6 | 1 | 30 | SWNW | 1013415 | 447182 | Inyan Kara | Domestic | | | Not In Use |
| 41 | 6 | 1 | 31 | SWNE | 1015385 | 442081 | Unknown | Stock | | | Not In Use |
| 42 | 7 | 1 | 5 | SWNE | 1021144 | 436481 | Chilson | Domestic | | 16.2 | |
| 43 | 6 | 1 | 34 | SWSE | 1031123 | 439436 | Chilson | Domestic | | | Not In Use |
| 49 | 6 | 1 | 32 | NWNW | 1018932 | 444022 | Fall River | Stock | Flowing | 1.2 | |
| 51 | 7 | 1 | 9 | SENE | 1027411 | 431487 | Chilson | Stock | Flowing | 12.9 | |
| 61 | 7 | 1 | 11 | NWSE | 1036832 | 429987 | Chilson | Stock | | | |
| 96 | 41 | 60 | 22 | SWSW | 1011630 | 451853 | Chilson | Domestic | | 0.11 | 4 X 40 GPD |
| 102 | 6 | 1 | 18 | SWNE | 1016825 | 458312 | Chilson | Domestic | | 1.5 | 2 Residents & 2 Gardens |
| 106 | 6 | 1 | 18 | NENE | 1018099 | 459625 | Unknown | Stock | | | |
| 107 | 6 | 1 | 18 | SWNE | 1017018 | 458158 | Fall River | Domestic | | | Not In Use |
| 108 | 6 | 1 | 18 | SWNE | 1016478 | 458698 | Fall River | Domestic | | | Not In Use |
| 109 | 6 | 1 | 17 | NENW | 1020801 | 459625 | Chilson | Domestic | | 0.085 | 1 X 123 GPD (Est) |
| 110 | 6 | 1 | 17 | NENE | 1023777 | 459643 | Chilson | Stock | | | |
| 111 | 6 | 1 | 17 | NWNE | 1022074 | 459586 | Fall River | Stock | | | |
| 112 | 6 | 1 | 16 | SESE | 1027864 | 455881 | Fall River | Stock | | | Windmill - Not In Use |
| 113 | 7 | 2 | 6 | NESW | 1046437 | 434417 | Unknown | Stock | | | Not In Use |
| 114 | 7 | 2 | 7 | SESW | 1045410 | 428654 | Unkpapa | Stock | | 0.56 | 40 cows X 20 GPD |
| 115 | 6 | 1 | 18 | SENE | 1017697 | 457640 | Fall River | Domestic | | 0.17 | 2 X 123 GPD |
| 116 | 6 | 1 | 18 | SENE | 1017992 | 458111 | Fall River | Stock | Flowing | 1.5 | Dewey Post Office |

| Hydro ID | Township | Range | Section | 1/4 - 1/4 Location | Coordinates East | Coordinates North | Screened Location | Well Use | Status | Flow Rate (GPM) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 117 | 6 | 1 | 8 | SWSE | 1022177 | 460796 | Unknown | Stock | | | Not In Use |
| 138 | 6 | 1 | 18 | NENE | 1017537 | 459030 | Fall River | Domestic | | 0.75 | 2 Residents & 10 Horses |
| 147 | 6 | 1 | 17 | NESW | 1020879 | 456566 | Chilson | Monitor | | | |
| 220 | 6 | 1 | 19 | SENE | 1017872 | 452334 | Unknown | Stock | Flowing | 0.2 | |
| 270 | 6 | 1 | 19 | NWSW | 1014108 | 451942 | Unknown | Stock | Flowing | 0.8 | |
| 436 | 6 | 1 | 20 | NWNE | 1021450 | 454700 | Fall River | Monitor | | | |
| 506 | 7 | 2 | 8 | SWNW | 1050129 | 430704 | Unkpapa | Stock | | | |
| 510 | 7 | 1 | 12 | SESE | 1042933 | 428178 | Chilson | Stock | | | |
| 609 | 6 | 1 | 29 | SWNE | 1021735 | 447808 | Chilson | Monitor | | | |
| 610 | 6 | 1 | 29 | SWNE | 1021599 | 447969 | Fall River | Monitor | | | |
| 611 | 6 | 1 | 20 | NWNE | 1021835 | 453954 | Chilson | Monitor | | | |
| 612 | 6 | 1 | 20 | NWNE | 1021755 | 454128 | Chilson | Monitor | | | |
| 613 | 6 | 1 | 20 | NWNE | 1022125 | 453775 | Fall River | Monitor | | | |
| 614 | 6 | 1 | 20 | NWNE | 1022185 | 453769 | Fuson | Monitor | | | |
| 615 | 6 | 1 | 20 | NWNE | 1022172 | 453708 | Chilson | Monitor | | | |
| 616 | 6 | 1 | 20 | SWNE | 1022132 | 453134 | Chilson | Monitor | | | |
| 617 | 6 | 1 | 20 | NENW | 1021026 | 453582 | Chilson | Monitor | | | |
| 618 | 7 | 1 | 2 | SENE | 1038074 | 435906 | Unknown | Stock | | | |
| 619 | 7 | 1 | 2 | SENW | 1034866 | 436729 | Chilson | Stock | | | |
| 620 | 6 | 1 | 35 | NWNW | 1033951 | 443209 | Chilson | Stock | | | |
| 622 | 6 | 1 | 20 | NENE | 1022776 | 454033 | Chilson | Monitor | | | |
| 623 | 6 | 1 | 20 | NENE | 1022686 | 454311 | Fall River | Monitor | | | |
| 628 | 6 | 1 | 20 | SESE | 1022496 | 449718 | Fall River | Stock | | | |
| 631 | 6 | 1 | 23 | SWSW | 1034177 | 449309 | Fall River | Stock | | | |
| 635 | 7 | 1 | 14 | NENW | 1004085 | 427131 | Sundance | Monitor | | | |
| 637 | 7 | 1 | 11 | NESE | 1038075 | 430320 | Unknown | Monitor | | | |
| 638 | 7 | 1 | 2 | NENE | 1038269 | 437976 | Fall River | Monitor | | | |
| 639 | 7 | 2 | 7 | SENW | 1045704 | 430722 | Unknown | Stock | | | |
| 640 | 7 | 1 | 12 | SESE | 1043010 | 427965 | Unknown | Stock | | | |
| 642 | 7 | 1 | 12 | SESE | 1042926 | 428042 | Unknown | Stock | | | |
| 645 | 7 | 1 | 16 | NENE | 1027681 | 427998 | Unknown | Stock | | | |
| 650 | 7 | 1 | 1 | SESE | 1043781 | 433331 | Chilson | Stock | | | |
| 656 | 6 | 1 | 31 | SENW | 1014230 | 442000 | Unknown | Stock | Flowing | 6.25 | |
| 657 | 6 | 1 | 20 | NWNE | 1021483 | 454729 | Chilson | Monitor | | | |
| 662 | 7 | 1 | 11 | SESW | 1035381 | 428928 | Unknown | Monitor | | | |
| 668 | 7 | 1 | 15 | NWNE | 1031029 | 427450 | Inyan Kara | Stock | Flowing | 6.25 | Measured @ ST |
| 676 | 6 | 1 | 34 | SESW | 1030846 | 439891 | Alluvial | Monitor | | | |
| 677 | 7 | 1 | 4 | SWSW | 1023527 | 434077 | Alluvial | Monitor | | | |

| Hydro ID | Township | Range | Section | 1/4 - 1/4 Location | Coordinates East | Coordinates North | Screened Location | Well Use | Status | Flow Rate (GPM) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 678 | 7 | 1 | 9 | SWNE | 1026522 | 431925 | Alluvial | Monitor | | | |
| 679 | 6 | 1 | 27 | NWSE | 1032294 | 446245 | Alluvial | Monitor | | | |
| 680 | 7 | 1 | 11 | NESW | 1035078 | 429969 | Chilson | Monitor | | | |
| 681 | 6 | 1 | 32 | NENW | 1020330 | 443725 | Fall River | Monitor | Flowing | | Shut-In |
| 682 | 7 | 1 | 11 | SENW | 1035139 | 431257 | Chilson | Monitor | | | |
| 683 | 6 | 1 | 29 | NESW | 1020212 | 446104 | Fall River | Monitor | | | |
| 684 | 7 | 1 | 11 | NESW | 1035191 | 429744 | Chilson | Monitor | | | |
| 685 | 6 | 1 | 32 | NWNE | 1020690 | 443409 | Fall River | Monitor | Flowing | | Shut-In |
| 686 | 7 | 1 | 11 | NESW | 1034970 | 429749 | Chilson | Monitor | | | |
| 687 | 6 | 1 | 32 | NENW | 1020081 | 443724 | Fall River | Monitor | Flowing | | Shut-In |
| 688 | 7 | 1 | 11 | NESW | 1035027 | 429974 | Fall River | Monitor | | | |
| 689 | 6 | 1 | 32 | NENW | 1020316 | 443789 | Chilson | Monitor | Flowing | | Shut-In |
| 690 | 7 | 1 | 11 | NESW | 1035114 | 429970 | Unkpapa | Monitor | Flowing | | Shut-In |
| 691 | 6 | 1 | 32 | NENW | 1020364 | 443698 | Fall River | Monitor | Flowing | | Shut-In |
| 692 | 7 | 1 | 11 | NESW | 1035075 | 430014 | Chilson | Monitor | | | |
| 693 | 6 | 1 | 32 | NENW | 1020327 | 443661 | Unkpapa | Monitor | Flowing | | Shut-In |
| 694 | 7 | 1 | 15 | NWNW | 1028717 | 426836 | Fall River | Monitor | Flowing | | Shut-In |
| 695 | 6 | 1 | 32 | SESE | 1022385 | 439312 | Fall River | Monitor | Flowing | | Shut-In |
| 696 | 7 | 1 | 15 | NWNW | 1028538 | 427141 | Chilson | Monitor | Flowing | | Shut-In |
| 697 | 6 | 1 | 32 | SESE | 1022350 | 439347 | Chilson | Monitor | Flowing | | Shut-In |
| 698 | 7 | 1 | 2 | NESW | 1035909 | 435651 | Fall River | Monitor | | | |
| 703 | 7 | 1 | 1 | SWSE | 1041621 | 434334 | Unkpapa | Domestic | | | Not In Use |
| 704 | 7 | 1 | 5 | SWNE | 1020966 | 436647 | Chilson | Domestic | | 1.5 | 1 Resident & Stock (est) |
| 705 | 6 | 1 | 21 | NENE | 1028624 | 453314 | Chilson | Monitor | | | |
| 706 | 6 | 1 | 21 | NENE | 1028589 | 453276 | Fall River | Monitor | | | |
| 707 | 6 | 1 | 34 | SWNE | 1031935 | 441809 | Alluvial | Monitor | | | |
| 708 | 7 | 1 | 3 | SESW | 1030254 | 434094 | Alluvial | Monitor | | | |
| 709 | 7 | 1 | 15 | SENW | 1029286 | 426603 | Alluvial | Monitor | | | |
| 3026 | 7 | 1 | 12 | NENE | 1043638 | 432833 | Chilson | Monitor | | | |
| 4002 | 6 | 1 | 30 | NWSW | 1013414 | 446931 | Inyan Kara | Domestic | | 2.72 | |
| 7002 | 7 | 1 | 23 | NWNW | 1033333 | 421931 | Chilson | Stock | | 3.45 | |



POWERTECH (USA) INC.

| Hydro ID | Township | Range | Section | 1/4 - 1/4 Location | Coordinates East | Coordinates North | Screened Location | Well Use | Total Depth | Screened Interval | Screened Aquifer | Work to Complete |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7 | 1 | 9 | SESE | 1027696 | 429227 | Chilson | Stock | | | | 1 Inch Camera |
| 2 | 7 | 1 | 16 | SESE | 1026724 | 423922 | Chilson | Domestic | 650 | 566-650 | | Need Access, Artesian |
| 3 | 7 | 1 | 22 | SWNW | 1028593 | 421104 | Chilson | Stock | | | | 1 Inch Camera |
| 4 | 7 | 1 | 15 | SESE | 1032516 | 423080 | Unknown | Stock | | | | 1 Inch Camera & Access |
| 5 | 7 | 1 | 14 | NENW | 1035181 | 427284 | Fall River | Stock | 175 | 155-175 | Lower Fall River | Complete |
| 6 | 7 | 1 | 14 | NESE | 1037218 | 425012 | Unknown | Stock | 200 | 135-200 | | Complete |
| 7 | 7 | 1 | 23 | NWNW | 1033304 | 422417 | Fall River | Domestic | 200 | | | Need Access, Artesian |
| 8 | 7 | 1 | 23 | SWSE | 1036052 | 418515 | Fall River | Domestic | 240 | | | Need Access, Artesian |
| 9 | 7 | 1 | 23 | NENE | 1038003 | 421806 | Fall River | Stock | | | | 1 Inch Camera |
| 12 | 7 | 1 | 4 | SESE | 1026978 | 434378 | Chilson | Stock | 805 | | | 1 Inch Camera |
| 13 | 7 | 1 | 3 | NWNW | 1028360 | 438470 | Chilson | Domestic | 625 | 580-625 | | Complete |
| 14 | 7 | 1 | 2 | NWSW | 1033704 | 434723 | Fall River | Stock | 300 | | Lower Fall River | 1 Inch Camera |
| 15 | 7 | 1 | 2 | NENW | 1035304 | 438317 | Chilson | Stock | | | | Ready, Dry Hole |
| 16 | 7 | 1 | 1 | NESW | 1041428 | 434446 | Chilson | Domestic | 330 | | | Remove Shed |
| 17 | 7 | 1 | 12 | SENW | 1040223 | 431329 | Fall River | Stock | | | | Need Access, Pull Windmill |
| 18 | 7 | 1 | 9 | SWSW | 1022812 | 428960 | Fall River | Domestic | 527 | | | Need Access |
| 37 | 7 | 2 | 18 | NWSW | 1044183 | 423947 | Fall River | Stock | 145 | 93-145 | Upper Fall River | Complete |
| 38 | 6 | 1 | 33 | SWNW | 1024328 | 442289 | Fall River | Stock | 494 | | | Pull Pump |
| 40 | 6 | 1 | 30 | SWNW | 1013415 | 447182 | Inyan Kara | Domestic | | | | 1 Inch Camera & Access |
| 41 | 6 | 1 | 31 | SWNE | 1015385 | 442081 | Unknown | Stock | | | | Need Access |
| 42 | 7 | 1 | 5 | SWNE | 1021144 | 436481 | Chilson | Domestic | 600 | | | Need Access, Artesian |
| 43 | 6 | 1 | 34 | SWSE | 1031123 | 439436 | Chilson | Domestic | | | | Need Access |
| 49 | 6 | 1 | 32 | NWNW | 1018932 | 444022 | Fall River | Stock | 600 | 475-540 | Upper Fall River | Complete |
| 51 | 7 | 1 | 9 | SENE | 1027411 | 431487 | Chilson | Stock | | | | Need Access |
| 61 | 7 | 1 | 11 | NWSE | 1036832 | 429987 | Chilson | Stock | | | | Ready |
| 96 | 41 | 60 | 22 | SWSW | 1011630 | 451853 | Chilson | Domestic | | | | Need Access |
| 102 | 6 | 1 | 18 | SWNE | 1016825 | 458312 | Chilson | Domestic | | | | Need Access |
| 106 | 6 | 1 | 18 | NENE | 1018099 | 459625 | Unknown | Stock | 196 | 160-196 | | Complete |
| 107 | 6 | 1 | 18 | SWNE | 1017018 | 458158 | Fall River | Domestic | | | | Need Access |
| 108 | 6 | 1 | 18 | SWNE | 1016478 | 458698 | Fall River | Domestic | | | | Need Access |
| 109 | 6 | 1 | 17 | NENW | 1020801 | 459625 | Chilson | Domestic | | | | Need Access |
| 110 | 6 | 1 | 17 | NENE | 1023777 | 459643 | Chilson | Stock | | | | Need Access |
| 111 | 6 | 1 | 17 | NWNE | 1022074 | 459586 | Fall River | Stock | | | | Need Access |
| 112 | 6 | 1 | 16 | SESE | 1027864 | 455881 | Fall River | Stock | | | | Need Access, Pull Windmill |
| 113 | 7 | 2 | 6 | NESW | 1046437 | 434417 | Unknown | Stock | | | | Need Access, Pull Windmill |
| 114 | 7 | 2 | 7 | SESW | 1045410 | 428654 | Unkpapa | Stock | | | | Need Access, Pull Windmill |
| 115 | 6 | 1 | 18 | SENE | 1017697 | 457640 | Fall River | Domestic | | | | Need Access |
| 116 | 6 | 1 | 18 | SENE | 1017992 | 458111 | Fall River | Stock | | | | Need Access |
| 117 | 6 | 1 | 8 | SWSE | 1022177 | 460796 | Unknown | Stock | | | | Pull Pump |
| 138 | 6 | 1 | 18 | NENE | 1017537 | 459030 | Fall River | Domestic | | | | Need Access |
| 147 | 6 | 1 | 17 | NESW | 1020879 | 456566 | Chilson | Monitor | 750 | 650-750 | | Complete |
| 220 | 6 | 1 | 19 | SENE | 1017872 | 452334 | Unknown | Stock | | 463-523+ | Upper Fall River | Complete |
| 270 | 6 | 1 | 19 | NWSW | 1014108 | 451942 | Unknown | Stock | | | | 1 Inch Camera |

By Mike Beehore, Powertech (USA) Inc.

October 4, 2011

| Hydro ID | Township | Range | Section | 1/4 - 1/4 Location | Coordinates East | Coordinates North | Screened Location | Well Use | Total Depth | Screened Interval | Screened Aquifer | Work to Complete |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 436 | 6 | 1 | 20 | NWNE | 1021450 | 454700 | Fall River | Monitor | 590 | 505-590 | Lower Fall River | Complete |
| 506 | 7 | 2 | 8 | SWNW | 1050129 | 430704 | Unkpapa | Stock |  |  |  | Ready |
| 510 | 7 | 1 | 12 | SESE | 1042933 | 428178 | Chilson | Stock |  |  |  | Need Access, Pull Pump |
| 609 | 6 | 1 | 29 | SWNE | 1021735 | 447808 | Chilson | Monitor | 1000 | 903-966 | Lower Chilson | Complete |
| 610 | 6 | 1 | 29 | SWNE | 1021599 | 447969 | Fall River | Monitor | 680 | 630-672 | Lower Fall River | Complete |
| 611 | 6 | 1 | 20 | NWNE | 1021835 | 453954 | Chilson | Monitor | 804 | 695-730,<br>755-800 | Middle Chilson,<br>Lower Chilson | Complete |
| 612 | 6 | 1 | 20 | NWNE | 1021755 | 454128 | Chilson | Monitor | 800 | 692-800 | Lower Chilson | Complete |
| 613 | 6 | 1 | 20 | NWNE | 1022125 | 453775 | Fall River | Monitor | 580 | 504-580 | Lower Fall River | Complete |
| 614 | 6 | 1 | 20 | NWNE | 1022185 | 453769 | Fuson | Monitor | 620 | 609-620 | Fuson | Complete |
| 615 | 6 | 1 | 20 | NWNE | 1022172 | 453708 | Chilson | Monitor | 800 | 712-800 | Lower Chilson | Complete |
| 616 | 6 | 1 | 20 | SWNE | 1022132 | 453134 | Chilson | Monitor | 835 | 735-835 | Lower Chilson | Complete |
| 617 | 6 | 1 | 20 | NENW | 1021026 | 453582 | Chilson | Monitor | 810 | 715-810 | Lower Chilson | Complete |
| 618 | 7 | 1 | 2 | SENE | 1038074 | 435906 | Unknown | Stock |  |  |  | Complete |
| 619 | 7 | 1 | 2 | SENW | 1034866 | 436729 | Chilson | Stock | 288 | 230-288 | Upper Chilson | Pull Pump |
| 620 | 6 | 1 | 35 | NWNW | 1033951 | 443209 | Chilson | Stock |  |  |  | Need Access, Pull Pump |
| 622 | 6 | 1 | 20 | NENE | 1022776 | 454033 | Chilson | Monitor | 780 | 714-780 | Lower Chilson | Complete |
| 623 | 6 | 1 | 20 | NENE | 1022686 | 454311 | Fall River | Monitor | 580 | 503-580 | Lower Fall River | Complete |
| 628 | 6 | 1 | 20 | SESE | 1022496 | 449718 | Fall River | Stock | 520 |  | Upper Fall River | Need Access, Pull Pump |
| 631 | 6 | 1 | 23 | SWSW | 1034177 | 449309 | Fall River | Stock | 80 | 30-80 | Lower Fall River | Need Access, Pull Pump |
| 635 | 7 | 1 | 14 | NENW | 1004085 | 427131 | Sundance | Monitor |  |  |  | Not A Well |
| 637 | 7 | 1 | 11 | NESE | 1038075 | 430320 | Unknown | Monitor |  |  |  | 1 Inch Camera |
| 638 | 7 | 1 | 2 | NENE | 1038269 | 437976 | Fall River | Monitor |  |  |  | Plugged?, Need to Verify |
| 639 | 7 | 2 | 7 | SENW | 1045704 | 430722 | Unknown | Stock |  |  |  | Ready, Hand Dug Well |
| 640 | 7 | 1 | 12 | SESE | 1043010 | 427965 | Unknown | Stock |  |  |  | Pull Pump |
| 642 | 7 | 1 | 12 | SESE | 1042926 | 428042 | Alluvial | Stock | 33 | 12-33 | Alluvial | Complete |
| 645 | 7 | 1 | 16 | NENE | 1027681 | 427998 | Unknown | Stock |  |  |  | Need Access, Pull Pump |
| 650 | 7 | 1 | 1 | SESE | 1043781 | 433331 | Chilson | Stock |  |  |  | Pull Pump |
| 656 | 6 | 1 | 31 | SENW | 1014230 | 442000 | Unknown | Stock |  |  |  | Remove Shed to Access |
| 657 | 6 | 1 | 20 | NWNE | 1021483 | 454729 | Chilson | Monitor | 800 | 715-800 | Lower Chilson | Complete |
| 662 | 7 | 1 | 11 | SESW | 1035381 | 428928 | Unknown | Monitor |  |  |  | 1 Inch Camera |
| 668 | 7 | 1 | 15 | NWNE | 1031029 | 427450 | Inyan Kara | Stock | 550 | 300-350,<br>495-550 | Lower Fall River,<br>Lower Chilson | Complete |
| 676 | 6 | 1 | 34 | SESW | 1030846 | 439891 | Alluvial | Monitor | 22.5 | 12-22 | Alluvial | Complete |
| 677 | 7 | 1 | 4 | SWSW | 1023527 | 434077 | Alluvial | Monitor | 14.5 | 4-14 | Alluvial | Complete |
| 678 | 7 | 1 | 9 | SWNE | 1026522 | 431925 | Alluvial | Monitor | 14.5 | 4-14 | Alluvial | Complete |
| 679 | 6 | 1 | 27 | NWSE | 1032294 | 446245 | Alluvial | Monitor | 39 | 29-39 | Alluvial | Complete |
| 680 | 7 | 1 | 11 | NESW | 1035078 | 429969 | Chilson | Monitor | 436 | 426-436 | Lower Chilson | Complete |
| 681 | 6 | 1 | 32 | NENW | 1020330 | 443725 | Fall River | Monitor | 600 | 585-600 | Lower Fall River | Complete |
| 682 | 7 | 1 | 11 | SENW | 1035139 | 431257 | Chilson | Monitor | 460 | 450-460 | Lower Chilson | Complete |
| 683 | 6 | 1 | 29 | NESW | 1020212 | 446104 | Fall River | Monitor | 650 | 635-650 | Lower Fall River | Complete |
| 684 | 7 | 1 | 11 | NESW | 1035191 | 429744 | Chilson | Monitor | 423 | 413-423 | Lower Chilson | Complete |
| 685 | 6 | 1 | 32 | NWNE | 1020690 | 443409 | Fall River | Monitor | 595 | 580-595 | Lower Fall River | Complete |

| Hydro ID | Township | Range | Section | 1/4 - 1/4 Location | Coordinates East | Coordinates North | Screened Location | Well Use | Total Depth | Screened Interval | Screened Aquifer | Work to Complete |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 686 | 7 | 1 | 11 | NESW | 1034970 | 429749 | Chilson | Monitor | 428 | 418-428 | Lower Chilson | Complete |
| 687 | 6 | 1 | 32 | NENW | 1020081 | 443724 | Fall River | Monitor | 608 | 593-608 | Lower Fall River | Complete |
| 688 | 7 | 1 | 11 | NESW | 1035027 | 429974 | Fall River | Monitor | 255 | 245-255 | Lower Fall River | Complete |
| 689 | 6 | 1 | 32 | NENW | 1020316 | 443789 | Chilson | Monitor | 730 | 715-730 | Middle Chilson | Complete |
| 690 | 7 | 1 | 11 | NESW | 1035114 | 429970 | Unkpapa | Monitor | 631 | 621-631 | Unkpapa | Complete |
| 691 | 6 | 1 | 32 | NENW | 1020364 | 443698 | Fall River | Monitor | 505 | 490-505 | Upper Fall River | Complete |
| 692 | 7 | 1 | 11 | NESW | 1035075 | 430014 | Chilson | Monitor | 335 | 325-335 | Upper Chilson | Complete |
| 693 | 6 | 1 | 32 | NENW | 1020327 | 443661 | Unkpapa | Monitor | 930 | 910-930 | Unkpapa | Complete |
| 694 | 7 | 1 | 15 | NWNW | 1028717 | 426836 | Fall River | Monitor | 392 | 377-392 | Lower Fall River | Complete |
| 695 | 6 | 1 | 32 | SESE | 1022385 | 439312 | Fall River | Monitor | 508 | 493-508 | Lower Fall River | Complete |
| 696 | 7 | 1 | 15 | NWNW | 1028538 | 427141 | Chilson | Monitor | 587 | 572-587 | Middle Chilson | Complete |
| 697 | 6 | 1 | 32 | SESE | 1022350 | 439347 | Chilson | Monitor | 682 | 667-682 | Middle Chilson | Complete |
| 698 | 7 | 1 | 2 | NESW | 1035909 | 435651 | Fall River | Monitor | 205 | 180-205 | Lower Fall River | Complete |
| 703 | 7 | 1 | 1 | SWSE | 1041621 | 434334 | Unkpapa | Domestic | 525 | 475-525 | Unkpapa | Complete |
| 704 | 7 | 1 | 5 | SWNE | 1020966 | 436647 | Chilson | Domestic |  |  |  | Complete |
| 705 | 6 | 1 | 21 | NENE | 1028624 | 453314 | Chilson | Monitor | 460 | 428-458 | Middle Chilson | Complete |
| 706 | 6 | 1 | 21 | NENE | 1028589 | 453276 | Fall River | Monitor | 316 | 284-314 | Lower Fall River | Complete |
| 707 | 6 | 1 | 34 | SWNE | 1031935 | 441809 | Alluvial | Monitor | 44 | 30-40 | Alluvial | Complete |
| 708 | 7 | 1 | 3 | SESW | 1030254 | 434094 | Alluvial | Monitor | 28 | 17-27 | Alluvial | Complete |
| 709 | 7 | 1 | 15 | SENW | 1029286 | 426603 | Alluvial | Monitor | 40 | 28-38 | Alluvial | Complete |
| 3026 | 7 | 1 | 12 | NENE | 1043638 | 432833 | Chilson | Monitor | 196 | 166-196 | Middle Chilson | Complete |
| 4002 | 6 | 1 | 30 | NWSW | 1013414 | 446931 | Inyan Kara | Domestic |  |  |  | Need Access, 1 Inch Camera |
| 7002 | 7 | 1 | 23 | NWNW | 1033333 | 421931 | Chilson | Stock | 500 |  |  | Need Access, Artesian |

# Powertech (USA) Inc.

## Standard Operating Procedure (SOP)

## Groundwater Well Water Level Monitoring

This SOP outlines procedures for measuring and documenting artesian and sub-surface water levels within groundwater monitoring wells.

**Materials:**

- Powertech Groundwater Well Monitoring Data Sheet.
- Electric Logging Water Level Measuring Tape.
- High-Resolution Digital Pressure Gauge.
- Tape Measure with 1/100th foot accuracy.

**Personal Protective Equipment (PPE):**

- Several potential hazards exist during groundwater well water level monitoring. These include but are limited to pinch-points, pressure, slip/trip/fall, and environmental hazards. Appropriate PPE must always be utilized when conducting groundwater well water level monitoring.

**Documentation:**

- The person conducting the groundwater well monitoring must completely and accurately fill out the Groundwater Well Monitoring Data Sheet.
- The person conducting the groundwater well monitoring must read and sign the SOP for Groundwater Well Water Level Monitoring. A copy of the signed SOP should be filed at the nearest Powertech Field Office. A copy of the SOP must accompany the person conducting the monitoring in the field.

**Procedures:**

1. Completely fill in the Powertech Groundwater Well Monitoring Data Sheet.
2. Procedure for pressurized artesian groundwater wells.
   a. Fully shut-in the artesian groundwater well so that there are no leaks that result in the loss of artesian pressure. This may require some tightening or replacement of plumbing fixtures. A closable valve should be fitted to the well head that allows the attachment of the high-resolution digital pressure gauge. This valve and other plumbing fittings should not be removed, so that future measurements can be conducted at the same elevation.
   b. Make sure that all air has been evacuated from the artesian groundwater well. The high-resolution digital pressure gauge can now be installed and turned on. Make sure that the gauge has been reset, or zeroed out.

   c. Take an initial pressure measurement in pounds/square-inch (PSI) and document the measurement and time on the Powertech Groundwater Well Monitoring Data Sheet. Pressure measurements should be taken with an accuracy of 0.01 PSI.
   d. Continue to take and document pressure measurements until the artesian water well pressure has stabilized. A stabilized artesian pressure measurement is defined as one of the following:
      a. A pressure measurement that reaches a maximum value, and then slightly decreases, but does not exceed the maximum documented value within a period of 15 minutes.
      b. If the pressure measurements DO NOT fluctuate more than 0.04 PSI (or 0.1 feet of water head) over 3 measurements within a 15 minute time period.
   e. Make sure to measure the vertical distance between the surveyed control point (Top of Casing or Survey Pin) and the pressure sensor diaphragm on the pressure gauge. This measurement must be taken with an accuracy of 1/100th of a foot.
3. Procedure for sub-surface water level groundwater wells.
   a. Lower the probe of an Electric Logging Water Level Measuring Tape into the groundwater well, and lower at a slow rate. Be careful not to let the probe and tape unwind too quickly as they may come free of the spool and be lost into the well.
   b. Also make sure that the probe sensitivity is adequately adjusted. The deeper the water is in the well, the less sensitivity the probe will require. This is important as condensation in the well could give false readings of the water level in the well.
   c. Measure and document the depth to the water in the well from the top of the well casing. This measurement must be logged with an accuracy of 1/100th of a foot. Make sure to take several measurements to ensure an accurate final water level.

I certify that I have read and understand the content of this Standard Operating Procedure.

Employee Signature: ______________________________ Date: ______________

# SOURCE F

# RESPEC RESPONSES TO NUCLEAR REGULATORY COMMISSION COMMENTS (REVISION 1)

(Letter from Crystal Hocking, RESPEC, to Mark Hollenbeck, Powertech (USA) Inc., July 22, 2010)

RESPEC
WATER & NATURAL RESOURCES

RSI(RCO)-1853/7-10/20

# External Memorandum

**To:** Mr. Mark Hollenbeck
Powertech (USA) Inc.
310 2nd Avenue
P.O. Box 812
Edgemont, SD 57735

**cc:** Mr. John Mays, Powertech
Mr. Cory Foreman, RESPEC
Project Central File 1853 — Category A

**From:** Ms. Crystal Hocking
Staff Geologist
RESPEC
P.O. Box 725
Rapid City, SD 57709

**Date:** July 22, 2010

**Subject:** Responses to Nuclear Regulatory Commission Comments (Revision 1)

The purpose of this memorandum is to respond to the five tasks designated by Powertech to help respond to Nuclear Regulatory Commission (NRC) comments regarding the technical report. These tasks were outlined by Mr. John Mays and you at a meeting with RESPEC on June 24, 2010.

## Task 1. Check Well 650 and Compare Water Level to Depth to Lakota to Determine Saturated/Unsaturated Conditions at That Location

In an effort to help identify areas where the Lakota Formation is fully saturated, water level measurements of Lakota wells were compared to the elevation of the top of the aquifer. Tables 1 and 2 include well completion and water level measurements for Wells 650, 3026, and 619. Well locations are shown on Figure 1.

The elevation of the top of the Lakota at Well 650, 3,775 feet, was approximated by interpolating the known depth to Lakota at Well 3026 with the location of the outcrop (where the depth equals 0). The average water level measurement is at 3,682 feet elevation, or 92 feet below the approximate top of the Lakota. At the location of Well 3026 (DB08-01-06), the water level is approximately 60 feet below the top of the Lakota Formation. At both of these wells, the Lakota is only partially saturated. At Well 619, the water level in the Lakota is approximately 300 feet above the top of the Lakota Aquifer based on estimates of the Lakota elevation from the sitewide structural contour maps; here the Lakota is fully saturated.

— DRAFT —

### Table 1. Well Completion for Wells 650, 3026, and 619

| **Hydro I.D. or Hydro Code** | 650 | 3026 | 619 |
|---|---|---|---|
| **Powertech Borehole I.D.** | | DB08-01-06 | |
| **Formation** | Lakota | Lakota | Lakota |
| **Subsurface (SS) or Free-Flowing (FF)** | SS | SS | SS |
| **Depth (ft)** | Unknown | 196 | 280 |
| **Screened Interval (ft)** | Unknown | 166–196 | Unknown |
| **Measuring Point** | Top of 8-inch steel casing | Top of 6-inch casing pipe | Top of 5-inch steel coupling on casing |
| **Surveyed Well Casing Elevation (ft)** | | 3,820.48 | 3,700.12 |
| **Stick Up (Well Casing Mark) (ft)** | | –0.20 | 0.00 |
| **Surveyed Control Point Elevation (ft)** | 3,821.06 | | 3,698.82 |
| **Stick Up (Control Point) (ft)** | –0.56 | | |
| **Calculated Measuring Point Elevation (ft)** | 3,821.62 | 3,820.68 | 3,700.12 |

In an effort to better delineate where the Lakota Aquifer becomes fully saturated, RESPEC recommends Powertech acquire water levels from two or three additional Lakota wells in close proximity to the outcrop. Recommended wells include Wells 16, 61, and/or 620 (Figure 1). None of these wells have well completion reports, although they are listed in Tennessee Valley Authority (TVA) reports as being completed within the Lakota. Well 16 is listed in the TVA draft Environmental Impact Statement (EIS) as having a water elevation of 3,747 feet, and based on approximations from structure contour maps, the elevation of the Lakota is 3,730 feet or just below the water level of the Lakota. Based on this information alone, it appears that Well 16 is at or very near the area where the Lakota Aquifer becomes fully saturated. From this, it is reasonable to assume that the transition from saturated to unsaturated conditions in the Lakota is located geographically in the central to western portion of the Fall River Formation outcrop. However, because of fluctuations in the water table with time and precipitation patterns, it is highly recommended to take a new water level measurement at Well 16, the only Lakota well located on the Fall River outcrop.

## Task 2. Check Field Notes to Verify Data on Existing Potentiometric Surfaces Is Correct

Water level data for wells with questionable data were spot checked to compare field notes with the tabular data. An explanation of the results is provided in the following sections.

— DRAFT —

### Table 2. Water Level Measurements for Wells 650, 3026, and 619

| **Hydro I.D. or Hydro Code** | 650 | 3026 | 619 |
|---|---|---|---|
| **Powertech Borehole I.D.** | | DB08-01-06 | |
| **Date** | **ft above mean sea level** | | |
| 2007-09-27 | | | 3,679.13 |
| 2007-10-02 | 3,682.35 | | |
| 2007-11-09 | 3,682.35 | | 3,679.19 |
| 2008-02-20 | 3,682.13 | | |
| 2008-03-24 | 3,681.92 | | |
| 2008-03-30 | | 3,681.89 | |
| 2008-04-22 | | 3,681.77 | |
| 2008-05-21 | | 3,682.13 | |
| 2008-05-28 | | 3,681.73 | |
| 2008-05-30 | 3,682.00 | | |
| 2008-06-24 | | 3,681.85 | |
| 2008-07-13 | | 3,681.78 | |
| 2008-08-19 | | 3,681.63 | |
| 2008-09-22 | | 3,681.78 | |
| 2008-10-20 | | 3,681.83 | |
| 2008-11-18 | | 3,681.85 | |
| 2008-12-17 | | 3,682.50 | |
| 2009-01-20 | | 3,682.53 | |
| 2009-02-24 | | 3,682.50 | |
| Number | 5 | 13 | 2 |
| Mean Water Level Elevation | **3,682** | **3,682** | **3,679** |
| Elevation of Top Lakota | **3,775**(a) | **3,741** | **3,375** |
| Difference(b) | **-92** | **-59** | **304** |

(a) Based on interpolation.

(b) Negative value indicates Lakota Aquifer is unsaturated at well location. Positive value indicates Lakota Aquifer is saturated at well location.

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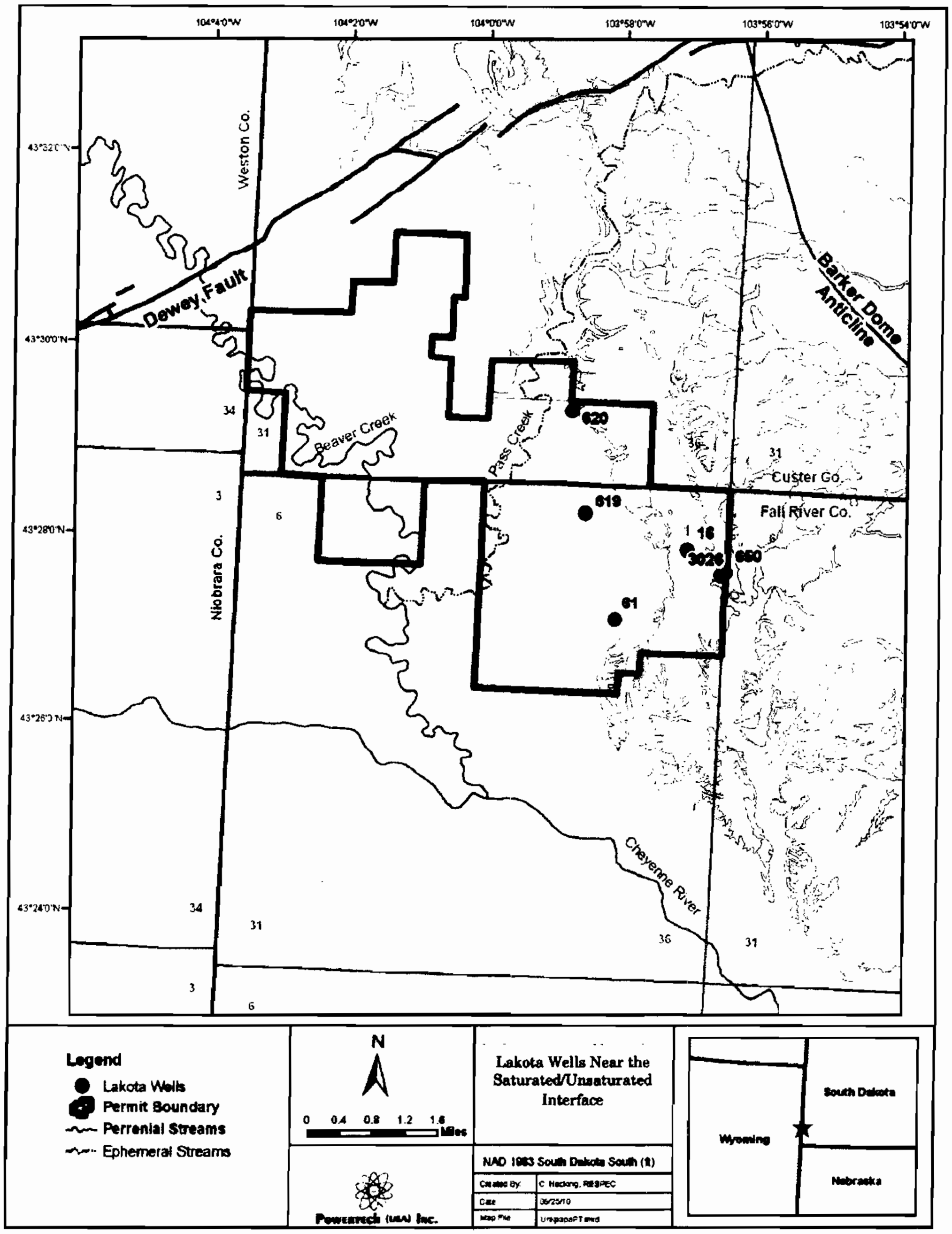

**Figure 1. Lakota Wells Near the Saturated/Unsaturated Interface.**

**— DRAFT —**

## Fall River Aquifer

*Well 613 and Well 622.* These two wells are both completed to similar depth in the Fall River Formation (well completion reports available) and are located about 700 feet apart. Both wells have a total depth of 580 feet and similar surface elevation with well 613 screened between 504 and 580 feet and well 622 screened between 503 and 580 feet. The average water levels reported on Figure 2.7-14 of the NRC technical report (TR) are correct as compared to original field notes. These two wells have a difference in head of about 8 feet based on recent averages (3,701 and 3,709 feet elevation, respectively); at the time these wells were drilled, they also exhibited a difference of 8 feet (3,711 and 3,719 feet elevation). The difference in head between these two closely spaced wells is likely the result of minor differences in lithology and permeability of the aquifer.

*Well 695.* The mean water elevation for this well is 3,632 feet and is correct as presented on Figure 2.7-14 of the NRC TR. The pressure has a mean average of 12 pounds per square inch (psi) with individual measurements that range from 12.7 to 13.8 psi. As in all free-flowing wells, psi is converted to feet by the formula:

$$\text{Feet } H_2O \text{ above measuring point} = \text{psi} \times \left(144\,\text{in}^2/\text{ft}^2\right) \times \left(\text{ft}^3/62.43\,\text{lb}\right). \qquad (1)$$

## Lakota Aquifer

*Well 8002.* This Lakota stock well has an average elevation of 3,578 feet as presented on Figure 2.7-15 of the TR. This value was not used while generating the water level contours for several reasons. First, this well is a free-flowing artesian that was shut in during measurements; although no leaks were visible, it is possible that this well could not completely be shut in, as it is an older well with multiple fittings at the surface. Over the measurement time interval (September 2007 through February 2009), only 3 pressure measurements were made: 13, 15, and 14.65. Based on field notes, the value of 14.65 psi should be discarded as one of the lines froze during the stabilization period and the sampler was required by the landowner to open the valve to prevent well damage. It is also believed that the other two readings were potentially taken before the well had completely stabilized.

In generating the water level contours, Well 608 to the west was considered to have more reliable readings as this well is nonartesian and was measured with a water level tape. Water levels at Well 608 indeed exceeded estimates at Well 8002; that is unexpected and unlikely given the water gradient decreases toward the southwest. Water level data for Well 696, although not used in the generation of the original potentiometric surface, have an average value of 3,639 feet elevation; this value is extremely close to the potentiometric surface generated by ignoring the data from Well 8002. Therefore, it is our position that this decision to not use data from Well 8002 was sound. It is advisable to verify completion of this well and obtain additional water level measurements.

*Well 615.* Based on six measurements, the mean potentiometric surface at Well 615 is correctly reported at 3,690 feet elevation. A well completion report for this well is available to verify this well is completed into the Lakota.

— DRAFT —

*Well 609.* There are a total of 11 measurements for this well, all within ± 2 feet of each other. The value of 3,690 feet elevation on the existing potentiometric surface map is correct. A well completion report for this well is available to verify this well is completed into the Lakota. In addition, Well 610 (completed in the Fall River) is immediately adjacent to this well and has a comparable water level of 3,693 feet.

*Well 689.* This well was recently installed by Powertech as a monitoring well for the Dewey pump test. It is screened for 15 feet in the upper Lakota Formation. A total of 11 pressure measurements were collected from this well, ranging from 23 to 25 psi. The mean water level of 3,684 feet presented on the potentiometric surface is correct according to our database and field records.

*Well 38.* Based on the TVA EIS, this stock well is located in Sec. 33, T6S, R1E with a depth of 550 feet and completed in the Lakota. However, data from a well completion report (Figure 2) indicate this well has a depth of 494 feet. The surface elevation at this well is roughly 3,630 feet, making the depth of this well have an elevation of 3,136 feet (assuming the well completion report is correct). Based on structure contour maps, the bottom of the Fall River (top of Fuson) is around 3,130 feet. Based on the depth reported on the well completion form and the structural contour information based on exploration boreholes, this well is now believed to be completed in the Fall River Formation and not the Lakota Formation. The mean water elevation of 3,644 feet measured at this well could be used in the future to slightly modify the potentiometric surface for the Fall River Formation; the measured value is not unreasonable for the Fall River. Since this is a free-flowing well, it is also possible the water level could be higher than measured if shut in for a longer period of time. If potentiometric surfaces are redrawn in the near future, it is recommended to not include Well 38 on the Lakota surface. It is also recommended to log this well to verify completion.

### Task 3. Generate Map of Potentiometric Surfaces That has Wells Labeled by Well I.D.

Existing potentiometric surfaces for the Fall River, Lakota, and Unkpapa Aquifers are presented in Figures 3 through 6. Contours have not been modified from previous versions. Figure 5 is a revised potentiometric map of the Lakota that has wells not used in generating contours removed to reduce confusion.

### Task 4. Compile Water Level Data and Completion Information Into a Table

Tables 3 through 8 contain the field water level measurements and calculated water table elevations. Tables 3 and 4 contain data for the Inyan Kara Aquifers, Tables 5 and 6 contain alluvial aquifer information, and Tables 7 and 8 contain water level information on the Unkpapa Aquifer.

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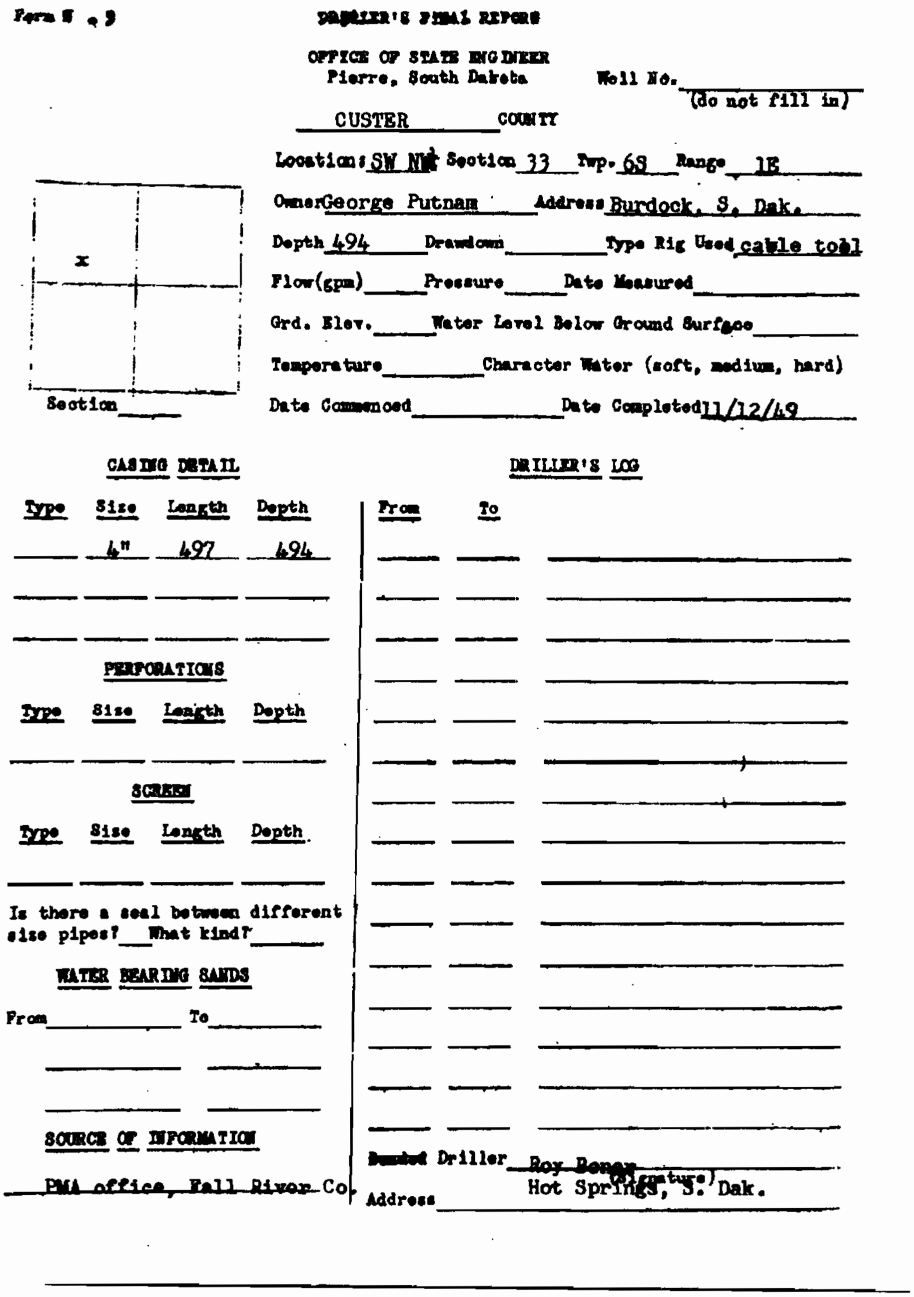

Form [illegible]

DRILLER'S FINAL REPORT

OFFICE OF STATE ENGINEER
Pierre, South Dakota

Well No.____
(do not fill in)

CUSTER COUNTY

Location: SW NW¼ Section 33 Twp. 6S Range 1E

Owner George Putnam Address Burdock, S. Dak.

Depth 494 Drawdown____ Type Rig Used cable tool

Flow(gpm)____ Pressure____ Date Measured____

Grd. Elev.____ Water Level Below Ground Surface____

Temperature____ Character Water (soft, medium, hard)

Date Commenced____ Date Completed 11/12/49

x

Section____

CASING DETAIL

| Type | Size | Length | Depth |
|---|---|---|---|
| | 4" | 497 | 494 |
| | | | |
| | | | |

PERFORATIONS

| Type | Size | Length | Depth |
|---|---|---|---|
| | | | |

SCREEN

| Type | Size | Length | Depth |
|---|---|---|---|
| | | | |

Is there a seal between different size pipes?____ What kind?____

WATER BEARING SANDS

From____ To____

SOURCE OF INFORMATION

PMA office, Fall River Co.

DRILLER'S LOG

| From | To | |
|---|---|---|
| | | |

Bonded Driller Roy Boner
(Signature)

Address Hot Springs, S. Dak.

**Figure 2.** Well Completion Report for Well 38.

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RSI-1853-10-035

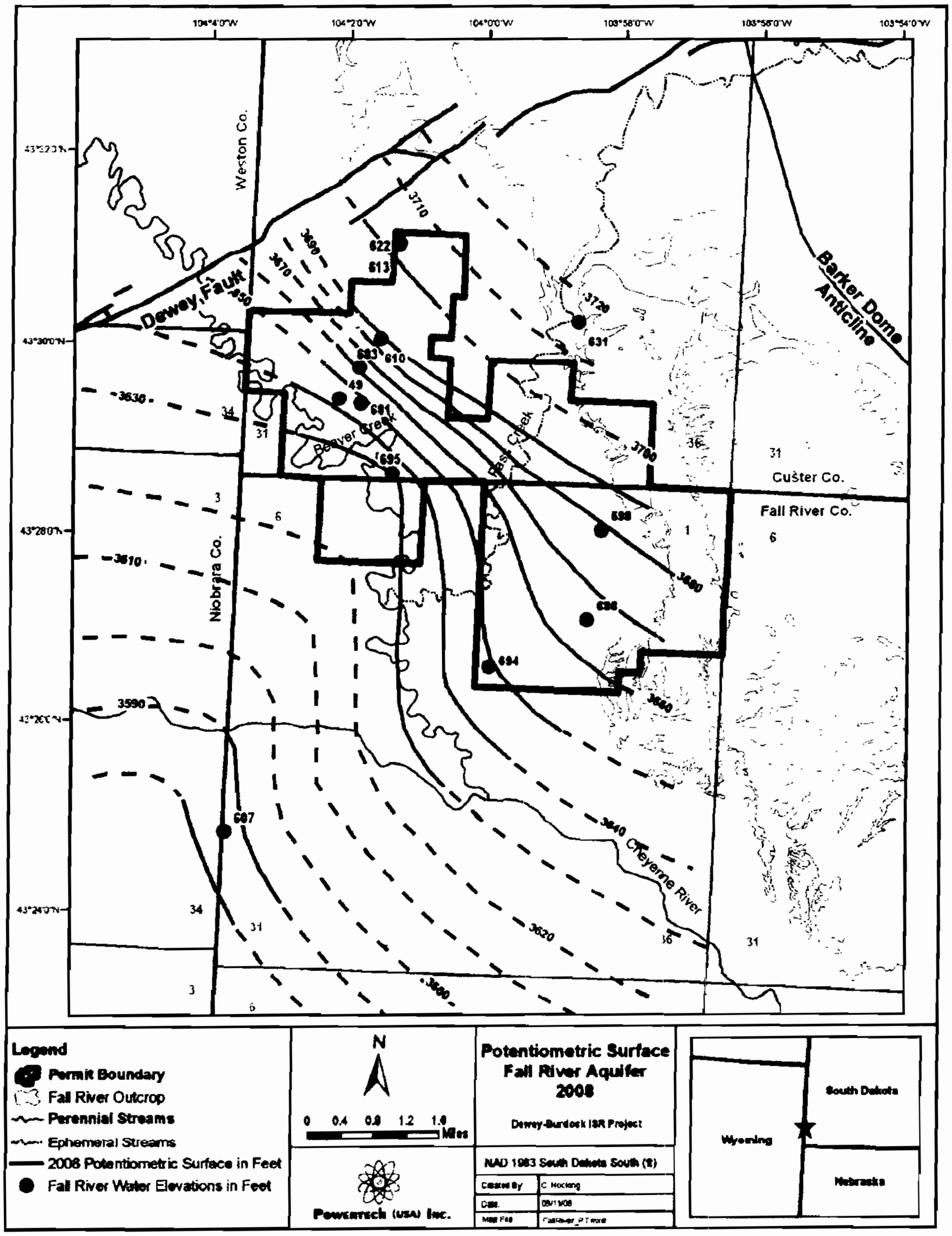

**Figure 3.** Fall River Aquifer Potentiometric Map With Wells Labeled by Hydro I.D.

— DRAFT —

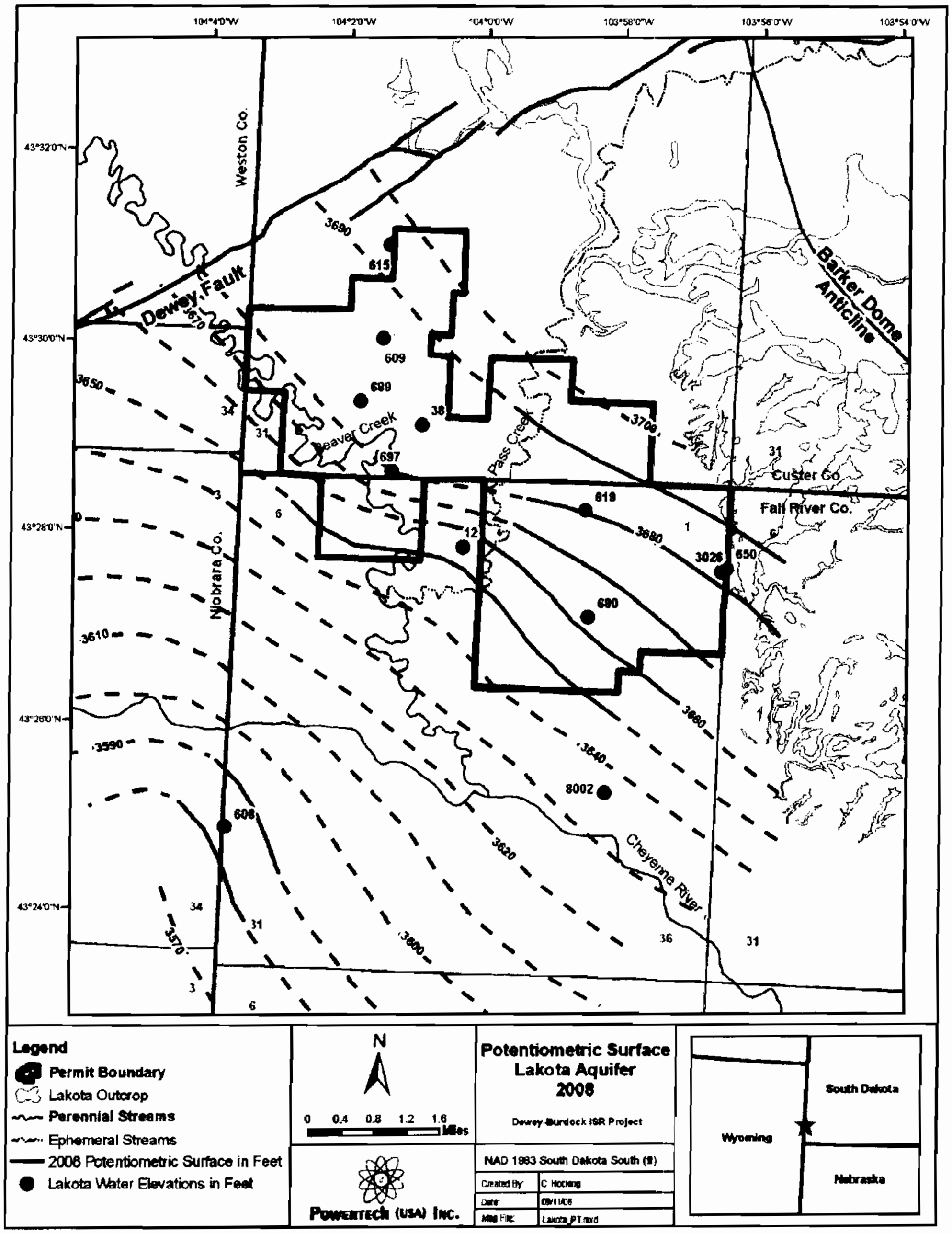

**Figure 4.** Lakota Aquifer Potentiometric Map With Wells Labeled by Hydro I.D.

— DRAFT —

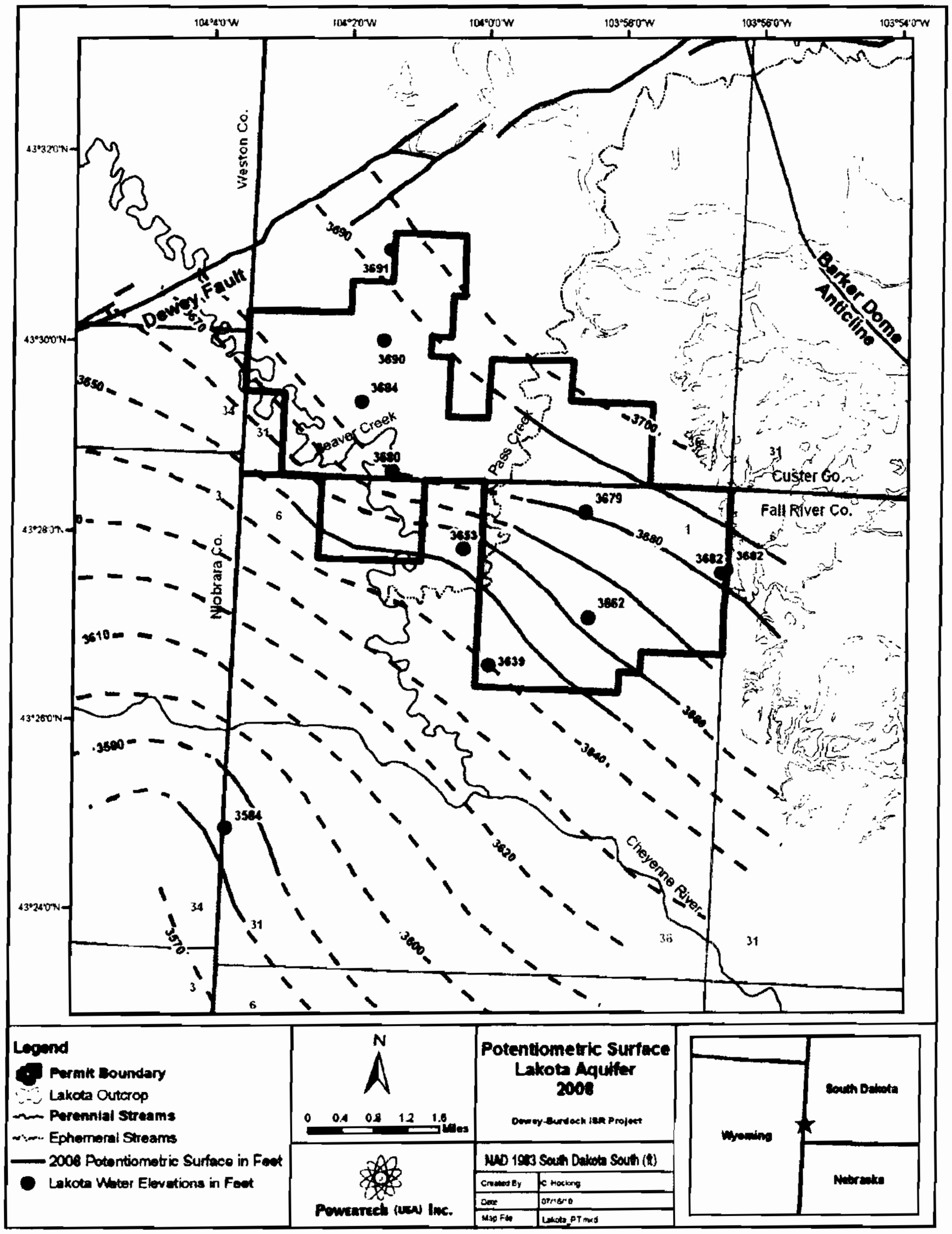

**Figure 5.** Revised Lakota Aquifer Potentiometric Surface. This map has removed Wells 38 and 8002 and added Well 696 to reflect data that were actually used to generate the contour map.

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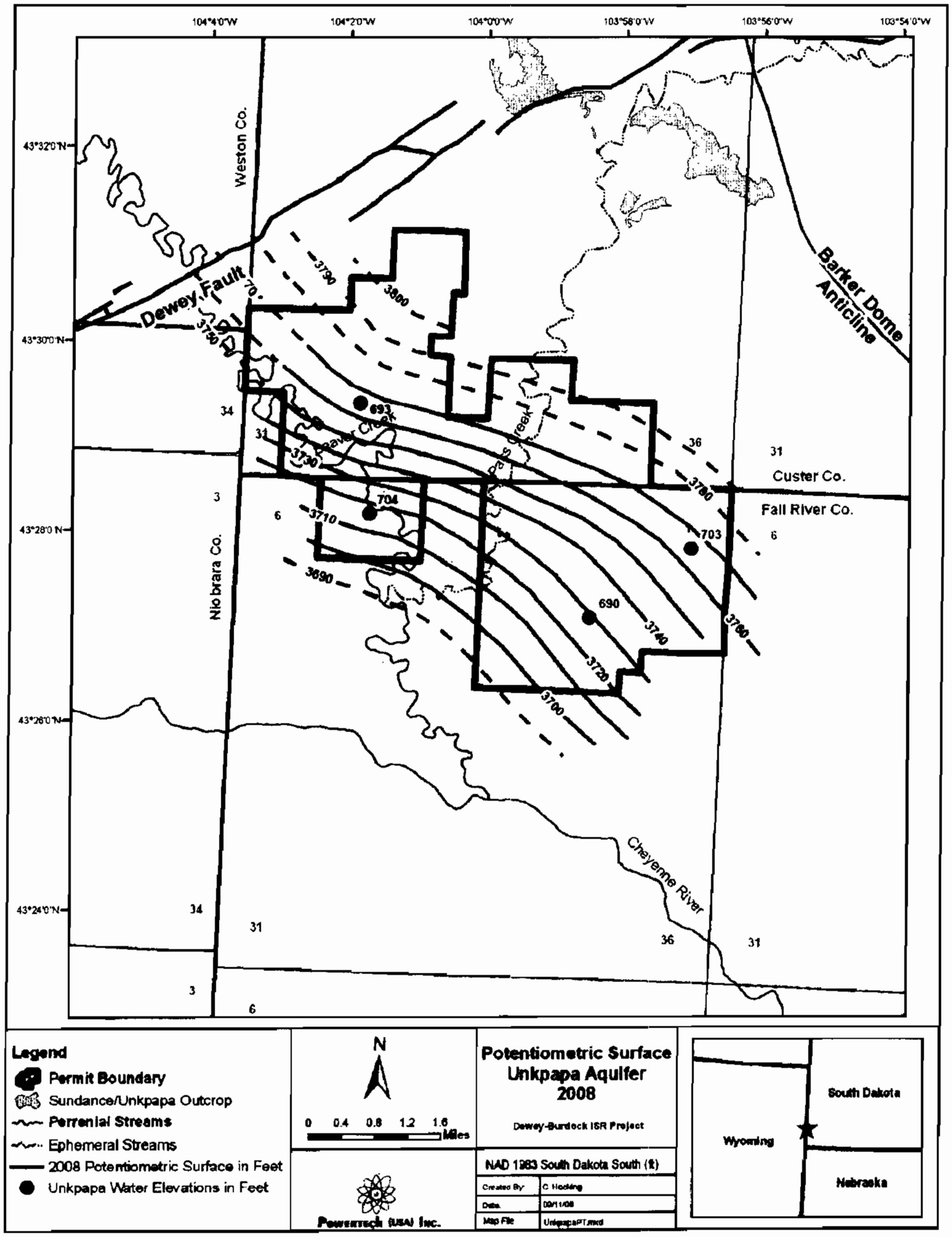

**Figure 6.** Unkpapa Aquifer Potentiometric Map With Wells Labeled by Hydro I.D.

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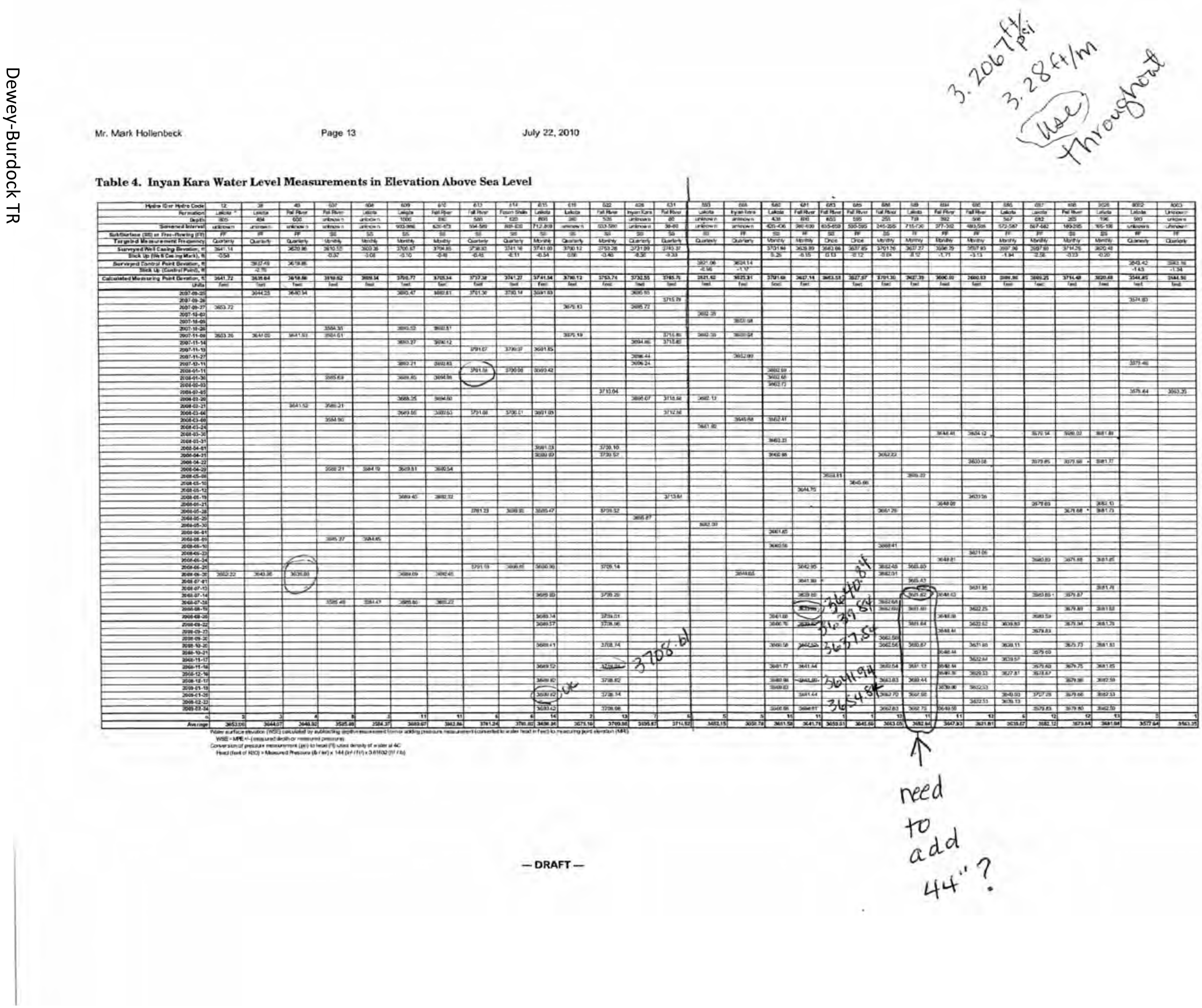
683?.

## Table 3. Inyan Kara Water Level Measurements in Feet or Pounds per Square Inch

| Hydro ID or Hydro Code | 12 | 38 | 49 | 607 | 609 | 608 | 610 | 613 | 614 | 615 | 619 | 622 | 626 | 627 | 650 | 668 | 680 | 681 | 685 | 688 | 689 | 694 | 695 | 696 | 697 | 698 | 3026 | 6002 | 6003 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Formation | Lakota | Lakota | Fall River | Fall River | Lakota | Lakota | Fall River | Fall River | Fuson Shale | Lakota | Lakota | Fall River | Inyan Kara | Fall River | Lakota | Inyan Kara | Lakota | Fall River | Fall River | Fall River | Lakota | Fall River | Fall River | Lakota | Lakota | Fall River | Lakota | Lakota | Unknown |
| Depth | 805 | 484 | 630 | unknown | unknown | 1000 | 680 | 580 | 625 | 800 | 288 | 598 | unknown | 30 | unknown | unknown | 438 | 600 | 650 | 595 | 255 | 730 | 392 | 508 | 587 | 682 | 205 | 196 | 506 |
| Screened Interval | unknown | unknown | unknown | unknown | unknown | 953-988 | 630-672 | 504-580 | 679-620 | 712-800 | unknown | 520-580 | unknown | 30-60 | unknown | unknown | 425-438 | 530-600 | 635-650 | 580-595 | 245-255 | 715-730 | 377-392 | 483-508 | 572-587 | 667-682 | 185-205 | 186-196 | unknown |
| Sub-Surface (SS) or Free-Flowing (FF) | FF | FF | FF | SS | SS | SS | SS | SS | SS | SS | SS | SS | SS | SS | SS | FF | SS | FF | FF | SS | FF | FF | FF | FF | FF | SS | SS | FF | FF |
| Targeted Measurement Frequency | Quarterly | Quarterly | Quarterly | Monthly | Monthly | Monthly | Monthly | Quarterly | Quarterly | Monthly | Quarterly | Monthly | Quarterly | Quarterly | Quarterly | Quarterly | Monthly | Monthly | Once | Monthly | Monthly | Monthly | Monthly | Monthly | Monthly | Monthly | Monthly | Quarterly | Quarterly |
| Measuring Point | End of 2" horizontal steel pipe | Set marker on Black "x" on top of cross member | Black X on concrete slab north side of tank | Top of 2" female coupler on casing | Top of 2" female coupler on casing | Top of female end of 6" steel coupler on casing | Top of female end of 8" steel coupler on casing | Top of 8" female coupler on casing | Top of 5" female coupler on casing | Top of casing | Top of 5" steel coupling on casing | Top of female coupler on casing | Top of pipe | Top of casing | Top of 8" steel casing | Large valve side – middle of 2" pipe | Top of well casing | Top of well casing | Top of well casing | Top of well casing | Top of well casing | Center of 90 elbow | Center of 90 elbow | Center of 90 elbow | Center of 90 elbow | Top of 6" well casing | Top of 6" casing pipe | End of 1" PVC pipe over stock tank | Center of horizontal pipe at valve in yard well |
| Surveyed Well Casing Elevation, ft | 3641.14 | 3638.75 | 3628.86 | 3613.55 | 3609.25 | 3700.57 | 3704.85 | 3726.03 | 3741.36 | 3741.00 | 3709.12 | 3753.28 | 3731.89 | 3746.37 | 3821.64 | 3626.05 | 3781.94 | 3625.90 | 3627.85 | 3701.26 | 3627.37 | 3598.70 | 3596.80 | 3597.95 | 3597.46 | 3714.25 | 3820.48 | 3543.37 | |
| Stick Up (Well Casing Mark), ft | -0.58 | | | -0.07 | -0.08 | -0.19 | -0.49 | -0.65 | -0.11 | -0.54 | 3.80 | -0.48 | -0.58 | -0.32 | | | 0.26 | -0.15 | -0.13 | -0.64 | -0.12 | -1.71 | -2.13 | -1.94 | -2.56 | -0.23 | -0.20 | | |
| Surveyed Control Point Elevation, ft | 3639.51 | 3637.49 | 3618.86 | 3609.88 | 3608.50 | 3697.80 | 3703.79 | 3725.75 | 3740.41 | 3750.83 | 3698.83 | 3751.64 | 3730.36 | 3740.50 | 3821.06 | 3624.11 | 3701.10 | 3625.64 | 3627.43 | 3700.57 | 3626.09 | 3596.79 | 3596.67 | 3596.18 | 3596.67 | 3710.83 | 3810.86 | 3543.42 | 3543.16 |
| Stick Up (Control Point), ft | | -2.15 | | | | | | | | | | | | | -0.58 | -1.17 | | | | | | | | | | | | -1.43 | -1.34 |
| Calculated Measuring Point Elevation, ft | 3641.22 | 3636.84 | 3618.86 | 3610.62 | 3609.34 | 3700.77 | 3705.34 | 3727.58 | 3741.27 | 3741.04 | 3708.12 | 3753.74 | 3732.53 | 3745.10 | 3821.62 | 3625.31 | 3781.68 | 3627.14 | 3627.97 | 3701.30 | 3627.49 | 3600.00 | 3600.93 | 3598.92 | 3600.25 | 3714.48 | 3820.68 | 3544.65 | 3544.50 |
| Units | psi | psi | psi | feet | feet | feet | feet | feet | feet | feet | feet | feet | feet | feet | feet | psi | feet | psi | psi | feet | psi | psi | psi | psi | psi | feet | feet | psi | psi |
| 2007-09-05 | | 2 | 3.4 | | | -10.299 | -12.52 | -29.08 | -41.13 | -49.84 | | | -35.6 | | | | | | | | | | | | | | | | |
| 2007-09-20 | | | | | | | | | | | | | | -29.91 | | | | | | | | | | | | | | 12 | |
| 2007-09-27 | 5.2 | | | | | | | | | | -20.98 | | -36.83 | | | | | | | | | | | | | | | | |
| 2007-10-02 | | | | | | | | | | | | | | | -138.27 | | | | | | | | | | | | | | |
| 2007-10-03 | | | | | | | | | | | | | | | | 11 | | | | | | | | | | | | | |
| 2007-10-26 | | | | -26.27 | | -10.15 | -12.53 | | | | | | | | | | | | | | | | | | | | | | |
| 2007-11-08 | 5 | 1.9 | 10 | -26.01 | | | | | | | -20.92 | | | -29.65 | -138.27 | 11 | | | | | | | | | | | | | |
| 2007-11-14 | | | | | | -10.5 | -15.22 | | | | | | -37.58 | -29.85 | | | | | | | | | | | | | | | |
| 2007-11-19 | | | | | | | | -36.2 | -41.2 | -49.89 | | | | | | | | | | | | | | | | | | | |
| 2007-11-27 | | | | | | | | | | | | | -36.11 | | | 12 | | | | | | | | | | | | | |
| 2007-12-11 | | | | | | -10.56 | -11.51 | | | | | | -36.31 | | | | | | | | | | | | | | | 15 | |
| 2008-01-11 | | | | | | | | -35.8 | -41.18 | -51.12 | | | | | | | -38.96 | | | | | | | | | | | | |
| 2008-01-30 | | | | -24.53 | | -10.90 | -10.36 | | | | | | | | | | -39 | | | | | | | | | | | | |
| 2008-02-03 | | | | | | | | | | | | | | | | | -38.02 | | | | | | | | | | | | |
| 2008-02-05 | | | | | | | | | | | | -43.7 | | | | | | | | | | | | | | | | 14.68 | 8.17 |
| 2008-02-20 | | | | | | -12.52 | -10.74 | | | | | | -36.48 | -30.02 | -138.49 | | | | | | | | | | | | | | |
| 2008-02-21 | | | 9.523 | -25.41 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2008-03-06 | | | | | | -11.22 | -12.71 | -36.285 | -41.25 | -50.46 | | | | -33.62 | | | | | | | | | | | | | | | |
| 2008-03-09 | | | | -25.72 | | | | | | | | | | | | 19.65 | -38.27 | | | | | | | | | | | | |
| 2008-03-24 | | | | | | | | | | | | | | | -138.7 | | | | | | | | | | | | | | |
| 2008-03-30 | | | | | | | | | | | | | | | | | | | | | | 21.02 | 14.39 | | 34.2 | -34.48 | -138.79 | | |
| 2008-03-31 | | | | | | | | | | | | | | | | | -35.15 | | | | | | | | | | | | |
| 2008-04-01 | | | | | | | | | | -50.17 | | -44.64 | | | | | | | | | | | | | | | | | |
| 2008-04-21 | | | | | | | | | | -50.51 | | -44.22 | | | | | -40.5 | | | -39.09 | | | | | | | | | |
| 2008-04-22 | | | | | | | | | | | | | | | | | | | | | | | 12.9 | | 34.51 | -34.5 | -138.91 | | |
| 2008-04-29 | | | | -25.41 | -25.15 | -10.96 | -12.7 | | | | | | | | | | | | | | | | | | | | | | |
| 2008-05-08 | | | | | | | | | | | | | | | | | | | | | 24.95 | | | | | | | | |
| 2008-05-12 | | | | | | | | | | | | | | | | | | 7.63 | | | | | | | | | | | |
| 2008-05-19 | | | | | | -11.33 | -13.02 | | | | | | | -32.98 | | | | | | | | | 12.72 | | | | | | |
| 2008-05-21 | | | | | | | | | | | | | | | | | | | | | | 20.65 | | | 34.4 | | -138.56 | | |
| 2008-05-28 | | | | | | | | -36.15 | -41.35 | -51.27 | | -44.43 | | | | | | | | -40.34 | | | | | | -34.6 | -138.35 | | |
| 2008-05-29 | | | | | | | | | | | | | -35.58 | | | | | | | | | | | | | | | | |
| 2008-05-30 | | | | | | | | | | | | | | | -139.62 | | | | | | | | | | | | | | |
| 2008-06-01 | | | | | | | | | | | | | | | | | -39.63 | | | | | | | | | | | | |
| 2008-06-09 | | | | -25.35 | -24.69 | | | | | | | | | | | | | | | | | | | | | | | | |
| 2008-06-10 | | | | | | | | | | | | | | | | | -40.12 | | | -31.89 | | | | | | | | | |
| 2008-06-23 | | | | | | | | | | | | | | | | | | | | | | | 13.06 | | | | | | |
| 2008-06-24 | | | | | | | | | | | | | | | | | | | | | | 21.15 | | | 34.30 | -34.6 | -138.63 | | |
| 2008-06-25 | | | | | | | | -36.2 | -41.38 | -51.48 | | -44.5 | | | | | | 6.85 | | -38.63 | 25.24 | | | | | | | | |
| 2008-06-30 | 4.55 | 1.87 | 8.79 | | | -11.69 | -12.59 | | | | | | | | | 19.35 | | | | -39.25 | | | | | | | | | |
| 2008-07-01 | | | | | | | | | | | | | | | | | | 6.44 | | | 25.1 | | | | | | | | |
| 2008-07-12 | | | | | | | | | | | | | | | | | | | | | | | 13.45 | | | | -138.9 | | |
| 2008-07-14 | | | | | | | | | | -51.85 | | -44.43 | | | | | | 6.23 | | | 23.59 | 21.065 | | | 34.86 | -34.67 | | | |
| 2008-07-28 | | | | -25.13 | -24.87 | -11.91 | -13.13 | | | | | | | | | | | | | -38.62 | | | | | | | | | |
| 2008-08-19 | | | | | | | | | | | | | | | | | | 5.94 | | -38.7 | 22.59 | | 13.58 | | | -34.88 | -139.05 | | |
| 2008-08-20 | | | | | | | | | | -51.8 | | -44.73 | | | | | -40.52 | | | | | 21.28 | | | 34.83 | | | | |
| 2008-09-22 | | | | | | | | | | -51.97 | | -44.78 | | | | | -40.92 | 5.5 | | | 23.52 | | 13.74 | 17.1 | | -34.54 | -138.9 | | |
| 2008-09-23 | | | | | | | | | | | | | | | | | | | | | | 21 | | | 34.5 | | | | |
| 2008-09-30 | | | | | | | | | | | | | | | | | | | | -38.9 | | | | | | | | | |
| 2008-10-20 | | | | | | | | | | -52.13 | | -45 | | | | | -40.1 | 4.5 | | -38.74 | 23.1 | | 13.3 | 17 | | -34.75 | -138.85 | | |
| 2008-10-21 | | | | | | | | | | | | | | | | | | | | | | 21 | | | 34.6 | | | | |
| 2008-11-17 | | | | | | | | | | | | | | | | | | | | | | | 13.75 | 17.2 | | | | | |
| 2008-11-19 | | | | | | | | | | -52.22 | | -44.72 | | | | | -39.91 | 6.2 | | -38.76 | 23.3 | 21 | | | 34.6 | -34.73 | -138.83 | | |
| 2008-12-16 | | | | | | | | | | | | | | | | | | | | | | 21.4 | 12.4 | 12.1 | 34 | | | | |
| 2008-12-17 | | | | | | | | | | -51.62 | | -44.93 | | | | | -40.7 | 6.4 | | -37.47 | 25 | | | | | -34.5 | -138.18 | | |
| 2009-01-09 | | | | | | | | | | | | | | | | | -40.85 | | | | | 17.2 | 13.1 | | | | | | |
| 2009-01-28 | | | | | | | | | | -51.52 | | -45 | | | | | | 6.2 | | -36.5 | 24.1 | | | 21.3 | 45.4 | -34.87 | -138.15 | | |
| 2009-02-23 | | | | | | | | | | | | | | | | | | | | | | | 13.7 | 17.07 | | | | | |
| 2009-02-24 | | | | | | | | | | -51.12 | | -44.76 | | | | | -40.7 | 12 | | -38.47 | 24 | 21.5 | | | 34.5 | -34.69 | -138.19 | | |
| n | 3 | 3 | 4 | 8 | 3 | 11 | 11 | 6 | 6 | 16 | 2 | 13 | 7 | 6 | 5 | 5 | 15 | 11 | 0 | 13 | 11 | 11 | 12 | 6 | 12 | 12 | 13 | 3 | 1 |
| Average | 4.92 | 1.93 | 8.56 | -25.53 | -24.97 | -11.10 | -12.46 | -36.14 | -41.25 | -51.19 | -20.96 | -43.84 | -36.67 | -30.78 | -138.47 | 11.04 | -40.10 | 6.82 | #DIV/0! | -38.25 | 23.89 | 20.78 | 13.38 | 16.59 | 35.40 | -34.64 | -138.78 | 14.22 | 8.17 |



Mr. Mark Hollenbeck Page 13 July 22, 2010

3.2067 ft/psi
3.28 ft/m
Use throughout

**Table 4. Inyan Kara Water Level Measurements in Elevation Above Sea Level**

3708.61

ok

3640.84
3639.84
3637.58
3641.94
3654.84

Water surface elevation (WSE) calculated by subtracting depth measurement from or adding pressure measurement (converted to water head in feet) to measuring point elevation (MPE)
WSE = MPE +/- (measured depth or measured pressure)
Conversion of pressure measurement (psi) to head (ft) uses density of water at 4C
Head (feet of H2O) = Measured Pressure (lb/in²) x 144 (in²/ft²) x 0.01602 (ft³/lb)

need to add 44"?

— DRAFT —

**Table 5. Alluvial Water Level Measurements in Feet Below Measuring Point**

| **Hydro I.D. or Hydro Code** | 675 | 676 | 677 | 678 | 679 |
|---|---|---|---|---|---|
| **Targeted Measurement Frequency** | Monthly | Monthly | Monthly | Monthly | Monthly |
| **Measuring Point** | top of well casing | top of well casing | top of well casing | top of well casing | top of well casing |
| **Distance from Measuring Point to Ground (ft)** | 2.3 | 2.4 | 2.3 | 2.3 | 2.3 |
| **Approximate Land Elevation From Topographic Map (ft)** | 3,491 | 3,662 | 3,570 | 3,591 | 3,717 |
| **Calculated Measuring Point Elevation (ft)** | 3,493.3 | 3,664.4 | 3,572.3 | 3,593.3 | 3,719.3 |
| **Date** | **ft below measuring point** | | | | |
| 9/28/2007 | –11.18 | –20.14 | –11.51 | –12.1 | –33.6 |
| 10/26/2007 | –11.04 | –20.3 | –11.35 | –11.73 | –33.83 |
| 11/9/2007 | –10.99 | –20.3 | –11.25 | –11.45 | –33.85 |
| 11/14/2007 | | | | | –33.85 |
| 11/27/2007 | –10.99 | –20.37 | –11.12 | –11.22 | |
| 12/11/2007 | –10.82 | –20.4 | | –11.15 | –33.88 |
| 1/11/2008 | –10.6 | –20.44 | | | –33.87 |
| 1/30/2008 | | | –10.17 | –10.82 | |
| 2/3/2008 | | | | | –33.88 |
| 2/5/2008 | –10.37 | –20.5 | –10.1 | –10.81 | |
| 3/6/2008 | –10.045 | –20.53 | –9.9 | –10.75 | –33.93 |
| 4/29/2008 | –10.42 | –20.6 | –9.63 | –10.38 | |
| 5/18/2008 | | | | | –34.02 |
| 6/30/2008 | | –20.65 | –9.45 | –10.95 | –34.03 |

— DRAFT —

## Table 6. Alluvial Water Level Measurements in Elevation Above Mean Sea Level

| **Hydro ID or Hydro Code** | 675 | 676 | 677 | 678 | 679 |
|---|---|---|---|---|---|
| **Formation** | Alluvial | Alluvial | Alluvial | Alluvial | Alluvial |
| **Subsurface (SS) or Free-Flowing (FF)** | SS | SS | SS | SS | SS |
| **Depth (ft)** | 14–4 | 22.5 | 14.5 | 14.5 | 39 |
| **Screened Interval (ft)** | 4–14 | 12–22 | 4–14 | 4–14 | 29–39 |
| **Targeted Measurement Frequency** | Monthly | Monthly | Monthly | Monthly | Monthly |
| **Measuring Point** | top of well casing | top of well casing | top of well casing | top of well casing | top of well casing |
| **Distance from Measuring Point to Ground (ft)** | 2.3 | 2.4 | 2.3 | 2.3 | 2.3 |
| **Approximate Land Elevation From Topographic Map (ft)** | 3,491 | 3,662 | 3,570 | 3,591 | 3,717 |
| **Calculated Measuring Point Elevation (ft)** | 3,493.3 | 3,664.4 | 3,572.3 | 3,593.3 | 3,719.3 |
| **Date** | **ft above mean sea level** | | | | |
| 9/28/2007 | 3,482.1 | 3,644.3 | 3,560.8 | 3,581.2 | 3,685.7 |
| 10/26/2007 | 3,482.3 | 3,644.1 | 3,561.0 | 3,581.6 | 3,685.5 |
| 11/9/2007 | 3,482.3 | 3,644.1 | 3,561.1 | 3,581.9 | 3,685.5 |
| 11/14/2007 | | | | | 3,685.5 |
| 11/27/2007 | 3,482.3 | 3,644.0 | 3,561.2 | 3,582.1 | |
| 12/11/2007 | 3,482.5 | 3,644.0 | | 3,582.2 | 3,685.4 |
| 1/11/2008 | 3,482.7 | 3,644.0 | | | 3,685.4 |
| 1/30/2008 | | | 3,562.1 | 3,582.5 | |
| 2/3/2008 | | | | | 3,685.4 |
| 2/5/2008 | 3,482.9 | 3,643.9 | 3,562.2 | 3,582.5 | |
| 3/6/2008 | 3,483.3 | 3,643.9 | 3,562.4 | 3,582.6 | 3,685.4 |
| 4/29/2008 | 3,482.9 | 3,643.8 | 3,562.7 | 3,582.9 | |
| 5/18/2008 | | | | | 3,685.3 |
| 6/30/2008 | | 3,643.8 | 3,562.9 | 3,582.4 | 3,685.3 |
| **Mean** | **3,483** | **3,644** | **3,562** | **3,582** | **3,685** |

— DRAFT —

**Table 7. Unkpapa Water Level Measurements in Feet**

| Hydro I.D. or Hydro Code | 690 | 693 | 703 | 704 |
|---|---|---|---|---|
| Targeted Measurement Frequency | Once | Once | Once | Once |
| Measuring Point | top of casing | top of casing | top of casing | top of casing |
| Distance from Measuring Point to Ground | | | | 2 |
| Surveyed Well Casing Elevation (ft) | 3,700.04 | 3,627.27 | | |
| Stick Up (Well Casing Mark) (ft) | | | | |
| Surveyed Control Point Elevation (ft) | 3,699.59 | 3,626.31 | | |
| Stick Up (Control Point) (ft) | 0.41 | | | |
| Calculated Measuring Point Elevation (ft) | 3,699.18 | 3627.27 | 3,877[a] | 3,599[a] |
| **Date** | **ft above (+) or below (–) measuring point** | | | |
| 5/14/08 | 29.15 | 135.77 | | |
| 5/21/08 | | | −109.96 | |
| 5/28/08 | 30.65 | | | |
| 5/30/08 | | | | 116.5 |
| 6/24/08 | | | −109.4 | |

(a) Wells were not surveyed. Elevation estimated from topographic map.

### Task 5. Generate an Explanation of Water Level Measurement Feasibility for the Wells Listed in the NRC Comments

The wells listed in the NRC review of the TR and an explanation of the feasibility of obtaining a water level measurement from those specific wells is included in Table 9. Figures 7 and 8 display these wells for possible inclusion alongside those wells that are in the current water level monitoring plan. For many of these wells, water level measurements were not easily obtained, but could be obtained with additional work such as pulling a pump and shutting in a well for a period of time. At this time, it is assumed that Powertech will be conducting further field investigations into this matter based on RESPEC's cursory review.

— DRAFT —

**Table 8. Unkpapa Water Level Measurements in Elevation Above Sea Level**

| **Hydro I.D. or Hydro Code** | 690 | 693 | 703 | 704 |
|---|---|---|---|---|
| **Formation** | Unkpapa | Unkpapa | Unkpapa | Unkpapa |
| **Subsurface (SS) or Free-Flowing (FF)** | FF | FF | SS | FF |
| **Depth (ft)** | 623 | 930 | 525 | 955 |
| **Screened Interval (ft)** | 621–631 | 910–930 | 475–525 | 915–955 |
| **Targeted Measurement Frequency** | Once | Once | Once | Once |
| **Measuring Point** | top of well casing | top of well casing | top of well casing | top of well casing |
| **Distance from Measuring Point to Ground** | | | | 2 |
| **Approximate Land Elevation from topographic map (ft)** | | | 3,877 | 3,599 |
| **Calculated Measuring Point Elevation (ft)** | 3,699.2 | 3,627.3 | 3,877 | 3,599 |
| **Date** | **ft above mean sea level** | | | |
| 5/14/08 | 3,728.3 | 3,763.0 | | |
| 5/21/08 | | | 3,767.0 | |
| 5/28/08 | 3,729.8 | | | |
| 5/30/08 | | | | 3,715.5 |
| 6/24/08 | | | 3,767.6 | |
| **Mean** | **3,729** | **3,763** | **3,767** | **3,716** |

## Task 6. Review the Water Rights, Well Completion, and Water Quality for the Well North of Kennobbie's Ranch to Determine Aquifer

Well 4, a stock well located in SESE Sec. 15, T7S, R1E, was brought into question as to which aquifer the well is completed in. A well log indicates this well was originally drilled as on oil exploration well (API# 5093) into the Minnelusa Formation to a depth of 2,264 feet. This log (Figure 9) also indicates the well was plugged and abandoned. RESPEC was not able to find any water rights or well completion information describing how this well was completed as a water well. However, information in Table 2.5.2-1 of the TVA EIS report describes this well (D-19) as being 2,264 feet deep, coinciding with the original drilling depth into the Minnelusa, and with a water level of 3,580 feet elevation.

— DRAFT —

**Table 9. Wells for Possible Inclusion in Water Level Measurement Plan (Page 1 of 3)**

| Aquifer | Well | Free Flowing or Subsurface | Reason for not Measuring Originally | Could be Measured With Minimal Additional Effort | Other Comments |
|---|---|---|---|---|---|
| Fall River | 7 | Unknown | Domestic can not measure without pulling pump | Yes | There is a .las file for this well, so it must be possible to measure |
| Fall River | 8 | FF | Domestic can not measure without pulling pump and shutting in for period of time | Maybe | Requires further investigation to determine feasibility |
| Fall River | 17 | SS | Stock well would need pump pulled and to stop being use to stabilized | Maybe | Requires further investigation to determine feasibility |
| Fall River | 18 | FF | Domestic can not measure without pulling pump and shutting in for period of time | Maybe | Requires further investigation to determine feasibility |
| Fall River | 20 | Unknown | Domestic can not measure without pulling pump and shutting in for period of time | Maybe | Requires further investigation to determine feasibility |
| Lakota | 1 | FF | Could not be sealed for psi measurement because of leaks caused by corrosion and age | No | Could only be measured if well casing is repaired |
| Lakota | 2 | FF | Could not be sealed for psi measurement because of leaks caused by corrosion and age | No | Could only be measured if well casing is repaired |
| Lakota | 13 | Unknown | Domestic can not measure without pulling pump; well is no longer used as resident moved | Maybe | Requires further investigation to determine feasibility |

— DRAFT —

**Table 9. Wells for Possible Inclusion in Water Level Measurement Plan (Page 2 of 3)**

| Aquifer | Well | Free Flowing or Subsurface | Reason for not Measuring Originally | Could be Measured With Minimal Additional Effort | Other Comments |
|---|---|---|---|---|---|
| Lakota | 14 | SS | Difficult surface access | Maybe | Requires further investigation to determine feasibility |
| Lakota | 16 | SS | difficult surface access because of fittings, domestic well would have to be shut in for period | Maybe | Requires further investigation to determine feasibility |
| Lakota | 42 | Unknown | Domestic could not measure without pulling pump. Well has been revamped and completed in the Fall River Formation (?) | Yes | We are not sure when or to what formation this well is now completed in. |
| Lakota | 51 | FF | Surface casing in poor condition, leaking | No | This well is not measurable under the present condition |
| Lakota | 96 | FF | Domestic can not measure without pulling pump and shutting in for period of time | Maybe | Requires further investigation to determine feasibility |
| Lakota | 115 | FF | Domestic can not measure without pulling pump and shutting in for period of time; also not measured because of location north of Dewey Fault | Maybe | Requires further investigation to determine feasibility |
| Lakota | 147 | SS | Not measured because of location north of Dewey Fault | Yes | This is a 1-inch piezometer that could easily be measured |
| Lakota | 510 | FF | Difficult access, would require shut | Maybe | Requires further investigation to determine feasibility |

— DRAFT —

**Table 9. Wells for Possible Inclusion in Water Level Measurement Plan (Page 3 of 3)**

| Aquifer | Well | Free Flowing or Subsurface | Reason for not Measuring Originally | Could be Measured With Minimal Additional Effort | Other Comments |
|---|---|---|---|---|---|
| Lakota | 620 | SS | Stock well would need pump pulled and to stop being use to stabilized | Maybe | This well has a good potential for measurement |
| Lakota | 696 | FF | Could not be measured at time of potentiometric map generation because of poor or cracked valve fittings. Valves were replaced and RESPEC has record of six measurements from 9/22/08 to 2/22/09 | Yes, and it has been | |
| Lakota | 697 | FF | This well was inadvertently left off potentiometric maps. It has been measured 12 times between 3/30/08 and 2/24/09. | Yes, and it has been | |
| Lakota | 7002 | FF | Because of the age of this well, it is believed that pressurizing may cause a line to rupture | No | Could only be measured if well casing is repaired |

This well was sampled three times in 1979 by TVA and once by RESPEC in 2008. Data results are presented in Table 10. In comparison to nearby Well 7 and Well 7002, this well has nearly twice the value of chemical conductivity and sulfates. Conductivity and sulfate values observed at this well are dissimilar from other Inyan Kara wells in the area as well, but values are more compatible with expected water quality for the Minnelusa Aquifer. A detailed statistical comparison of water quality was not conducted at this time.

Based on the available information, it is now reasonable to believe Well 4 may be completed in the Minnelusa Aquifer. It is recommended to try to log this well with a borehole televiewer to confirm the completion of this well.

If you have any further questions or need further explanation of these items, please do not hesitate to contact me.

CMH:llf

— DRAFT —

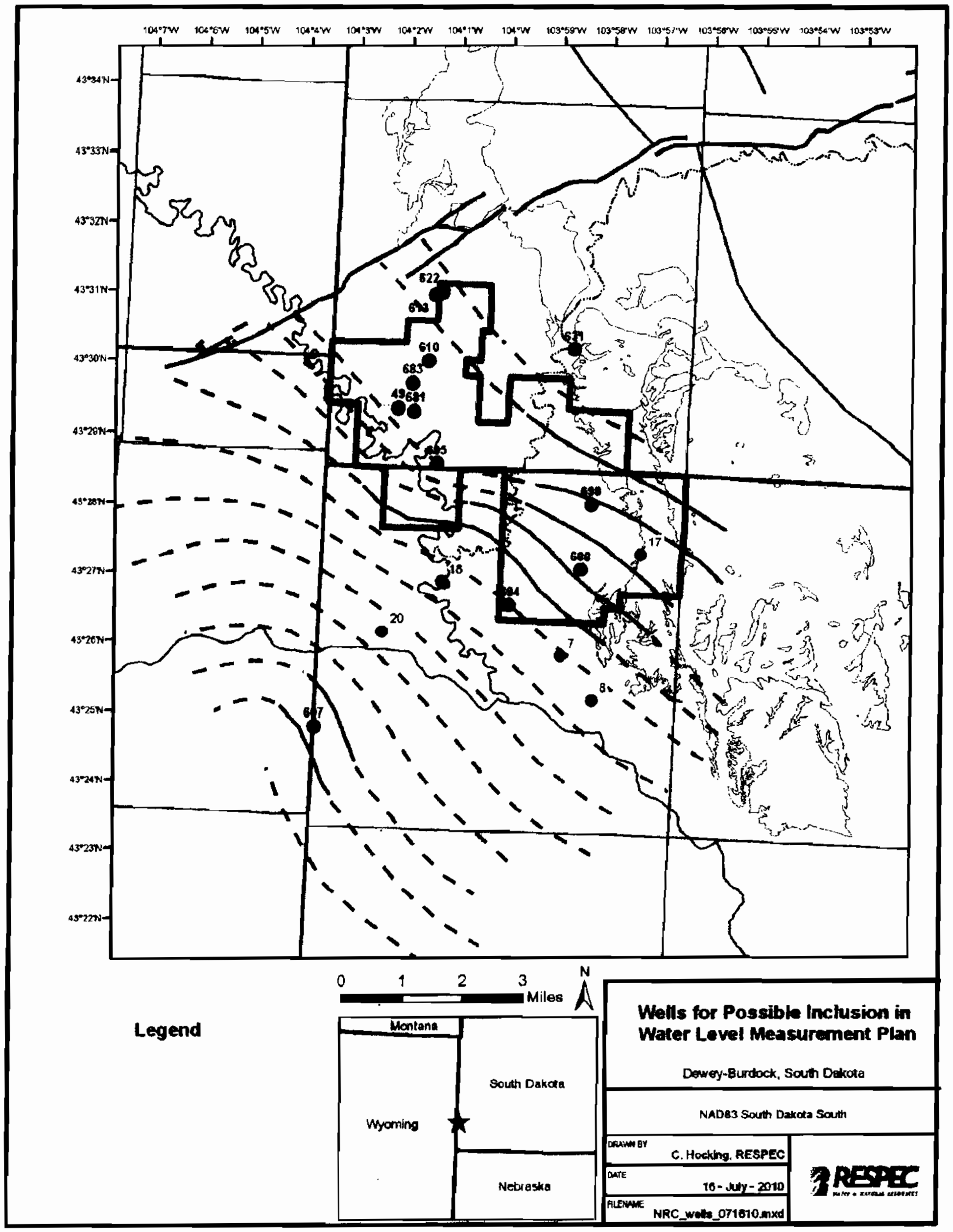


**Figure 7.** Fall River Aquifer Wells for Possible Inclusion in the Water Level Measurement Plan. Black dots are wells in the current monitoring plan while blue dots are wells not currently included.

— DRAFT —

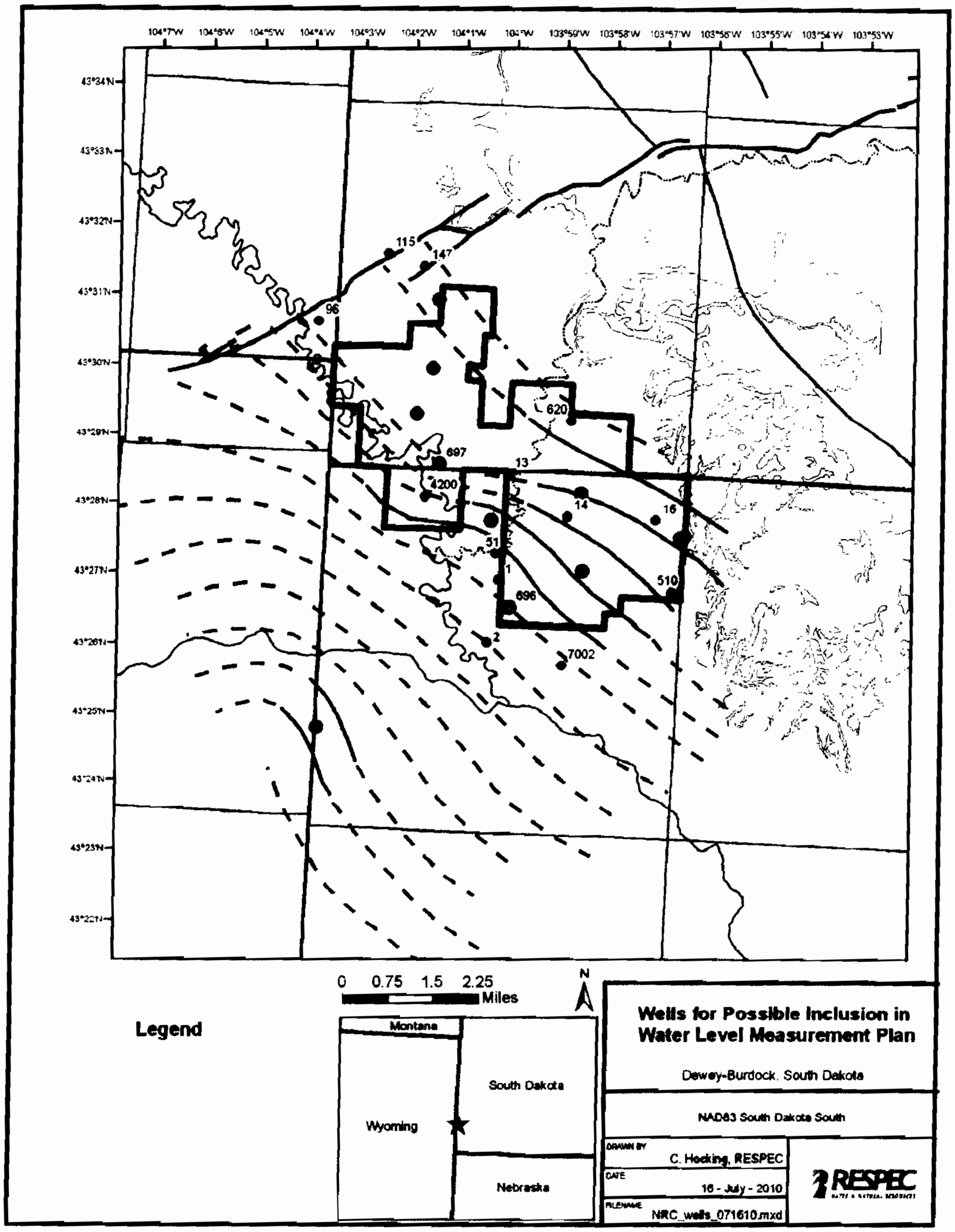
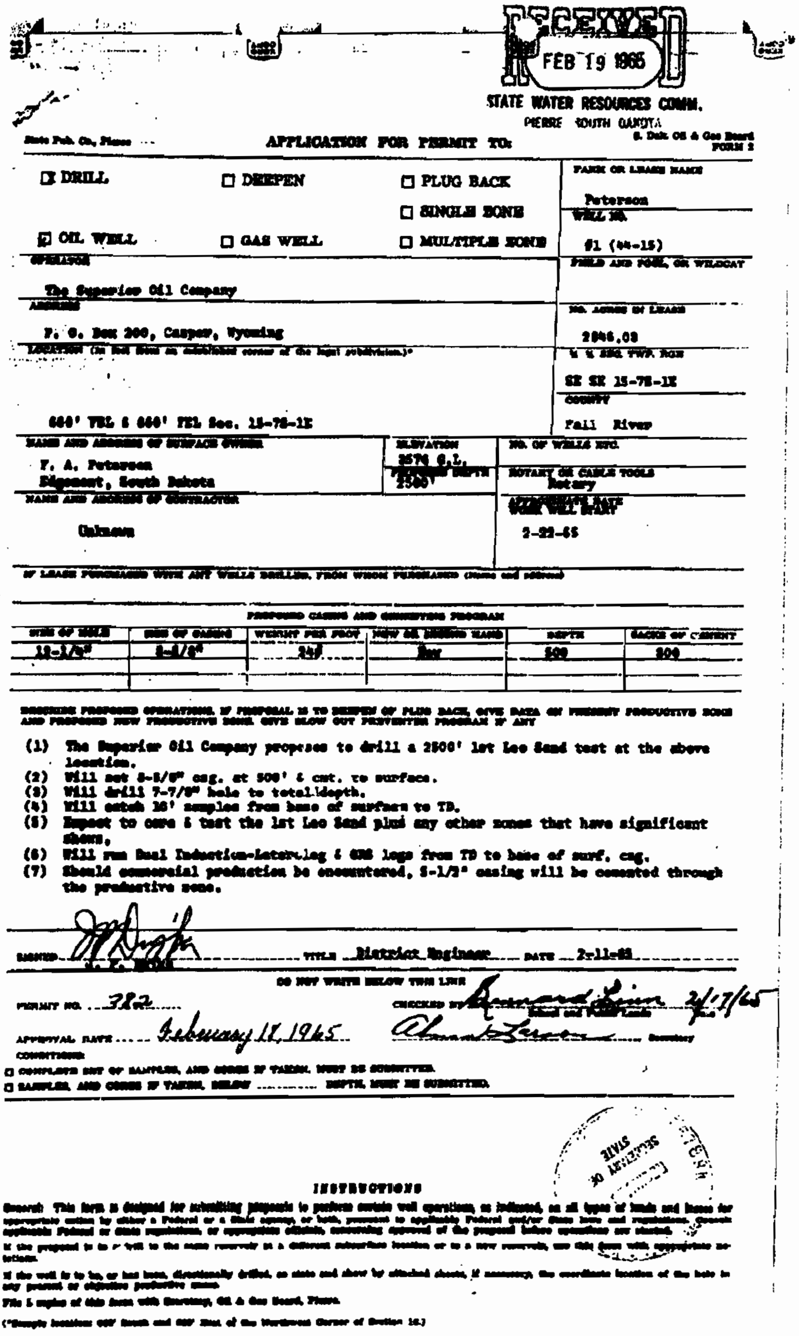


**Figure 8.** Lakota Aquifer Wells for Possible Inclusion in the Water Level Measurement Plan. Black dots are wells in the current monitoring plan while blue dots are wells not currently included.

— DRAFT —



RECEIVED
FEB 19 1965
STATE WATER RESOURCES COMM.
PIERRE SOUTH DAKOTA

State Pub. Co., Pierre

**APPLICATION FOR PERMIT TO:**

S. Dak. Oil & Gas Board
FORM 2

☒ DRILL ☐ DEEPEN ☐ PLUG BACK
☐ SINGLE ZONE
☒ OIL WELL ☐ GAS WELL ☐ MULTIPLE ZONE

FARM OR LEASE NAME: Peterson
WELL NO.: #1 (44-15)
FIELD AND POOL, OR WILDCAT:
OPERATOR: The Superior Oil Company
ADDRESS: P. O. Box 200, Casper, Wyoming
NO. ACRES IN LEASE: 2846.08
LOCATION (In feet from an established corner of the legal subdivision.)*: 660' FSL & 660' FEL Sec. 15-7S-1E
¼ ¼ SEC. TWP. RGE: SE SE 15-7S-1E
COUNTY: Fall River
NAME AND ADDRESS OF SURFACE OWNER: F. A. Peterson, Edgemont, South Dakota
ELEVATION: 3576 G.L.
PROPOSED DEPTH: 2500'
NO. OF WELLS ETC.:
ROTARY OR CABLE TOOLS: Rotary
NAME AND ADDRESS OF CONTRACTOR: Unknown
APPROXIMATE DATE WORK WILL START: 2-22-65
IF LEASE PURCHASED WITH ANY WELLS DRILLED, FROM WHOM PURCHASED (Name and address):

PROPOSED CASING AND CEMENTING PROGRAM

| SIZE OF HOLE | SIZE OF CASING | WEIGHT PER FOOT | NEW OR SECOND HAND | DEPTH | SACKS OF CEMENT |
|---|---|---|---|---|---|
| 12-1/4" | 8-5/8" | 24# | New | 500 | 300 |
| | | | | | |
| | | | | | |

DESCRIBE PROPOSED OPERATIONS. IF PROPOSAL IS TO DEEPEN OR PLUG BACK, GIVE DATA ON PRESENT PRODUCTIVE ZONE AND PROPOSED NEW PRODUCTIVE ZONE. GIVE BLOW OUT PREVENTER PROGRAM IF ANY

(1) The Superior Oil Company proposes to drill a 2500' 1st Leo Sand test at the above location.
(2) Will set 8-5/8" csg. at 500' & cmt. to surface.
(3) Will drill 7-7/8" hole to total depth.
(4) Will catch 10' samples from base of surface to TD.
(5) Expect to core & test the 1st Leo Sand plus any other zones that have significant shows.
(6) Will run Dual Induction-Laterolog & GRS logs from TD to base of surf. csg.
(7) Should commercial production be encountered, 5-1/2" casing will be cemented through the productive zone.

SIGNED [illegible] TITLE District Engineer DATE 2-11-65

DO NOT WRITE BELOW THIS LINE

PERMIT NO. 382
CHECKED BY Bernard Linn 2/17/65
School and Public Lands Date
APPROVAL DATE February 18, 1965 ........ Secretary
CONDITIONS:
☐ COMPLETE SET OF SAMPLES, AND CORES IF TAKEN, MUST BE SUBMITTED.
☐ SAMPLES, AND CORES IF TAKEN, BELOW .......... DEPTH, MUST BE SUBMITTED.

INSTRUCTIONS

General: This form is designed for submitting proposals to perform certain well operations, as indicated, on all types of lands and leases for appropriate action by either a Federal or a State agency, or both, pursuant to applicable Federal and/or State laws and regulations. Consult applicable Federal or State regulations, or appropriate officials, concerning approval of the proposal before operations are started.

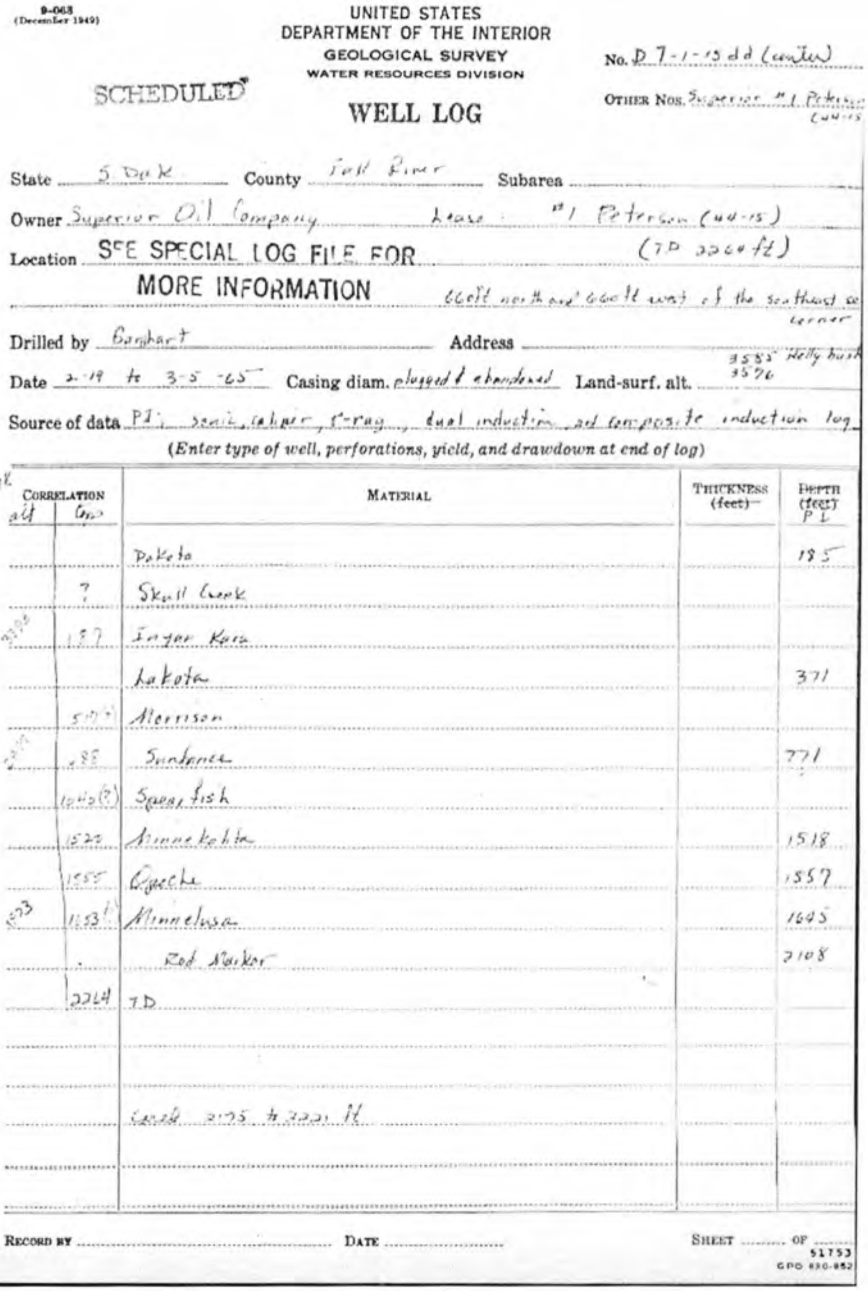
If the proposal is to re-drill to the same reservoir at a different subsurface location or to a new reservoir, use this form with appropriate notations.

If the well is to be, or has been, directionally drilled, so state and show by attached sheets, if necessary, the coordinate location of the hole in any present or objective productive zone.

File 5 copies of this form with Secretary, Oil & Gas Board, Pierre.

(*Sample location: 660' South and 660' East of the Northwest Corner of Section 16.)

**Figure 9.** Well Completion Report for Well I.D. #4 (Page 1 of 3).



9-063
(December 1949)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

SCHEDULED

WELL LOG

No. D 7-1-15 dd (center)

Other Nos. Superior #1 Peterson (44-15

State S Dak County Fall River Subarea

Owner Superior Oil Company Lease: #1 Peterson (44-15)

Location SEE SPECIAL LOG FILE FOR (TD 2264 ft)
MORE INFORMATION 660 ft north and 660 ft west of the southeast corner

Drilled by Barnhart Address

Date 2-19 to 3-5-65 Casing diam. plugged & abandoned Land-surf. alt. 3583 Kelly bush 3576

Source of data PI; sonic, caliper, γ-ray, dual induction and composite induction log

*(Enter type of well, perforations, yield, and drawdown at end of log)*

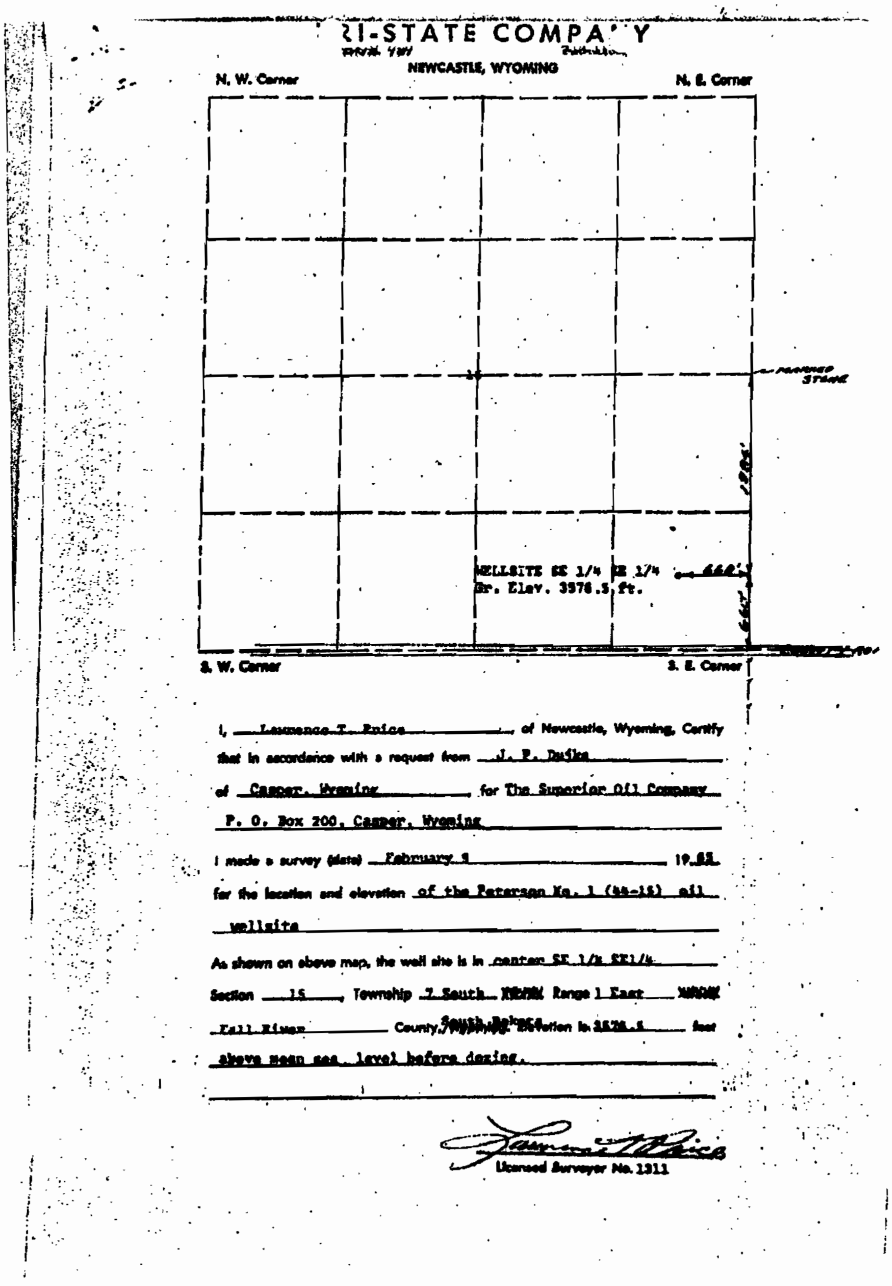
| Correlation alt | Correlation Cm | Material | Thickness (feet) | Depth (feet) P L |
|---|---|---|---|---|
| | | Dakota | | 185 |
| | ? | Skull Creek | | |
| | 187 | Inyan Kara | | |
| | | Lakota | | 371 |
| | 517(?) | Morrison | | |
| | 785 | Sundance | | 771 |
| | 1040(?) | Spearfish | | |
| | 1522 | Minnekahta | | 1518 |
| | 1555 | Opeche | | 1557 |
| | 1653(?) | Minnelusa | | 1645 |
| | . | Red Marker | | 2108 |
| | 2264 | TD | | |
| | | | | |
| | | | | |
| | | Cored 2175 to 2221 ft | | |
| | | | | |
| | | | | |

Record by Date Sheet of

51753
GPO 830-852

Figure 9. Well Completion Report for Well I.D. #4 (Page 2 of 3).

— DRAFT —



RI-STATE COMPA Y

NEWCASTLE, WYOMING

I, Lawrence T. Price of Newcastle, Wyoming, Certify

that in accordance with a request from J. P. Dufka

of Casper, Wyoming for The Superior Oil Company

P. O. Box 200, Casper, Wyoming

I made a survey (date) February 9 19 81

for the location and elevation of the Peterson No. 1 (44-15) oil

wellsite

As shown on above map, the well site is in center SE 1/4 SE1/4

Section 15, Township 7 South ~~XXXX~~ Range 1 East ~~XXXX~~

Fall River County, ~~Wyoming~~ South Dakota Elevation is 3576.5 feet

above mean sea level before dozing.

Lawrence T. Price
Licensed Surveyor No. 1311

**Figure 9.** Well Completion Report for Well I.D. #4 (Page 3 of 3).

— DRAFT —

Table 10. Water Quality Data for Well 4 (Page 1 of 4)

| | 1979-06-15 | 1979-08-15 | 1979-09-12 | 2008-02-12 |
|---|---|---|---|---|
| ALKALIN | 80 | | 181 | 88 |
| ANIONS | | | | 53.3 |
| As | 0.01 | | 0.01 | |
| B | 1 | | 1 | |
| BALANCE | –57.3 | | –54.9 | –2.6 |
| BICARB | 73 | | 220 | 107 |
| B-TDS | | | | 1.02 |
| Ca | 349 | | 477 | |
| CARB | 12 | | 0 | 5 |
| CATIONS | | | | 50.6 |
| Cl | 28 | | 26 | 26 |
| Cond, Field | 4,550 | | 4,500 | |
| CONDUCT Lab | | | | 4,400 |
| C-SOLIDS | | | | 3,600 |
| D-Ag | | | | 0.005 |
| D-Al | | | | 0.1 |
| D-As | | | | 0.001 |
| D-B | | | | 0.7 |
| D-Ba | | | | 0.1 |
| D-Ca | | | | 241 |
| D-Cd | | | | 0.005 |
| D-Cr | | | | 0.05 |
| D-Cu | | | | 0.01 |
| D-Fe | | | | 0.03 |
| D-GALPHA | | | | 3.5 |
| D-GBETA | | | | 14.4 |
| D-GGAMMA | | | | 20 |

— DRAFT —

**Table 10. Water Quality Data for Well 4 (Page 2 of 4)**

| | 1979-06-15 | 1979-08-15 | 1979-09-12 | 2008-02-12 |
|---|---|---|---|---|
| D-Hg | | | | 0.001 |
| D-K | | | | 7.8 |
| D-Mg | | | | 87 |
| D-Mn | | | | 0.07 |
| D-Mo | | | | 0.1 |
| D-Na | | | | 716 |
| D-Ni | | | | 0.05 |
| DO | | | | |
| D-Pb | | | | 0.001 |
| D-Pb210 | | | | 1 |
| D-Po210 | | | | 2.7 |
| D-Ra226 | | | | 1.1 |
| D-Se | | | | 0.001 |
| D-SeIV | | | | 0.001 |
| D-SeVI | | | | 0.001 |
| D-Si | | | | 10.2 |
| D-SOLIDS | 4,733 | | 4,117 | 3,700 |
| D-Th | | | | 0.005 |
| D-Th230 | | | | 0.2 |
| D-U | | | | 0.0004 |
| D-V | | | | 0.1 |
| D-Zn | | | | 0.01 |
| F | | | | 0.4 |
| Fe | 1.68 | | 1.59 | |
| F-pH | | | | 7.83 |
| hardness | 1,459 | | 1,392 | |
| K | 15 | | 14 | |

— DRAFT —

## Table 10. Water Quality Data for Well 4 (Page 3 of 4)

| | 1979-06-15 | 1979-08-15 | 1979-09-12 | 2008-02-12 |
|---|---|---|---|---|
| L-pH | 8 | | 7.7 | 7.94 |
| Mg | 143 | | 49 | |
| Mn | 0.12 | | 0.08 | |
| N | 0.64 | | 0.22 | |
| Na | 920 | | 743 | |
| NH3 | | | | 0.8 |
| NO2 | | | | 0.1 |
| NO3 | | | | 0.1 |
| ORP | | | | 120 |
| Pb | 0.05 | | 0.05 | |
| PO4 | 0.01 | | 0.01 | |
| SAR | | | | 10 |
| Se | 0.01 | | 0.01 | |
| SiO2 | 9.4 | | 8.6 | |
| SO4 | 3,230 | | 2,700 | 2,440 |
| S-Pb210 | | | | 1 |
| S-Po210 | | | | 1 |
| S-Ra226 | | | | 0.7 |
| S-Th230 | | | | 0.2 |
| S-U | | | | 0.0003 |
| T-Ag | | | | 0.005 |
| T-As | | | | 0.001 |
| T-B | | | | 0.6 |
| T-Ba | | | | 0.1 |
| T-Be | | | | 0.001 |
| T-Cd | | | | 0.005 |
| T-Cr | | | | 0.05 |

— DRAFT —

**Table 10. Water Quality Data for Well 4 (Page 4 of 4)**

| | 1979-06-15 | 1979-08-15 | 1979-09-12 | 2008-02-12 |
|---|---|---|---|---|
| T-Cu | | | | 0.01 |
| TEMP | | | | 11.92 |
| T-Fe | | | | 1.32 |
| T-Hg | | | | 0.001 |
| T-Mn | | | | 0.06 |
| T-Mo | | | | 0.02 |
| T-Ni | | | | 0.05 |
| T-Pb | | | | 0.001 |
| T-Pb210 | | | | |
| T-Po210 | | | | |
| T-Ra222 | | | | 908 |
| T-Ra226 | | 0.11 | | |
| T-Sb | | | | 0.003 |
| T-Se | | | | 0.002 |
| T-Sr | | | | 5.7 |
| TSS | 6 | | 5.2 | |
| T-Th230 | | | | |
| T-Tl | | | | 0.001 |
| T-U | | 28 | | 0.0005 |
| TURB | | | | 0 |
| T-Zn | | | | 0.01 |
| V | 0.05 | | 0.05 | |
| Zn | 0.01 | | 0.01 | |

— DRAFT —

# SOURCE G

# DOMESTIC AND LIVESTOCK WELLS MONITORED DURING FEBRUARY 1982 DEWEY PUMP TEST

(Letter from Gary Cummings, Silver King Mines, Inc., to Peter Martin, Tennessee Valley Authority, April 12, 1982)

D19 820414 007

RECEIVED
Division of Fuels
APR 14 1982
Uranium Operations
Branch
Casper

armo w/

PWM
dAO

**Silver King Mines, Inc.**
*P.O. Box 49*
*Edgemont, South Dakota 57735*

April 12, 1982

Peter W. Martin
Technical Engineer
Edgemont Project
Tennessee Valley Authority
P. O. Box 2957
Casper, Wyoming 82602

RE: GWC; 223,82

[illegible]

Dear Pete:

Enclosed you will find the information relating to domestic and livestock wells that were monitored during the Dewey Pump Test.

If you have any questions, please call.

Very truly yours,

SILVER KING MINES, INC.

Gary W. Cummings
Resident Manager

GWC:dlg
Enclosure
cc: R. M. Caywood
D. H. Marks
R. H. Davidson
Mark Boggs

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | 610 | 609 |  |  | 40 | 4002 |  |  |  |  | 40U Recompletion? |
| WELL NUMBERS | 119 | 103 | 104 | 39 | BPZ 20 FR | BPZ 20 LAK | D-7 |  | 40U | 40L | 102 | 13 | 41 | 48 | 8Y-1 FR |
| DATE | FT | GPM | FT | FT | FT | FT | FT |  | GPM | PSI | GPM | FT | GPM | PSI | PSI |
| 2-16-82 | PUMP TEST STARTED |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2-17-82 | - | - | - | 26.89 | Froze | 4.88 | 4.54 |  | - | - | - | - | - | - | - |
| 2-18-82 | 10.73 | .72 | 9.40 | 26.93 | Froze | 14.35 | Froze at<br>4.54 |  | - | - | - | - | - | - | - |
| 2-19-82 | - | - | - | 26.83 | 3.91 | 20.18 | 4.61 |  | - | - | - | - | - | - | - |
| 2-19-82 | - | - | - | - | 4:00 PM<br>3.88 | 4:00 PM<br>22.44 | - |  | - | - | - | - | - | - | - |
| 2-20-81 | 10.69 | .75 | 9.63 | 26.93 | 8:20 AM<br>3.96 | 8:20 AM<br>27.59 | 4.61 |  | - | - | - | - | - | - | - |
| 2-21-82 | - | - | - | 26.94 | 1:10 PM<br>3.95 | 1:10 PM<br>35.90 | 4.83 |  | - | - | - | - | - | - | - |
| 2-22-82 | - | - | - | 26.84 | 1:00 PM<br>3.89 | 1:00 PM<br>42.30 | 4.62 |  | - | - | - | - | - | Stopped<br>Flowing | - |
| 2-23-82 | - | - | - | - | 3.91 | 10:30 AM<br>47.90 | - |  | 8:15 AM<br>1.48 GPM | - | 10.80 | - | - | - | - |
| 2-23-82 | - | - | - | - | - | - | - |  | 2:30 PM<br>.70 GPM | - | - | - | - | - | - |
| 2-24-82 | 10.77 | .70 | 9.62 | Windmill<br>Running | 4.70 | 12:00 noon<br>54.32 | 4.78 |  | Dribbles | - | 10.90 | - | - | - | - |
| 2-25-82 | - | - | - | 28.43 | 5.00 | 10:40 AM<br>59.64 | 4.74 |  | Drips | - | 10.80 | 7.10 | 11.40 | - | - |
| 2-26-82 | 10.70 | .72 | 9.53 | - | 4.73 | 12:18 PM<br>65.20 | 4.78 |  | No Water | - | 10.80 | 7.35 | 11.50 | - | - |
| 2-27-82 | - | - | - | - | - | 9:35 AM<br>69.35 | - |  | - | - | - | - | - | - | - |
| 2-27-82 | - | - | - | - | - | 3:20 PM<br>70.81 | - |  | - | - | - | - | - | - | - |
| 2-28-82 | - | - | - | - | 4.85 | 10:30 AM<br>71.00 | 4.67 |  | - | - | - | - | - | - | - |
| 3-1-82 | 10.62 | .75 | 9.46 | - | 4.79 | 12:30 PM<br>67.91 | 4.56 |  | - | - | 10.90 | 5.74 | 11.40 | - | - |
| 3-2-82 | - | - | - | - | 4.88 | 1:08 PM<br>64.82 | 4.56 |  | - | - | 10.90 | - | - | - | - |
| 3-3-82 | - | - | - | - | 5.07 | 11:50 AM<br>62.10 | 4.59 |  | .80 | - | 10.80 | - | - | - | - |
| 3-4-82 | 10.47 | .72 | 9.52 | - | 5.29 | 12:10 PM<br>59.46 | 4.70 |  | .80 | - | 10.80 | 6.37 | 11.20 | - | - |
| 3-5-82 | - | - | - | - | 5.49 | 2:25 PM<br>56.76 | 4.75 |  | .92 | - | - | - | - | 13.54' | - |
| 3-6-82 | - | - | - | - | - | 11:34 AM<br>54.89 | - |  | - | - | - | - | - | 11.05' | - |
| 3-7-82 | - | - | - | - | - | 52.60 | - |  | - | - | - | - | - | 8.25' | - |
| 3-8-82 | 10.70 | .75 | 9.48 | - | 6.00 | 50.28 | 4.58 |  | .80 | - | 10.80 | 6.63 | - | 5.54 | - |
| 3-10-82 | 10.42 | - | - | - | 6.98 | 46.37 | 4.58 |  | .50 | - | - | - | - | 0.80 | - |
| 3-11-82 | - | - | - | - | - | - | - |  | Dry | 16 GPM<br>12 PSI | - | - | - | Flow<br>5 GPM | 1.6 GPM<br>25 PSI |
| 3-12-82 | 10.18 | .77 | 9.41 | - | 6.49 | 42.98 | 4.61 |  | - | - | 9.80 | 6.86 | 10.80 | Flow<br>8 GPM |  |
| 3-15-82 | - | - | - | - | 6.73 | 38.42 | 4.85 |  | - | 14 PSI | - | - | - | Flow<br>15 GPM | 25.8 PSI |
| 3-17-82 | - | - | - | - | 7.15 | 36.05 | 4.99 |  | - | PSI<br>14.45 | - | - | - | 5.45 PSI | 25.5 PSI |
| 3-19-82 | 10.50 | .72 | 9.40 | - | 7.21 | 2:00 PM<br>33.48 | 4.91 |  | - | PSI<br>15.20 | 10.6 | 6.66 | - | 6.75 | 25.0 |
| 3-22-82 | - | - | - | - | 7.65 | Noon<br>30.58 | 5.49 |  | - | PSI<br>14.75 | - | - | - | 8.00 | 25.0 |
| 3-24-82 | - | - | - | - | 7.81 | 1:00 PM<br>28.60 | 4.54 |  | - | PSI<br>15.75 | - | - | - | - | 25.25 |
| 3-26-82 | 10.72 | .70 | 9.42 | - | 7.95 | 11:45<br>26.73 | 4.47 |  | - | PSI<br>17.25 | 8.8' | 9.50 | 10.5 | 9.80 | 25.0 |
| 3-30-82 | - | - | - | - | 7.92 | 23.38 | - |  | - | PSI<br>18.40 | - | - | - | - | 25.0 PSI |

626

625

| WELL NUMBERS | BPZ LA 22 | BPZ FR 22 | 99 | 96 | 106 | 107 | 115 | 147 | 148 | 38 | 49 | 109 | 110 | 111 | 117 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DATE | FT | FT | GPM | GPM | GPM | FT | GPM | FT | FT | GPM | GPM | FT | FT | FT | FT |
| 2-16-82 | PUMP TEST STARTED | | | | | | | | | | | | | | |
| 2-17-82 | 70.62 | 74.92 | - | 4.00 | 1.80 | 1.23 | 1.15 | 13.06 | - | 1.80 | 2.50 | 60.35 | 83.95 | 8.08 | 29.78 |
| 2-18-82 | 70.69 | 74.89 | Well in use<br>1.50 | 4.00 | 1.75 | 1.25 | 1.15 | 13.06 | - | 1.75 | Leaks<br>2.43 | 60.02 | 83.68 | 8.21 | 29.87 |
| 2-19-82 | 70.63 | 74.88 | - | 4.00 | 1.80 | 1.27 | 1.15 | 13.06 | - | 1.80 | 2.38 | 59.89 | 83.63 | 8.13 | 29.83 |
| 2-19-82 | | | | | | | | | | | | | | | |
| 2-20-82 | 70.74 | 74.96 | 1.55 | 4.00 | 1.75 | 1.26 | 1.15 | 13.05 | - | 1.80 | 2.42 | Well in use<br>60.22 | 83.65 | 8.21 | 29.90 |
| 2-21-82 | 70.75 | 74.95 | - | 4.00 | 1.80 | 1.55 | 1.17 | 13.08 | - | 1.80 | 2.35 | Well in use<br>60.60 | 83.86 | 8.26 | 29.94 |
| 2-22-82 | 70.71 | 74.91 | - | 9:00 AM<br>3.90 | 1.80 | 1.30 | 1.17 | 13.10 | - | 1.80 | 2.40 | 60.32 | 83.78 | 8.17 | 29.89 |
| 2-23-82 | - | - | - | 3.90 | - | - | - | - | - | - | 2.40 | - | - | - | - |
| 2-24-82 | 70.92 | 75.10 | 1.55 | 3.90 | 1.80 | 1.45 | 1.10 | 13.35 | Water at Surface | 1.80 | 2.40 | 60.35 | 83.96 | 8.33 | 29.95 |
| 2-25-82 | 70.92 | 75.09 | - | 3.90 | 1.80 | 1.42 | 1.10 | 13.68 | Water at Surface | 1.80 | 2.35 | 60.20 | 83.94 | 8.32 | 30.02 |
| 2-26-82 | 70.87 | 74.95 | 1.60 | 3.90 | 1.80 | 1.48 | 1.15 | 14.12 | Water at Surface | 1.80 | 2.35 | Well in use<br>60.32 | 83.91 | 8.25 | 29.95 |
| 2-28-82 | 70.98 | 75.00 | - | 3.70 | 1.80 | 1.35 | 1.20 | 15.44 | 0.10' | - | 2.35 | 60.57 | 84.21 | 8.29 | 30.00 |
| 3-01-82 | 70.75 | 74.87 | 1.60 | 3.95 | 1.80 | 1.24 | 1.20 | 16.32 | .60 | 1.80 | 2.35 | 60.15 | 83.95 | 8.23 | Pump on |
| 3-02-82 | 70.82 | 74.85 | - | 3.95 | 1.80 | 1.23 | - | 17.09 | .90 | - | 2.30 | 59.83 | 84.19 | 8.15 | 29.77 |
| 3-03-82 | 70.80 | 74.81 | - | 3.95 | 1.80 | 1.25 | 1.17 | 17.93 | 1.22 | - | 2.32 | 59.89 | 84.27 | 8.17 | 29.80 |
| 3-04-82 | 70.84 | 74.95 | 1.57 | 3.95 | 1.80 | 1.36 | 1.20 | 18.72 | 1.47 | 1.80 | 2.35 | 59.99 | 84.31 | 8.25 | 29.82 |
| 3-05-82 | 70.97 | 75.05 | - | 3.95 | 1.80 | 1.42 | 1.15 | 19.48 | 1.74 | - | 2.32 | 60.05 | 84.40 | 8.30 | 29.95 |
| 3-6-82 | - | - | - | - | - | - | - | 20.21 | - | - | - | - | - | - | - |
| 3-07-82 | - | - | - | - | - | - | - | 20.85 | - | - | - | - | - | - | - |
| 3-08-82 | 70.99 | 75.06 | 1.60 | 3.95 | 1.80 | 1.27 | 1.20 | 21.38 | 1.89 | 1.80 | Leaks<br>2.35 | 60.00 | 84.49 | 8.31 | 30.35 |
| 3-10-82 | 70.91 | 74.98 | - | 3.75 | 1.80 | 1.23 | No flow | 22.35 | 1.73 | - | - | 60.00 | 84.51 | 8.16 | 29.90 |
| 3-11-82 | | | | | | | | | | | | | | | |
| 3-12-82 | 70.78 | 74.88 | 1.60 | 3.95 | 1.80 | 1.28 | 1.10 | 22.98 | 1.52 | 1.80 | 2.20 | 60.21 | 84.60 | 8.20 | 29.73 |
| 3-15-82 | 70.51 | 74.51 | - | 3.90 | 1.80 | 1.52 | 1.00 | 23.61 | 1.43 | - | 2.25 | 59.79 | 84.36 | 8.11 | - |
| 3-17-82 | - | - | - | - | - | 1.67 | .85 | 23.86 | 1.41 | - | Leaks<br>2.18 | - | - | - | - |
| 3-19-82 | 70.63 | 74.67 | 1.57 | 3.85 | 1.80 | 1.57 | Well in use | 24.02 | 1.22 | 1.80 | 2.20 | 59.75 | 84.40 | 8.15 | |
| 3-22-82 | - | - | - | - | - | 1.80 | 1.10 | 24.05 | 1.15 | - | 2.18 | - | - | - | - |
| 3-24-82 | - | - | - | - | - | 1.23 | 1.12 | 24.04 | .80 | - | - | - | - | - | - |
| 3-26-82 | 70.96 | 75.00 | 1.55 | 3.90 | 1.80 | 1.14 | 1.25 | 24.06 | .76 | 1.70 | 2.25 | 60.02 | 84.77 | 8.40 | 29.92 |
| 3-30-82 | - | - | - | - | - | - | - | 24.02 | .13 | - | - | - | - | - | - |

# SOURCE H

# ADDITIONAL WATER WELLS IN EDGEMONT PROJECT AREA

(Silver King Mines, Inc., Interoffice Correspondence, Keith Andersen to R.M. Caywood, August 3, 1979)

# INTEROFFICE CORRESPONDENCE

Company Silver King Mines, Inc. Date August 3, 1979

To: R. M. Caywood

From: Keith E. Andersen Subject: Quarterly Burdock Area Water Levels

Attached are quarterly measurements of Burdock Area water well flow rates and water levels. Wells numbered 135 - 143 are new wells or wells added to our monitoring program by request. Wells numbered 200 - 216 are probable Sundance wells located east of the Burdock Area.

In an effort to obtain all possible information, several measurements of questionable accuracy were made as noted below.

| Well No. | Problem |
|---|---|
| 2 | Leaking around casing |
| 4 | Leaking around casing |
| 7S | Measuring point changes |
| 13 | Pipeline use affects flow |
| 33 | Measuring point changes |
| 35 | Measured inside cylinder drop pipe |
| 36 | Leaking around pipeline fittings |
| 37 | Measured inside cylinder drop pipe |
| 40 | Two wells at different elevations piped together |
| 41 | Pump had been operating |
| 42 | Leaking around pipeline fittings |
| 52 | Measuring point changed |
| 53 | Measured through cylinder drop pipe |
| 56 | Casing broken out |
| 98 | Casing leaking |
| 113 | Measured inside cylinder drop pipe |
| 114 | Measured inside cylinder drop pipe |

Water quality data on these wells is not yet complete.

Keith E. Andersen

Keith E. Andersen, Chief Engineer

F 300 B 4M 7-58

# Additional Water Wells In Edgemont Project Area

| Well No. | Location |
|---|---|
| 135 | T 8 S, R 2 E, Sec. 1 bd |
| 136 | T 8 S, R 2 E, Sec. 5 bb |
| 137 | T 7 S, R 2 E, Sec. 17 bd |
| 138 | T 6 S, R 1 E, Sec. 18 a |
| 139 | T 41 N, R 60 W, Sec. 18 dd |
| 140 | T 9 S, R 3 E, Sec. 19 bc |
| 141 | T 10 S, R 3 E, Sec. 20 aa |
| 142 | T 7 S, R 2 E, Sec. 35 bd |
| 143 | T 8 S, R 1 E, Sec. 30 dc |
| 200 | T 7 S, R 2 E, Sec. 13 ca |
| 201 | T 7 S, R 2 E, Sec. 13 ca |
| 202 | T 7 S, R 2 E, Sec. 13 ca |
| 203 | T 7 S, R 2 E, Sec. 12 cd |
| 204 | T 7 S, R 2 E, Sec. 12 cb |
| 205 | T 7 S, R 2 E, Sec. 12 ac |
| 206 | T 7 S, R 2 E, Sec. 12 ac |
| 207 | T 7 S, R 2 E, Sec. 12 aa |
| 208 | T 7 S, R 2 E, Sec. 2 bc |
| 209 | T 7 S, R 2 E, Sec. 3 da |
| 210 | T 7 S, R 2 E, Sec. 2 bd |
| 211 | T 7 S, R 2 E, Sec. 12 ba |
| 212 | T 8 S, R 3 E, Sec. 8 db |
| 213 | T 7 S, R 3 E, Sec. 20 dc |
| 214 | T 7 S, R 3 E, Sec. 18 cd |
| 215 | T 6 S, R 2 E, Sec. 27 dd |
| 216 | T 6 S, R 2 E, Sec. 22 aa |
| 144 | T9S, R3E, Sec. 21 |
| 145 | T8S, R2E, sec 3 dc |
| 146 | T9S, R2E, sec 21 bc |

# Additional Water Wells In Edgemont Project Area

| No. | Owner | Use | Depth | Probable Aquifer | Remarks |
|---|---|---|---|---|---|
| 135 | Mike Ringer | D,S | 360 | Lakota | Drilled 1977 - Submersible Pump |
| 136 | Ed Dodson | D,S | | Spring | Source Uncertain |
| 137 | USFS | S | | | Windmill |
| 138 | John Carlson | D | 100 | Fall River | Drilled 1977, flows, Jet Pump |
| 139 | Gerald Darrow | S | 620 | Lakota | Drilled 1978, flows 20 gpm |
| 140 | Ken Barker | D,S | | | |
| 141 | Howard Henderson | S | | Spring | Source Uncertain |
| 142 | Jack Standen | D,S | 280 | Fall River | Submersible Pump |
| 143 | Jeff Schultz | D,S | 1,640 | Fall River | Drilled 1962, Submersible Pump @ 440 |
| 200 | George Hey | D,S | 108 | Sundance | Water Level 52.7', Submersible Pump |
| 201 | George Hey | S | 110 | Sundance | Pump Jack |
| 202 | George Hey | S | 200 | Sundance | Water Level 16.7' |
| 203 | Donald Spencer | D,S | 200 | Sundance | Submersible Pump at 160 |
| 204 | Donald Spencer | U | 170 | Sundance | |
| 205 | Mason Miller | U | 108 | Sundance | Water Level 24.5 |
| 206 | Mason Miller | D,S | 200 | Sundance | Water Level 18.4, Jet Pump |
| 207 | Mason Miller | D,S | | | Submersible Pump, Pipeline |
| 208 | Mason Miller | S | 179 | Sundance | Pump Jack |
| 209 | Donald Spencer | U | 247 | Sundance | Water Level 145.2 |
| 210 | George Hey | S | 125 | Sundance | Pump Jack |
| 211 | Donald Spencer | S | 161 | Sundance | Pump Jack - Water Level 8.14 |
| 212 | Carl Reutter | S | 2,204 | | Flows 1.5 gpm, old oil test |
| 213 | George Hey | S | 100 | Sundance | Submersible Pump, Water Level 34.1 |
| 214 | George Hey | S | 270 | Sundance | Water Level 39.1 |
| 215 | Claude Smith | S | 900 | | Water Level 60.7, Submersible Pump, Pipeline |
| 216 | Claude Smith | U | | | Water Level 217.9 |
| 144 | | S.O | | | Water Level 368.4' |

# SOURCE I

# FOREST SERVICE WELLS AND SPRINGS

(Letter from Keith Andersen, Silver King Mines, Inc., to John Hatch, South Dakota Water Rights Commission, January 12, 1979)

## FOREST SERVICE WELLS AND SPRINGS

This list of wells and springs located on U. S. Forest Service land was obtained from the Forest Service office in Newcastle, Wyo. These wells and springs will be visited and an attempt made to determine the aquifer from which they produce. The water on Forest Service land is used by ranches for stock water during the summer months and to supply water for wild life.

| Name | Location | |
|---|---|---|
| Bennett Canyon Well | T7S, R2E, SW¼, Sec. 7 | #114 |
| Driftwood Canyon Well | NW¼, Sec. 16 | no match > 2 km |
| Heck Well | NW¼, Sec. 17 | #137 > 2 km |
| Spencer Well | NE¼, Sec. 7 | no match |
| Bennett # 2 Well | SW¼, Sec. 6 | #113 |
| Hey Well | T7S, R3E, SW¼, Sec. 18 | > 2 km |
| Roderick Spring | T7S, R2E, SE¼, Sec. 18 | |
| North Roderick Spring | NE¼, Sec. 17 | |
| North Long Mountain Spring | T7S, R3E, NW¼, Sec. 32 | |
| South Long Mountain Spring | NW¼, Sec. 32 | |
| Dewey Well | T6S, R1E, SW¼, Sec. 5 | #120 > 2 km |
| Cook Well | NW¼, Sec. 9 | no match > 2 km |
| Pass Creek Well | NE¼, Sec. 22 | #632 > 2 km |
| Lower Turkey Spring | T5S, R1E, SW¼, Sec. 32 | |
| Turkey Spring | NE¼, Sec. 32 | |
| Tailend Reservoir Spring | Sec. 15 | |
| Bowl Spring | T5S, R1E, NE¼, Sec. 29 | |
| Bosley Spring | SE¼, Sec. 17 | |
| Barrel Spring | NW¼, Sec. 7 | |
| Sheepwagon Spring | T4S, R1E, SW¼, Sec. 32 | |
| Lower Dugout Spring | NW¼, Sec. 29 | |
| Dugout Spring | NE¼, Sec. 19 | |
| North Spring | Sec. 6 | |
| South Spring | Sec. 6 | |
| Carr Spring | T42N, R60W, SE¼, Sec. 4 | |
| Mix Spring | T43N, R60W, NW¼, Sec. 28 | |
| Pipeline Spring | Sec. 21 | |
| Pollard Spring | NE¼, Sec. 9 | |

# SOURCE J

# HYDROGEOLOGIC INVESTIGATIONS AT PROPOSED URANIUM MINE NEAR DEWEY, SOUTH DAKOTA

(Report No. WR28-2-520-128, J. Mark Boggs, Tennessee Valley Authority, October 1983)

SEE APPENDIX 2.7-K FOR THIS SOURCE REPORT

# SOURCE K

# COORDINATES, ELEVATIONS AND WATER LEVELS FOR BURDOCK PIEZOMETERS

(Letter from Keith Andersen, Silver King Mines, Inc., to John Hatch, South Dakota Water Rights Commission, January 12, 1979)

## Coordinates (SKM Grid) and Elevations for Burdock Area Observation Wells

| Well | Aquifer | Coordinates | | Measuring Point Elevation | Height of Measuring Point Above Ground Level |
|---|---|---|---|---|---|
| Original Nine Wells Installed Fall 1976 (Abandoned five Fall 1978) | | | | | |
| B-1 FR 672 | Kf | 90,856 E | 188,869 N | 3622.07 | - 1.0 ft. |
| B-2 Aban | Kl | 90,808 E | 188,859 N | 3621.08 | 0 |
| B-3 FR ? | Kf | 93,532 E | 190,992 N | 3701.16 | 2.0 ft. |
| B-3 Aban | Kl | 93,583 E | 191.005 N | 3701.63 | 1.6 ft. |
| B-4 Aban | Kl | 95,531 E | 190,551 N | 3679.45 | 2.58 ft. |
| B-5 637 Aban | l | 97,944 E | 191,909 N | 3731.04 | 1.9 ft. |
| B-6 FR 659 | Kf | 91,925 E | 192,493 N | 3642.64 | 0 |
| B-6 660 Aban | l | 91,874 E | 192,472 N | 3644.12 | 0 |
| B-8 661 | Kl | 100,952 E | 193,839 N | 3788.58 | 2.0 ft. |
| Burdock Well | Kf,Kl 668 | 91,081 E | 189,167 N | 3624.16 | = GL Elevation |
| Four Additional Wells Installed August 1977 | | | | | |
| B-7 FR 665 | Kf | 93,303 E | 190,402 N | 3671.24 | 1.75 ft. |
| B-7 666 | Kl | 93,279 E | 190,373 N | 3671.1 | 2.08 ft. |
| B-9 FR 646 | Kf | 91,389 E | 187,658 N | 3605.42 | 3.0 ft. |
| B-9 658 | Kl | 91,389 E | 187,658 N | 3605.42 | 2.6 ft. |
| Seven Replacement Wells Installed Fall 1978 | | | | | |
| B-2 LAK 674 | Kf | 90,776 E | 188,900 N | 3621.11 | 1.3 ft. |
| B-2 FU 673 | Klf | 90,767 E | 188,841 N | 3619.96 | 0 |
| B-10 FR 671 | Kf | 91,221 E | 189,275 N | 3631.19 | 1.4 ft. |
| B-10 FU 670 | Klf | 91,265 E | 189,344 N | 3630.31 | 1.6 ft. |
| B-10 LAK 669 | Kl | 91,206 E | 189,317 N | 3631.24 | 1.6 ft. |
| B-11 FR 664 | Kf | 90,805 E | 189,721 N | 3623.94 | 0 |
| B-11 LAK 663 | Kl | 90,843 E | 189,739 N | 3624.82 | 1.0 ft. |

Source: Letter from Keith Andersen, Silver King Mines, Inc., to John Hatch, South Dakota Water Rights Commission, January 12, 1979

## Revised Coordinates and Elevations for Burdock Piezometers

| ell | Coordinates | | Measuring Point Elevation | Height of Measuring Point to Ground Level |
|---|---|---|---|---|
| 3-1 FR | 90,856.22 E | 188,868.81 N | 3622.07 | -1.0 |
| 3-2 LAK | 90,775.65 E | 188,899.89 N | 3621.11 | 1.3 ft. |
| 3-2 Fuson | 90,767.34 E | 188,841.37 N | 3619.96 | 0' |
| 3-3 FR | 93,531.56 E | 190,991.69 N | 3701.16 | 2 ft. |
| 3-4 | 95,530.98 E | 190,550.99 N | 3679.45 | 2.58 ft. |
| 3-6 FR | 91,924.72 E | 192,492.25 N | 3642.64 | 0' |
| 3-6 | 91,874.49 E | 192,471.83 N | 3644.12 | 0' |
| 3-7 | 93,279.33 E | 190,372.99 N | 3671.10 | 2.08 ft. |
| 3-7 FR | 93,303.13 E | 190,401.62 N | 3671.24 | 1.75 ft. |
| 3-9 | 91,388.52 E | 187,657.99 N | 3605.42 | 3 ft. |
| 3-10 FR | 91,220.54 E | 189,274.64 | 3631.19 | 1.4 ft. |
| 3-10 LAK | 91,205.62 | 189,317.02 | 3631.24 | 1.6 ft. |
| 3-10 Fuson | 91,265.09 | 189,343.85 | 3630.31 | 1.6 ft. |
| 3-11 LAK | 90,842.73 | 189,738.78 | 3624.82 | 1 ft. |
| 3-11 FR | 90,805.19 | 189,720.73 | 3623.94 | 0' |
| Sundance Well | 662 5,840.49 E | 189,370.12 N | 3647.84 | 3 ft. |
| Burdock Well | 91,081.12 | 189,167.42 | 3624.16 = GL Elevation | |

## Water Level Measurements for Burdock Piezometers

All pressure measurements on 9-21 are 2-2.75 psi lower than previous measurement - gauge may not have been accurate.

| | | | |
|---|---|---|---|
| B-1 | 7-20-78 | 14.25 psi | |
| | 9-21-78 | 12.25 psi | |
| | 10-13-78 | 8.80 psi | Burdock well flowing |
| B-2 | 7-20-78 | 16.0 psi | Abandoned 11-10-78 |
| | 9-21-78 | 13.25 psi | |
| B-3 | 7-20-78 | 35.9' | |
| | 8-4-78 | 36.3' | |
| | airlifted on 8-4 | | Abandoned 11-10-78 |
| | 8-21-78 | 36.5 | |
| | 9-21-78 | 36.8 | |
| B-3 FR | 7-20-78 | 37.5 | |
| | 8-4-78 | 37.7 | |
| | airlifted on 8-4 | | |
| | 8-21-78 | 37.3 | |
| | 9-21-78 | 37.6 | |
| | 10-13-78 | 38.7 | Burdock well flowing |
| | 11-22-78 | 38.8 | |
| B-4 | 7-20-78 | 11.5' | Water Level in Annulus 11.8' |
| | 9-21-78 | 12.1' | |
| | 10-13-78 | 13.6 | Burdock well flowing |
| | 11-21-78 | 13.9 | Abandoned 12-5-78 |

Source: Letter from Keith Andersen, Silver King Mines, Inc., to John Hatch, South Dakota Water Rights Commission, January 12, 1979

(Continued - Page 2)

| | | | |
|---|---|---|---|
| B-5 | 7-20-78 | 48.8 | |
| | 9-21-78 | 49.4 | |
| | 10-13-78 | 49.7 | Burdock well flowing |
| | 11-21-78 | 50.0 | Abandoned - 12-5-78 |
| B-6 | 7-20-78 | 10.3 psi | |
| | 9-21-78 | 8.25 psi | |
| | 10-13-78 | 7.75 psi | Burdock well flowing<br>Abandoned 12-5-78 |
| B-6 FR | 7-20-78 | 7.75 psi | |
| | 9-21-78 | 5.5 psi | |
| | 10-13-78 | 5.5 psi | Burdock well flowing |
| B-7 | 7-20-78 | 8.9' | |
| | 7-26-78 | 9.0' | Airlifted |
| | 8-4-78 | 9.3' | |
| | 8-7-78 | 9.2' | |
| | 8-21-78 | 9.2' | Airlifted |
| | 9-21-78 | 9.3' | Airlifted |
| | 10-13-78 | 12.6 | Burdock well flowing |
| | 11-21-78 | 11.5 | |
| B-7 FR | 7-20-78 | 17.6' | |
| | 7-26-78 | 17.4 | Airlifted |
| | 8-4-78 | 12.5' | |
| | 8-8-78 | 12.4' | |
| | 8-21-78 | 12.3' | Airlifted |
| | 9-21-78 | 12.6' | Airlifted |
| | 10-12-78 | 13.75 | Burdock well flowing |
| | 11-21-78 | 15.5 | |
| B-8 | 7-20-78 | 96.25' | |
| | 8-4-78 | 97.5' | Airlifted |
| | 8-21-78 | 97.3' | |
| | 9-21-78 | 97.9' | |
| B-9 | 7-20-78 | 19.2 psi | |
| | 9-21-78 | 17.0 psi | |
| | 10-13-78 | 15.0 psi | Burdock well flowing |
| B-9 FR | 7-20-78 | 17.9 psi | |
| | 9-21-78 | 16.0 psi | |
| | 10-13-78 | 15.25 psi | Burdock wel |

BPZ 14 #602
BPZ 15 FR #601
BPZ 16 #643
BPZ 17FR #644
BPZ 18 #608
BPZ 19 FR #607
BPZ 20 #609
BPZ 21 FR #610
BPZ 22 #626
BPZ 23 FR #625

## Outlying Piezometer Wells

Locations:

| | | | | |
|---|---|---|---|---|
| BPZ 14 & 15 FR | T8S, R2E, sec 23 | NE/4 | NW/4 | NW/4 |
| BPZ 16 & 17 FR | T7S, R2E, sec 30 | SW/4 | SE/4 | SE/4 |
| BPZ 18 & 19 FR | T40N, R60W, sec 27 | SE/4 | SE/4 | NW/4 |
| BPZ 20 & 21 FR | T6S, R1E, sec 29 | SW/4 | NW/4 | NE/4 |
| BPZ 22 & 23 FR | T41N, R60W, sec 9 | SW/4 | SE/4 | SE/4 |

**Source:** Letter from Keith Andersen, Silver King Mines, Inc., to John Hatch, South Dakota Water Rights Commission, January 12, 1979

(Continued - Page 3)

Water Levels:

| | | | |
|---|---|---|---|
| BPZ 14 | 7-20-78 | 130.5' | |
| | 8-7-78 | 130.2' | Airlifted |
| | 8-22-78 | 136' | Airlifted |
| | 9-21-78 | 136.5' | |
| | 10-13-78 | 136.6 | |
| | 11-21-78 | 135.9 | |
| BPZ-15 FR | 7-20-78 | 59.5' | |
| | 8-7-78 | 51.5' | Airlifted |
| | 8-9-78 | 47.7' | |
| | 8-22-78 | 47.5 | Airlifted |
| | 9-21-78 | 47.7' | Airlifted |
| | 10-13-78 | 47.8 | |
| | 11-21-78 | 47.5 | |
| BPZ-16 | 7-20-78 | 7.0 psi | shut in on this date |
| | 8-9-78 | | Airlifted |
| | 9-21-78 | 9.0 psi | |
| | 10-13-78 | 9.0 psi | |
| BPZ-17 | 7-20-78 | 20.6' | |
| | 8-9-78 | 20.6' | Airlifted |
| | 8-22-78 | 21.8' | |
| | 9-21-78 | 21.9' | |
| | 10-13-78 | 21.9' | |
| | 11-21-78 | 22.0' | |
| BPZ-18 | 8-7-78 | 17.5' | |
| | 9-21-78 | 17.7' | |
| | 10-16-78 | 17.7 | Airlifted |
| | 11-20-78 | 20.3" | |
| BPZ-19 FR | 8-7-78 | 21.8' | Airlifted |
| | 8-22-78 | 18.3' | Airlifted |
| | 9-21-78 | 18.7' | Airlifted |
| | 10-16-78 | 21.1 | |
| | 11-21-78 | 19.8 | |
| BPZ-20 | 7-20-78 | 4.8' | |
| | 7-31-78 | 4.75' | Airlifted - much mud |
| | 8-3-78 | 172.7' | |
| | 8-21-78 | 83' | Airlifted |
| | 9-20-78 | 73.3' | Airlifted |
| | 10-12-78 | 108.5 | Airlifted |
| | 11-21-78 | 89.9 | |

Source: Letter from Keith Andersen, Silver King Mines, Inc., to John Hatch, South Dakota Water Rights Commission, January 12, 1979

(Continued-Page 4)

| | | | |
|---|---|---|---|
| BPZ-21 FR | 7-31-78 | Slight Flow | Airlifted |
| | 8-3-78 | 15' | |
| | 8-8-78 | 11.5' | |
| | 8-21-78 | 6.3' | Airlifted |
| | 9-20-78 | 7.5' | Airlifted |
| | 10-12-78 | 9.3 | |
| | 11-21-78 | 8.7 | |
| BPZ-22 | 7-20-78 | 65.9' | |
| | 7-31-78 | 64.5' | Airlifted - much mud |
| | 8-3-78 | 153.9' | |
| | 8-21-78 | 89.3' | Airlifted |
| | 9-20-78 | 76.1' | Airlifted |
| | 10-12-78 | 85.1' | Airlifted |
| | 11-21-78 | 70.5' | |
| BPZ-23 FR | 7-20-78 | 73.2' | |
| | 7-31-78 | 70' | Airlifted |
| | 8-3-78 | 72.7' | |
| | 8-21-78 | 70.3' | Airlifted |
| | 9-20-78 | 68.6' | Airlifted |
| | 10-12-78 | 73.8 | |
| | 11-21-78 | 73.3 | |

Depth of Screen:

| | | |
|---|---|---|
| BPZ-14 | 588-630 | |
| BPZ-15 FR | 336-378 | |
| BPZ-16 | 252-294 | |
| BPZ-17 FR | 84-126 | |
| BPZ-18 | 798-882 | attempted to set 42' dec |
| BPZ-19 FR | 672-714 | |
| BPZ-20 | 903-966 | |
| BPZ-21FR | 630-672 | |
| BPZ-22 | 588-630 | not pressure grouted |
| BPZ-23 FR | 420-462 | |

BPZ 14 #602
BPZ 15 FR #601
BPZ 16 #643
BPZ 17FR #644
BPZ 18 #608
BPZ 19 FR #607
BPZ 20 #609
BPZ 21 FR #610
BPZ 22 #626
BPZ 23 FR #625

All wells constructed of 1" blk iron pipe with torch slot screen. Grout pumped down annulus to desired depth with 1" plastic pipe.

Source: Letter from Keith Andersen, Silver King Mines, Inc., to John Hatch, South Dakota Water Rights Commission, January 12, 1979

# SOURCE L

# CONSTRUCTION AND LOCATION DATA FOR DEWEY PUMP TEST WELLS

(in letter from Keith Andersen, Silver King Mines, Inc., to Steve Stampfli, Office of Surface Mining, South Dakota Department of Water and Natural Resources, March 3, 1982)

| | 611 | 613 | 614 | 615 | 612 | 436 | 657 | 623 | 622 | 616 | 617 | 624 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **WELL #** | DEWEY TEST WELL | D-1 FR | D-1 Fu | D-1 LK | D-2 LK | D-3 FR | D-3 LK | D-4 FR | D-4 LK | D-5 LK | D-6 LK | D-7 FR |
| Hole Number | DWT-99 | DWM-51 | 54 | 46 | 47 | 49 | 48 | 52 | 50 | 55 | 56 | DXM-1 |
| Date Drilled | 10-17-81 | 7-21-81 | 9-04-81 | 7-07-81 | 7-09-81 | 7-16-81 | 7-14-81 | 7-23-81 | 7-20-81 | 9-09-81 | 9-11-81 | 7-30-81 |
| Date Completed | 10-17-81 | 8-14-81 | 9-14-81 | 8-13-81 | 8-14-81 | 8-18-81 | 8-18-81 | 8-17-81 | 8-17-81 | 9-15-81 | 9-15-81 | 7-30-81 |
| Depth Cased | 694 | 504 | 609 | 712 | 692 | 505 | 715 | 503 | 714 | 735 | 715 | 120 |
| Depth Completed | 801 | 580 | 620 | 800 | 800 | 590 | 800 | 580 | 780 | 835 | 810 | 120 |
| X-Coord. | 80798 | 80923 | 80982 | 80972 | 80710 | 80385 | 80416 | 81564 | 81618 | 81126 | 80004 | 76979 |
| Y-Coord. | 214898 | 215036 | 215035 | 214972 | 215068 | 215595 | 215658 | 215330 | 215281 | 214090 | 214495 | 219008 |
| Collar Elev. | 3736.2 | 3737.3 | 3741.1 | 3741.4 | 3728.5 | 3738.0 | 3744.3 | 3753.5 | 3751.4 | 3747.7 | 3723.3 | 3723.9 |
| "r" | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| SWL (12-3-81) | 34.16 | 26.23 | 32.16 | 39.68 | 26.56 | 21.03 | 42.37 | 34.22 | 49.68 | 45.86 | 21.42 | Surface |

Source: Letter from Keith Andersen, Silver King Mines, Inc., to Steve Stampfli, Office of Surface Mining, South Dakota Department of Water and Natural Resources, March 3, 1982

# SOURCE M

# BURDOCK MINE AREA HYDROLOGY STATUS REPORT

(Silver King Mines, Inc. Interoffice Correspondence from Keith Andersen to R.M. Caywood, December 18, 1978, provided in a letter from Keith Andersen to John Hatch, South Dakota Water Rights Commission, January 12, 1979)

POWERTECH (USA) INC.

**INTEROFFICE CORRESPONDENCE**

Company: Silver King Mines, Inc. Date: December 18, 1978

To: R. M. Caywood

From: Keith E. Andersen

Subject: Burdock Mine Area Hydrology
Status Report

Uranium ore in economically recoverable quantities has been discovered northwest of Edgemont, South Dakota, near Burdock on lands leased by the Tennessee Valley Authority. The ore is located in the Lakota Formation. Tentative plans call for conventional underground mining techniques which will require dewatering the ore zone during the mining operation. The Lakota Formation and the overlying Fall River Formation are the two principal aquifers supplying domestic water for area ranches. In view of this information, it was apparent that extensive hydrologic investigations would be required in planning the proposed mine.

An attempt has been made to identify all wells and springs having their source in the Fall River or Lakota Formation within approximately a 25 mile radius of the proposed mine. Appended are lists of these wells. The list entitled 'Water Wells in the Edgemont Project Area" includes those wells felt most likely to be affected by proposed mine dewatering because of their proximity to the mine and their topographic location along the Cheyenne River Basin. Information on these wells was obtained from personal visits to the wells and with the well owners, Silver King Mines, Inc. files, South Dakota Geological Survey Report #109 "Ground Water Resources of the Western Half of Fall River County, SD" by Jack Keene, and from USGS Hydrologic Atlas 'Water Resources of the Powder River Basin and Adjacent Areas, Northeastern Wyoming" by Hodson, Pearl, and Druse. Since completion of this listing in May, 1977, selected wells from this list have been monitered on a quarterly basis. Information on other wells within 25 miles of the proposed mine is as shown on the listings.

In addition to monitering selected existing wells several observation wells have been installed to moniter water levels in the Fall River and Lakota aquifers. Initially nine observation wells were constructed in the Burdock area during the fall of 1976 to moniter water level drawdown during the February, 1977, pump test. Four more wells were installed during August, 1977, to provide additional information for the November, 1977, pump test. To provide additional information on area water levels ten wells were installed during the summer of 1978 at selected locations throughout the project area. Finally, when it appeared that some of the original nine wells were not providing reliable data, five of these wells were cemented off and abandoned and seven replacement wells drilled during the fall of 1978. Information on all of the observation wells is appended.

F 300 B 4M 7-78

A test well was constructed during January, 1977, for the purpose of conducting pump tests and potentially for dewatering use. This well was pumped during the February, 1977, and November, 1977, pump tests.

The well was allowed to free flow after completion until February 11, 1977, the starting date for the first pump test. This flow resulted in pre-pump test drawdown as shown in the attached data. The well was pumped from both aquifers for 337 hours at an average discharge of 261 gpm. The water level in the well stabalized at 433 feet of drawdown after 280 hours. Data from observation well B-2 indicated the static head on the well before it was allowed to flow was about +30 feet. Using a total drawdown of 463 feet the specific capacity of the well was estimated at 0.56 gpm/ft..

Coefficients of transmissibility and storage were estimated from the observation well drawdown data using the time-drawdown graphical solution to the Theis non-equilibrium well formula. It was necessary to estimate the pumping rate from the Fall River and Lakota for this analysis. The Fall River pumping rate was estimated at 100 gpm and the Lakota at 161 gpm. Using these figures, the transmissivity and storage coefficient of the Lakota were estimated at 1600 gpd/ft. and $5.5 \times 10^{-5}$, respectively, and at 860 gpd/ft. and $4 \times 10^{-5}$ for the Fall River.

Since approximately one-half of the domestic wells in the area produce from the Fall River aquifer and since it would be possible to sink a shaft through the Fall River with minimal disturbance to water levels, another pump test was planned to determine if the Fall River and Lakota were hydraulically connected. Four additional observation wells were installed in preparation for this test.

Following the February, 1977, pump test the well was shut in and not allowed to flow at the surface. Water was able to communicate between the aquifers since the well screen was open to both aquifers. During the week of October 25, 1977, the Fall River aquifer was isolated and shut in with a pneumatic packer. The Lakota was allowed to free flow until the pump test, November 14, again resulted in pre-pump test drawdown.

The pump test began at 10:00 a.m. on November 14, and continued until November 17. By the morning of November 17, it appeared that sufficient data had been obtained to determine whether or not leaky aquifer conditions existed in the Burdock area and the initial phase of the test was terminated at 11:30 a.m.. The average pumping rate for this period was 193 gpm. Assuming that the water levels in piezometers B-1 FR and B-2 were the same as the Fall River and Lakota water levels in the well before the pump was installed, the total Lakota drawdown at the end of the initial phase was 267 feet and the total Fall River drawdown was 49 feet. At 11:30 a.m. the pumping rate was increased to 225 gpm in an attempt to provide additional data on the apparent specific capacity of the well and on the rate of drawdown in the Fall River with respect to the head differential between the Fall River and Lakota water levels.

After two hours additional pumping at 225 gpm the Lakota drawdown was 298 feet and the Fall River drawdown was 50 feet. At 1:30 p.m. the pumping rate was increased to 250 gpm. For the next hour the pumping rate fluctuated considerably because the pipeline from the well head to the holding reservoir was not capable of handling the increased flow. The pipeline broke and was repaired several times causing a varying pumping head and varying pumping rate. The pumping rate was cut back to 230 gpm at 3:00 p.m.. The pneumatic packer, which had been set at 200 psi, was pressured to 250 psi at 3:15 p.m. to see what effect this might have on the rate of drawdown in the Fall River. The pump was shutoff at 4:15 p.m. and water level recovery rates monitered.

Time-drawdown data from this pump test indicated a complex hydrologic system in this area, with the effects of both leakage and boundary conditions influencing ground water flow. Early time data indicated a transmissivity of about 1600 gpd/ft. and storage coefficient of about $7.5 \times 10^{-5}$ for the Lakota, which agreed reasonably well with the values calculated for the first test. Attempts at more detailed analysis of the data were not successful.

Because of the difficulty in analyzing the drawdown data it began to appear that some of the data might be unreliable. To investigate this possibility, cemoton logs were run on wells B-2, B-3, B-4, and B-5. These logs showed the cement grout was not properly placed to isolate the Fall River and Lakota in these wells. These four wells and well B-6 have been abandoned and replaced with seven new wells. Sonic bond logs were run on the new wells, which showed the wells to be properly grouted.

At this time two additional pump tests are planned in the Burdock Area to obtain more reliable hydrologic data on the Lakota and Fall River aquifers. A three-five day test pumping from the Lakota is tentatively scheduled for early January, 1979, followed by a three-five day test pumping from the Fall River.

Keith E. Andersen

Keith E. Andersen, Chief Engineer

# SOURCE N

# ANALYSIS OF AQUIFER TESTS CONDUCTED AT THE PROPOSED BURDOCK URANIUM MINE SITE, BURDOCK, SOUTH DAKOTA

(Report No. WR28-1-520-109, J. M. Boggs and A.M. Jenkins, Tennessee Valley Authority, May 1980)

SEE APPENDIX 2.7-K FOR THIS SOURCE REPORT

SOURCE O

HYDRO ID 704 RECOMPLETION

(Email from Len Eakin, Powertech (USA) Inc., to Mike Beshore, Powertech (USA) Inc., May 9, 2011)

**Powertech (USA) Inc.**

**Elizabeth Scheinost**

---

**From:** Leonard Eakin [leakin@powertechuranium.com]
**Sent:** Monday, May 09, 2011 4:44 PM
**To:** Michael Beshore; Frank Lichnovsky; leakin@powertechuranium.com
**Cc:** escheinost@powertechuranium.com
**Subject:** re: Putnam Water Well 704
**Attachments:** _Certification_.htm

For DB08-5-1 the Unkpapa completion date was 4/29/2008. The Unkpapa was cemented off on 1/28/2009 and the Lakota was perf'd by Goodwell on 2/4/2009.

---

**From**: "Michael Beshore" <mbeshore@powertechuranium.com>
**Sent**: Monday, May 09, 2011 4:35 PM
**To**: "Frank Lichnovsky" <flichnovsky@powertechuranium.com>, leakin@powertechuranium.com
**Subject**: Putnam Water Well 704

Gents, Could Lisa and myself be provided the following information on well 704. This was the Putnam well that was originally drilled to the Unkpapa, and then cemented up to the Lakota.

Please Provide:
Date Drilled to Unkpapa and the Date Cemented up to the Lakota.

This may have occurred on the same day, but need to make certain so we know what water quality samples are from what.

Thanks, Mike

**Powertech (USA) Inc.**

**Michael D. Beshore, P.G.**
**Senior Environmental Coordinator**

Powertech (USA) Inc.
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Wellington, CO 80549
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(970) 556-5988 cell
Email: mbeshore@powertechuranium.com
Website: www.powertechuranium.com

# APPENDIX 2.4-A

# CULTURAL RESOURCES REPORT

(PLEASE SEE SUPPLEMENTAL SET OF 11 BINDERS)

# APPENDIX 2.4-B

# MEMORANDUM OF AGREEMENT

# MEMORANDUM OF AGREEMENT

# BETWEEN POWERTECH (USA) INC.

# AND THE ARCHAEOLOGICAL RESEARCH CENTER (ARC), A PROGRAM OF THE SOUTH DAKOTA STATE HISTORICAL SOCIETY, REGARDING THE DEWEY-BURDOCK PROJECT

**Located in Custer and Fall River Counties, South Dakota**

Establishing Procedures to Avoid or Mitigate Potential Effects on Archeological and Historic Sites pursuant to SDCL 45-6D-14 and SDCL ch. 45-6B

**WHEREAS** Powertech (USA) Inc. (Powertech) plans to seek a mining permit for the Dewey-Burdock Uranium In Situ Mining Project ("Project") pursuant to the South Dakota Mined Land Reclamation Act (SDCL ch. 45-6B);

**WHEREAS** the Project consists of construction, operation and reclamation of uranium in situ mining and recovery facilities in Custer and Fall River Counties;

**WHEREAS,** Powertech has defined the Project's area of potential effect ("APE") as described in Attachment A;

**WHEREAS** Powertech has determined that the Project may have an affect on archaeological or historic sites that contain or are likely to contain information significant to the state or local history or prehistory, and has consulted, and will continue to consult, with the ARC Archaeologist pursuant to SDCL 45-6D-14 and SDCL ch. 45-6B;

**WHEREAS,** Powertech has also consulted with the South Dakota Department of Environment and Natural Resources (DENR) regarding the effects of the Project on archaeological or historic properties;

**NOW, THEREFORE,** Powertech and the ARC agree that the Project shall be implemented in accordance with the following stipulations in order to prevent or mitigate any effect of the Project on archeological or historic sites.

## STIPULATIONS

**Powertech** shall ensure that the following measures are carried out:

**I.** Archaeological or historic sites threatened or potentially threatened by proposed ground disturbing activity in the current and projected phases of the Project will be investigated prior to the proposed activity to determine their significance or research potential.

**II.** Historic or archaeological sites located in the remainder of the APE that are not

proposed to be affected, and that were previously identified in the archaeological investigation conducted by Augustana Laboratory ("Augustana") entitled, *A Level III Cultural Resources Evaluation of Powertech (USA) Incorporated's Proposed Dewey-Burdock Uranium Project Locality within the Southern Black Hills, Custer and Fall River Counties, South Dakota* by Kruse *et al*. that was provided to the ARC, will be avoided. If surface disturbance of a site becomes necessary, the ARC will be notified at least 30 days in advance of surface disturbance.

**III.** Augustana will be authorized to proceed with the evaluation of the selected sites pursuant to the scope of work described in Attachment WWW upon execution of this MOA.

**IV.** Each quarter during the first year and each year thereafter following the execution of this MOA until it expires or is terminated, Powertech shall provide ARC a summary report detailing work undertaken pursuant to its terms. Such report shall include any scheduling changes proposed, any problems encountered, and any disputes and objections received in Powertech's efforts to carry out the terms of this MOA.

## V. DURATION

This MOA will be null and void if its terms are not carried out within five (5) years from the date of its execution. Prior to such time, Powertech may consult with the other signatory to reconsider the terms of the MOA and amend it in accordance with Stipulation VIII below.

## VI. UNANTICIPATED DISCOVERIES

If historic or archaeological sites are discovered or unanticipated effects on historic or archeological sites are found during any phase of the Project, Powertech shall temporarily halt any surface disturbing activities in the immediate vicinity and contact ARC. Powertech will not resume its activities in the area until and unless the unanticipated effects or sites are investigated and clearance to proceed is granted by ARC.

## VII. REPORTING

Refer to article IV in this MOA.

## VIII. DISPUTE RESOLUTION

Should either party to this MOA object at any time to any actions proposed or the manner in which the terms of this MOA are implemented, Powertech and ARC shall consult to resolve the objection. If Powertech determines the objection cannot be resolved, Powertech will:

A. File a petition for a contested case hearing that includes all documentation relevant to the dispute, including Powertech's proposed resolution, with the South

Dakota Board of Minerals and Environment (BME), which is the entity with jurisdiction over such mining activities pursuant to SDCL ch. 45-6B, and including 45-6B-33.3 to -33.8, inclusive . The BME shall timely schedule a hearing on the issues and shall notify all parties of the hearing. All parties shall be allowed to present evidence and argument to the BME at the hearing. Powertech will proceed in accordance with the final decision of the BME.

B. Powertech may not proceed until the BME has issued a final decision on the dispute.

C. Powertech's responsibility to carry out all other actions subject to the terms of this MOA that are not the subject of the dispute remain unchanged.

## IX. AMENDMENTS

This MOA may be amended when such an amendment is agreed to in writing by both parties. The amendment will be effective on the date a copy signed by ARC.

## X. TERMINATION

If either party to this MOA determines that its terms will not or cannot be carried out, that party shall immediately consult with the other parties to attempt to develop an amendment per Stipulation VIII, above. If within thirty (30) days (or another time period agreed to by both parties) an amendment cannot be reached, either party may terminate the MOA upon written notification to the other signatories.

Execution of this MOA by Powertech and ARC and implementation of its terms constitute evidence that Powertech has taken into account the effects of this Project on potential significant historic and archaeological sites and is committed to working closely with ARC to avoid and/or mitigate any potential affects on such properties.

This MOA does not supersede any future Federal involvement in the Project and does not constitute compliance with Federal laws such as the National Historic Preservation Act or the National Environmental Policy Act.

**SIGNATORIES:**

**Powertech (USA) Inc.**

Date 9/10/08

**Richard E. Blubaugh**
**Vice President-Environmental,**
**Health and Safety Resources**

**Archaeological Research Center**

Date 9.15.08

**James Haug**
**State Archaeologist**

# ATTACHMENT A

Powertech (USA) Inc.'s Dewey-Burdock Project in Custer and Fall River Counties, South Dakota is outlined by its proposed **Project Boundary** in Figure A (Confidential), following this Attachment. The Project Boundary encompasses the following sections (or portions thereof):

T6S, R1E:
Sections 20, 21, and 27 – 35

T7S, R1E:
Sections 1 – 5, 10 – 12, and 15

The **Area of Potential Effect (APE)** is defined as the areas that would potentially be affected by the surface-disturbing activities of the project and is a much smaller area than the area encompassed by the Project Boundary. The APE is based on known mining resources and is subject to change as additional resources are identified. The APE is depicted in Figure A (Confidential) and is generally described as follows:

T6S, R1E:
Sections (or portions thereof): 28, 29, 32, 33, 35

T7S, R1E:
Sections (or portions thereof): 1 – 3, 10 - 12

# FIRST AMENDMENT
# TO
# MEMORANDUM OF AGREEMENT
# BETWEEN POWERTECH (USA) INC.
# AND THE
# ARCHAEOLOGICAL RESEARCH CENTER (ARC),
# A PROGRAM OF THE SOUTH DAKOTA STATE HISTORICAL SOCIETY, REGARDING THE DEWEY – BURDOCK PROJECT

**Located in Custer and Fall River Counties, South Dakota**
**Establishing Procedures to Avoid or Mitigate Potential Effects on**
**Archaeological and Historic Sites**
**pursuant to SDCL 45-6D-14 and SDCL ch. 45-6B**

## RECITALS

1. The ARC and POWERTECH (USA) INC. ("Powertech") previously entered into a Memorandum of Agreement ("MOA") regarding Powertech's proposed Dewey-Burdock Uranium In-Situ Mining Project ("Project") in Custer and Fall River Counties. South Dakota.

2. The sections containing the lands enclosed within the Project Boundary were described in Attachment A to the MOA.

3. It has come to the attention of Powertech that a minor change in the Project Boundary has resulted in the inclusion of approximately 280 additional acres within the Project Boundary that are not covered by the description in said Attachment A.

4. The parties desire to amend the MOA to include the description of the section containing the additional acres.

**NOW, THEREFORE,** Powertech and the ARC hereby amend the MOA as follows:

1. **Description of Lands to be Added to Attachment A.** The description of the sections encompassed within the Project Boundary, as described in Attachment A to the MOA, is hereby amended to include Section 14, T7S, R1E, B.H.M., Fall River County, South Dakota.

2. **Ratification.** In all other respects, the MOA is hereby ratified and confirmed.

Dated by Powertech 2/10, 2009.

**POWERTECH (USA) INC.**

**By:**
**Richard E. Blubaugh, Vice President-**
**Environmental, Health and Safety**
**Resources**

Dated by the ARC 1.28.09, 2009.

**ARCHAEOLOGICAL RESEARCH CENTER**

**By:**
**James Haug, State Archaeologist**

# APPENDIX 2.5-A

# SUPPORT INFORMATION FOR NEWCASTLE, WYOMING METEOROLOGICAL MONITORING SITE

IML Air Science (IML), in Sheridan, Wyoming, operates a meteorological station in Newcastle, Wyoming, which has generated more than 9 years (2002 to present) of hourly meteorological data. Newcastle is approximately 30 miles north-northwest of the Dewey-Burdock project site and provides a better comparison to the Dewey-Burdock permit area than the Chadron site in terms of elevation, surrounding topography and proximity to the southwestern flank of the Black Hills.

The meteorological station at Newcastle is used to supplement the ambient air quality compliance demonstration. The station meets the requirements of Ambient Air Monitoring Guidelines for Prevention of Significant Deterioration (EPA, 1987). Table 1 identifies the instruments and associated specifications at this station. Figures 1 through 8 summarize the historical meteorological data for the Newcastle station.

**Table 1: Newcastle MET Station Equipment List (IML, 2011)**

**Newcastle Met Station**

| Parameter | Instrument | Range | Accuracy | Threshold | Instrument Height |
|---|---|---|---|---|---|
| Wind Speed | RM Young 05305 Wind Monitor AQ | 0 to 112 mph | ±0.4 mph or 1% of reading | 0.9 mph | 10 meters |
| Wind Direction | RM Young 05305 Wind Monitor AQ | 0 to 360º | ±3º | 1.0 mph | 10 meters |
| Temperature | Fenwal Electronics 107 Temperature Probe | -25º to 50º C | ±0.2º C @ 0 - 60º C, ±0.4º C @ -35º C | -- | 2 meters |
| Precipitation | Met One Tipping Bucket | 0 to 12 inches | ±0.5% @ 0.5 in/hr rate | 0.01 inch | 1 meter |
| Barometric Pressure | Campbell Scientific - 105 | 600 – 1060 millibar | ±0.5 mb @ 20º C | -- | 2 meters |
| Relative Humidity | CS 500-L Temp/RH probe | 0 – 100%<br>-40º to 60ºC | ±3% RH 10% to 90% | -- | 2 meters |
| Data Logger | CS CR510 | -- | -- | -- | -- |

The specifications in Table 1 meet or exceed the requirements set forth in NRC Regulatory Guide 3.63, Section C3. All instruments are audited for accuracy on a semi-annual basis. Sample audit records are included as Tables 2 through 5 at the end of this appendix. Data recovery for all parameters at Newcastle exceeded 96% for both long-term (2002 through August 2011) and concurrent-year (7/18/2007 to 7/17/2008) periods.

## References:

EPA (U.S. Environmental Protection Agency), 1987, Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD), EPA-450/4-87-007, May 1987.

IML Air Science, 2011, hourly average data from the Wyoming Refining Company Meteorological Monitoring Station, Newcastle, Wyoming, 2002 - 2011.

# Figure 1

## Wyoming Refining

Meteorological Data Summary

1/1/2002 - 8/31/2011

**Hourly Data**

| | Average/Total | Max | Min |
|---|---|---|---|
| Wind Speed (mph) | 6.8 | 31.2 | 0.0 |
| Sigma-Theta (°) | 19.4 | 86.1 | 0.0 |
| Temperature (F) | 47.2 | 101.1 | -18.5 |
| Relative Humidity (%) | 58.5 | 100.0 | 6.7 |
| Bar. Pressure (in Hg) | 25.6 | 26.2 | 24.8 |
| Solar Radiation (w/m^2) | 185.4 | 1,031.0 | |

Predominant wind direction was from the NE sector,
accounting for 16.6% of the possible winds

**Data Recovery**

| Parameter | Possible (hours) | Reported (hours) | Recovery |
|---|---|---|---|
| Wind Speed | 84720 | 81975 | 96.76% |
| Wind Direction | 84720 | 81975 | 96.76% |
| Sigma-Theta | 84720 | 81975 | 96.76% |
| Temperature | 30419 | 30391 | 99.91% |
| Relative Humidity | 30419 | 30391 | 99.91% |
| Bar. Pressure | 30419 | 30389 | 99.90% |
| Solar Radiation | 30419 | 30391 | 99.91% |

# Figure 2

## Wyoming Refining

Meteorological Data Summary

7/18/2007 - 7/17/2008

**Hourly Data**

| | **Average/Total** | **Max** | **Min** |
|---|---|---|---|
| Wind Speed (mph) | 7.0 | 27.9 | 0.2 |
| Sigma-Theta (°) | 19.6 | 83.2 | 5.5 |
| Temperature (F) | 51.9 | 93.5 | 12.4 |
| Relative Humidity (%) | 55.3 | 100.0 | 8.7 |
| Bar. Pressure (in Hg) | 25.6 | 26.0 | 25.0 |
| Solar Radiation (w/m^2) | 246.8 | 984.0 | |

Predominant wind direction was from the NE sector, accounting for 20.7% of the possible winds

**Data Recovery**

| **Parameter** | **Possible** (hours) | **Reported** (hours) | **Recovery** |
|---|---|---|---|
| Wind Speed | 8784 | 8475 | 96.48% |
| Wind Direction | 8784 | 8475 | 96.48% |
| Sigma-Theta | 8784 | 8475 | 96.48% |
| Temperature | 3059 | 3058 | 99.97% |
| Relative Humidity | 3059 | 3058 | 99.97% |
| Bar. Pressure | 3059 | 3058 | 99.97% |
| Solar Radiation | 3059 | 3058 | 99.97% |

## Figure 3

# 10-YR Wind Frequency Distribution
# Newcastle, Wyoming
### 1/1/2002 Hr. 1 to 8/31/2011 Hr. 24

## RELATIVE FREQUENCY (% of Recorded Winds) TABLE

| | mph | | | | | | |
|---|---|---|---|---|---|---|---|
| Wind Direction | 0.0- 4.0 | 4.0- 7.4 | 7.4-12.1 | 12.1-19.0 | 19.0-25.8 | 25.8-100.0 | Row Total |
| 0.0 deg.(North) | 1.6 | 1.4 | 1.1 | 0.5 | 0.1 | 0.0 | 4.7 |
| 22.5 deg. | 4.3 | 3.5 | 0.6 | 0.2 | 0.0 | 0.0 | 8.7 |
| 45.0 deg. | 7.0 | 9.0 | 0.4 | 0.1 | 0.0 | 0.0 | 16.6 |
| 67.5 deg. | 3.6 | 3.1 | 0.4 | 0.1 | 0.0 | 0.0 | 7.1 |
| 90.0 deg. | 1.7 | 2.2 | 1.0 | 0.3 | 0.0 | 0.0 | 5.3 |
| 112.5 deg. | 1.2 | 2.0 | 2.2 | 0.8 | 0.1 | | 6.2 |
| 135.0 deg. | 0.9 | 1.5 | 1.7 | 1.1 | 0.1 | | 5.3 |
| 157.5 deg. | 1.0 | 1.6 | 1.6 | 0.7 | 0.0 | | 5.0 |
| 180.0 deg. | 1.2 | 2.2 | 1.2 | 0.3 | 0.0 | | 4.9 |
| 202.5 deg. | 1.1 | 1.6 | 0.5 | 0.1 | 0.0 | | 3.4 |
| 225.0 deg. | 0.9 | 1.2 | 0.4 | 0.2 | 0.0 | | 2.7 |
| 247.5 deg. | 0.8 | 1.4 | 0.8 | 0.2 | 0.0 | | 3.2 |
| 270.0 deg. | 0.7 | 1.4 | 1.2 | 0.3 | 0.0 | | 3.7 |
| 292.5 deg. | 0.7 | 1.5 | 2.3 | 1.0 | 0.1 | 0.0 | 5.6 |
| 315.0 deg. | 0.7 | 1.8 | 3.8 | 3.3 | 0.6 | 0.0 | 10.2 |
| 337.5 deg. | 1.0 | 1.7 | 2.5 | 1.9 | 0.2 | 0.0 | 7.3 |
| | 28.5 | 37.1 | 21.8 | 11.2 | 1.4 | 0.1 | 100.0 |

0 mph ( 0.8%) INVALID READINGS 2745

NUMBER OF POSSIBLE READINGS 84720 VALID READINGS 81975 DATA CAPTURE 96.76%

## Figure 4

# 1-YR Wind Frequency Distribution
# Newcastle, Wyoming

**7/18/2007 Hr. 1 to 7/17/2008 Hr. 24**

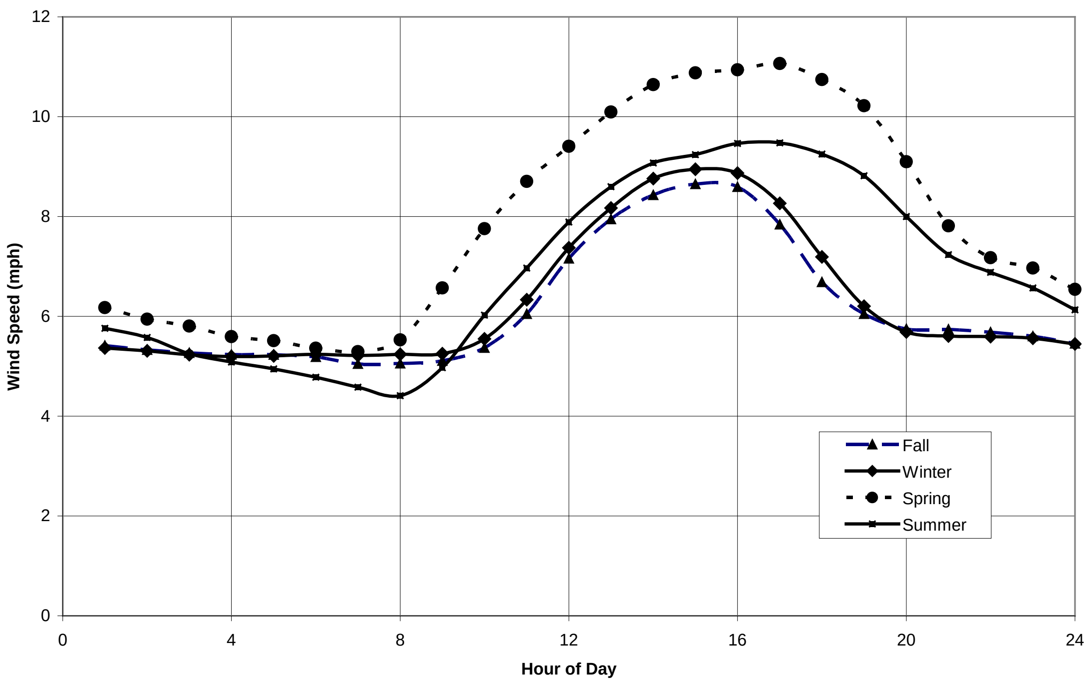
## RELATIVE FREQUENCY (% of Recorded Winds) TABLE

| | mph | | | | | | |
|---|---|---|---|---|---|---|---|
| Wind Direction | 0.0- 4.0 | 4.0- 7.4 | 7.4-12.1 | 12.1-19.0 | 19.0-25.8 | 25.8-100.0 | Row Total |
| 0.0 deg.(North) | 1.7 | 1.3 | 0.5 | 0.4 | 0.0 | | 3.9 |
| 22.5 deg. | 4.6 | 2.5 | 0.5 | 0.1 | | | 7.6 |
| 45.0 deg. | 7.6 | 12.5 | 0.5 | 0.1 | 0.0 | 0.0 | 20.7 |
| 67.5 deg. | 2.0 | 2.7 | 0.4 | 0.2 | 0.0 | 0.0 | 5.3 |
| 90.0 deg. | 1.5 | 2.2 | 0.7 | 0.4 | 0.1 | 0.0 | 4.8 |
| 112.5 deg. | 1.0 | 2.3 | 2.5 | 1.1 | 0.1 | | 6.9 |
| 135.0 deg. | 0.9 | 1.4 | 1.5 | 1.1 | 0.0 | | 4.9 |
| 157.5 deg. | 0.8 | 1.5 | 1.3 | 0.7 | 0.0 | | 4.4 |
| 180.0 deg. | 1.2 | 2.1 | 1.6 | 0.3 | | | 5.1 |
| 202.5 deg. | 1.0 | 1.5 | 0.5 | 0.1 | 0.0 | | 3.2 |
| 225.0 deg. | 0.8 | 1.4 | 0.3 | 0.3 | 0.0 | | 2.8 |
| 247.5 deg. | 0.8 | 1.5 | 0.6 | 0.2 | 0.0 | | 3.1 |
| 270.0 deg. | 0.5 | 1.7 | 1.4 | 0.3 | | | 3.9 |
| 292.5 deg. | 0.5 | 1.4 | 1.8 | 1.1 | 0.0 | | 4.8 |
| 315.0 deg. | 0.6 | 1.5 | 4.8 | 4.5 | 0.6 | | 11.9 |
| 337.5 deg. | 1.0 | 1.7 | 2.0 | 1.7 | 0.2 | | 6.6 |
| | 26.5 | 39.0 | 20.7 | 12.6 | 1.3 | 0.1 | 100.0 |

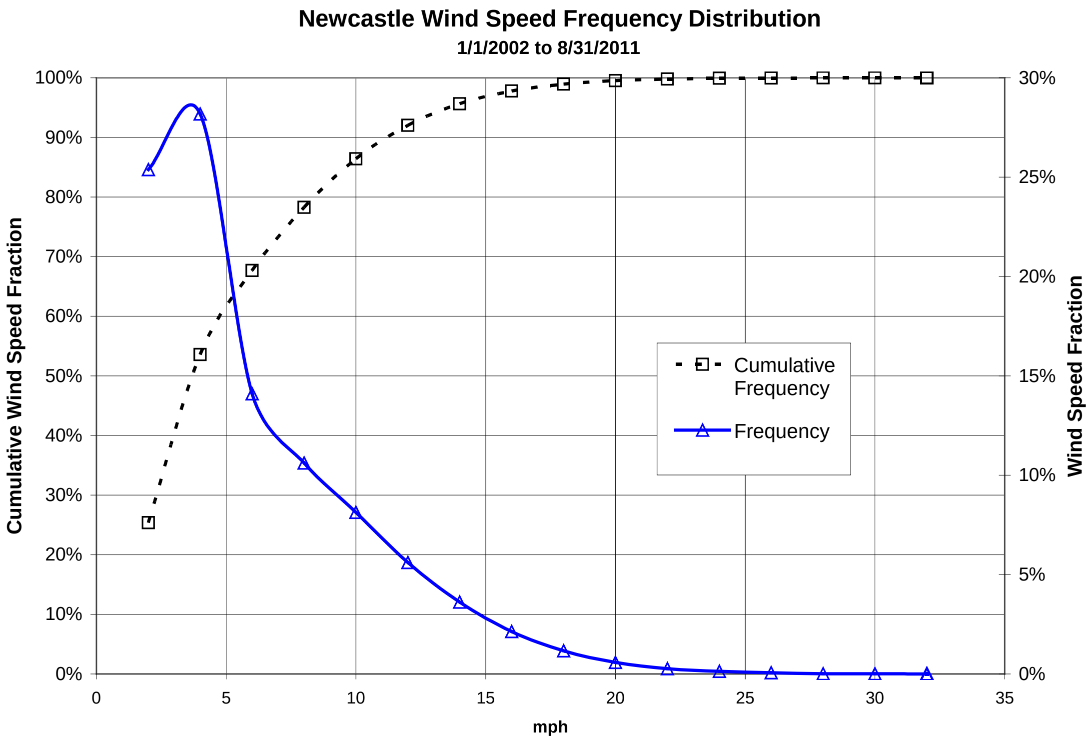
0 mph ( 0.3%) INVALID READINGS 309

NUMBER OF POSSIBLE READINGS 8784 VALID READINGS 8475 DATA CAPTURE 96.48%

# Figure 5



# Figure 6



# Figure 7

## Newcastle Wind Data Summary

**1/1/2002 - 8/31/2011**

### Hourly Data

| | | Average | Max | Min |
|---|---|---|---|---|
| Wind Speed (mph) | | 6.84 | 31.23 | - |
| Sigma Theta (º) | | 19.39 | 86.10 | 0.00 |
| Wind Direction | | | | |
| | N | 6.71 | 29.40 | - |
| | NNE | 4.60 | 28.19 | 0.06 |
| | NE | 4.38 | 27.31 | 0.03 |
| | ENE | 4.35 | 26.96 | - |
| | E | 5.89 | 27.87 | 0.04 |
| | ESE | 7.75 | 25.11 | 0.02 |
| | SE | 8.51 | 23.96 | 0.19 |
| | SSE | 7.69 | 25.66 | 0.13 |
| | S | 6.38 | 22.48 | 0.11 |
| | SSW | 5.55 | 23.26 | 0.00 |
| | SW | 5.90 | 25.23 | 0.03 |
| | WSW | 6.41 | 25.18 | 0.02 |
| | W | 7.11 | 25.77 | 0.12 |
| | WNW | 8.93 | 27.69 | 0.04 |
| | NW | 11.05 | 31.23 | 0.07 |
| | NNW | 9.55 | 29.93 | 0.06 |

Predominant wind direction was from the NE sector, accounting for 16.6% of the winds, the average wind direction was 31°.

### Data Recovery

| | | Possible (hours) | Reported (hours) | Recovery |
|---|---|---|---|---|
| Wind Speed | | 84720 | 81975 | 96.76% |
| Sigma Theta | | 84720 | 81975 | 96.76% |
| Wind Direction | | 84720 | 81975 | 96.76% |

# Figure 8

| Stability Class | Wind Direction | Wind Speed (mph) - One Year (Calm = 1.22%) | | | | | | Row Total |
|---|---|---|---|---|---|---|---|---|
| | | < 3 | 4 - 7 | 8 - 12 | 13 - 18 | 19 - 24 | > 24 | |
| A | N | 0.001298 | 0.001098 | | | | | 0.002396 |
| | NNE | 0.002686 | 0.001073 | | | | | 0.003759 |
| | NE | 0.003297 | 0.001500 | | | | | 0.004797 |
| | ENE | 0.002838 | 0.001464 | | | | | 0.004302 |
| | E | 0.002826 | 0.001586 | | | | | 0.004412 |
| | ESE | 0.002673 | 0.002733 | | | | | 0.005406 |
| | SE | 0.002788 | 0.003879 | | | | | 0.006667 |
| | SSE | 0.003373 | 0.006319 | | | | | 0.009692 |
| | S | 0.003908 | 0.011101 | | | | | 0.015009 |
| | SSW | 0.004531 | 0.010003 | | | | | 0.014534 |
| | SW | 0.003602 | 0.008869 | | | | | 0.012471 |
| | WSW | 0.003106 | 0.007502 | | | | | 0.010608 |
| | W | 0.002202 | 0.005099 | | | | | 0.007301 |
| | WNW | 0.001336 | 0.003074 | | | | | 0.004411 |
| | NW | 0.000993 | 0.002611 | | | | | 0.003603 |
| | NNW | 0.000815 | 0.001781 | | | | | 0.002596 |
| B | N | 0.000127 | 0.000573 | 0.001134 | | | | 0.001835 |
| | NNE | 0.000700 | 0.000561 | 0.000403 | | | | 0.001664 |
| | NE | 0.001209 | 0.000878 | 0.000256 | | | | 0.002344 |
| | ENE | 0.001146 | 0.000647 | 0.000232 | | | | 0.002024 |
| | E | 0.000815 | 0.001500 | 0.000342 | | | | 0.002657 |
| | ESE | 0.000586 | 0.002147 | 0.000695 | | | | 0.003428 |
| | SE | 0.000471 | 0.002830 | 0.001439 | | | | 0.004741 |
| | SSE | 0.000356 | 0.003306 | 0.003879 | | | | 0.007542 |
| | S | 0.000675 | 0.004221 | 0.005148 | | | | 0.010043 |
| | SSW | 0.000586 | 0.002501 | 0.002769 | | | | 0.005855 |
| | SW | 0.000496 | 0.002013 | 0.002489 | | | | 0.004998 |
| | WSW | 0.000267 | 0.002269 | 0.004343 | | | | 0.006879 |
| | W | 0.000331 | 0.001891 | 0.004343 | | | | 0.006565 |
| | WNW | 0.000216 | 0.001171 | 0.004538 | | | | 0.005925 |
| | NW | 0.000140 | 0.001122 | 0.004038 | | | | 0.005300 |
| | NNW | 0.000255 | 0.000842 | 0.002586 | | | | 0.003682 |
| C | N | 0.000204 | 0.000403 | 0.002830 | 0.001391 | | | 0.004827 |
| | NNE | 0.000789 | 0.001122 | 0.001134 | 0.000427 | | | 0.003473 |
| | NE | 0.001897 | 0.002245 | 0.000671 | 0.000281 | | | 0.005093 |
| | ENE | 0.001260 | 0.001781 | 0.000781 | 0.000146 | | | 0.003968 |
| | E | 0.000573 | 0.002110 | 0.000988 | 0.000354 | | | 0.004025 |
| | ESE | 0.000344 | 0.002781 | 0.003733 | 0.001171 | | | 0.008029 |
| | SE | 0.000242 | 0.002135 | 0.005489 | 0.002623 | | | 0.010489 |
| | SSE | 0.000382 | 0.001793 | 0.007722 | 0.002818 | | | 0.012715 |
| | S | 0.000509 | 0.003099 | 0.006026 | 0.001403 | | | 0.011037 |
| | SSW | 0.000522 | 0.001354 | 0.001891 | 0.000622 | | | 0.004389 |
| | SW | 0.000127 | 0.000586 | 0.001147 | 0.000586 | | | 0.002445 |
| | WSW | 0.000165 | 0.001013 | 0.003062 | 0.000647 | | | 0.004886 |
| | W | 0.000153 | 0.001269 | 0.005807 | 0.001134 | | | 0.008363 |
| | WNW | 0.000115 | 0.000842 | 0.010308 | 0.004074 | | | 0.015339 |
| | NW | 0.000076 | 0.000927 | 0.012821 | 0.008527 | | | 0.022351 |
| | NNW | 0.000064 | 0.000744 | 0.008112 | 0.005014 | | | 0.013934 |

## Figure 8 (continued)

| Stability Class | Wind Direction | Wind Speed (mph) - One Year | | | | | | Row Total |
|---|---|---|---|---|---|---|---|---|
| | | < 3 | 4 - 7 | 8 - 12 | 13 - 18 | 19 - 24 | > 24 | |
| D | N | 0.001311 | 0.006258 | 0.007246 | 0.004916 | 0.000549 | 0.000134 | 0.020414 |
| | NNE | 0.005562 | 0.026215 | 0.004782 | 0.002428 | 0.000207 | 0.000049 | 0.039243 |
| | NE | 0.011214 | 0.074706 | 0.003623 | 0.001598 | 0.000085 | 0.000024 | 0.091250 |
| | ENE | 0.004862 | 0.020689 | 0.003599 | 0.000769 | 0.000122 | 0.000024 | 0.030065 |
| | E | 0.001769 | 0.011260 | 0.010259 | 0.002867 | 0.000220 | 0.000073 | 0.026448 |
| | ESE | 0.000853 | 0.007551 | 0.018408 | 0.008917 | 0.000598 | 0.000037 | 0.036364 |
| | SE | 0.000356 | 0.003477 | 0.009478 | 0.010015 | 0.001195 | | 0.024522 |
| | SSE | 0.000420 | 0.002403 | 0.005355 | 0.005929 | 0.000293 | 0.000024 | 0.014424 |
| | S | 0.000586 | 0.002598 | 0.002696 | 0.002062 | 0.000134 | | 0.008076 |
| | SSW | 0.000356 | 0.001330 | 0.001805 | 0.001000 | 0.000134 | | 0.004626 |
| | SW | 0.000140 | 0.000220 | 0.000756 | 0.001598 | 0.000293 | 0.000012 | 0.003019 |
| | WSW | 0.000153 | 0.000915 | 0.001927 | 0.001720 | 0.000232 | 0.000012 | 0.004959 |
| | W | 0.000267 | 0.002232 | 0.003440 | 0.002171 | 0.000378 | 0.000012 | 0.008502 |
| | WNW | 0.000255 | 0.003525 | 0.008490 | 0.007563 | 0.001549 | 0.000268 | 0.021651 |
| | NW | 0.000191 | 0.005306 | 0.019225 | 0.027484 | 0.007453 | 0.000903 | 0.060563 |
| | NNW | 0.000471 | 0.006258 | 0.013443 | 0.016383 | 0.002867 | 0.000244 | 0.039666 |
| E | N | 0.002011 | 0.003489 | 0.000317 | | | | 0.005817 |
| | NNE | 0.006313 | 0.009869 | 0.000293 | | | | 0.016475 |
| | NE | 0.009623 | 0.024154 | 0.000281 | | | | 0.034057 |
| | ENE | 0.004149 | 0.009222 | 0.000256 | | | | 0.013628 |
| | E | 0.001286 | 0.004026 | 0.000354 | | | | 0.005665 |
| | ESE | 0.000827 | 0.002598 | 0.000232 | | | | 0.003657 |
| | SE | 0.000573 | 0.001415 | 0.000159 | | | | 0.002146 |
| | SSE | 0.000458 | 0.001110 | 0.000207 | | | | 0.001776 |
| | S | 0.000611 | 0.000756 | 0.000146 | | | | 0.001514 |
| | SSW | 0.000191 | 0.000488 | 0.000134 | | | | 0.000813 |
| | SW | 0.000140 | 0.000244 | 0.000037 | | | | 0.000421 |
| | WSW | 0.000140 | 0.000549 | 0.000098 | | | | 0.000787 |
| | W | 0.000255 | 0.001061 | 0.000207 | | | | 0.001523 |
| | WNW | 0.000356 | 0.002159 | 0.000317 | | | | 0.002833 |
| | NW | 0.000573 | 0.002659 | 0.000415 | | | | 0.003647 |
| | NNW | 0.001031 | 0.003281 | 0.000378 | | | | 0.004691 |
| F | N | 0.007637 | 0.004428 | | | | | 0.012065 |
| | NNE | 0.014612 | 0.008442 | | | | | 0.023054 |
| | NE | 0.016636 | 0.012955 | | | | | 0.029591 |
| | ENE | 0.009865 | 0.007575 | | | | | 0.017440 |
| | E | 0.004595 | 0.004599 | | | | | 0.009194 |
| | ESE | 0.003157 | 0.002391 | | | | | 0.005548 |
| | SE | 0.002393 | 0.001818 | | | | | 0.004211 |
| | SSE | 0.002342 | 0.001256 | | | | | 0.003599 |
| | S | 0.002049 | 0.001232 | | | | | 0.003281 |
| | SSW | 0.002367 | 0.001220 | | | | | 0.003587 |
| | SW | 0.001960 | 0.001537 | | | | | 0.003497 |
| | WSW | 0.002138 | 0.001671 | | | | | 0.003810 |
| | W | 0.001986 | 0.002110 | | | | | 0.004096 |
| | WNW | 0.002838 | 0.003111 | | | | | 0.005949 |
| | NW | 0.003144 | 0.003562 | | | | | 0.006706 |
| | NNW | 0.004519 | 0.003806 | | | | | 0.008325 |

# Table 2: Newcastle MET Station Audit 1st Quarter 2007

## METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 15-Mar-07
Audit Performed by: B. Kelly, C. Medill - IML Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | digital thermistor |
| Data acquisition system (DAS): | Campbell Scientific CR510 | N/A |

### Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0 | 1.5 | 1 | 5 | (1) |
| | | 90 | 89.9 | 0 | 5 | (1) |
| | | 180 | 179.2 | 1 | 5 | (1) |
| | | 270 | 268.7 | 1 | 5 | (1) |
| Temperature (°F) | | 71.6 | 71.6 | 0.0 | 1.8 | (1) |
| | ice water bath | 32.3 | 32.1 | 0.2 | 1.8 | (1) |
| | warm water bath | 130.7 | 129.3 | 1.4 | 1.8 | (1) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

### Notes, Recommendations

System off-line @ 0905
System on-line @ 1015
Replaced anemometer with new Wind Monitor AQ

# Table 3: Newcastle MET Station Audit 3rd Quarter 2007

## METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 13-Sep-07
Audit Performed by: B. Kelly, C. Medill - IML Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | digital thermistor |
| Data acquisition system (DAS): | Campbell Scientific CR510 | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0 | 0.1 | 0 | 5 | (1) |
| | | 90 | 89.9 | 0 | 5 | (1) |
| | | 180 | 180.8 | 1 | 5 | (1) |
| | | 270 | 268.1 | 2 | 5 | (1) |
| Temperature (°F) | | 84.6 | 84.5 | 0.0 | 0.9 | (1) |
| | ice water bath | 32.2 | 32.0 | 0.1 | 0.9 | (1) |
| | warm water bath | 127.9 | 126.8 | 1.1 | 0.9 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996

(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line @ 0834
System on-line @ 0850

# Table 4: Newcastle MET Station Audit 1$^{st}$ Quarter 2008

## METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining
Audit Date: 12-Mar-08
Audit Performed By: S. Hansen, C. Medill, IML-Air Science

| Sensor | Mfr./Model | Serial Number | Reference Device | Serial/ID Number |
|---|---|---|---|---|
| Vert. Wind Speed 10m: | RM Young Wind Monitor AQ | NA | quartz referenced drive motor | CA02423 |
| Wind Speed (WS): | RM Young Wind Monitor AQ | WM75308 | quartz referenced drive motor | IML0853 & IML0858 |
| Wind Direction (WD): | RM Young Wind Monitor AQ | WM75308 | transit, compass | Brunton 5080393535 |
| Temperature @ 2 Meters: | RM Young 41342, power aspirated | TS13799 | digital thermistor | IML0987 |
| Temperature @ 10 Meters: | RM Young 41342, power aspirated | TS13880 | digital thermistor | IML0987 |
| Relative Humidity: | Vaisala HMP50 | C4240028 | digital psychrometer | Thermo-Hygro 22087796 |
| Barometric Pressure: | Vaisala PTB101B | C4240018 | digital barometer | IML0968 |
| Solar Radiation: | LI-COR LI200X | PY57681 | Li-Cor | PY54289 |
| Data acquisition system: | CSI CR1000 datalogger | 13147 | N/A | N/A |

## Audit Results

|  | Reference RPM | Reference MPH | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|
| WS (mph) | 0 | 0.00 | 0.00 | 0.00 | below threshold |  |
|  | 300 | 3.44 | 3.44 | 0.00 | 0.56 | (2) |
|  | 800 | 9.16 | 9.16 | 0.00 | 0.56 | (2) |
|  | 3000 | 34.35 | 34.35 | 0.00 | 1.72 | (2) |
|  | 8000 | 91.60 | 91.60 | 0.00 | 4.58 | (2) |

|  |  | Reference | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|
| WS start torque (gm-cm) |  | <.1 | N/A | N/A | 1.0 | (3) |
| WD (degrees) |  | 0.0 | 0.3 | 0.3 | 5.0 | (2) |
|  |  | 90.0 | 90.4 | 0.4 | 5.0 | (2) |
|  |  | 180.0 | 180.2 | 0.2 | 5.0 | (2) |
|  |  | 270.0 | 269.8 | 0.2 | 5.0 | (2) |
| Temp. (°C): Upper Sensor |  | 49.22 | 49.36 | 0.14 | 0.5 | (2) |
|  |  | 5.09 | 5.34 | 0.25 | 0.5 | (2) |
|  |  | 18.13 | 18.16 | 0.03 | 0.5 | (2) |
| Temp. (°C): Lower Sensor |  | 49.22 | 49.33 | 0.11 | 0.5 | (2) |
|  |  | 5.09 | 5.39 | 0.30 | 0.5 | (2) |
|  |  | 18.13 | 18.10 | 0.03 | 0.5 | (2) |

|  | Upper Sensor | Lower Sensor | \|Difference\| | Specification |  |
|---|---|---|---|---|---|
| Delta T. (°C) | 49.36 | 49.33 | 0.03 | 0.10 | (2) |
|  | 5.34 | 5.39 | 0.05 | 0.10 | (2) |
|  | 18.16 | 18.10 | 0.06 | 0.10 | (2) |

|  |  | Reference | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|
| Relative Humidity (%) |  | 32.0 | 29.6 | 2.4 | 7.0 | (2) |
| Solar Radiation (W/m$^2$) | uncovered | NA | 123.8 | NA | 5.0% | (4) |
|  | covered | NA | 0.0 | NA | 5.0% | (4) |
| Barometric Pressure ("Hg) |  | 25.51 | 25.47 | 0.04 | 0.09 | (2) |

|  |  | Reference RPM | Reference cm/s | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|---|
| Vert WS 10 meters (cm/s) |  | 0 | 0.00 | 0.00 | 0.00 | below threshold |  |
| **(CW)** |  | 20 | -100.00 | -99.63 | 0.37 | 25.00 | (2) |
|  | U: | 60 | -300.00 | -302.30 | 2.30 | 35.00 | (2) |
|  |  | 100 | -1000.00 | -1001.30 | 1.30 | 70.00 | (2) |
|  |  | 500 | -2500.00 | -2499.30 | 0.70 | 145.00 | (2) |

|  |  | RPM | cm/s | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|---|
| Vert WS 10 meters (cm/s) |  | 0 | 0.00 | 0.00 | 0.00 | below threshold |  |
| **(CCW)** |  | 20 | 100.00 | 98.41 | 1.59 | 25.00 | (2) |
|  | U: | 60 | 300.00 | 300.90 | 0.90 | 35.00 | (2) |
|  |  | 100 | 1000.00 | 1001.10 | 1.10 | 70.00 | (2) |
|  |  | 500 | 2500.00 | 2497.30 | 2.70 | 145.00 | (2) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications
(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

## Notes, Recommendations

Datalogger taken off line @ 0852 MST -- returned on-line 1352 MST.
Complettion of AERMOD and solar equipement installation.

# Table 5: Newcastle MET Station Audit 3rd Quarter 2008

## METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining
Audit Performed By: C. Medill - IML Air Science
Audit Date: 27-Aug-08

| Sensor | Mfr./Model | Serial Number | Reference Device | Serial/ID Number |
|---|---|---|---|---|
| Vert. Wind Speed 10m: | RM Young Wind Monitor AQ | NA | quartz referenced drive motor | CA02423 |
| Wind Speed (WS): | RM Young Wind Monitor AQ | WM75308 | quartz referenced drive motor | IML0853 & IML0858 |
| Wind Direction (WD): | RM Young Wind Monitor AQ | WM75308 | transit, compass | Brunton 5080393535 |
| Temperature @ 2 Meters: | Fenwall 107 | NA | digital thermistor | IML0987 |
| Relative Humidity: | Vaisala HMP50 | C4240028 | digital psychrometer | Thermo-Hygro 22087796 |
| Barometric Pressure: | Vaisala PTB101B | C4240018 | digital barometer | IML0968 |
| Solar Radiation: | LI-COR LI200X | PY57681 | Li-Cor | PY54289 |
| Data acquisition system: | CSI CR1000 datalogger | 13147 | N/A | N/A |

### Audit Results

| | | RPM | MPH | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|---|
| WS (mph) | | 0 | 0.00 | 0.00 | 0.00 | below threshold | |
| | | 300 | 3.44 | 3.44 | 0.00 | 0.56 | (2) |
| | | 800 | 9.16 | 9.16 | 0.00 | 0.56 | (2) |
| | | 3000 | 34.35 | 34.35 | 0.00 | 1.72 | (2) |
| | | 8000 | 91.60 | 91.60 | 0.00 | 4.58 | (2) |
| | | | Reference | DAS Value | \|Difference\| | Specification | |
| WS start torque (gm-cm) | | | <.1 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | | 0.0 | 0.1 | 0.1 | 5.0 | (2) |
| | | | 90.0 | 89.4 | 0.6 | 5.0 | (2) |
| | | | 180.0 | 179.6 | 0.4 | 5.0 | (2) |
| | | | 270.0 | 270.0 | 0.0 | 5.0 | (2) |
| | | | Reference | DAS Value | \|Difference\| | Specification | |
| Temp. (°F): | | | 0.93 | 0.87 | 0.06 | 0.5 | (2) |
| | | | 23.28 | 23.32 | 0.04 | 0.5 | (2) |
| | | | 45.41 | 45.29 | 0.12 | 0.5 | (2) |
| | | | Reference | DAS Value | \|Difference\| | Specification | |
| Relative Humidity (%) | | | 27.0 | 26.9 | 0.1 | 7.0 | (2) |
| Barometric Pressure ("Hg) | | | 25.56 | 25.58 | 0.02 | 0.09 | (2) |
| | | Reference RPM | Reference cm/s | DAS Value | \|Difference\| | Specification | |
| Vert WS 10 meters (cm/s) | | 0 | 0.00 | 0.00 | 0.00 | below threshold | |
| **(CW)** | | 20 | 100.00 | 100.80 | 0.80 | 25.00 | (2) |
| | U: | 60 | 300.00 | 300.10 | 0.10 | 35.00 | (2) |
| | | 100 | 1000.00 | 1001.00 | 1.00 | 70.00 | (2) |
| | | 500 | 2500.00 | 2500.00 | 0.00 | 145.00 | (2) |
| | | RPM | cm/s | DAS Value | \|Difference\| | Specification | |
| Vert WS 10 meters (cm/s) | | 0 | 0.00 | 0.00 | 0.00 | below threshold | |
| **(CCW)** | | 20 | 100.00 | 100.80 | 0.80 | 25.00 | (2) |
| | U: | 60 | 300.00 | 295.30 | 4.70 | 35.00 | (2) |
| | | 100 | 1000.00 | 999.10 | 0.90 | 70.00 | (2) |
| | | 500 | 2500.00 | 2503.00 | 3.00 | 145.00 | (2) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications
(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

### Notes, Recommendations

Datalogger taken off line @ 0826 MST -- returned on-line 1027 MST.

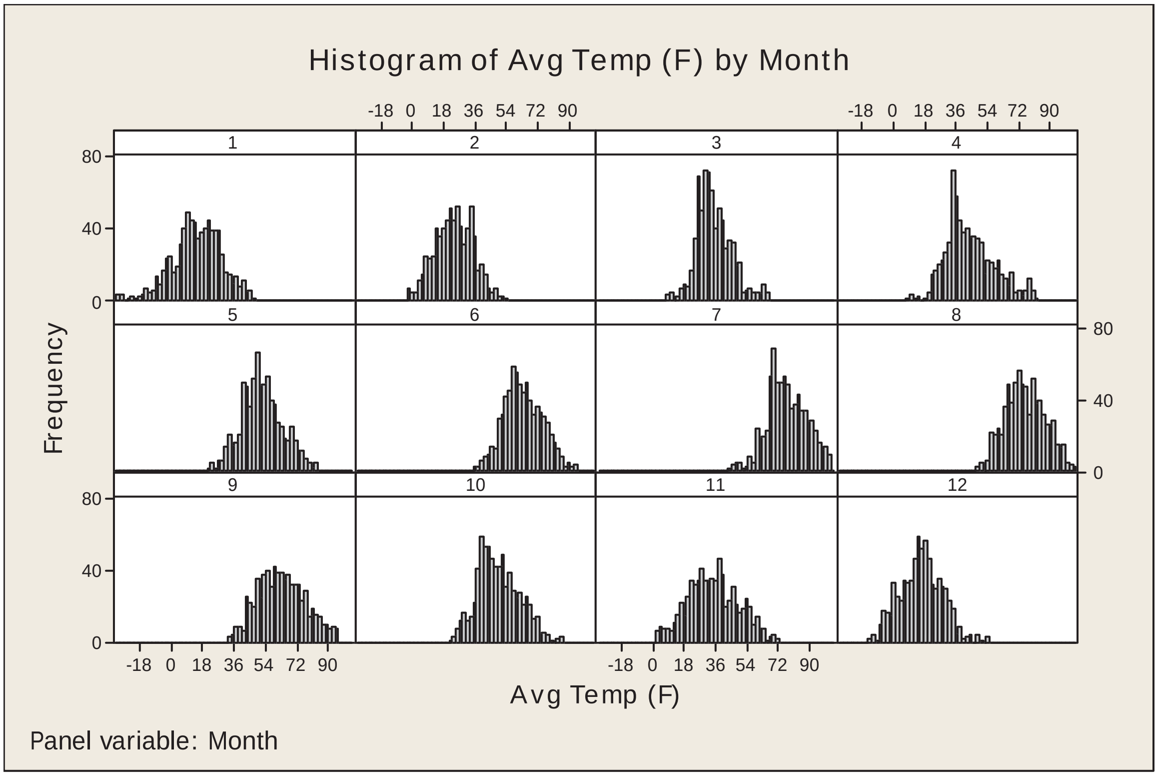
# APPENDIX 2.5-B

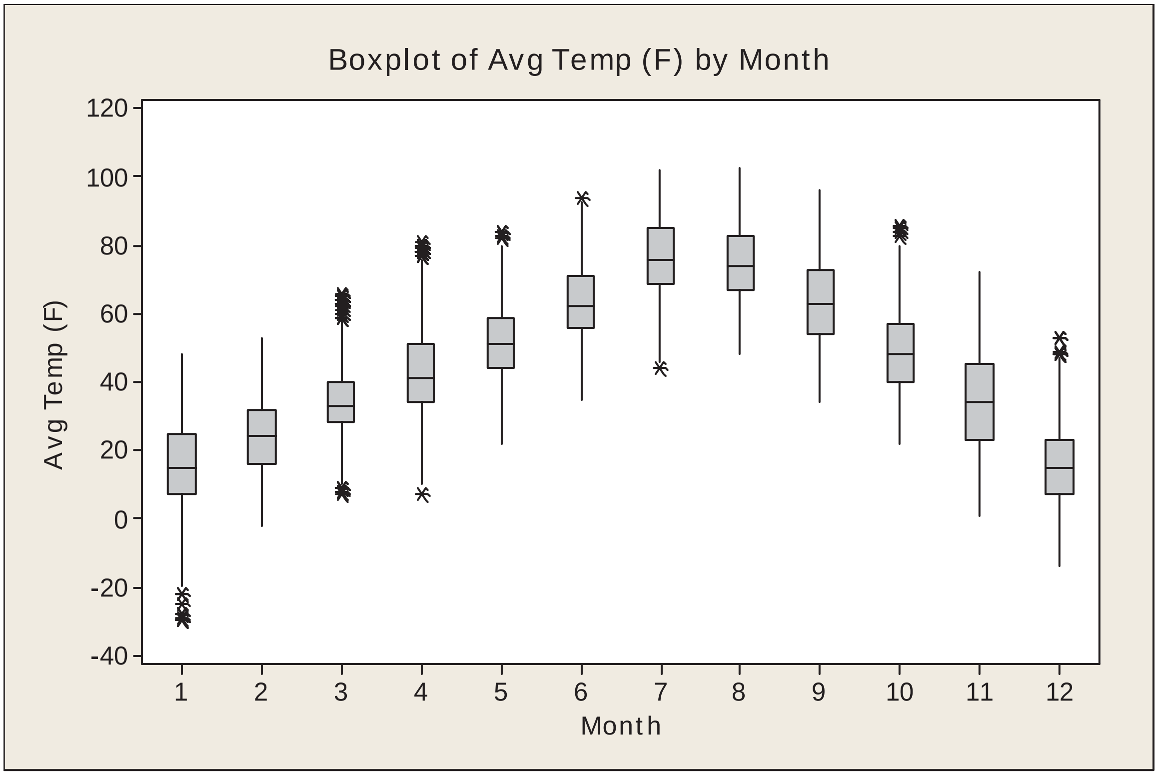
# STATISTICAL REPORTS FOR DEWEY-BURDOCK METEOROLOGICAL SITE

# APPENDIX 2.5-B
# STATISTICAL REPORTS FOR DEWEY-BURDOCK METEOROLOGICAL SITE

**Descriptive Statistics: Avg Temp (F)**

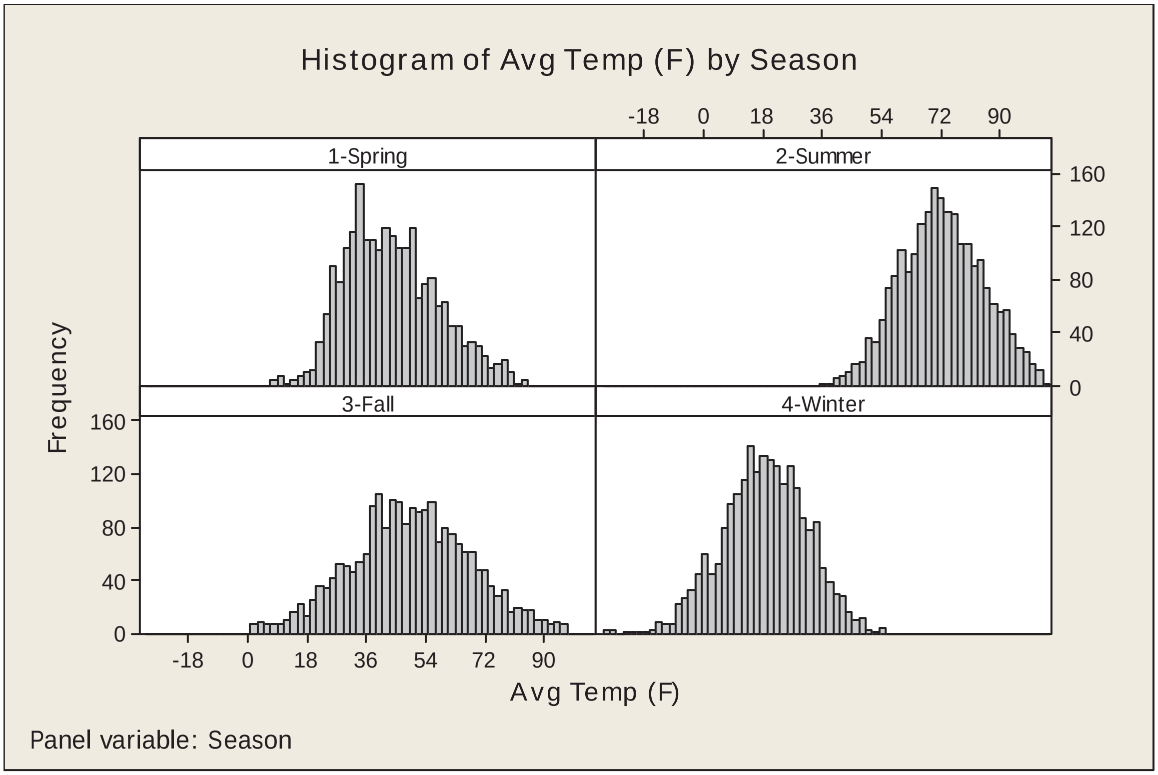
```
Variable      Month    N  N*    Mean   StDev  Minimum      Q1  Median      Q3  Maximum
Avg Temp (F)   1     744   0  14.792  13.859  -30.000   7.000  15.000  25.000   48.000
               2     696   0  23.520  10.861   -2.000  16.000  24.000  32.000   53.000
               3     720   0  34.550  10.040    7.000  28.000  33.000  40.000   66.000
               4     720   0  43.082  13.914    7.000  34.000  41.000  51.000   81.000
               5     744   0  52.173  11.654   22.000  44.000  51.000  59.000   84.000
               6     720   0  63.306  10.914   35.000  56.000  62.000  71.000   94.000
               7     744   0  76.858  11.231   44.000  69.000  76.000  85.000  102.000
               8     744   0  75.160  11.226   48.000  67.000  74.000  83.000  103.000
               9     720   0  63.747  13.787   34.000  54.000  63.000  73.000   96.000
              10     744   0  49.210  12.055   22.000  40.000  48.000  57.000   86.000
              11     720   0  34.061  14.761    1.000  23.000  34.000  45.000   72.000
              12     744   0  15.073  12.085  -14.000   7.000  15.000  23.000   53.000
```

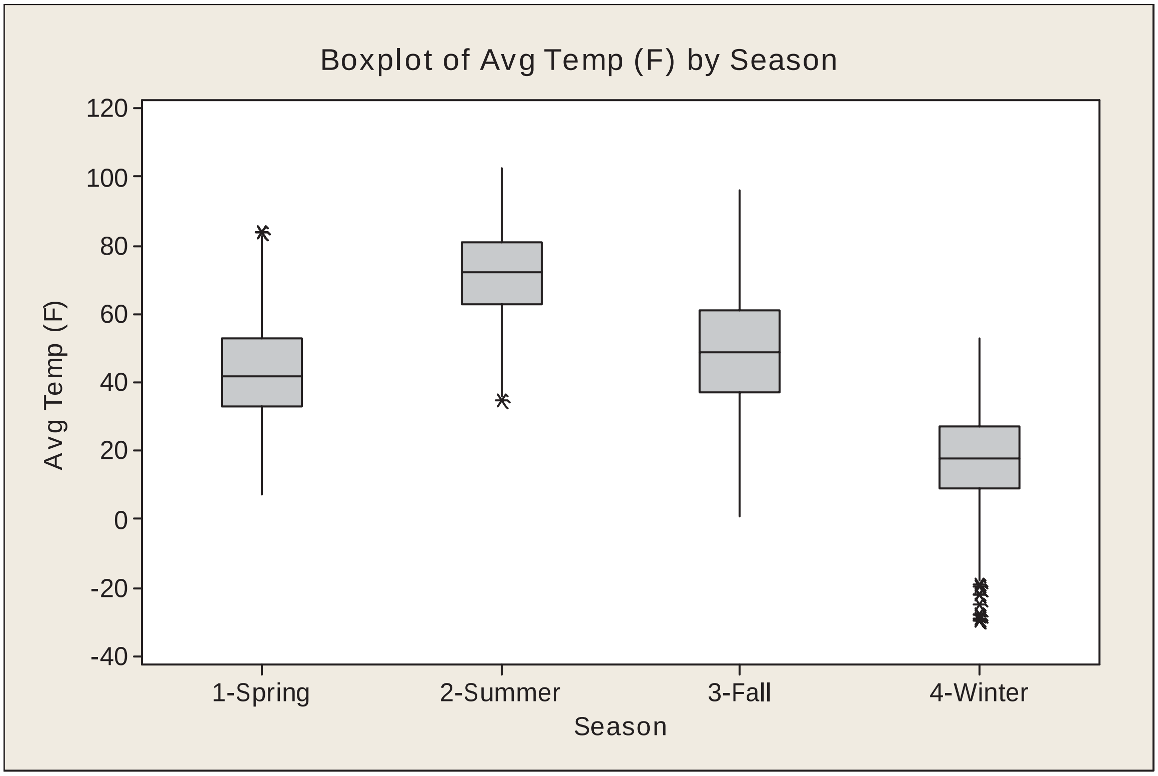




**Descriptive Statistics: Avg Temp (F)**

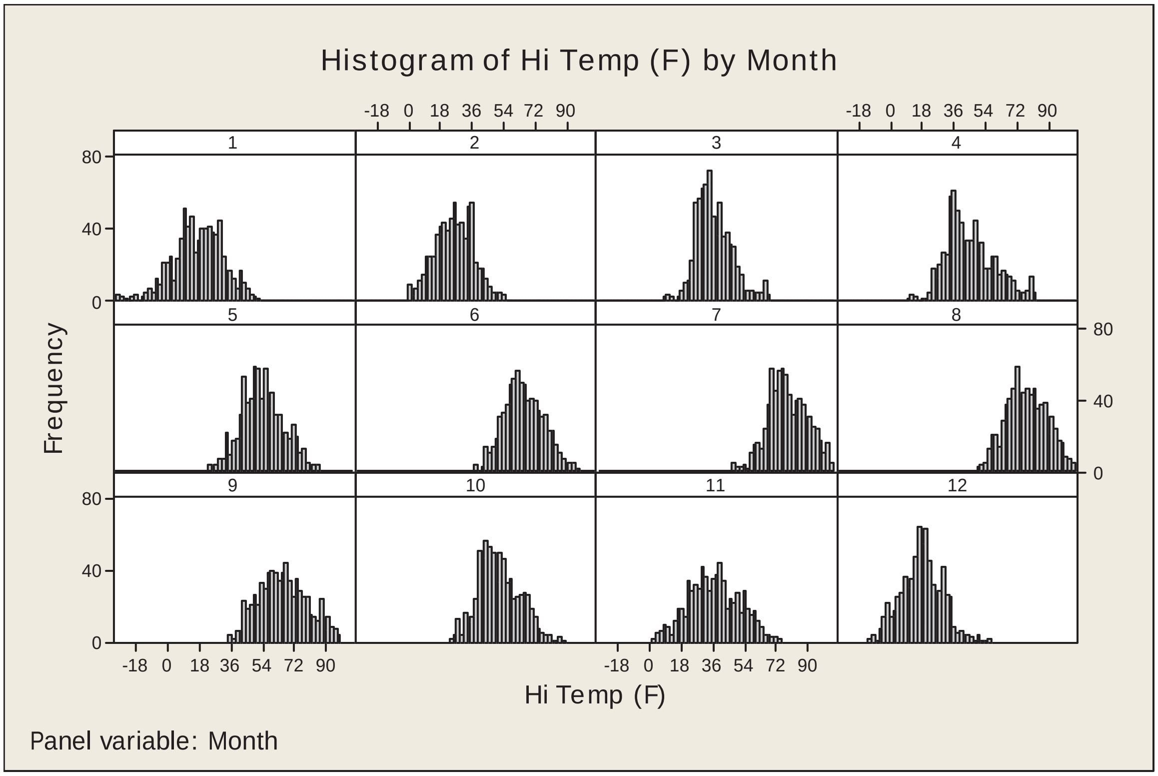
```
   Variable       Season         N   N*     Mean    StDev   Minimum        Q1   Median        Q3
Maximum
   Avg Temp (F)   1-Spring    2184    0   43.366   13.975     7.000    33.000   42.000    53.000
84.000
                 2-Summer   2208    0   71.866   12.636    35.000    63.000   72.000    81.000
103.000
                 3-Fall      2184    0   49.008   18.144     1.000    37.000   49.000    61.000
96.000
                 4-Winter   2184    0   17.669   12.987   -30.000     9.000   18.000    27.000
53.000
```

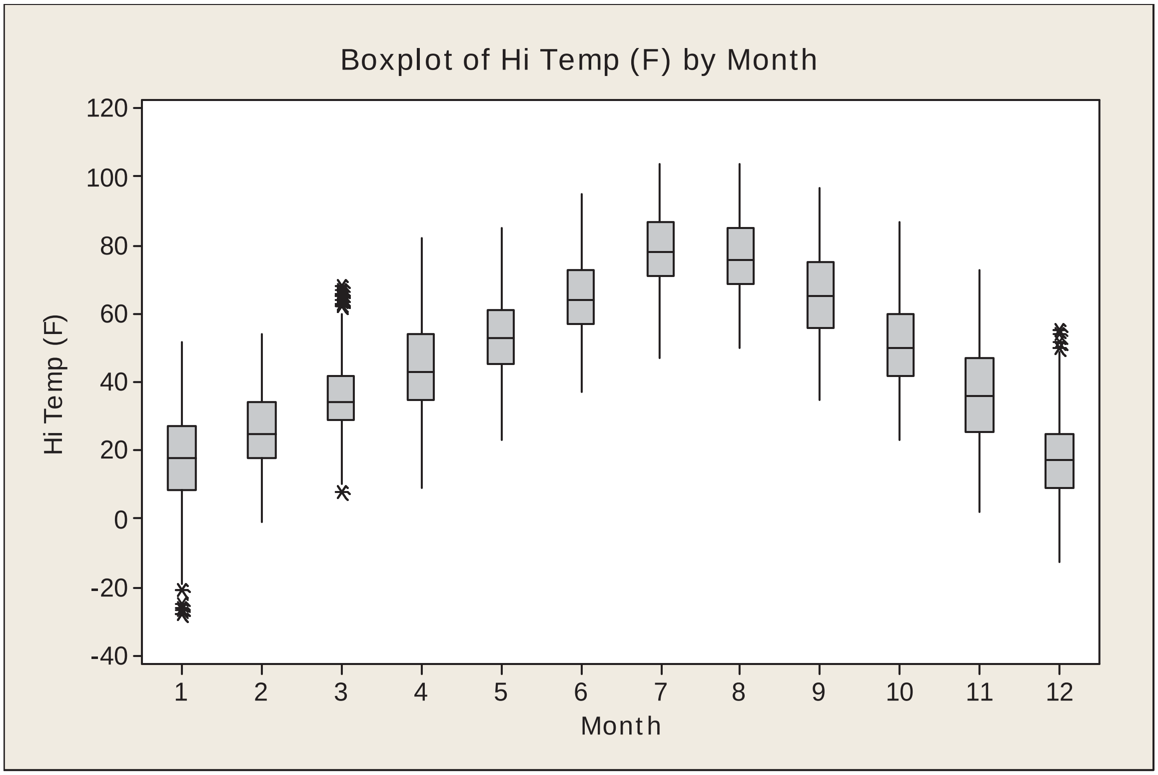

Histogram of Avg Temp (F) by Season
1-Spring
2-Summer
3-Fall
4-Winter
Frequency
0
40
80
120
160
-18
0
18
36
54
72
90
Avg Temp (F)
Panel variable: Season


Boxplot of Avg Temp (F) by Season
Avg Temp (F)
120
100
80
60
40
20
0
-20
-40
1-Spring
2-Summer
3-Fall
4-Winter
Season

**Descriptive Statistics: Hi Temp (F)**

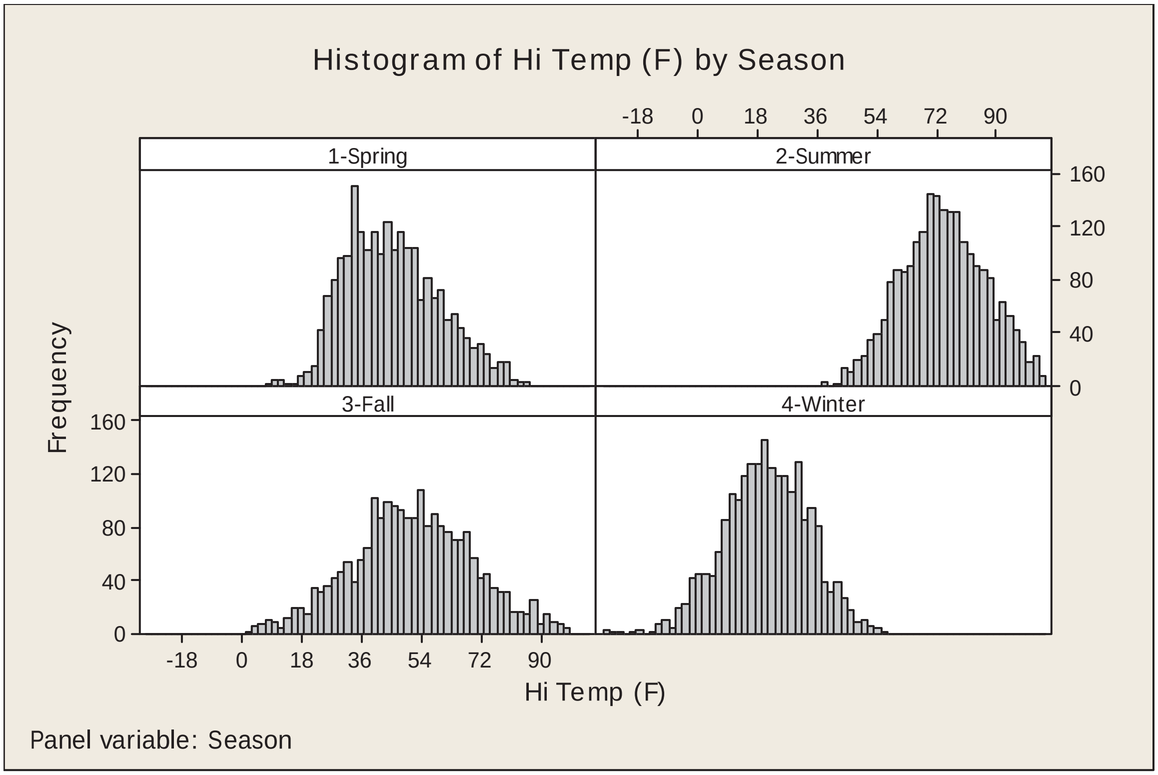
```
Variable     Month    N  N*    Mean   StDev  Minimum      Q1  Median      Q3  Maximum
Hi Temp (F)    1    744   0  17.176  14.043  -28.000   8.250  18.000  27.000   52.000
               2    696   0  25.307  10.827   -1.000  18.000  25.000  34.000   54.000
               3    720   0  36.100  10.286    8.000  29.000  34.000  42.000   68.000
               4    720   0  44.954  14.008    9.000  35.000  43.000  54.000   82.000
               5    744   0  53.663  11.834   23.000  45.000  53.000  61.000   85.000
               6    720   0  65.026  10.932   37.000  57.000  64.000  73.000   95.000
               7    744   0  78.593  11.209   47.000  71.000  78.000  87.000  104.000
               8    744   0  76.902  11.387   50.000  69.000  76.000  85.000  104.000
               9    720   0  65.635  13.798   35.000  56.000  65.000  75.000   97.000
              10    744   0  51.003  12.020   23.000  42.000  50.000  60.000   87.000
              11    720   0  36.133  14.917    2.000  25.250  36.000  47.000   73.000
              12    744   0  17.262  11.831  -13.000   9.000  17.000  25.000   55.000
```

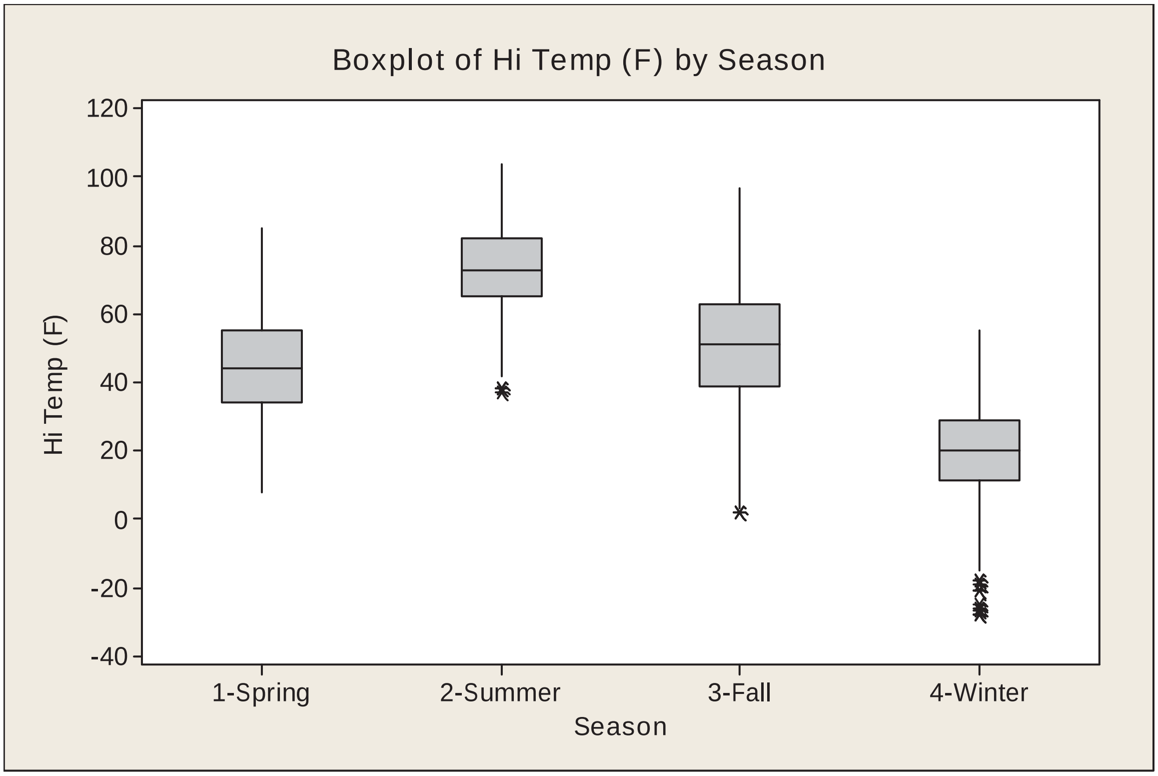




**Descriptive Statistics: Hi Temp (F)**

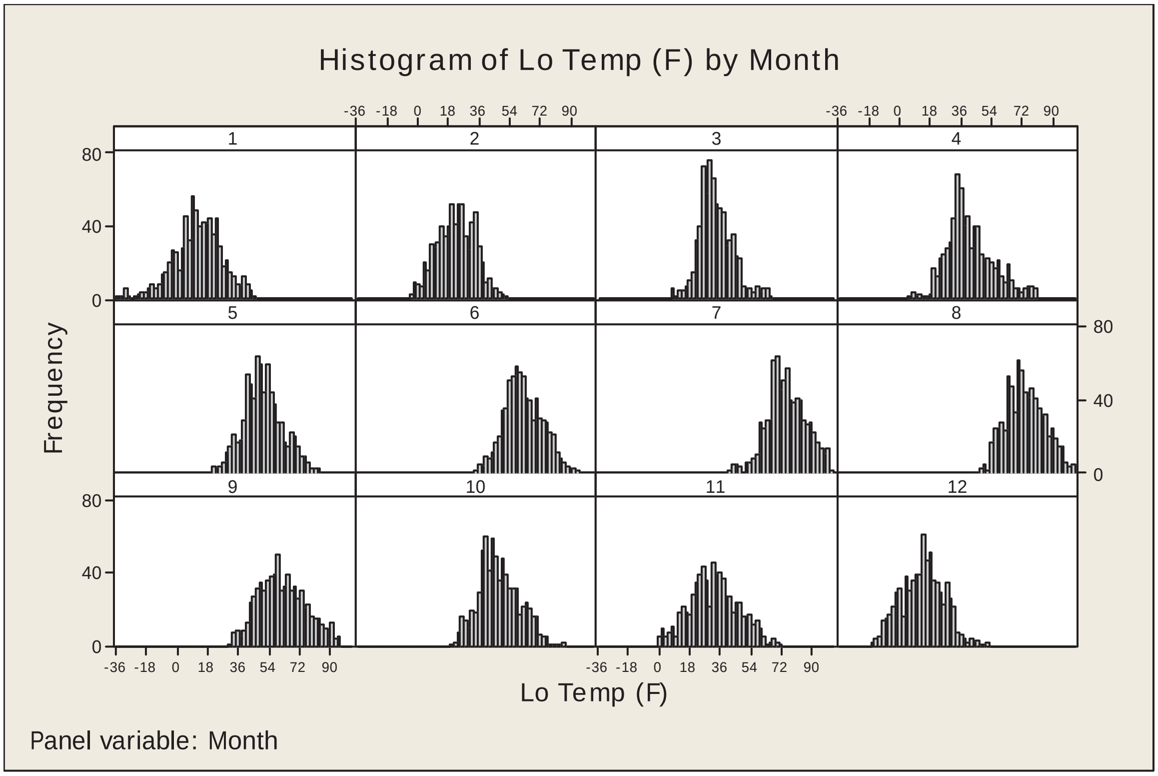
```
   Variable      Season         N   N*     Mean    StDev   Minimum       Q1   Median       Q3
Maximum
   Hi Temp (F)   1-Spring    2184    0   45.002   14.101     8.000   34.000   44.000   55.000
85.000
                2-Summer   2208    0   73.599   12.686    37.000   65.000   73.000   82.000
104.000
                3-Fall      2184    0   50.924   18.130     2.000   39.000   51.000   63.000
97.000
                4-Winter   2184    0   19.797   12.896   -28.000   11.000   20.000   29.000
55.000
```

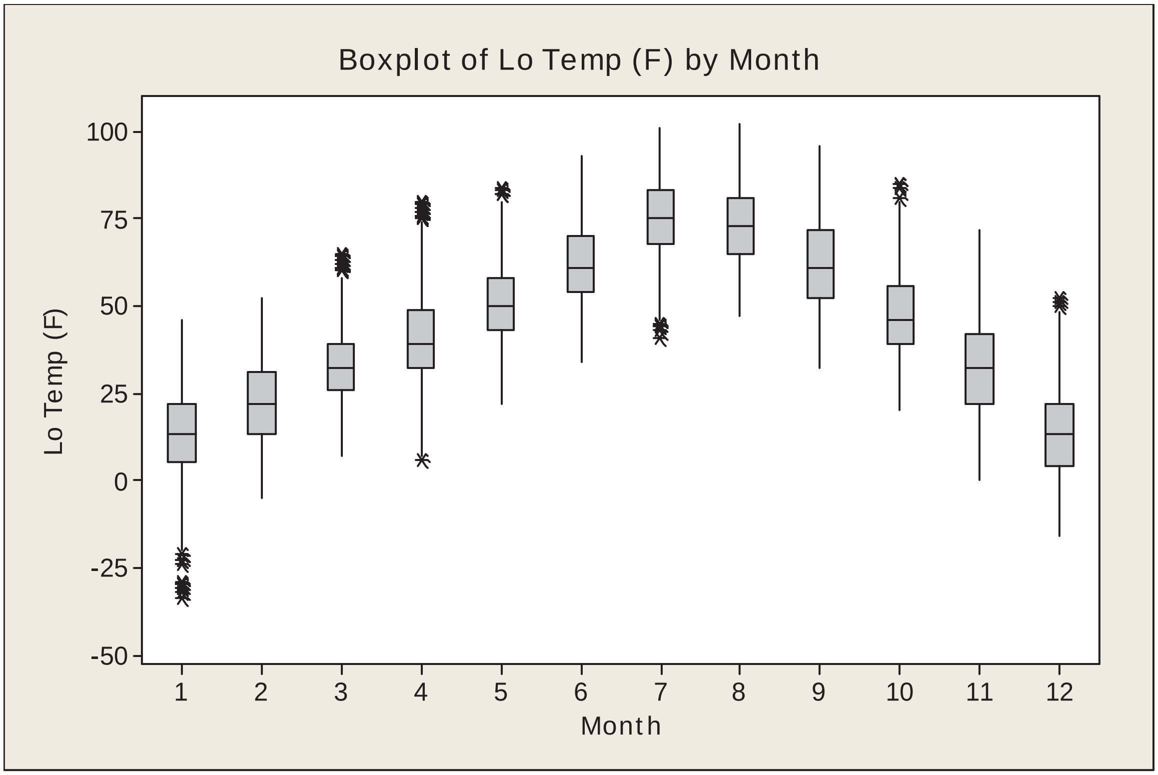

Histogram of Hi Temp (F) by Season
1-Spring
2-Summer
3-Fall
4-Winter
Frequency
0
40
80
120
160
-18
0
18
36
54
72
90
Hi Temp (F)
Panel variable: Season


Boxplot of Hi Temp (F) by Season
Hi Temp (F)
120
100
80
60
40
20
0
-20
-40
1-Spring
2-Summer
3-Fall
4-Winter
Season

**Descriptive Statistics: Lo Temp (F)**

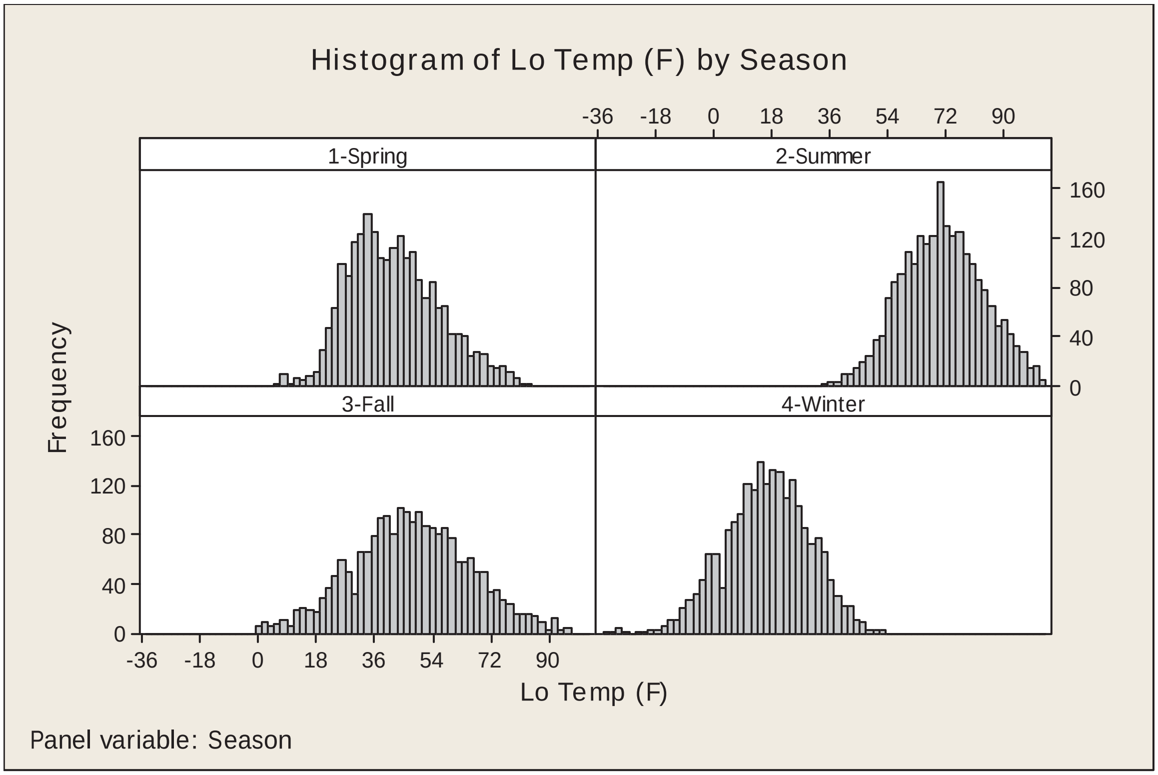
```
Variable     Month    N  N*    Mean   StDev  Minimum      Q1  Median      Q3  Maximum
Lo Temp (F)    1    744   0  12.538  13.869  -34.000   5.000  13.000  22.000   46.000
               2    696   0  21.797  11.032   -5.000  13.250  22.000  31.000   52.000
               3    720   0  32.993   9.890    7.000  26.000  32.000  39.000   65.000
               4    720   0  41.326  13.840    6.000  32.000  39.000  49.000   80.000
               5    744   0  50.719  11.503   22.000  43.000  50.000  58.000   84.000
               6    720   0  61.635  10.928   34.000  54.000  61.000  70.000   93.000
               7    744   0  75.144  11.330   41.000  68.000  75.000  83.000  101.000
               8    744   0  73.449  11.173   47.000  65.000  73.000  81.000  102.000
               9    720   0  61.931  13.775   32.000  52.000  61.000  72.000   96.000
              10    744   0  47.539  12.074   20.000  39.000  46.000  55.750   85.000
              11    720   0  32.004  14.599    0.000  22.000  32.000  42.000   72.000
              12    744   0  12.957  12.541  -16.000   4.000  13.000  22.000   52.000
```

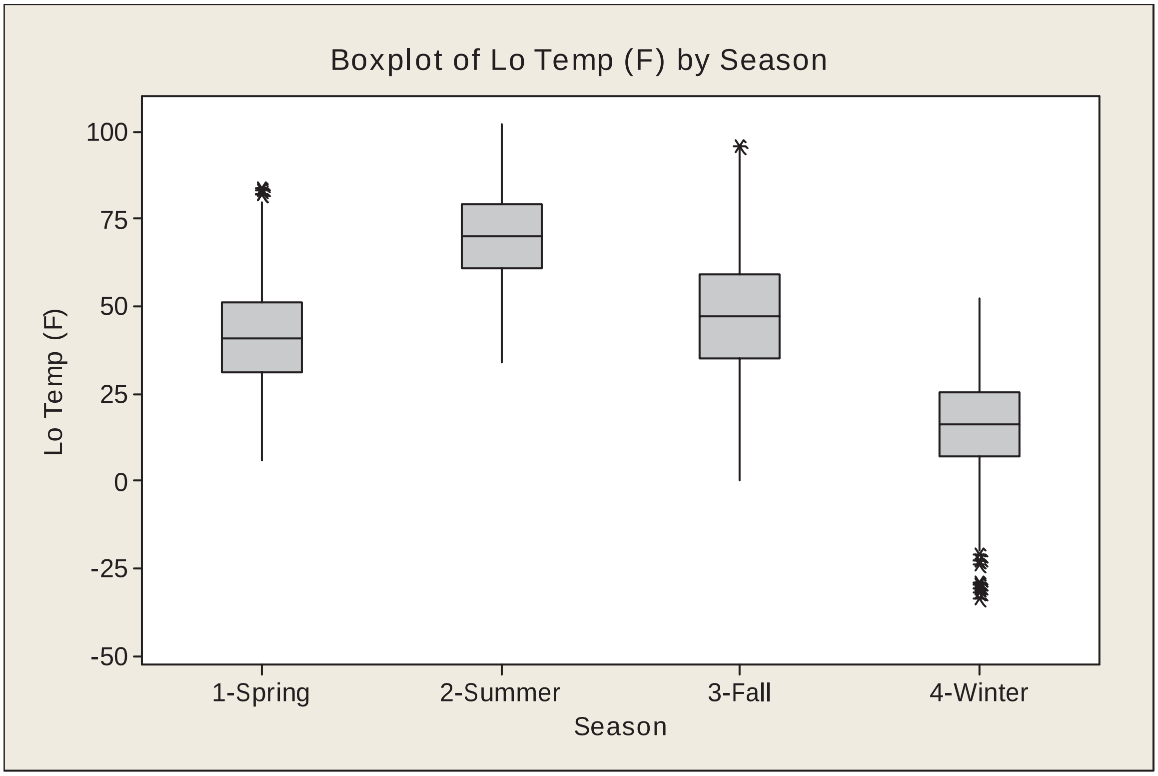




**Descriptive Statistics: Lo Temp (F)**

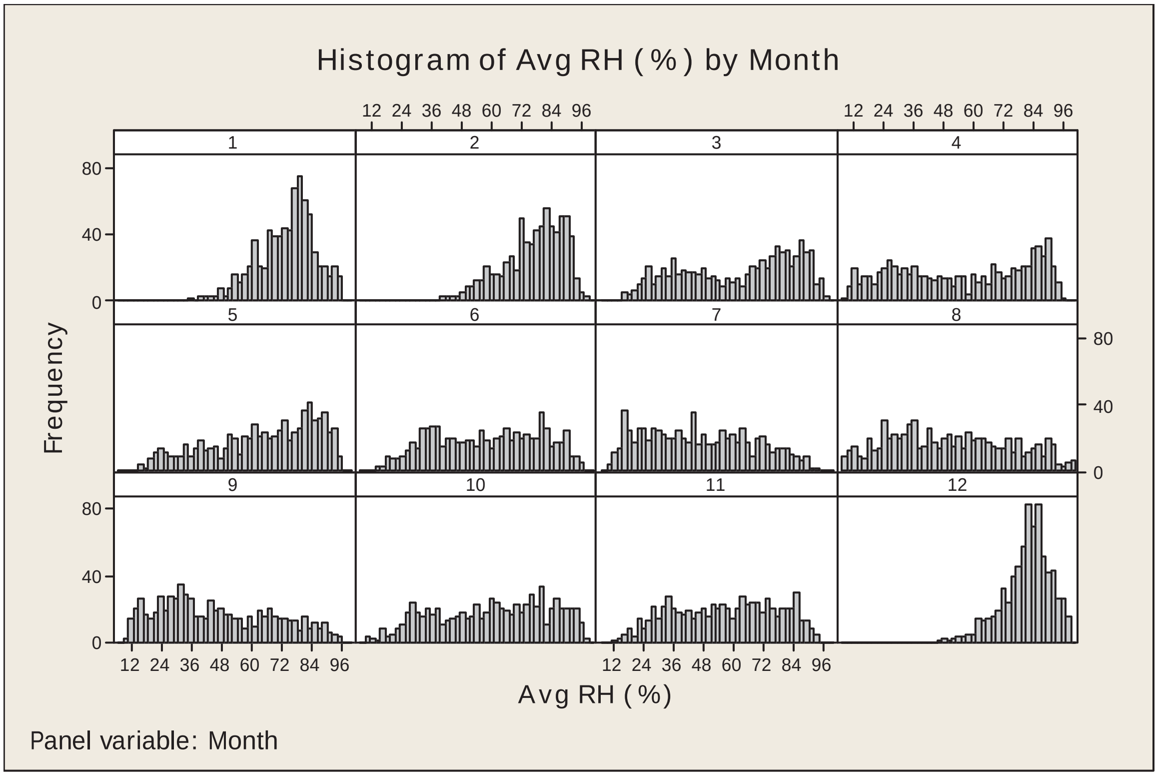
```
   Variable      Season         N   N*     Mean    StDev   Minimum       Q1   Median       Q3
Maximum
   Lo Temp (F)   1-Spring    2184    0   41.779   13.896     6.000   31.000   41.000   51.000
84.000
                2-Summer   2208    0   70.168   12.644    34.000   61.000   70.000   79.000
102.000
                3-Fall      2184    0   47.162   18.168     0.000   35.000   47.000   59.000
96.000
                4-Winter   2184    0   15.631   13.250   -34.000    7.000   16.000   25.000
52.000
```

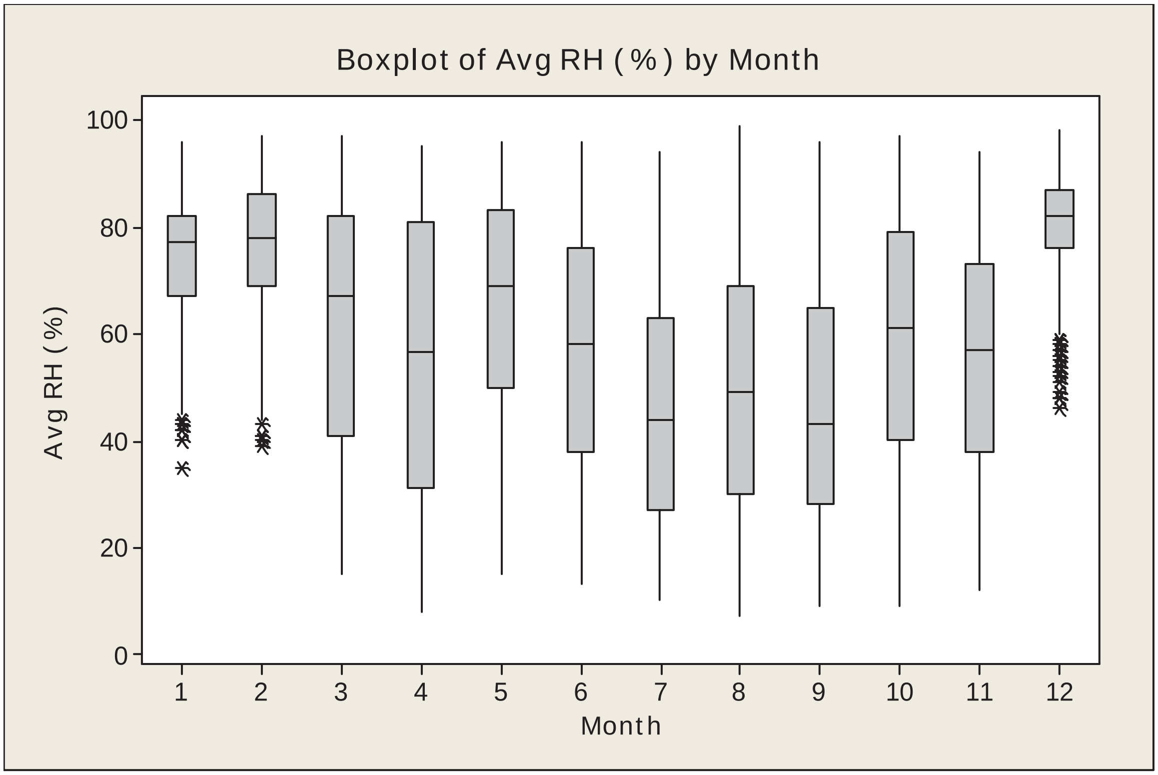

Histogram of Lo Temp (F) by Season
1-Spring
2-Summer
3-Fall
4-Winter
Frequency
0
40
80
120
160
-36
-18
0
18
36
54
72
90
Lo Temp (F)
Panel variable: Season


Boxplot of Lo Temp (F) by Season
Lo Temp (F)
100
75
50
25
0
-25
-50
1-Spring
2-Summer
3-Fall
4-Winter
Season

**Descriptive Statistics: Avg RH (%)**

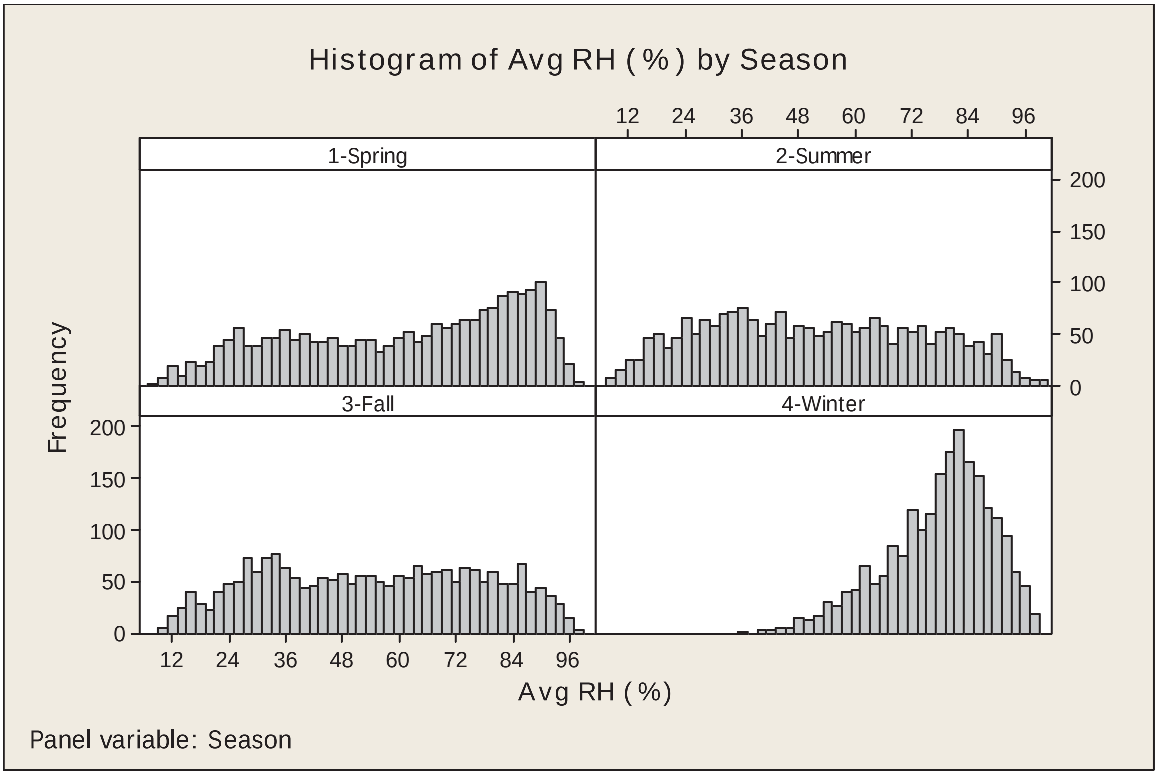
```
Variable    Month    N  N*    Mean   StDev  Minimum      Q1  Median      Q3  Maximum
Avg RH (%)      1  744   0  74.401  11.316   35.000  67.000  77.000  82.000   96.000
                2  696   0  76.204  12.055   39.000  69.000  78.000  86.000   97.000
                3  720   0  61.858  22.846   15.000  41.000  67.000  82.000   97.000
                4  720   0  55.276  26.033    8.000  31.250  56.500  80.750   95.000
                5  744   0  64.849  21.121   15.000  50.000  69.000  83.000   96.000
                6  720   0  57.286  21.158   13.000  38.000  58.000  76.000   96.000
                7  744   0  45.902  21.533   10.000  27.000  44.000  63.000   94.000
                8  744   0  49.981  23.951    7.000  30.000  49.000  69.000   99.000
                9  720   0  46.239  22.786    9.000  28.000  43.000  65.000   96.000
               10  744   0  59.480  22.502    9.000  40.000  61.000  79.000   97.000
               11  720   0  56.265  20.717   12.000  38.000  57.000  73.000   94.000
               12  744   0  80.942   9.595   46.000  76.000  82.000  87.000   98.000
```

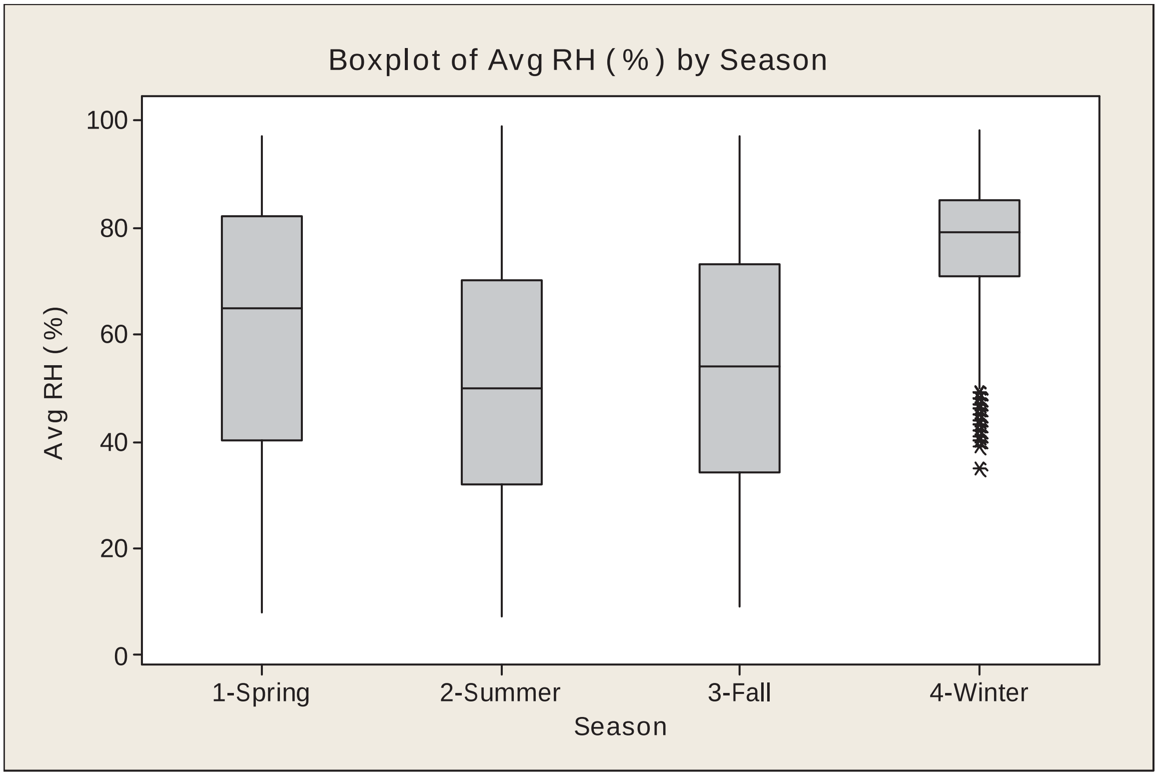




**Descriptive Statistics: Avg RH (%)**

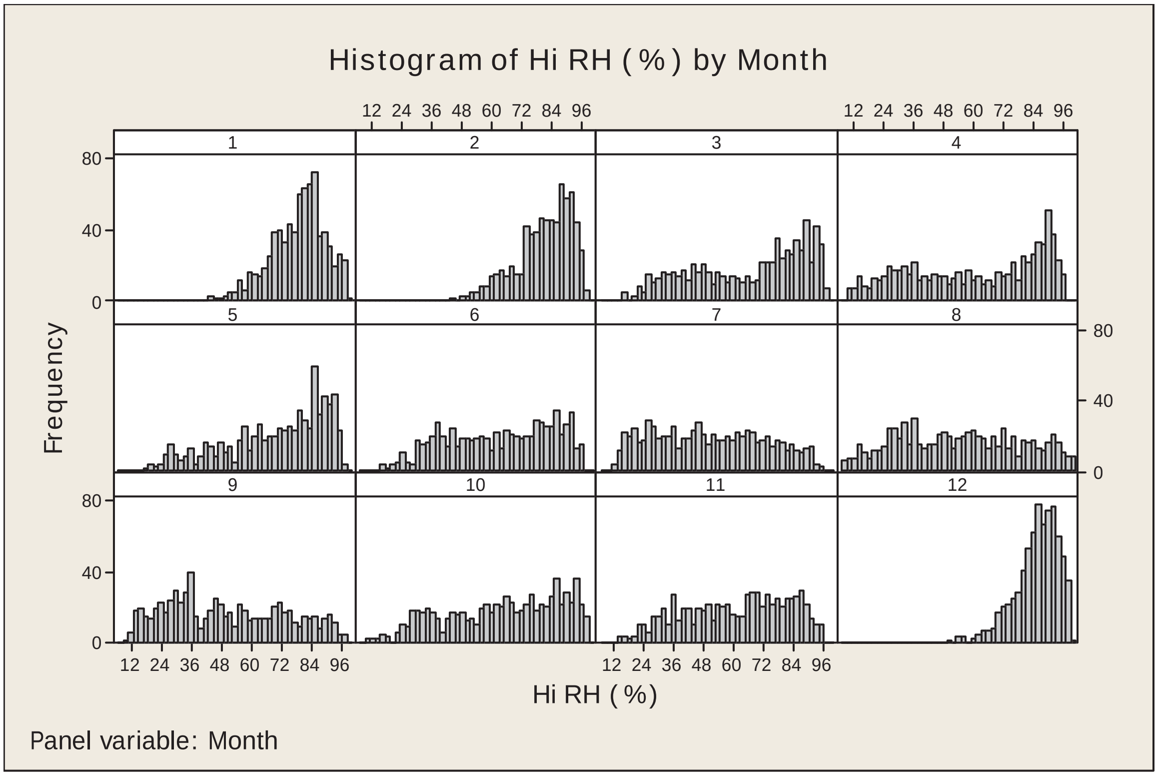
```
   Variable     Season          N   N*      Mean    StDev   Minimum        Q1   Median        Q3
Maximum
   Avg  RH  (%)   1-Spring   2184    0   60.707   23.727      8.000   40.000   65.000   82.000
97.000
                2-Summer   2208    0   50.989   22.739      7.000   32.000   50.000   70.000
99.000
                3-Fall      2184    0   54.055   22.726      9.000   34.000   54.000   73.000
97.000
                4-Winter   2184    0   77.204   11.355     35.000   71.000   79.000   85.000
98.000
```

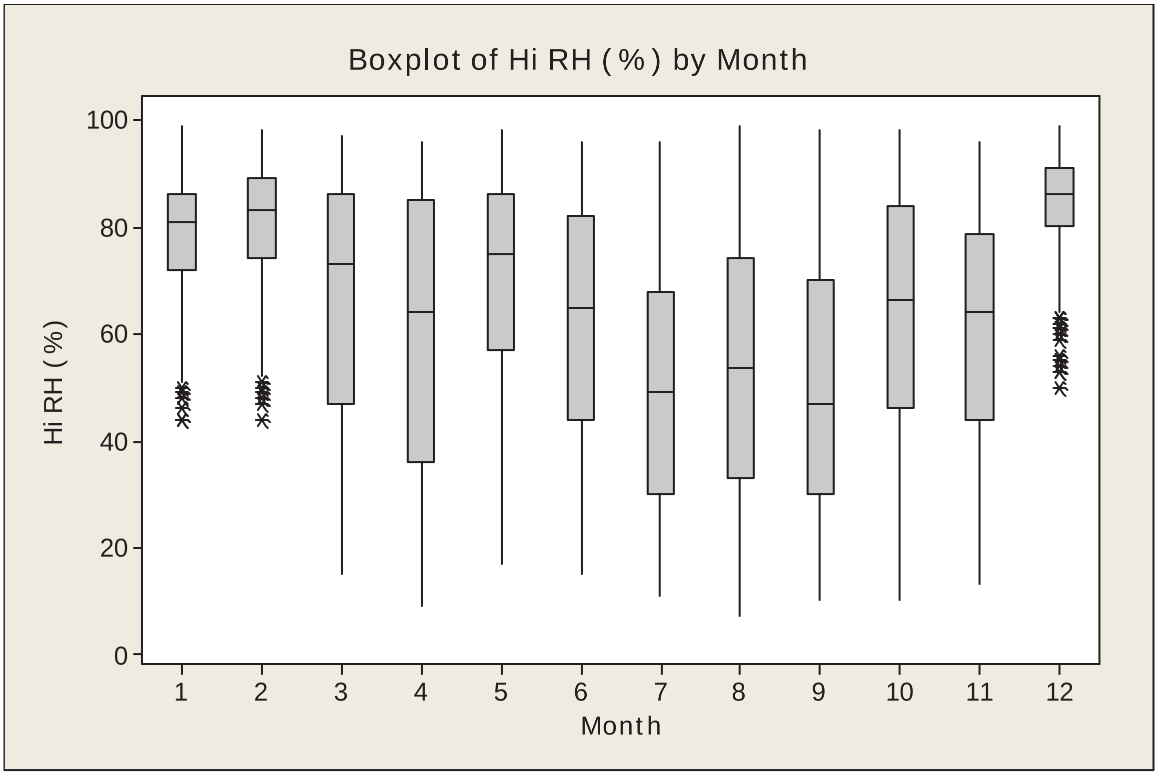

Histogram of Avg RH (%) by Season
1-Spring
2-Summer
3-Fall
4-Winter
Frequency
0
50
100
150
200
12
24
36
48
60
72
84
96
Avg RH (%)
Panel variable: Season


Boxplot of Avg RH (%) by Season
Avg RH (%)
0
20
40
60
80
100
1-Spring
2-Summer
3-Fall
4-Winter
Season

**Descriptive Statistics: Hi RH (%)**

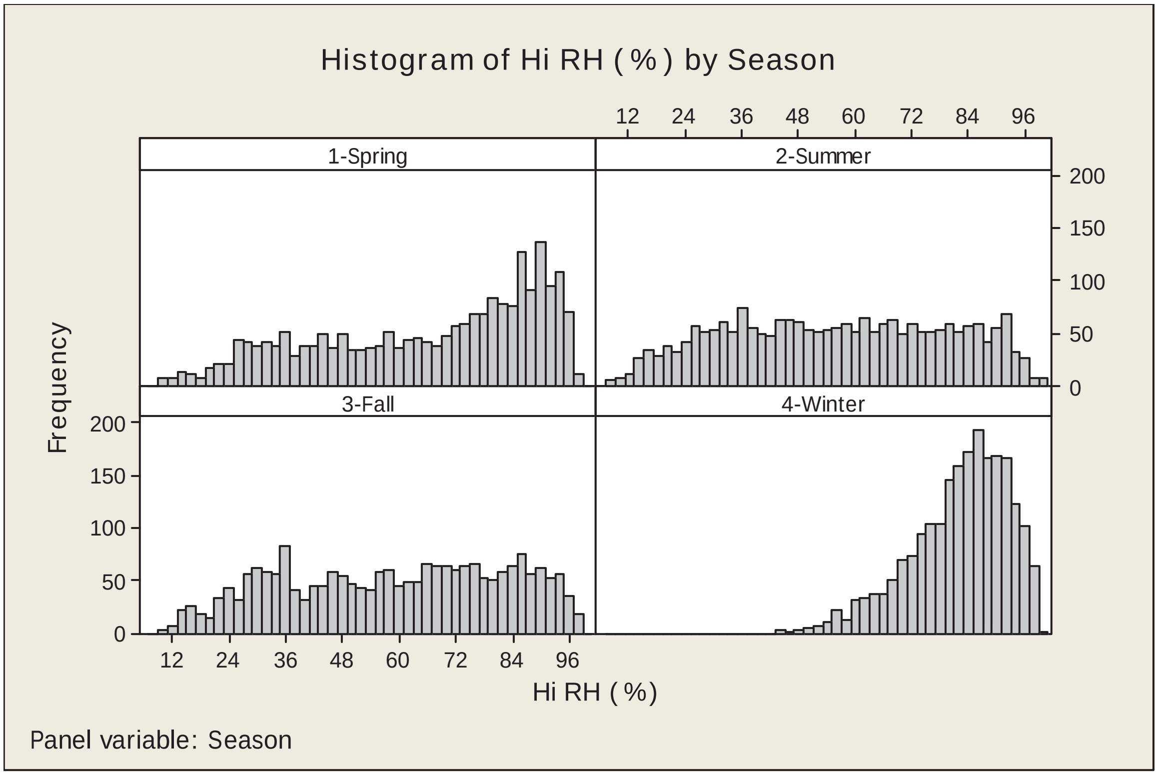
```
Variable    Month     N  N*    Mean   StDev  Minimum      Q1  Median      Q3  Maximum
Hi RH (%)     1     744   0  79.089  10.652   44.000  72.000  81.000  86.000   99.000
              2     696   0  80.704  10.902   44.000  74.000  83.000  89.000   98.000
              3     720   0  66.451  22.568   15.000  47.000  73.000  86.000   97.000
              4     720   0  60.206  26.101    9.000  36.000  64.000  85.000   96.000
              5     744   0  69.940  20.135   17.000  57.000  75.000  86.000   98.000
              6     720   0  62.814  21.013   15.000  44.000  65.000  82.000   96.000
              7     744   0  49.991  22.415   11.000  30.000  49.000  68.000   96.000
              8     744   0  53.909  24.419    7.000  33.000  53.500  74.000   99.000
              9     720   0  50.150  23.648   10.000  30.000  47.000  70.000   98.000
             10     744   0  63.888  22.670   10.000  46.000  66.500  84.000   98.000
             11     720   0  60.954  20.860   13.000  44.000  64.000  78.750   96.000
             12     744   0  84.997   8.711   50.000  80.000  86.000  91.000   99.000
```

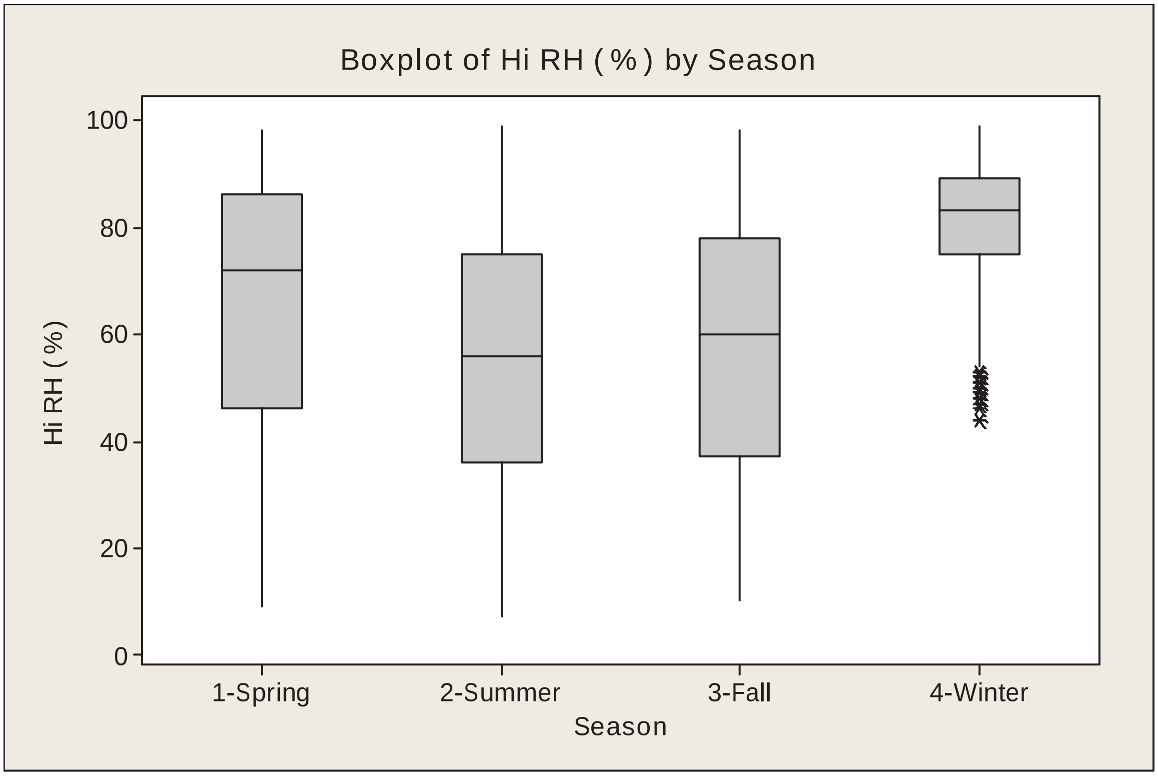




**Descriptive Statistics: Hi RH (%)**

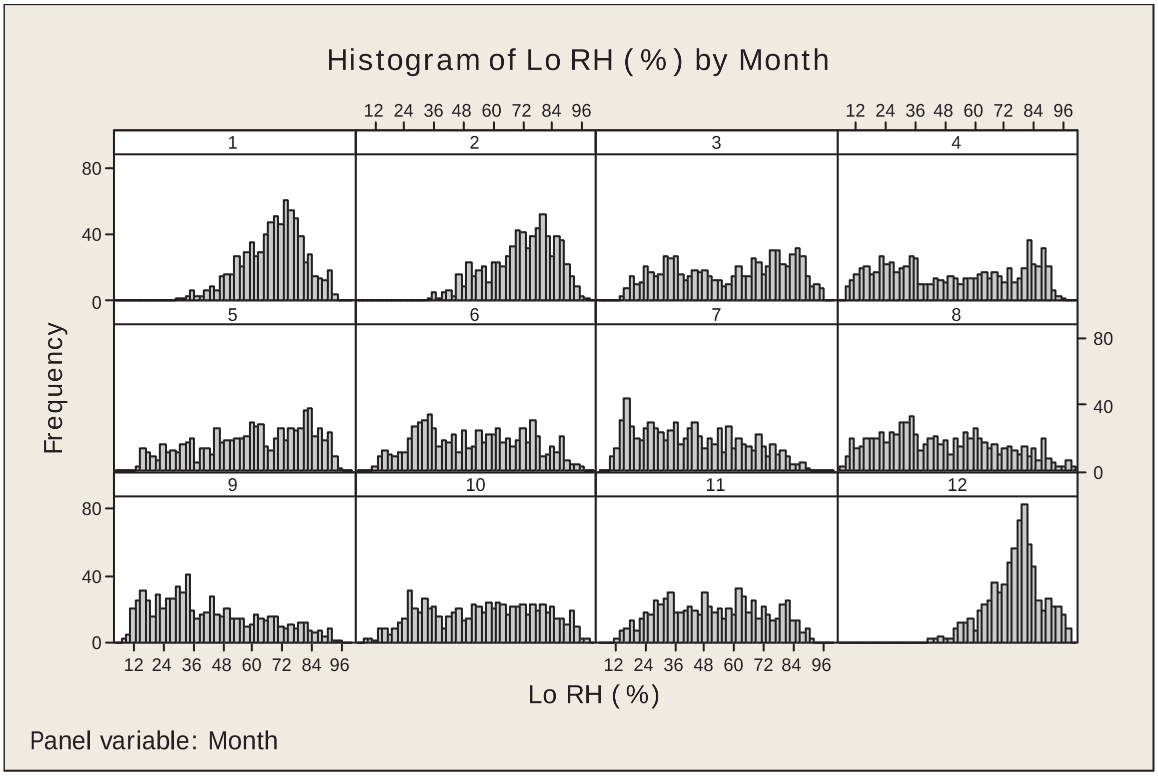
```
   Variable    Season         N   N*     Mean    StDev   Minimum        Q1   Median        Q3
Maximum
   Hi  RH  (%)   1-Spring   2184    0   65.581   23.375     9.000   46.000   72.000   86.000
98.000
              2-Summer   2208    0   55.492   23.286     7.000   36.000   56.000   75.000
99.000
              3-Fall      2184    0   58.392   23.180    10.000   37.000   60.000   78.000
98.000
              4-Winter   2184    0   81.616   10.422    44.000   75.000   83.000   89.000
99.000
```

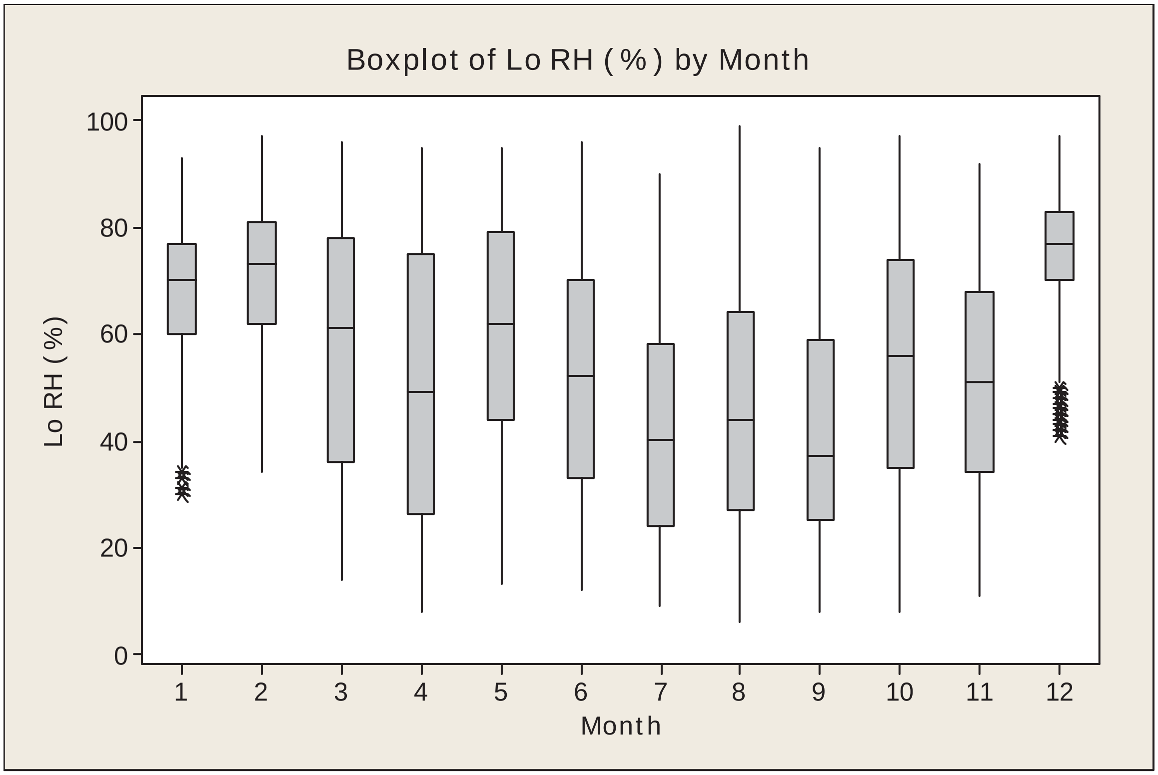

Histogram of Hi RH ( % ) by Season
1-Spring
2-Summer
3-Fall
4-Winter
Frequency
0
50
100
150
200
12
24
36
48
60
72
84
96
Hi RH ( % )
Panel variable: Season


Boxplot of Hi RH ( % ) by Season
Hi RH ( % )
0
20
40
60
80
100
1-Spring
2-Summer
3-Fall
4-Winter
Season

**Descriptive Statistics: Lo RH (%)**

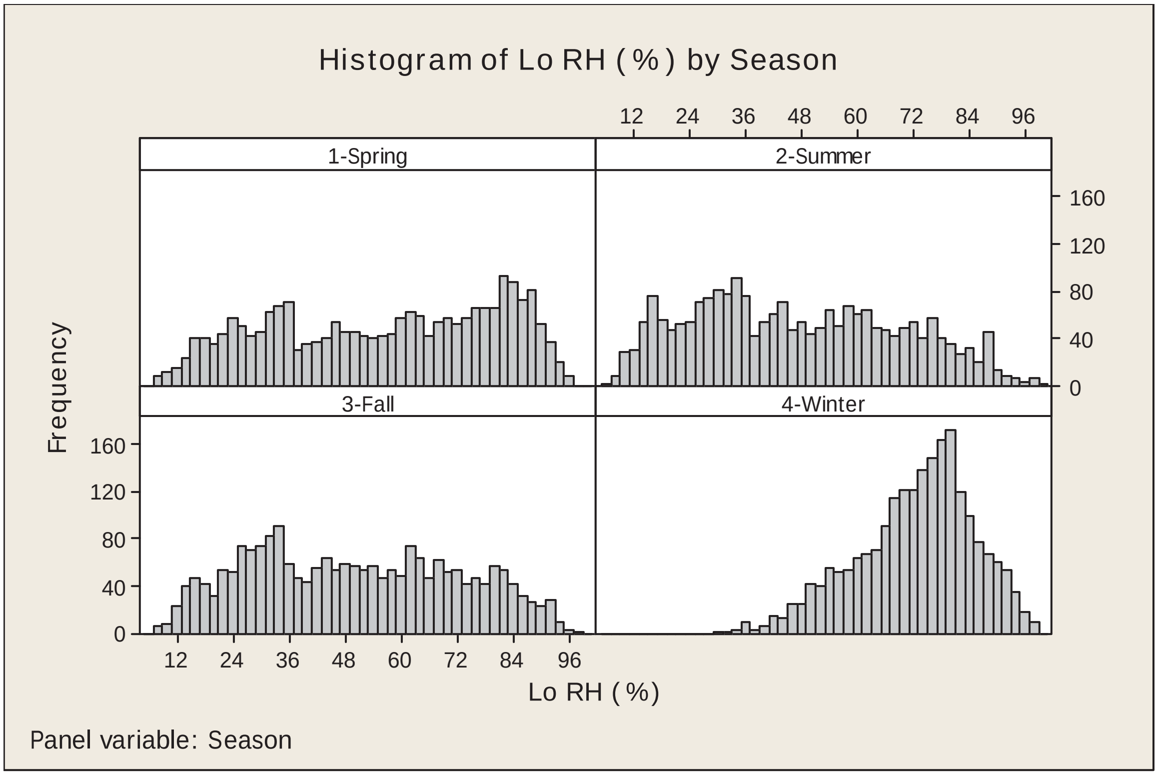
```
Variable    Month     N  N*    Mean   StDev  Minimum      Q1  Median      Q3  Maximum
Lo RH (%)     1     744   0  68.601  12.330   30.000  60.000  70.000  77.000   93.000
              2     696   0  71.119  13.476   34.000  62.000  73.000  81.000   97.000
              3     720   0  57.353  22.974   14.000  36.000  61.000  78.000   96.000
              4     720   0  50.326  25.874    8.000  26.250  49.000  75.000   95.000
              5     744   0  59.954  21.723   13.000  44.000  62.000  79.000   95.000
              6     720   0  51.854  21.077   12.000  33.000  52.000  70.000   96.000
              7     744   0  42.000  20.728    9.000  24.000  40.000  58.000   90.000
              8     744   0  45.991  23.599    6.000  27.000  44.000  64.000   99.000
              9     720   0  42.293  21.856    8.000  25.000  37.000  59.000   95.000
             10     744   0  54.921  22.251    8.000  35.000  56.000  74.000   97.000
             11     720   0  51.574  20.250   11.000  34.000  51.000  68.000   92.000
             12     744   0  75.931  11.041   41.000  70.000  77.000  83.000   97.000
```

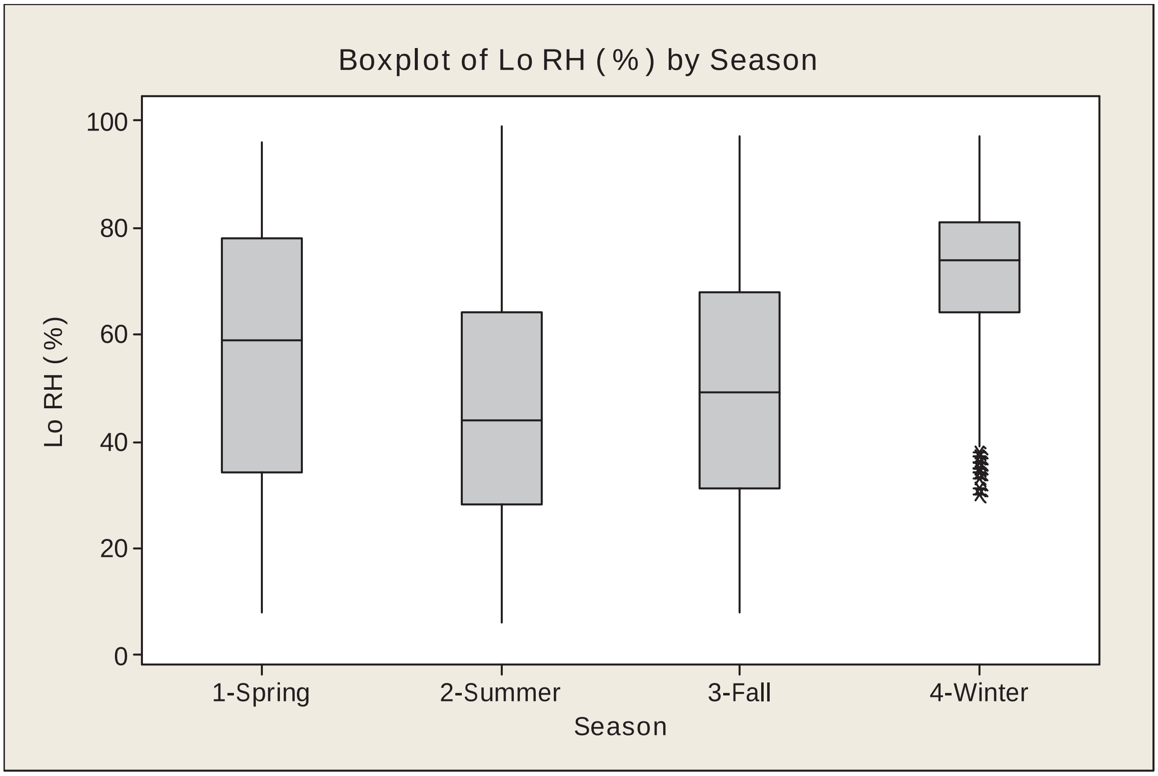




**Descriptive Statistics: Lo RH (%)**

```
   Variable    Season          N   N*     Mean    StDev   Minimum       Q1   Median       Q3
Maximum
   Lo  RH  (%)   1-Spring   2184    0   55.923   23.906     8.000   34.000   59.000   78.000
96.000
              2-Summer   2208    0   46.558   22.206     6.000   28.000   44.000   64.000
99.000
              3-Fall      2184    0   49.654   22.123     8.000   31.000   49.000   68.000
97.000
              4-Winter   2184    0   71.901   12.669    30.000   64.000   74.000   81.000
97.000
```


Histogram of Lo RH ( % ) by Season
1-Spring
2-Summer
3-Fall
4-Winter
Frequency
0
40
80
120
160
12
24
36
48
60
72
84
96
Lo RH ( %)
Panel variable: Season


Boxplot of Lo RH ( % ) by Season
Lo RH ( %)
0
20
40
60
80
100
1-Spring
2-Summer
3-Fall
4-Winter
Season

**Descriptive Statistics: Precip (Inches)**

```
Variable         Month    N  N*       Sum   Maximum
Precip (Inches)   1      744   0  0.130000  0.050000
                  2      696   0  0.210000  0.040000
                  3      720   0  0.400000  0.130000
                  4      720   0  0.980000  0.330000
                  5      744   0   3.80000   0.71000
                  6      720   0  1.770000  0.420000
                  7      744   0  1.870000  0.460000
                  8      744   0  0.870000  0.160000
                  9      720   0  0.790000  0.140000
                 10      744   0  1.230000  0.220000
                 11      720   0  0.100000  0.050000
                 12      744   0  0.270000  0.040000
```

# APPENDIX 2.5-C

# SUPPORT INFORMATION FOR DEWEY-BURDOCK METEOROLOGICAL MONITORING SITE

The following presents the stability classes and joint frequency distribution for the Dewey-Burdock permit area and describes the methodology used for calculations. Atmospheric stability class can be derived from solar radiation during the daylight hours, and vertical temperature gradient (delta-T) measurements during the nighttime hours according to the SRDT (solar radiation delta-T) method. However, meteorological monitoring at the Dewey-Burdock site included solar radiation but not delta-T. In the absence of the delta-T measurements required by the SRDT method, a possible modification was considered. This modified SRDT approach would assume a positive delta-T (increasing temperature with height) during nighttime hours, thereby producing the most stable class possible and, therefore, the lowest modeled pollutant dispersion.

Another alternative to determine atmospheric stability classes and resulting joint frequency distributions is the sigma theta method. This method is turbulence-based, which uses the standard deviation of the horizontal wind direction ($\sigma_\theta$) in combination with the scalar mean wind speed. Since $\sigma_\theta$ was not logged, it was necessary to derive this parameter from the hourly variation of 5-minute wind directions.

The procedure for deriving hourly average $\sigma_\theta$ values is outlined as follows:

1. Compute a scalar mean wind direction by averaging 5-minute azimuth angles over four, 15-minute periods for each hour. The choice of 15-minute averaging periods is intended to minimize the effect of wind meander (wind direction changes over longer periods that are non-random and unrelated to turbulence). The use of 5-minute source data further reduces the likelihood of conflicts between scalar and vector averages.
2. Compute a standard deviation of each 15-minute grouping of 5-minute wind directions, based on the differences between the 5-minute readings and the 15-minute mean from step 1 above.
3. Compute an hourly average standard deviation as the geometric average of the four 15-minute standard deviations from step 2 above.

Steps 1 and 2 utilize the Mitsua method: $\bar{\theta} = \frac{1}{N}\sum_{1}^{N} D_i$ (N = 3 in this case)

where $D_i = \theta_i$; for $i = 1$
$D_i = D_{i-1} + \delta_i + 360$; for $\delta_i < -180$ and $i > 1$
$D_i = D_{i-1} + \delta_i$; for $|\delta_i| < 180$ and $i > 1$
$D_i = D_{i-1} + \delta_i - 360$; for $\delta_i > 180$ and $i > 1$
$D_i =$ undefined; for $\delta_i = 180$ and $i > 1$
$\delta_i = \theta_i - D_{i-1}$ ; for $i > 1$
$\theta_i$ is the azimuth angle of the wind vane for the $i^{th}$ sample

then $$\sigma_\theta = \left\{ \frac{1}{N}\sum_{1}^{N} D_i^{\,2} - \frac{1}{N}\left(\sum_{1}^{N} D_i\right)^2 \right\}^{1/2}$$

In step 3, the hourly average standard deviation can then be calculated from these 15-minute values:

$$\sigma_\theta(1-hr) = \sqrt{\frac{(\sigma_{\theta_1})^2 + (\sigma_{\theta_2})^2 + (\sigma_{\theta_3})^2 + (\sigma_{\theta_4})^2}{4}}$$

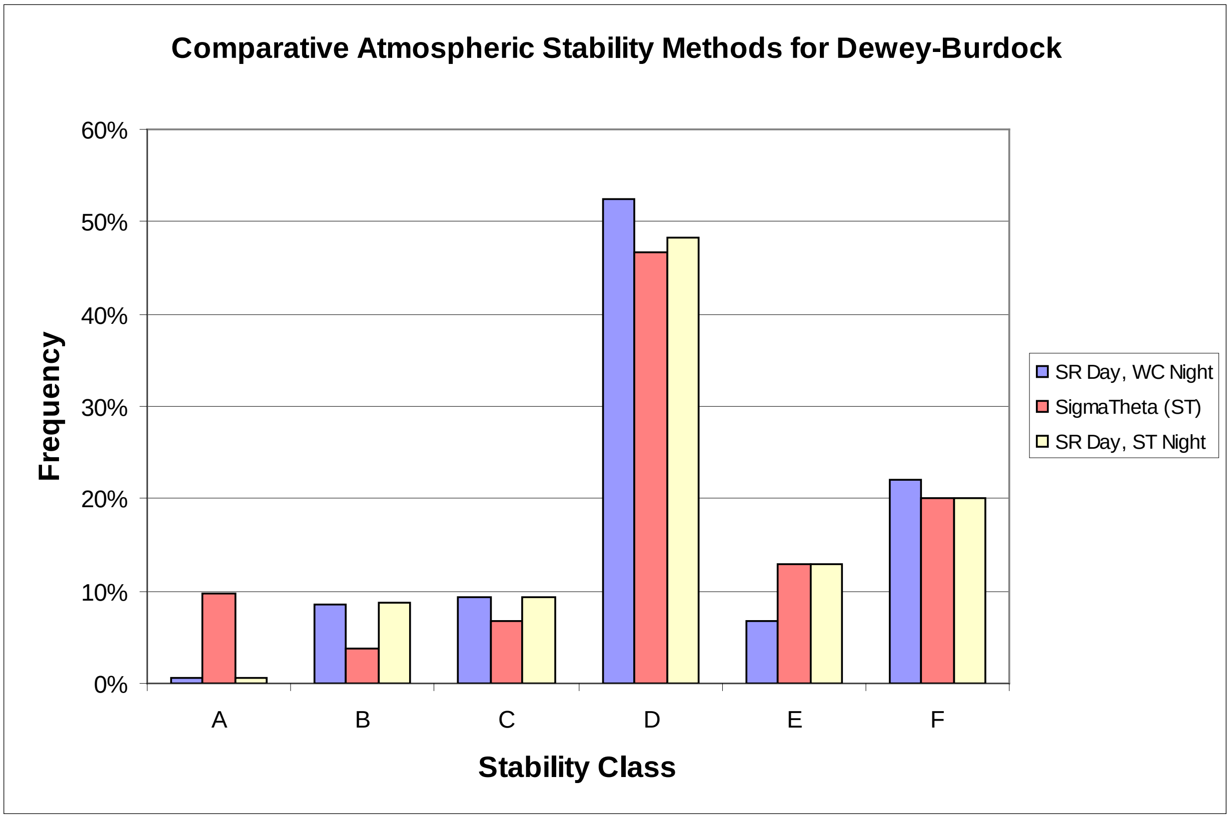
The above procedure, when applied to the Dewey-Burdock wind data, yields hourly $\sigma_\theta$ values similar to the hourly values logged at the nearby Newcastle meteorological station. Newcastle $\sigma_\theta$ values averaged 19.6º during the baseline monitoring year, while the derived $\sigma_\theta$ values from Dewey-Burdock data averaged 18.7º. The sigma theta method of atmospheric stability determination is considered more representative than the modified SRDT method described above, because it requires no simplifying assumptions.

Having developed these hourly $\sigma_\theta$ values, however, the choice remained whether to use the sigma theta method exclusively, or to use a hybrid method that takes advantage of solar radiation (SR) data during the daytime. To facilitate this choice, the two methods were compared along with the modified SRDT method which used SR during the day, and assumed worst-case delta-T (WC) at night. Figure 1 shows the results of this comparison.

The sigma theta method was ruled out since it resulted in a much higher percentage of the hours in the least stable class. Stability class A produces the greatest amount of atmospheric mixing and pollutant dispersion, so the sigma theta method compromises the preference for conservatism. The remaining two methods yield similar results. The hybrid SR/ST method was chosen because it makes use of the greatest amount of monitoring data covering both daytime and nighttime.

Based upon the data and method selections discussed above, the combination of hourly wind speed, wind direction and stability class was used to generate Joint Frequency Distributions (JFDs) for the anticipated release height of 10 meters. The annual JFD in Table 1 was used as the basis for a revised MILDOS-AREA model run. The 1st Quarter JFD in Table 2 reflects January 1, 2008 through March 31, 2008. Table 3 reflects 2nd Quarter (April 1, 2008 through June 30, 2008). Table 4 reflects the 3rd Quarter (July 2007 and 2008 and August 1, 2007 through September 30, 2007). Table 5 reflects the 4th Quarter (October 1, 2007 through December 31, 2007). Each table footer shows the number of hours for which valid data are available, the total number of hours possible, and the number of calm hours during the period represented.

**Figure 1: Comparative Atmospheric Stability Methods for Dewey-Burdock**



Data recoveries at the 3-meter level exceeded 99%. However, regulatory guidance specifies that wind characteristics should reflect the anticipated release height for modeled emission sources. Therefore, the joint frequency distributions depicted below are based on 10-meter wind data. Joint data recovery (wind speed and wind direction) for the baseline year was 87%, above the recommended minimum of 75% (Reference 3). Individual data recovery was also around 87%, slightly below the recommended 90% for individual parameters (Reference 3). However, the tradeoff between marginal recovery percentage and representative height above the ground appears justified in this case.

## Table 1: Annual (July 18, 2007 to July 17, 2008) Joint Frequency Distribution

| Stability Class | Wind Direction | Wind Speed (mph) - One Year (Calm = 1.22%) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | < 3 | 4 - 7 | 8 - 12 | 13 - 18 | 19 - 24 | > 24 | Row Total |
| A | N | | | | | | | |
| | NNE | | 0.000131 | | | | | 0.000131 |
| | NE | | | | | | | |
| | ENE | | | | | | | |
| | E | | | | | | | |
| | ESE | 0.000274 | | | | | | 0.000274 |
| | SE | | 0.000262 | | | | | 0.000262 |
| | SSE | 0.000274 | 0.000393 | | | | | 0.000667 |
| | S | 0.000274 | 0.000524 | | | | | 0.000798 |
| | SSW | 0.000411 | 0.000786 | | | | | 0.001197 |
| | SW | 0.000411 | 0.000393 | | | | | 0.000804 |
| | WSW | 0.000137 | 0.000786 | | | | | 0.000923 |
| | W | 0.000274 | 0.000393 | | | | | 0.000667 |
| | WNW | 0.000411 | 0.000524 | | | | | 0.000935 |
| | NW | | | | | | | |
| | NNW | | | | | | | |
| B | N | 0.002740 | 0.000524 | | | | | 0.003264 |
| | NNE | 0.001096 | | | | | | 0.001096 |
| | NE | 0.001096 | | | | | | 0.001096 |
| | ENE | 0.000822 | 0.000262 | | | | | 0.001084 |
| | E | 0.000822 | 0.000131 | 0.000131 | | | | 0.001084 |
| | ESE | 0.000411 | 0.000393 | 0.000655 | | | | 0.001459 |
| | SE | 0.001781 | 0.001964 | 0.002095 | | | | 0.005841 |
| | SSE | 0.002603 | 0.004191 | 0.001441 | | | | 0.008234 |
| | S | 0.005206 | 0.003143 | 0.000524 | | | | 0.008872 |
| | SSW | 0.005069 | 0.001702 | 0.000131 | | | | 0.006902 |
| | SW | 0.003562 | 0.002226 | 0.000393 | | | | 0.006181 |
| | WSW | 0.003699 | 0.002881 | 0.000262 | | | | 0.006842 |
| | W | 0.003836 | 0.005369 | 0.001441 | | | | 0.010646 |
| | WNW | 0.004384 | 0.004191 | 0.003405 | | | | 0.011979 |
| | NW | 0.004384 | 0.001833 | 0.000917 | | | | 0.007134 |
| | NNW | 0.003973 | 0.001048 | 0.000131 | | | | 0.005151 |
| C | N | | 0.001310 | | | | | 0.001310 |
| | NNE | | 0.000393 | | | | | 0.000393 |
| | NE | | 0.000131 | | | | | 0.000131 |
| | ENE | | 0.000262 | 0.000131 | | | | 0.000393 |
| | E | | 0.001310 | 0.001702 | 0.000131 | | | 0.003143 |
| | ESE | | 0.001964 | 0.003274 | 0.000131 | | | 0.005369 |
| | SE | | 0.003798 | 0.004191 | 0.000131 | | | 0.008119 |
| | SSE | | 0.004845 | 0.003405 | | | | 0.008250 |
| | S | | 0.005500 | 0.000786 | | | | 0.006286 |
| | SSW | | 0.001572 | 0.000917 | | | | 0.002488 |
| | SW | | 0.001702 | 0.000655 | | | | 0.002357 |
| | WSW | | 0.003929 | 0.001310 | | | | 0.005238 |
| | W | | 0.006548 | 0.001310 | 0.000393 | | | 0.008250 |
| | WNW | | 0.011524 | 0.008905 | 0.000131 | 0.000393 | | 0.020953 |
| | NW | | 0.007072 | 0.004845 | 0.001441 | 0.000393 | | 0.013751 |
| | NNW | | 0.005107 | 0.001833 | | | | 0.006941 |

## Table 1: Annual (July 18, 2007 to July 17, 2008) Joint Frequency Distribution (cont'd)

| Stability Class | Wind Direction | Wind Speed (mph) - One Year | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | < 3 | 4 - 7 | 8 - 12 | 13 - 18 | 19 - 24 | > 24 | Row Total |
| D | N | 0.008493 | 0.010215 | 0.002226 | 0.001310 | 0.000393 | | 0.022637 |
| | NNE | 0.007671 | 0.004976 | 0.001702 | 0.000524 | | 0.000131 | 0.015005 |
| | NE | 0.002740 | 0.002750 | 0.004060 | 0.002357 | 0.000131 | 0.000393 | 0.012431 |
| | ENE | 0.001781 | 0.005631 | 0.012834 | 0.013751 | 0.002357 | 0.002095 | 0.038449 |
| | E | 0.003288 | 0.007596 | 0.024227 | 0.016370 | 0.001572 | 0.000655 | 0.053707 |
| | ESE | 0.001644 | 0.007858 | 0.011655 | 0.009691 | 0.000917 | | 0.031764 |
| | SE | 0.001096 | 0.006024 | 0.007727 | 0.002226 | 0.000262 | | 0.017335 |
| | SSE | 0.002740 | 0.004584 | 0.004060 | 0.001441 | 0.000393 | | 0.013216 |
| | S | 0.002740 | 0.003012 | 0.001048 | 0.000131 | | | 0.006930 |
| | SSW | 0.003425 | 0.001964 | 0.001441 | 0.000393 | | | 0.007222 |
| | SW | 0.001370 | 0.000917 | 0.002095 | 0.002488 | 0.000917 | 0.000131 | 0.007918 |
| | WSW | 0.002329 | 0.002226 | 0.002619 | 0.003274 | 0.001048 | 0.000655 | 0.012151 |
| | W | 0.001644 | 0.003536 | 0.003274 | 0.003405 | 0.001702 | 0.000131 | 0.013692 |
| | WNW | 0.003699 | 0.011655 | 0.018989 | 0.021870 | 0.004453 | 0.000393 | 0.061059 |
| | NW | 0.005617 | 0.016370 | 0.038371 | 0.047669 | 0.019120 | 0.003143 | 0.130289 |
| | NNW | 0.006575 | 0.015191 | 0.008643 | 0.005631 | 0.001833 | 0.000393 | 0.038267 |
| E | N | 0.006438 | 0.010084 | 0.000786 | | | | 0.017308 |
| | NNE | 0.004247 | 0.004191 | 0.000131 | | | | 0.008568 |
| | NE | 0.002466 | 0.002226 | 0.000655 | | | | 0.005347 |
| | ENE | 0.001370 | 0.003929 | 0.002881 | | | | 0.008180 |
| | E | 0.000548 | 0.006810 | 0.007203 | | | | 0.014561 |
| | ESE | 0.000274 | 0.004453 | 0.003405 | | | | 0.008131 |
| | SE | 0.000548 | 0.004191 | 0.002095 | | | | 0.006834 |
| | SSE | 0.000411 | 0.003667 | 0.000655 | | | | 0.004733 |
| | S | 0.000411 | 0.001310 | | | | | 0.001721 |
| | SSW | 0.000274 | 0.001048 | 0.000524 | | | | 0.001845 |
| | SW | 0.000137 | 0.001179 | 0.000262 | | | | 0.001578 |
| | WSW | 0.000822 | 0.000786 | | | | | 0.001608 |
| | W | 0.000959 | 0.002881 | 0.001048 | | | | 0.004888 |
| | WNW | 0.001507 | 0.004584 | 0.004191 | | | | 0.010281 |
| | NW | 0.001644 | 0.009429 | 0.005107 | | | | 0.016180 |
| | NNW | 0.004932 | 0.009691 | 0.003667 | | | | 0.018289 |
| F | N | 0.018082 | 0.006679 | | | | | 0.024761 |
| | NNE | 0.019178 | 0.004715 | | | | | 0.023893 |
| | NE | 0.012877 | 0.003143 | | | | | 0.016020 |
| | ENE | 0.007260 | 0.003798 | | | | | 0.011058 |
| | E | 0.006027 | 0.003274 | | | | | 0.009301 |
| | ESE | 0.006164 | 0.002095 | | | | | 0.008260 |
| | SE | 0.004521 | 0.002226 | | | | | 0.006747 |
| | SSE | 0.007808 | 0.003536 | | | | | 0.011344 |
| | S | 0.005480 | 0.002488 | | | | | 0.007968 |
| | SSW | 0.005206 | 0.001179 | | | | | 0.006384 |
| | SW | 0.004384 | 0.001441 | | | | | 0.005824 |
| | WSW | 0.003973 | 0.001179 | | | | | 0.005151 |
| | W | 0.004795 | 0.002750 | | | | | 0.007545 |
| | WNW | 0.008219 | 0.004191 | | | | | 0.012410 |
| | NW | 0.013151 | 0.006417 | | | | | 0.019568 |
| | NNW | 0.017808 | 0.006941 | | | | | 0.024749 |

7,636 valid hours out of 8,784

## Table 2: 1st Quarter (January 1, 2008 to March 31, 2008) Joint Frequency Distribution

| Stability Class | Wind Direction | Wind Speed (mph) - Winter (Calm = 0.6%) | | | | | | Row Total |
|---|---|---|---|---|---|---|---|---|
| | | < 3 | 4 - 7 | 8 - 12 | 13 - 18 | 19 - 24 | > 24 | |
| A | N | | | | | | | |
| | NNE | | | | | | | |
| | NE | | | | | | | |
| | ENE | | | | | | | |
| | E | | | | | | | |
| | ESE | | | | | | | |
| | SE | | | | | | | |
| | SSE | | | | | | | |
| | S | | | | | | | |
| | SSW | | | | | | | |
| | SW | | | | | | | |
| | WSW | | | | | | | |
| | W | | | | | | | |
| | WNW | | | | | | | |
| | NW | | | | | | | |
| | NNW | | | | | | | |
| B | N | 0.005197 | | | | | | 0.005197 |
| | NNE | 0.001890 | | | | | | 0.001890 |
| | NE | 0.001890 | | | | | | 0.001890 |
| | ENE | 0.000945 | | | | | | 0.000945 |
| | E | 0.000945 | | | | | | 0.000945 |
| | ESE | 0.000945 | | 0.000463 | | | | 0.001408 |
| | SE | 0.001890 | 0.000463 | | | | | 0.002353 |
| | SSE | 0.003307 | 0.001390 | | | | | 0.004698 |
| | S | 0.005670 | 0.000927 | | | | | 0.006597 |
| | SSW | 0.003780 | 0.000463 | | | | | 0.004243 |
| | SW | 0.004252 | | | | | | 0.004252 |
| | WSW | 0.003307 | 0.000927 | | | | | 0.004234 |
| | W | 0.004725 | 0.003244 | | | | | 0.007969 |
| | WNW | 0.004725 | 0.001854 | 0.001390 | | | | 0.007969 |
| | NW | 0.003780 | 0.000463 | 0.000927 | | | | 0.005170 |
| | NNW | 0.005670 | | | | | | 0.005670 |
| C | N | | 0.002317 | | | | | 0.002317 |
| | NNE | | 0.000927 | | | | | 0.000927 |
| | NE | | 0.000463 | | | | | 0.000463 |
| | ENE | | 0.000463 | 0.000463 | | | | 0.000927 |
| | E | | | 0.003244 | | | | 0.003244 |
| | ESE | | 0.001854 | 0.002317 | | | | 0.004171 |
| | SE | | 0.003244 | 0.003244 | | | | 0.006487 |
| | SSE | | 0.004171 | 0.001854 | | | | 0.006024 |
| | S | | 0.002780 | 0.001390 | | | | 0.004171 |
| | SSW | | | 0.000927 | | | | 0.000927 |
| | SW | | 0.002317 | | | | | 0.002317 |
| | WSW | | 0.003707 | 0.000463 | | | | 0.004171 |
| | W | | 0.005097 | 0.000463 | | | | 0.005561 |
| | WNW | | 0.010195 | 0.008341 | | | | 0.018536 |
| | NW | | 0.014829 | 0.004171 | | | | 0.018999 |
| | NNW | | 0.007414 | 0.003244 | | | | 0.010658 |

### Table 2: 1st Quarter (January 1, 2008 to March 31, 2008) Joint Frequency Distribution (cont'd)

| Stability Class | Wind Direction | Wind Speed (mph) - Winter (Calm = 0.6%) | | | | | | Row Total |
|---|---|---|---|---|---|---|---|---|
| | | < 3 | 4 - 7 | 8 - 12 | 13 - 18 | 19 - 24 | > 24 | |
| D | N | 0.010867 | 0.010658 | 0.002317 | | 0.000463 | | 0.024305 |
| | NNE | 0.007560 | 0.006487 | 0.000927 | | | | 0.014974 |
| | NE | 0.003780 | 0.001854 | | 0.000927 | | | 0.006560 |
| | ENE | 0.000945 | 0.003244 | 0.009268 | 0.003707 | | | 0.017164 |
| | E | 0.001417 | 0.006024 | 0.014365 | 0.008341 | | | 0.030148 |
| | ESE | 0.001417 | 0.005561 | 0.007878 | 0.000927 | | | 0.015783 |
| | SE | 0.000945 | 0.005561 | 0.005097 | | | | 0.011603 |
| | SSE | 0.003307 | 0.005561 | 0.002780 | 0.000463 | | | 0.012112 |
| | S | 0.002362 | 0.003244 | 0.000463 | 0.000463 | | | 0.006533 |
| | SSW | 0.002362 | 0.002317 | 0.000927 | | | | 0.005606 |
| | SW | 0.000472 | 0.000463 | 0.002780 | 0.001854 | | | 0.005570 |
| | WSW | 0.001417 | 0.002780 | 0.001390 | 0.002780 | | 0.001854 | 0.010222 |
| | W | 0.000472 | 0.005097 | 0.004171 | 0.003244 | 0.002317 | 0.000463 | 0.015764 |
| | WNW | 0.003307 | 0.013902 | 0.024560 | 0.028267 | 0.005561 | 0.000927 | 0.076523 |
| | NW | 0.004252 | 0.016682 | 0.052363 | 0.055607 | 0.022243 | 0.001854 | 0.153001 |
| | NNW | 0.006142 | 0.015292 | 0.011585 | 0.008804 | 0.001390 | | 0.043214 |
| E | N | 0.008977 | 0.013438 | 0.001854 | | | | 0.024269 |
| | NNE | 0.006615 | 0.005561 | | | | | 0.012175 |
| | NE | 0.002835 | 0.000463 | 0.000927 | | | | 0.004225 |
| | ENE | 0.000472 | 0.002317 | 0.002317 | | | | 0.005106 |
| | E | 0.001417 | 0.004634 | 0.005561 | | | | 0.011612 |
| | ESE | 0.000472 | 0.002780 | 0.004634 | | | | 0.007887 |
| | SE | 0.000945 | 0.003707 | 0.003244 | | | | 0.007896 |
| | SSE | 0.000945 | 0.000927 | | | | | 0.001872 |
| | S | | 0.001390 | | | | | 0.001390 |
| | SSW | 0.000472 | | 0.000463 | | | | 0.000936 |
| | SW | 0.000472 | 0.000927 | | | | | 0.001399 |
| | WSW | 0.001890 | 0.000463 | | | | | 0.002353 |
| | W | 0.001417 | 0.003707 | 0.002780 | | | | 0.007905 |
| | WNW | 0.001417 | 0.008804 | 0.009268 | | | | 0.019490 |
| | NW | 0.002835 | 0.014365 | 0.008804 | | | | 0.026004 |
| | NNW | 0.005197 | 0.013438 | 0.006024 | | | | 0.024660 |
| F | N | 0.021262 | 0.008804 | | | | | 0.030066 |
| | NNE | 0.027876 | 0.006024 | | | | | 0.033900 |
| | NE | 0.016064 | 0.004171 | | | | | 0.020235 |
| | ENE | 0.010867 | 0.003244 | | | | | 0.014111 |
| | E | 0.006615 | 0.004634 | | | | | 0.011249 |
| | ESE | 0.004725 | 0.000927 | | | | | 0.005652 |
| | SE | 0.006615 | 0.001854 | | | | | 0.008468 |
| | SSE | 0.008977 | 0.004171 | | | | | 0.013148 |
| | S | 0.006142 | 0.001854 | | | | | 0.007996 |
| | SSW | 0.003307 | 0.000927 | | | | | 0.004234 |
| | SW | 0.003780 | | | | | | 0.003780 |
| | WSW | 0.002835 | 0.000927 | | | | | 0.003762 |
| | W | 0.004252 | 0.002317 | | | | | 0.006569 |
| | WNW | 0.009450 | 0.006024 | | | | | 0.015474 |
| | NW | 0.016537 | 0.008341 | | | | | 0.024878 |
| | NNW | 0.023624 | 0.009268 | | | | | 0.032892 |

2,158 valid hours out of 2,184

## Table 3: 2nd Quarter (April 1, 2008 to June 30, 2008) Joint Frequency Distribution

| Stability Class | Wind Direction | Wind Speed (mph) - Spring (Calm = 0.82%) | | | | | | Row Total |
|---|---|---|---|---|---|---|---|---|
| | | < 3 | 4 - 7 | 8 - 12 | 13 - 18 | 19 - 24 | > 24 | |
| A | N | | | | | | | |
| | NNE | | 0.000458 | | | | | 0.000458 |
| | NE | | | | | | | |
| | ENE | | | | | | | |
| | E | | | | | | | |
| | ESE | 0.000965 | | | | | | 0.000965 |
| | SE | | 0.000458 | | | | | 0.000458 |
| | SSE | 0.000483 | 0.000916 | | | | | 0.001398 |
| | S | 0.000483 | 0.001832 | | | | | 0.002314 |
| | SSW | 0.000483 | 0.002289 | | | | | 0.002772 |
| | SW | 0.001448 | 0.000916 | | | | | 0.002364 |
| | WSW | 0.000483 | 0.001832 | | | | | 0.002314 |
| | W | 0.000965 | 0.000916 | | | | | 0.001881 |
| | WNW | 0.001448 | 0.001374 | | | | | 0.002822 |
| | NW | | | | | | | |
| | NNW | | | | | | | |
| B | N | 0.000965 | 0.000916 | | | | | 0.001881 |
| | NNE | 0.000965 | | | | | | 0.000965 |
| | NE | 0.000483 | | | | | | 0.000483 |
| | ENE | 0.001448 | 0.000916 | | | | | 0.002364 |
| | E | 0.000483 | | | | | | 0.000483 |
| | ESE | | | 0.001374 | | | | 0.001374 |
| | SE | 0.002896 | 0.004121 | 0.003205 | | | | 0.010222 |
| | SSE | 0.001448 | 0.009615 | 0.003205 | | | | 0.014268 |
| | S | 0.003861 | 0.005495 | 0.000458 | | | | 0.009813 |
| | SSW | 0.002896 | 0.003663 | 0.000458 | | | | 0.007017 |
| | SW | 0.003861 | 0.005495 | 0.000916 | | | | 0.010271 |
| | WSW | 0.003378 | 0.008242 | 0.000916 | | | | 0.012536 |
| | W | 0.000483 | 0.009158 | 0.002747 | | | | 0.012387 |
| | WNW | 0.004344 | 0.006868 | 0.006868 | | | | 0.018080 |
| | NW | 0.002413 | 0.001374 | 0.002289 | | | | 0.006076 |
| | NNW | 0.002413 | 0.000458 | | | | | 0.002871 |
| C | N | | 0.001374 | | | | | 0.001374 |
| | NNE | | | | | | | |
| | NE | | | | | | | |
| | ENE | | 0.000458 | | | | | 0.000458 |
| | E | | 0.002747 | 0.002289 | 0.000458 | | | 0.005495 |
| | ESE | | 0.001832 | 0.006410 | 0.000458 | | | 0.008700 |
| | SE | | 0.005952 | 0.003205 | 0.000458 | | | 0.009615 |
| | SSE | | 0.004579 | 0.004579 | | | | 0.009158 |
| | S | | 0.007326 | 0.000916 | | | | 0.008242 |
| | SSW | | 0.001832 | 0.001374 | | | | 0.003205 |
| | SW | | 0.000916 | 0.002289 | | | | 0.003205 |
| | WSW | | 0.002747 | 0.000916 | | | | 0.003663 |
| | W | | 0.006868 | 0.002289 | 0.001374 | | | 0.010531 |
| | WNW | | 0.010073 | 0.010531 | 0.000458 | 0.001374 | | 0.022436 |
| | NW | | 0.002289 | 0.004579 | 0.005037 | 0.000458 | | 0.012363 |
| | NNW | | 0.002289 | 0.001374 | | | | 0.003663 |

**Table 3: 2nd Quarter (April 1, 2008 to June 30, 2008) Joint Frequency Distribution (cont'd)**

| Stability Class | Wind Direction | Wind Speed (mph) - Spring (Calm = 0.82%) | | | | | | Row Total |
|---|---|---|---|---|---|---|---|---|
| | | < 3 | 4 - 7 | 8 - 12 | 13 - 18 | 19 - 24 | > 24 | |
| D | N | 0.003861 | 0.006868 | 0.002747 | 0.001832 | 0.000458 | | 0.015766 |
| | NNE | 0.003378 | 0.004121 | 0.001832 | 0.001374 | | | 0.010704 |
| | NE | 0.003378 | 0.004579 | 0.007326 | 0.003205 | 0.000458 | 0.000916 | 0.019862 |
| | ENE | 0.002413 | 0.008242 | 0.013278 | 0.024725 | 0.005952 | 0.007326 | 0.061937 |
| | E | 0.002896 | 0.006410 | 0.039835 | 0.027473 | 0.005495 | 0.002289 | 0.084398 |
| | ESE | | 0.007784 | 0.012363 | 0.011447 | 0.002289 | | 0.033883 |
| | SE | 0.001931 | 0.008242 | 0.010531 | 0.002289 | 0.000458 | | 0.023451 |
| | SSE | 0.000965 | 0.004121 | 0.003663 | 0.002289 | 0.000916 | | 0.011954 |
| | S | 0.001448 | 0.001374 | 0.001374 | | | | 0.004195 |
| | SSW | 0.002896 | 0.000916 | 0.002747 | 0.000916 | | | 0.007475 |
| | SW | 0.001448 | 0.001374 | 0.000916 | 0.002747 | 0.003205 | 0.000458 | 0.010148 |
| | WSW | 0.000965 | 0.001374 | 0.005037 | 0.007326 | 0.002747 | | 0.017449 |
| | W | 0.000483 | 0.003205 | 0.004579 | 0.006410 | 0.000916 | | 0.015593 |
| | WNW | 0.001931 | 0.012821 | 0.015568 | 0.019689 | 0.005495 | | 0.055502 |
| | NW | 0.004826 | 0.016941 | 0.033883 | 0.065018 | 0.023352 | 0.005952 | 0.149973 |
| | NNW | 0.005309 | 0.011905 | 0.008242 | 0.006868 | 0.003205 | 0.001374 | 0.036902 |
| E | N | 0.000965 | 0.007326 | | | | | 0.008291 |
| | NNE | 0.002413 | 0.003205 | 0.000458 | | | | 0.006076 |
| | NE | 0.001931 | 0.000916 | 0.000458 | | | | 0.003304 |
| | ENE | 0.000965 | 0.004579 | 0.005037 | | | | 0.010581 |
| | E | | 0.007784 | 0.007784 | | | | 0.015568 |
| | ESE | | 0.004121 | 0.002289 | | | | 0.006410 |
| | SE | | 0.004121 | 0.002289 | | | | 0.006410 |
| | SSE | | 0.002289 | 0.000458 | | | | 0.002747 |
| | S | 0.000965 | 0.000458 | | | | | 0.001423 |
| | SSW | | 0.002289 | 0.000916 | | | | 0.003205 |
| | SW | | 0.001374 | 0.000458 | | | | 0.001832 |
| | WSW | | 0.000916 | | | | | 0.000916 |
| | W | 0.000483 | 0.002289 | 0.000916 | | | | 0.003688 |
| | WNW | 0.000483 | 0.000458 | 0.000916 | | | | 0.001856 |
| | NW | 0.000965 | 0.005495 | 0.004579 | | | | 0.011039 |
| | NNW | 0.002413 | 0.005952 | 0.001374 | | | | 0.009739 |
| F | N | 0.008687 | 0.007326 | | | | | 0.016013 |
| | NNE | 0.009653 | 0.002747 | | | | | 0.012400 |
| | NE | 0.007722 | 0.002289 | | | | | 0.010011 |
| | ENE | 0.006274 | 0.004121 | | | | | 0.010395 |
| | E | 0.004826 | 0.002289 | | | | | 0.007116 |
| | ESE | 0.005792 | 0.002747 | | | | | 0.008539 |
| | SE | 0.001448 | 0.001374 | | | | | 0.002822 |
| | SSE | 0.001931 | 0.001374 | | | | | 0.003304 |
| | S | 0.002413 | 0.001832 | | | | | 0.004245 |
| | SSW | 0.004826 | 0.000916 | | | | | 0.005742 |
| | SW | 0.000965 | 0.001374 | | | | | 0.002339 |
| | WSW | 0.000965 | 0.000458 | | | | | 0.001423 |
| | W | 0.001931 | 0.002289 | | | | | 0.004220 |
| | WNW | 0.001931 | 0.003205 | | | | | 0.005136 |
| | NW | 0.006757 | 0.008242 | | | | | 0.014999 |
| | NNW | 0.005792 | 0.002289 | | | | | 0.008081 |

2,184 valid hrs out of 2,184

### Table 4: 3rd Quarter (July 2007 and 2008, August and September 2007) Joint Frequency Distribution

| Stability Class | Wind Direction | Wind Speed (mph) - Summer (Calm = 1.4%) | | | | | | Row Total |
|---|---|---|---|---|---|---|---|---|
| | | < 3 | 4 - 7 | 8 - 12 | 13 - 18 | 19 - 24 | > 24 | |
| A | N | | | | | | | |
| | NNE | | | | | | | |
| | NE | | | | | | | |
| | ENE | | | | | | | |
| | E | | | | | | | |
| | ESE | | | | | | | |
| | SE | | 0.000873 | | | | | 0.000873 |
| | SSE | 0.000893 | 0.000873 | | | | | 0.001765 |
| | S | 0.001091 | | | | | | 0.001091 |
| | SSW | 0.001983 | 0.000873 | | | | | 0.002856 |
| | SW | | 0.000873 | | | | | 0.000873 |
| | WSW | | 0.001745 | | | | | 0.001745 |
| | W | | 0.000873 | | | | | 0.000873 |
| | WNW | | 0.000873 | | | | | 0.000873 |
| | NW | | | | | | | |
| | NNW | | | | | | | |
| B | N | | 0.000873 | | | | | 0.000873 |
| | NNE | | | | | | | |
| | NE | 0.000893 | | | | | | 0.000893 |
| | ENE | | | | | | | |
| | E | 0.001785 | | 0.000873 | | | | 0.002658 |
| | ESE | 0.000893 | 0.002618 | 0.000873 | | | | 0.004383 |
| | SE | 0.001091 | 0.004363 | 0.007853 | | | | 0.013307 |
| | SSE | 0.004165 | 0.006981 | 0.003490 | | | | 0.014636 |
| | S | 0.005752 | 0.008726 | 0.002618 | | | | 0.017096 |
| | SSW | 0.003967 | 0.002618 | | | | | 0.006585 |
| | SW | 0.001785 | 0.002618 | 0.000873 | | | | 0.005276 |
| | WSW | 0.002876 | 0.001745 | | | | | 0.004621 |
| | W | 0.003769 | 0.009599 | 0.004363 | | | | 0.017731 |
| | WNW | 0.004662 | 0.005236 | 0.006981 | | | | 0.016878 |
| | NW | 0.001091 | 0.005236 | | | | | 0.006326 |
| | NNW | 0.005950 | 0.000873 | 0.000873 | | | | 0.007696 |
| C | N | | 0.000873 | | | | | 0.000873 |
| | NNE | | 0.000873 | | | | | 0.000873 |
| | NE | | | | | | | |
| | ENE | | | | | | | |
| | E | | 0.002618 | 0.000873 | | | | 0.003490 |
| | ESE | | 0.004363 | 0.004363 | | | | 0.008726 |
| | SE | | 0.004363 | 0.010471 | | | | 0.014834 |
| | SSE | | 0.007853 | 0.006981 | | | | 0.014834 |
| | S | | 0.006981 | 0.000873 | | | | 0.007853 |
| | SSW | | 0.002618 | 0.000873 | | | | 0.003490 |
| | SW | | 0.002618 | | | | | 0.002618 |
| | WSW | | 0.003490 | 0.004363 | | | | 0.007853 |
| | W | | 0.007853 | 0.001745 | | | | 0.009599 |
| | WNW | | 0.015707 | 0.013962 | | | | 0.029668 |
| | NW | | 0.002618 | 0.007853 | | 0.001745 | | 0.012216 |
| | NNW | | 0.003490 | 0.001745 | | | | 0.005236 |

## Table 4: 3rd Quarter (July 2007 and 2008, August and September 2007) Joint Frequency Distribution (cont'd)

| Stability Class | Wind Direction | Wind Speed (mph) - Summer (Calm = 1.4%) | | | | | | Row Total |
|---|---|---|---|---|---|---|---|---|
| | | < 3 | 4 - 7 | 8 - 12 | 13 - 18 | 19 - 24 | > 24 | |
| D | N | 0.007340 | 0.011344 | 0.003490 | 0.004363 | 0.000873 | | 0.027410 |
| | NNE | 0.008629 | 0.006108 | 0.002618 | 0.000873 | | 0.000873 | 0.019100 |
| | NE | 0.000893 | 0.001745 | 0.009599 | 0.006108 | | 0.000873 | 0.019217 |
| | ENE | 0.002678 | 0.007853 | 0.028796 | 0.020942 | | | 0.060270 |
| | E | 0.004464 | 0.013962 | 0.031414 | 0.014834 | | | 0.064673 |
| | ESE | 0.004662 | 0.013962 | 0.027923 | 0.032286 | 0.001745 | | 0.080578 |
| | SE | 0.001091 | 0.007853 | 0.013962 | 0.006108 | 0.000873 | | 0.029887 |
| | SSE | 0.001091 | 0.002618 | 0.004363 | 0.002618 | 0.000873 | | 0.011562 |
| | S | | 0.004363 | 0.003490 | | | | 0.007853 |
| | SSW | 0.003967 | 0.000873 | 0.002618 | 0.000873 | | | 0.008330 |
| | SW | | 0.001745 | 0.006108 | 0.006108 | | | 0.013962 |
| | WSW | | 0.001745 | 0.004363 | | 0.000873 | | 0.006981 |
| | W | 0.000893 | 0.000873 | 0.002618 | | 0.001745 | | 0.006128 |
| | WNW | 0.002678 | 0.006981 | 0.013962 | 0.027051 | 0.000873 | | 0.051544 |
| | NW | 0.003967 | 0.006108 | 0.026178 | 0.030541 | 0.010471 | | 0.077265 |
| | NNW | 0.004165 | 0.012216 | 0.006981 | 0.002618 | | | 0.025980 |
| E | N | | 0.007853 | | | | | 0.007853 |
| | NNE | 0.001785 | 0.006108 | | | | | 0.007894 |
| | NE | 0.001983 | 0.005236 | 0.001745 | | | | 0.008964 |
| | ENE | | 0.006981 | 0.001745 | | | | 0.008726 |
| | E | | 0.010471 | 0.016579 | | | | 0.027051 |
| | ESE | 0.000893 | 0.006108 | 0.006108 | | | | 0.013109 |
| | SE | | 0.002618 | 0.000873 | | | | 0.003490 |
| | SSE | 0.000893 | 0.002618 | 0.001745 | | | | 0.005256 |
| | S | | 0.002618 | | | | | 0.002618 |
| | SSW | | 0.002618 | 0.000873 | | | | 0.003490 |
| | SW | | 0.000873 | 0.000873 | | | | 0.001745 |
| | WSW | | 0.000873 | | | | | 0.000873 |
| | W | | 0.002618 | | | | | 0.002618 |
| | WNW | | 0.002618 | 0.000873 | | | | 0.003490 |
| | NW | | 0.006108 | | | | | 0.006108 |
| | NNW | 0.001785 | 0.001745 | 0.001745 | | | | 0.005276 |
| F | N | 0.005752 | 0.004363 | | | | | 0.010115 |
| | NNE | 0.011109 | 0.003490 | | | | | 0.014599 |
| | NE | 0.007538 | 0.005236 | | | | | 0.012774 |
| | ENE | 0.005950 | 0.003490 | | | | | 0.009441 |
| | E | 0.002678 | 0.003490 | | | | | 0.006169 |
| | ESE | 0.004662 | 0.002618 | | | | | 0.007280 |
| | SE | 0.005356 | 0.000873 | | | | | 0.006229 |
| | SSE | 0.004860 | 0.007853 | | | | | 0.012713 |
| | S | | 0.003490 | | | | | 0.003490 |
| | SSW | 0.000893 | 0.000873 | | | | | 0.001765 |
| | SW | 0.003769 | 0.000873 | | | | | 0.004642 |
| | WSW | 0.001983 | 0.000873 | | | | | 0.002856 |
| | W | 0.002876 | 0.001745 | | | | | 0.004621 |
| | WNW | 0.004662 | 0.003490 | | | | | 0.008152 |
| | NW | 0.010216 | 0.003490 | | | | | 0.013707 |
| | NNW | 0.003967 | 0.006108 | | | | | 0.010075 |

1,146 valid hours out of 2,208

## Table 5: 4th Quarter (October 1, 2007 to December 31, 2007) Joint Frequency Distribution

| Stability Class | Wind Direction | Wind Speed (mph) - Fall (Calm = 2.14%) | | | | | | Row Total |
|---|---|---|---|---|---|---|---|---|
| | | < 3 | 4 - 7 | 8 - 12 | 13 - 18 | 19 - 24 | > 24 | |
| A | N | | | | | | | |
| | NNE | | | | | | | |
| | NE | | | | | | | |
| | ENE | | | | | | | |
| | E | | | | | | | |
| | ESE | | | | | | | |
| | SE | | | | | | | |
| | SSE | | | | | | | |
| | S | | | | | | | |
| | SSW | | | | | | | |
| | SW | | | | | | | |
| | WSW | | | | | | | |
| | W | | | | | | | |
| | WNW | | | | | | | |
| | NW | | | | | | | |
| | NNW | | | | | | | |
| B | N | 0.003437 | 0.000466 | | | | | 0.003902 |
| | NNE | 0.000982 | | | | | | 0.000982 |
| | NE | 0.000982 | | | | | | 0.000982 |
| | ENE | 0.000491 | | | | | | 0.000491 |
| | E | 0.000491 | 0.000466 | | | | | 0.000957 |
| | ESE | | | | | | | |
| | SE | 0.000982 | | | | | | 0.000982 |
| | SSE | 0.002455 | | | | | | 0.002455 |
| | S | 0.005892 | | | | | | 0.005892 |
| | SSW | 0.009329 | 0.000466 | | | | | 0.009794 |
| | SW | 0.003437 | 0.000931 | | | | | 0.004368 |
| | WSW | 0.004910 | | | | | | 0.004910 |
| | W | 0.006383 | 0.001397 | | | | | 0.007779 |
| | WNW | 0.003928 | 0.003259 | | | | | 0.007187 |
| | NW | 0.008838 | 0.001862 | | | | | 0.010700 |
| | NNW | 0.002946 | 0.002793 | | | | | 0.005739 |
| C | N | | 0.000466 | | | | | 0.000466 |
| | NNE | | | | | | | |
| | NE | | | | | | | |
| | ENE | | | | | | | |
| | E | | 0.000466 | | | | | 0.000466 |
| | ESE | | 0.000931 | 0.000466 | | | | 0.001397 |
| | SE | | 0.001862 | 0.002793 | | | | 0.004655 |
| | SSE | | 0.004190 | 0.001862 | | | | 0.006052 |
| | S | | 0.005587 | | | | | 0.005587 |
| | SSW | | 0.002328 | 0.000466 | | | | 0.002793 |
| | SW | | 0.001397 | | | | | 0.001397 |
| | WSW | | 0.005587 | 0.000931 | | | | 0.006518 |
| | W | | 0.006983 | 0.000931 | | | | 0.007914 |
| | WNW | | 0.012104 | 0.005121 | | | | 0.017225 |
| | NW | | 0.006518 | 0.004190 | | | | 0.010708 |
| | NNW | | 0.006518 | 0.000931 | | | | 0.007449 |

## Table 5: 4th Quarter (October 1, 2007 to December 31, 2007) Joint Frequency Distribution (cont'd)

| Stability Class | Wind Direction | Wind Speed (mph) - Fall (Calm = 2.14%) | | | | | | Row Total |
|---|---|---|---|---|---|---|---|---|
| | | < 3 | 4 - 7 | 8 - 12 | 13 - 18 | 19 - 24 | > 24 | |
| D | N | 0.011293 | 0.012570 | 0.000931 | 0.000466 | | | 0.025259 |
| | NNE | 0.011784 | 0.003724 | 0.001862 | | | | 0.017370 |
| | NE | 0.001964 | 0.002328 | 0.001862 | 0.000931 | | | 0.007085 |
| | ENE | 0.001473 | 0.004190 | 0.007449 | 0.008845 | 0.002328 | | 0.024285 |
| | E | 0.004910 | 0.006983 | 0.014432 | 0.013966 | | | 0.040292 |
| | ESE | 0.001964 | 0.006983 | 0.006052 | 0.004655 | | | 0.019655 |
| | SE | 0.000491 | 0.003259 | 0.004190 | 0.002328 | | | 0.010268 |
| | SSE | 0.004910 | 0.005121 | 0.005587 | 0.000931 | | | 0.016549 |
| | S | 0.005892 | 0.003724 | | | | | 0.009616 |
| | SSW | 0.004910 | 0.003259 | | | | | 0.008169 |
| | SW | 0.002946 | 0.000466 | 0.000466 | 0.000931 | | | 0.004808 |
| | WSW | 0.005892 | 0.002793 | 0.000466 | 0.001397 | 0.000466 | 0.000466 | 0.011478 |
| | W | 0.004419 | 0.003724 | 0.001397 | 0.002328 | 0.001862 | | 0.013730 |
| | WNW | 0.006383 | 0.010708 | 0.019553 | 0.014898 | 0.004190 | 0.000466 | 0.056197 |
| | NW | 0.008838 | 0.020950 | 0.035382 | 0.031192 | 0.016294 | 0.003259 | 0.115914 |
| | NNW | 0.009820 | 0.020019 | 0.006983 | 0.002793 | 0.001862 | | 0.041477 |
| E | N | 0.012766 | 0.010708 | 0.000931 | | | | 0.024404 |
| | NNE | 0.004910 | 0.002793 | | | | | 0.007703 |
| | NE | 0.002946 | 0.003724 | | | | | 0.006670 |
| | ENE | 0.003437 | 0.003259 | 0.001862 | | | | 0.008558 |
| | E | 0.000491 | 0.006052 | 0.003259 | | | | 0.009802 |
| | ESE | | 0.005587 | 0.001862 | | | | 0.007449 |
| | SE | 0.000982 | 0.005587 | 0.001397 | | | | 0.007965 |
| | SSE | | 0.008380 | 0.000931 | | | | 0.009311 |
| | S | 0.000491 | 0.001397 | | | | | 0.001888 |
| | SSW | 0.000491 | | | | | | 0.000491 |
| | SW | | 0.001397 | | | | | 0.001397 |
| | WSW | 0.000982 | 0.000931 | | | | | 0.001913 |
| | W | 0.001473 | 0.002793 | | | | | 0.004266 |
| | WNW | 0.003437 | 0.005587 | 0.004190 | | | | 0.013213 |
| | NW | 0.001964 | 0.010242 | 0.004655 | | | | 0.016862 |
| | NNW | 0.008838 | 0.013966 | 0.004655 | | | | 0.027460 |
| F | N | 0.030932 | 0.005121 | | | | | 0.036053 |
| | NNE | 0.024058 | 0.006052 | | | | | 0.030110 |
| | NE | 0.017675 | 0.001862 | | | | | 0.019538 |
| | ENE | 0.005401 | 0.004190 | | | | | 0.009591 |
| | E | 0.008347 | 0.002793 | | | | | 0.011140 |
| | ESE | 0.008838 | 0.002328 | | | | | 0.011165 |
| | SE | 0.004910 | 0.004190 | | | | | 0.009100 |
| | SSE | 0.014239 | 0.002793 | | | | | 0.017032 |
| | S | 0.010802 | 0.003259 | | | | | 0.014060 |
| | SSW | 0.009820 | 0.001862 | | | | | 0.011682 |
| | SW | 0.008838 | 0.003259 | | | | | 0.012097 |
| | WSW | 0.009329 | 0.002328 | | | | | 0.011656 |
| | W | 0.009329 | 0.004190 | | | | | 0.013519 |
| | WNW | 0.015220 | 0.003724 | | | | | 0.018945 |
| | NW | 0.017675 | 0.004190 | | | | | 0.021865 |
| | NNW | 0.031423 | 0.009777 | | | | | 0.041199 |

2,148 valid hours out of 2,208

# References

1. METEOROLOGICAL CHARACTERIZATION OF THE DEWEY-BURDOCK URANIUM PROJECT AREA FALL RIVER AND CUSTER COUNTIES, SOUTH DAKOTA, Jared Oswald, RESPEC Consulting Services: September 2008.
2. South Dakota Office of Climatology, Edgemont monitoring station: July 2007 to July 2008.
3. Meteorological Monitoring Guidance for Regulatory Modeling Applications, USEPA: February 2000.
4. NRC Regulatory Guide 3.63, Onsite Meteorological Measurement Program for Uranium Recovery Facilities – Data Acquisition and Reporting: March 1988.

# APPENDIX 2.5-D

# Newcastle Meteorological Station Audit Reports

# Table 1

## METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 15-Mar-07
Audit Performed by: B. Kelly, C. Medill - IML Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | digital thermistor |
| Data acquisition system (DAS): | Campbell Scientific CR510 | N/A |

### Audit Results

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| WS (mph) | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | 0 | 1.5 | 1 | 5 | (1) |
| | 90 | 89.9 | 0 | 5 | (1) |
| | 180 | 179.2 | 1 | 5 | (1) |
| | 270 | 268.7 | 1 | 5 | (1) |
| Temperature (°F) | 71.6 | 71.6 | 0.0 | 1.8 | (1) |
| ice water bath | 32.3 | 32.1 | 0.2 | 1.8 | (1) |
| warm water bath | 130.7 | 129.3 | 1.4 | 1.8 | (1) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

### Notes, Recommendations

System off-line @ 0905
System on-line @ 1015
Replaced anemometer with new Wind Monitor AQ

# Table 2

## METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 13-Sep-07
Audit Performed by: B. Kelly, C. Medill - IML Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | digital thermistor |
| Data acquisition system (DAS): | Campbell Scientific CR510 | N/A |

## Audit Results

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| WS (mph) | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | 0 | 0.1 | 0 | 5 | (1) |
| | 90 | 89.9 | 0 | 5 | (1) |
| | 180 | 180.8 | 1 | 5 | (1) |
| | 270 | 268.1 | 2 | 5 | (1) |
| Temperature (°F) | 84.6 | 84.5 | 0.0 | 0.9 | (1) |
| ice water bath | 32.2 | 32.0 | 0.1 | 0.9 | (1) |
| warm water bath | 127.9 | 126.8 | 1.1 | 0.9 | (1) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line @ 0834
System on-line @ 0850

# Table 3

## METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining    Audit Date: 12-Mar-08
Audit Performed By: S. Hansen, C. Medill, IML-Air Science

| Sensor | Mfr./Model | Serial Number | Reference Device | Serial/ID Number |
|---|---|---|---|---|
| Vert. Wind Speed 10m: | RM Young Wind Monitor AQ | NA | quartz referenced drive motor | CA02423 |
| Wind Speed (WS): | RM Young Wind Monitor AQ | WM75308 | quartz referenced drive motor | IML0853 & IML0858 |
| Wind Direction (WD): | RM Young Wind Monitor AQ | WM75308 | transit, compass | Brunton 5080393535 |
| Temperature @ 2 Meters: | RM Young 41342, power aspirated | TS13799 | digital thermistor | IML0987 |
| Temperature @ 10 Meters: | RM Young 41342, power aspirated | TS13880 | digital thermistor | IML0987 |
| Relative Humidity: | Vaisala HMP50 | C4240028 | digital psychrometer | Thermo-Hygro 22087796 |
| Barometric Pressure: | Vaisala PTB101B | C4240018 | digital barometer | IML0968 |
| Solar Radiation: | LI-COR LI200X | PY57681 | Li-Cor | PY54289 |
| Data acquisition system: | CSI CR1000 datalogger | 13147 | N/A | N/A |

### Audit Results

| | Reference RPM | Reference MPH | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | 0 | 0.00 | 0.00 | 0.00 | below threshold | |
| | 300 | 3.44 | 3.44 | 0.00 | 0.56 | (2) |
| | 800 | 9.16 | 9.16 | 0.00 | 0.56 | (2) |
| | 3000 | 34.35 | 34.35 | 0.00 | 1.72 | (2) |
| | 8000 | 91.60 | 91.60 | 0.00 | 4.58 | (2) |

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| WS start torque (gm-cm) | <.1 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | 0.0 | 0.3 | 0.3 | 5.0 | (2) |
| | 90.0 | 90.4 | 0.4 | 5.0 | (2) |
| | 180.0 | 180.2 | 0.2 | 5.0 | (2) |
| | 270.0 | 269.8 | 0.2 | 5.0 | (2) |
| Temp. (°C): Upper Sensor | 49.22 | 49.36 | 0.14 | 0.5 | (2) |
| | 5.09 | 5.34 | 0.25 | 0.5 | (2) |
| | 18.13 | 18.16 | 0.03 | 0.5 | (2) |
| Temp. (°C): Lower Sensor | 49.22 | 49.33 | 0.11 | 0.5 | (2) |
| | 5.09 | 5.39 | 0.30 | 0.5 | (2) |
| | 18.13 | 18.10 | 0.03 | 0.5 | (2) |

| | Upper Sensor | Lower Sensor | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| Delta T. (°C) | 49.36 | 49.33 | 0.03 | 0.10 | (2) |
| | 5.34 | 5.39 | 0.05 | 0.10 | (2) |
| | 18.16 | 18.10 | 0.06 | 0.10 | (2) |

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| Relative Humidity (%) | | 32.0 | 29.6 | 2.4 | 7.0 | (2) |
| Solar Radiation (W/m$^2$) | uncovered | NA | 123.8 | NA | 5.0% | (4) |
| | covered | NA | 0.0 | NA | 5.0% | (4) |
| Barometric Pressure ("Hg) | | 25.51 | 25.47 | 0.04 | 0.09 | (2) |

| | | Reference RPM | Reference cm/s | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|---|
| Vert WS 10 meters (cm/s) | | 0 | 0.00 | 0.00 | 0.00 | below threshold | |
| **(CW)** | | 20 | -100.00 | -99.63 | 0.37 | 25.00 | (2) |
| | U: | 60 | -300.00 | -302.30 | 2.30 | 35.00 | (2) |
| | | 100 | -1000.00 | -1001.30 | 1.30 | 70.00 | (2) |
| | | 500 | -2500.00 | -2499.30 | 0.70 | 145.00 | (2) |

| | | RPM | cm/s | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|---|
| Vert WS 10 meters (cm/s) | | 0 | 0.00 | 0.00 | 0.00 | below threshold | |
| **(CCW)** | | 20 | 100.00 | 98.41 | 1.59 | 25.00 | (2) |
| | U: | 60 | 300.00 | 300.90 | 0.90 | 35.00 | (2) |
| | | 100 | 1000.00 | 1001.10 | 1.10 | 70.00 | (2) |
| | | 500 | 2500.00 | 2497.30 | 2.70 | 145.00 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

### Notes, Recommendations

Datalogger taken off line @ 0852 MST -- returned on-line 1352 MST.
Complettion of AERMOD and solar equipement installation.

# Table 4

## METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining
Audit Date: 27-Aug-08
Audit Performed By: C. Medill - IML Air Science

| Sensor | Mfr./Model | Serial Number | Reference Device | Serial/ID Number |
|---|---|---|---|---|
| Vert. Wind Speed 10m: | RM Young Wind Monitor AQ | NA | quartz referenced drive motor | CA02423 |
| Wind Speed (WS): | RM Young Wind Monitor AQ | WM75308 | quartz referenced drive motor | IML0853 & IML0858 |
| Wind Direction (WD): | RM Young Wind Monitor AQ | WM75308 | transit, compass | Brunton 5080393535 |
| Temperature @ 2 Meters: | Fenwall 107 | NA | digital thermistor | IML0987 |
| Relative Humidity: | Vaisala HMP50 | C4240028 | digital psychrometer | Thermo-Hygro 22087796 |
| Barometric Pressure: | Vaisala PTB101B | C4240018 | digital barometer | IML0968 |
| Solar Radiation: | LI-COR LI200X | PY57681 | Li-Cor | PY54289 |
| Data acquisition system: | CSI CR1000 datalogger | 13147 | N/A | N/A |

## Audit Results

| | RPM | MPH | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | 0 | 0.00 | 0.00 | 0.00 | below threshold | |
| | 300 | 3.44 | 3.44 | 0.00 | 0.56 | (2) |
| | 800 | 9.16 | 9.16 | 0.00 | 0.56 | (2) |
| | 3000 | 34.35 | 34.35 | 0.00 | 1.72 | (2) |
| | 8000 | 91.60 | 91.60 | 0.00 | 4.58 | (2) |

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| WS start torque (gm-cm) | <.1 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | 0.0 | 0.1 | 0.1 | 5.0 | (2) |
| | 90.0 | 89.4 | 0.6 | 5.0 | (2) |
| | 180.0 | 179.6 | 0.4 | 5.0 | (2) |
| | 270.0 | 270.0 | 0.0 | 5.0 | (2) |

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| Temp. (°F): | 0.93 | 0.87 | 0.06 | 0.5 | (2) |
| | 23.28 | 23.32 | 0.04 | 0.5 | (2) |
| | 45.41 | 45.29 | 0.12 | 0.5 | (2) |

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| Relative Humidity (%) | 27.0 | 26.9 | 0.1 | 7.0 | (2) |
| Barometric Pressure ("Hg) | 25.56 | 25.58 | 0.02 | 0.09 | (2) |

| | | Reference RPM | Reference cm/s | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|---|
| Vert WS 10 meters (cm/s) | | 0 | 0.00 | 0.00 | 0.00 | below threshold | |
| **(CW)** | | 20 | 100.00 | 100.80 | 0.80 | 25.00 | (2) |
| | U: | 60 | 300.00 | 300.10 | 0.10 | 35.00 | (2) |
| | | 100 | 1000.00 | 1001.00 | 1.00 | 70.00 | (2) |
| | | 500 | 2500.00 | 2500.00 | 0.00 | 145.00 | (2) |

| | | RPM | cm/s | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|---|
| Vert WS 10 meters (cm/s) | | 0 | 0.00 | 0.00 | 0.00 | below threshold | |
| **(CCW)** | | 20 | 100.00 | 100.80 | 0.80 | 25.00 | (2) |
| | U: | 60 | 300.00 | 295.30 | 4.70 | 35.00 | (2) |
| | | 100 | 1000.00 | 999.10 | 0.90 | 70.00 | (2) |
| | | 500 | 2500.00 | 2503.00 | 3.00 | 145.00 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications
(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

## Notes, Recommendations

Datalogger taken off line @ 0826 MST -- returned on-line 1027 MST.

# Addendum to

# APPENDIX 2.5-D

# Newcastle Meteorological Station Audit Reports

# Addendum to Appendix 2.5-D
# Newcastle Meteorological Station Audit Reports

Appendix 2.5-D provides select audit records for the Wyoming Refining meteorological station in Newcastle. This addendum fills out the Newcastle audit records to span the entire monitoring period. It also provides audit records for the Antelope Mine, Buckskin Mine and Dry Fork Mine meteorological stations. In all cases, meteorological audits were performed semi-annually in accordance with EPA's Onsite Meteorological Program Guidance for Regulatory Modeling Applications. Semi-annual audits are also required by the Wyoming Department of Environmental Quality (DEQ) in conjunction with air quality monitoring. All meteorological audits were documented and reported to DEQ for each of the four sites since monitoring began. IML was unable to obtain copies of older reports (more than 10 to 15 years old), but the approval of such reports by DEQ provides de facto evidence that regular audits were performed and that meteorological instruments were kept within specification.

Also included in this addendum are standard operating procedures (SOPs) used by IML personnel to assure quality meteorological data. The SOPs prescribe instrument calibration, audit and inspection procedures, as well as data processing and reporting methods.

# Newcastle Meteorological Station Audit Reports

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 3-Jan-02
Audit Performed by: K. Fox, T. Mendenhall - iml Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | digital thermistor |
| Data acquisition system (DAS): | Campbell Scientific CR510 | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0 | 1 | 1 | 5 | (1) |
| | | 90 | 89 | 1 | 5 | (1) |
| | | 180 | 181 | 1 | 5 | (1) |
| | | 270 | 269 | 1 | 5 | (1) |
| Temperature (°F) | ice | 32.0 | 31.9 | 0.1 | 1.8 | (1) |
| | ambient | 47.5 | 46.8 | 0.7 | 1.8 | (1) |
| | warm | 98.2 | 98.1 | 0.1 | 1.8 | (1) |

**BOLD difference values exceed performance specifications**

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

## Notes, Recommendations

Initial Install Audit
System on-line @ 1535, 1/3/02

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 8-Aug-02
Audit Performed by: K. Fox - iml Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | digital thermistor |
| Data acquisition system (DAS): | Campbell Scientific CR510 | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0 | 2 | 2 | 5 | (1) |
| | | 90 | 90 | 0 | 5 | (1) |
| | | 180 | 180 | 0 | 5 | (1) |
| | | 270 | 271 | 1 | 5 | (1) |
| Temperature (°F) | ice | 32.7 | 32.3 | 0.4 | 1.8 | (1) |
| | ambient | 83.2 | 84.3 | 1.1 | 1.8 | (1) |
| | warm | 108.8 | 108.8 | 0.0 | 1.8 | (1) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line @ 1135
System on-line @ 1200

Installation:
System on-line @ 1535, 1/3/02

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 21-Jan-03
Audit Performed by: S. Heil, T. Shaw - iml Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | digital thermistor |
| Data acquisition system (DAS): | Campbell Scientific CR510 | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.43 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0 | 0 | 0 | 5 | (1) |
| | | 90 | 91 | 1 | 5 | (1) |
| | | 180 | 180 | 0 | 5 | (1) |
| | | 270 | 270 | 0 | 5 | (1) |
| Temperature (°F) | ice | 26.6 | 26.8 | 0.2 | 1.8 | (1) |
| | ambient | 31.9 | 31.9 | 0.0 | 1.8 | (1) |
| | warm | 116.7 | 116.9 | 0.2 | 1.8 | (1) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line @ 1031
System on-line @ 1100

Installation:
System on-line @ 1535, 1/3/02

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 16-Sep-03
Audit Performed by: K. Fox, K. Jahnke - iml Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | digital thermistor |
| Data acquisition system (DAS): | Campbell Scientific CR510 | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0 | 0 | 0 | 5 | (1) |
| | | 90 | 92 | 2 | 5 | (1) |
| | | 180 | 181 | 1 | 5 | (1) |
| | | 270 | 271 | 1 | 5 | (1) |
| Temperature (°F) | ice | 33.0 | 32.8 | 0.2 | 1.8 | (1) |
| | ambient | 71.2 | 70.5 | 0.7 | 1.8 | (1) |
| | warm | 113.3 | 113.4 | 0.1 | 1.8 | (1) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line @ 1103
System on-line @ 1129
Clock is on actual time, not Standard time. Will correct from Sheridan

Installation:
System on-line @ 1535, 1/3/02

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 10-Mar-04
Audit Performed by: J. Rogers, K. Jahnke - iml Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | digital thermistor |
| Data acquisition system (DAS): | Campbell Scientific CR510 | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0 | 1 | 1 | 5 | (1) |
| | | 90 | 90 | 0 | 5 | (1) |
| | | 180 | 180 | 0 | 5 | (1) |
| | | 270 | 271 | 1 | 5 | (1) |
| Temperature (°F) | ice | 31.8 | 31.8 | 0.0 | 1.8 | (1) |
| | ambient | 29.4 | 29.3 | 0.1 | 1.8 | (1) |
| | warm | 128.1 | 127.1 | 1.0 | 1.8 | (1) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 199
(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line @ 1049
System on-line @ 1105

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 2-Sep-04
Audit Performed by: T. Shaw, K. Jahnke - iml Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | digital thermistor |
| Data acquisition system (DAS): | Campbell Scientific CR510 | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.37 | 0.23 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0 | 1 | 1 | 5 | (1) |
| | | 90 | 90 | 0 | 5 | (1) |
| | | 180 | 180 | 0 | 5 | (1) |
| | | 270 | 270 | 0 | 5 | (1) |
| Temperature (°F) | ambient | 84.9 | 84.0 | 0.9 | 1.8 | (1) |
| | ice water bath | 38.1 | 38.4 | 0.3 | 1.8 | (1) |
| | warm water bath | 94.1 | 93.7 | 0.4 | 1.8 | (1) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line @ 1344
System on-line @ 1409

## METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 23-Mar-05
Audit Performed by: W. Adler, D. Tarver - iml Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | digital thermistor |
| Data acquisition system (DAS): | Campbell Scientific CR510 | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.23 | 0.23 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0 | 1 | 1 | 5 | (1) |
| | | 90 | 91 | 1 | 5 | (1) |
| | | 180 | 180 | 0 | 5 | (1) |
| | | 270 | 270 | 0 | 5 | (1) |
| Temperature (°F) | ambient | 45.3 | 44.3 | 1.0 | 1.8 | (1) |
| | ice water bath | 32.7 | 32.6 | 0.1 | 1.8 | (1) |
| | warm water bath | 137.0 | 135.4 | 1.6 | 1.8 | (1) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line @ 0937
System on-line @ 0958
Direction alignment was off by 12 degrees (pointed at magnetic South).

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 27-Sep-05
Audit Performed by: B. Hanewald, K. Fox - iml Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | digital thermistor |
| Data acquisition system (DAS): | Campbell Scientific CR510 | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.23 | 0.23 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0 | 1.1 | 1 | 5 | (1) |
| | | 90 | 89.6 | 0 | 5 | (1) |
| | | 180 | 179.5 | 1 | 5 | (1) |
| | | 270 | 271.7 | 2 | 5 | (1) |
| Temperature (°F) | ambient | 75.8 | 76.0 | 0.2 | 1.8 | (1) |
| | ice water bath | 32.5 | 32.1 | 0.4 | 1.8 | (1) |
| | warm water bath | 127.1 | 126.7 | 0.4 | 1.8 | (1) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line @ 1645
System on-line @ 1719
Tail is a little chewed up.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 30-Mar-06
Audit Performed by: K. Fox - IML Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | digital thermistor |
| Data acquisition system (DAS): | Campbell Scientific CR510 | N/A |

## Audit Results

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| WS (mph) | 0.00 | 0.23 | 0.23 | 0.56 | (1) |
| | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | 0 | 4.0 | 4 | 5 | (1) |
| | 90 | 86.0 | 4 | 5 | (1) |
| | 180 | 179.0 | 1 | 5 | (1) |
| | 270 | 271.0 | 1 | 5 | (1) |
| Temperature (°F) | 77.0 | 76.8 | 0.2 | 1.8 | (1) |
| ice water bath | 32.3 | 32.3 | 0.0 | 1.8 | (1) |
| warm water bath | 120.0 | 119.7 | 0.3 | 1.8 | (1) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line @ 1230
System on-line @ 1308
Tail is a little chewed up.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 20-Jul-06
Audit Performed by: B. Kelly, K. Fox - IML Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | digital thermistor |
| Data acquisition system (DAS): | Campbell Scientific CR510 | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.23 | 0.23 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0 | 1.5 | 2 | 5 | (1) |
| | | 90 | 88.0 | 2 | 5 | (1) |
| | | 180 | 179.0 | 1 | 5 | (1) |
| | | 270 | 274.0 | 4 | 5 | (1) |
| Temperature (°F) | | 72.9 | 72.9 | 0.0 | 1.8 | (1) |
| | ice water bath | 35.8 | 35.6 | 0.2 | 1.8 | (1) |
| | warm water bath | 128.2 | 127.2 | 1.0 | 1.8 | (1) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line @ 1433
System on-line @ 1503
Tail is a little chewed up.
Needs rebuilt sensor next trip - WD pot worn

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 15-Mar-07
Audit Performed by: B. Kelly, C. Medill - IML Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | digital thermistor |
| Data acquisition system (DAS): | Campbell Scientific CR510 | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0 | 1.5 | 1 | 5 | (1) |
| | | 90 | 89.9 | 0 | 5 | (1) |
| | | 180 | 179.2 | 1 | 5 | (1) |
| | | 270 | 268.7 | 1 | 5 | (1) |
| Temperature (°F) | | 71.6 | 71.6 | 0.0 | 1.8 | (1) |
| | ice water bath | 32.3 | 32.1 | 0.2 | 1.8 | (1) |
| | warm water bath | 130.7 | 129.3 | 1.4 | 1.8 | (1) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line @ 0905
System on-line @ 1015
Replaced anemometer with new Wind Monitor AQ

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 13-Sep-07
Audit Performed by: B. Kelly, C. Medill - IML Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | digital thermistor |
| Data acquisition system (DAS): | Campbell Scientific CR510 | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0 | 0.1 | 0 | 5 | (1) |
| | | 90 | 89.9 | 0 | 5 | (1) |
| | | 180 | 180.8 | 1 | 5 | (1) |
| | | 270 | 268.1 | 2 | 5 | (1) |
| Temperature (°F) | | 84.6 | 84.5 | 0.0 | 0.9 | (1) |
| | ice water bath | 32.2 | 32.0 | 0.1 | 0.9 | (1) |
| | warm water bath | 127.9 | 126.8 | 1.1 | 0.9 | (1) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line @ 0834
System on-line @ 0850

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining
Audit Date: 3-Mar-08
Audit Performed By: S. Hansen, C. Medill, IML-Air Science

| Sensor | Mfr./Model | Serial Number | Reference Device | Serial/ID Number |
|---|---|---|---|---|
| Vert. Wind Speed 10m: | RM Young Wind Monitor AQ | NA | quartz referenced drive motor | CA02423 |
| Wind Speed (WS): | RM Young Wind Monitor AQ | WM75308 | quartz referenced drive motor | IML0853 & IML0858 |
| Wind Direction (WD): | RM Young Wind Monitor AQ | WM75308 | transit, compass | Brunton 5080393535 |
| Temperature @ 2 Meters: | Fenwall 107 | NA | digital thermistor | IML0987 |
| Relative Humidity: | Vaisala HMP50 | C4240028 | digital psychrometer | Thermo-Hygro 22087796 |
| Barometric Pressure: | Vaisala PTB101B | C4240018 | digital barometer | IML0968 |
| Solar Radiation: | LI-COR LI200X | PY57681 | Li-Cor | PY54289 |
| Data acquisition system: | CSI CR1000 datalogger | 13147 | N/A | N/A |

## Audit Results

|  | RPM | MPH | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|
| WS (mph) | 0 | 0.00 | 0.00 | 0.00 | below threshold |  |
|  | 300 | 3.44 | 3.44 | 0.00 | 0.56 | (2) |
|  | 800 | 9.16 | 9.16 | 0.00 | 0.56 | (2) |
|  | 3000 | 34.35 | 34.35 | 0.00 | 1.72 | (2) |
|  | 8000 | 91.60 | 91.60 | 0.00 | 4.58 | (2) |

|  | Reference | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|
| WS start torque (gm-cm) | <.1 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | 0.0 | 0.7 | 0.7 | 5.0 | (2) |
|  | 90.0 | 89.8 | 0.2 | 5.0 | (2) |
|  | 180.0 | 179.8 | 0.2 | 5.0 | (2) |
|  | 270.0 | 269.9 | 0.1 | 5.0 | (2) |

|  | Reference | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|
| Temp. (°F): | 35.20 | 35.00 | 0.20 | 0.5 | (2) |
|  | 57.80 | 57.70 | 0.10 | 0.5 | (2) |
|  | 101.50 | 100.90 | 0.60 | 0.5 | (2) |

|  | Reference | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|
| Relative Humidity (%) | 37.0 | 38.9 | 1.9 | 7.0 | (2) |
| Barometric Pressure ("Hg) | 25.53 | 25.47 | 0.06 | 0.09 | (2) |

|  |  | Reference RPM | Reference cm/s | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|---|
| Vert WS 10 meters (cm/s) |  | 0 | 0.00 | 0.00 | 0.00 | below threshold |  |
| **(CW)** |  | 20 | 100.00 | 91.10 | 8.90 | 25.00 | (2) |
|  | U: | 60 | 300.00 | 110.20 | 189.80 | 35.00 | (2) |
|  |  | 100 | 1000.00 | 126.70 | 873.30 | 70.00 | (2) |
|  |  | 500 | 2500.00 | NA | NA | 145.00 | (2) |

|  |  | RPM | cm/s | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|---|
| Vert WS 10 meters (cm/s) |  | 0 | 0.00 | 0.00 | 0.00 | below threshold |  |
| **(CCW)** |  | 20 | 100.00 | NA | NA | 25.00 | (2) |
|  | U: | 60 | 300.00 | NA | NA | 35.00 | (2) |
|  |  | 100 | 1000.00 | NA | NA | 70.00 | (2) |
|  |  | 500 | 2500.00 | NA | NA | 145.00 | (2) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications
(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

## Notes, Recommendations

Datalogger taken off line @ 1015 MST -- returned on-line 1810 MST.
Vertical Wind Speed connector broke during audit.

## METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining
Audit Performed By: C. Medill - IML Air Science
Audit Date: 27-Aug-08

| Sensor | Mfr./Model | Serial Number | Reference Device | Serial/ID Number |
|---|---|---|---|---|
| Vert. Wind Speed 10m: | RM Young Wind Monitor AQ | NA | quartz referenced drive motor | CA02423 |
| Wind Speed (WS): | RM Young Wind Monitor AQ | WM75308 | quartz referenced drive motor | IML0853 & IML0858 |
| Wind Direction (WD): | RM Young Wind Monitor AQ | WM75308 | transit, compass | Brunton 5080393535 |
| Temperature @ 2 Meters: | Fenwall 107 | NA | digital thermistor | IML0987 |
| Relative Humidity: | Vaisala HMP50 | C4240028 | digital psychrometer | Thermo-Hygro 22087796 |
| Barometric Pressure: | Vaisala PTB101B | C4240018 | digital barometer | IML0968 |
| Solar Radiation: | LI-COR LI200X | PY57681 | Li-Cor | PY54289 |
| Data acquisition system: | CSI CR1000 datalogger | 13147 | N/A | N/A |

### Audit Results

|  | RPM | MPH | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|
| WS (mph) | 0 | 0.00 | 0.00 | 0.00 | below threshold |  |
|  | 300 | 3.44 | 3.44 | 0.00 | 0.56 | (2) |
|  | 800 | 9.16 | 9.16 | 0.00 | 0.56 | (2) |
|  | 3000 | 34.35 | 34.35 | 0.00 | 1.72 | (2) |
|  | 8000 | 91.60 | 91.60 | 0.00 | 4.58 | (2) |

|  | Reference | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|
| WS start torque (gm-cm) | <.1 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | 0.0 | 0.1 | 0.1 | 5.0 | (2) |
|  | 90.0 | 89.4 | 0.6 | 5.0 | (2) |
|  | 180.0 | 179.6 | 0.4 | 5.0 | (2) |
|  | 270.0 | 270.0 | 0.0 | 5.0 | (2) |

|  | Reference | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|
| Temp. (°F): | 0.93 | 0.87 | 0.06 | 0.5 | (2) |
|  | 23.28 | 23.32 | 0.04 | 0.5 | (2) |
|  | 45.41 | 45.29 | 0.12 | 0.5 | (2) |

|  | Reference | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|
| Relative Humidity (%) | 27.0 | 26.9 | 0.1 | 7.0 | (2) |
| Barometric Pressure ("Hg) | 25.56 | 25.58 | 0.02 | 0.09 | (2) |

|  |  | Reference RPM | Reference cm/s | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|---|
| Vert WS 10 meters (cm/s) |  | 0 | 0.00 | 0.00 | 0.00 | below threshold |  |
| (CW) |  | 20 | 100.00 | 100.80 | 0.80 | 25.00 | (2) |
|  | U: | 60 | 300.00 | 300.10 | 0.10 | 35.00 | (2) |
|  |  | 100 | 1000.00 | 1001.00 | 1.00 | 70.00 | (2) |
|  |  | 500 | 2500.00 | 2500.00 | 0.00 | 145.00 | (2) |

|  |  | RPM | cm/s | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|---|
| Vert WS 10 meters (cm/s) |  | 0 | 0.00 | 0.00 | 0.00 | below threshold |  |
| (CCW) |  | 20 | 100.00 | 100.80 | 0.80 | 25.00 | (2) |
|  | U: | 60 | 300.00 | 295.30 | 4.70 | 35.00 | (2) |
|  |  | 100 | 1000.00 | 999.10 | 0.90 | 70.00 | (2) |
|  |  | 500 | 2500.00 | 2503.00 | 3.00 | 145.00 | (2) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications
(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

### Notes, Recommendations

Datalogger taken off line @ 0826 MST -- returned on-line 1027 MST.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining
Audit Date: 13-Feb-09
Audit Performed By: D.Barkan, R. Campbell - IML Air Science

| Sensor | Mfr./Model | Serial Number | Reference Device | Serial/ID Number |
|---|---|---|---|---|
| Vert. Wind Speed 10m: | RM Young Wind Monitor AQ | NA | quartz referenced drive motor | |
| Wind Speed (WS): | RM Young Wind Monitor AQ | WM75308 | quartz referenced drive motor | |
| Wind Direction (WD): | RM Young Wind Monitor AQ | WM75308 | transit, compass | |
| Temperature @ 2 Meters: | Fenwall 107 | NA | digital thermistor | IML 0888 |
| Relative Humidity: | Vaisala HMP50 | C4240028 | digital psychrometer | IML 0891 |
| Barometric Pressure: | Vaisala PTB101B | C4240018 | digital barometer | IML 0904 |
| Solar Radiation: | LI-COR LI200X | PY57681 | Li-Cor | |
| Data acquisition system: | CSI CR1000 datalogger | 13147 | N/A | N/A |

## Audit Results

| | RPM | MPH | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | 0 | 0.00 | 0.00 | 0.00 | below threshold | |
| | 300 | 3.44 | 3.44 | 0.00 | 0.56 | (2) |
| | 800 | 9.16 | 9.16 | 0.00 | 0.56 | (2) |
| | 3000 | 34.35 | 34.35 | 0.00 | 1.72 | (2) |
| | 8000 | 91.60 | 91.60 | 0.00 | 4.58 | (2) |

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| WS start torque (gm-cm) | <.1 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | 0.0 | 1.0 | 1.0 | 5.0 | (2) |
| | 90.0 | 90.1 | 0.1 | 5.0 | (2) |
| | 180.0 | 180.3 | 0.3 | 5.0 | (2) |
| | 270.0 | 270.1 | 0.1 | 5.0 | (2) |

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| Temp. 2 meter (°F): | -0.09 | -0.08 | 0.01 | 0.5 | (2) |
| | 18.20 | 18.10 | 0.10 | 0.5 | (2) |
| | 43.80 | 43.90 | 0.10 | 0.5 | (2) |
| Temp. 10 meter (°F): | -0.09 | -0.04 | 0.05 | 0.5 | (2) |
| | 18.20 | 18.10 | 0.10 | 0.5 | (2) |
| | 43.80 | 43.90 | 0.10 | 0.5 | (2) |

| | Upper Sensor | Lower Sensor | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| Delta T. (°C) | -0.08 | -0.04 | 0.04 | 0.10 | (2) |
| | 18.10 | 18.10 | 0.00 | 0.10 | (2) |
| | 43.90 | 43.90 | 0.00 | 0.10 | (2) |

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| Relative Humidity (%) | 73.5 | 70.5 | 3.0 | 7.0 | (2) |
| Barometric Pressure ("Hg) | 25.77 | 25.70 | 0.07 | 0.09 | (2) |

|  |  | Reference<br>RPM | Reference<br>cm/s | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|---|
| Vert WS 10 meters (cm/s) |  | 0 | 0.00 | 0.00 | 0.00 | below threshold |  |
| **(CW)** |  | 20 | 10.00 | 10.90 | 0.90 | 20.50 | (2) |
|  | U: | 60 | 30.00 | 29.10 | 0.90 | 21.50 | (2) |
|  |  | 100 | 50.00 | 47.40 | 2.60 | 22.50 | (2) |
|  |  | 500 | 245.00 | 246.50 | 1.50 | 32.25 | (2) |

|  |  | RPM | cm/s | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|---|
| Vert WS 10 meters (cm/s) |  | 0 | 0.00 | 0.00 | 0.00 | below threshold |  |
| **(CCW)** |  | 20 | -10.00 | -9.70 | 0.30 | 20.50 | (2) |
|  | U: | 60 | -30.00 | -31.60 | 1.60 | 21.50 | (2) |
|  |  | 100 | -50.00 | -51.00 | 1.00 | 22.50 | (2) |
|  |  | 500 | -245.00 | -253.90 | 8.90 | 32.25 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

## Notes, Recommendations

Datalogger taken off line @ 0826 MST -- returned on-line 1027 MST.

## METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining
Audit Date: 30-Jul-09
Audit Performed By: D.Barkan, J. Goldsmith - IML Air Science

| Sensor | Mfr./Model | Serial Number | Reference Device | Serial/ID Number |
|---|---|---|---|---|
| Vert. Wind Speed 10m: | RM Young Wind Monitor AQ | NA | quartz referenced drive motor | IML 0857 |
| Wind Speed (WS): | RM Young Wind Monitor AQ | WM75308 | quartz referenced drive motor | IML 0857 |
| Wind Direction (WD): | RM Young Wind Monitor AQ | WM75308 | transit, compass | IML 0942 |
| Temperature @ 2 Meters: | Fenwall 107 | NA | digital thermistor | IML 1402 |
| Relative Humidity: | Vaisala HMP50 | C4240028 | digital psychrometer | IML 0890 |
| Barometric Pressure: | Vaisala PTB101B | C4240018 | digital barometer | IML 1404 |
| Solar Radiation: | LI-COR LI200X | PY57681 | Li-Cor | PY52289 |
| Data acquisition system: | CSI CR1000 datalogger | 13147 | N/A | N/A |

### Audit Results

| | RPM | MPH | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | 0 | 0.00 | 0.00 | 0.00 | below threshold | |
| | 300 | 3.44 | 3.43 | 0.00 | 0.56 | (2) |
| | 800 | 9.16 | 9.16 | 0.00 | 0.56 | (2) |
| | 3000 | 34.35 | 34.35 | 0.00 | 1.72 | (2) |
| | 8000 | 91.60 | 91.60 | 0.00 | 4.58 | (2) |

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| WS start torque (gm-cm) | <.1 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | 0.0 | 0.1 | 0.1 | 5.0 | (2) |
| | 90.0 | 91.9 | 1.9 | 5.0 | (2) |
| | 180.0 | 180.2 | 0.2 | 5.0 | (2) |
| | 270.0 | 270.2 | 0.2 | 5.0 | (2) |

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| Temp. 2 meter (°F): | 0.00 | 0.02 | 0.02 | 0.5 | (2) |
| | 24.49 | 24.66 | 0.17 | 0.5 | (2) |
| | 48.89 | 49.40 | **0.51** | 0.5 | (2) |
| Temp. 10 meter (°F): | 0.00 | 0.01 | 0.01 | 0.5 | (2) |
| | 24.49 | 24.66 | 0.17 | 0.5 | (2) |
| | 48.89 | 49.40 | **0.51** | 0.5 | (2) |

| | Upper Sensor | Lower Sensor | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| Delta T. (°C) | 0.02 | 0.01 | 0.01 | 0.10 | (2) |
| | 24.66 | 24.66 | 0.00 | 0.10 | (2) |
| | 49.40 | 49.40 | 0.00 | 0.10 | (2) |

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| Relative Humidity (%) | 70.6 | 69.1 | 1.5 | 7.0 | (2) |
| Barometric Pressure ("Hg) | 25.75 | 25.76 | 0.01 | 0.09 | (2) |

|  |  | Reference<br>RPM | Reference<br>cm/s | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|---|
| Vert WS 10 meters (cm/s) |  | 0 | 0.00 | 0.00 | 0.00 | below threshold |  |
| **(CW)** |  | 20 | 10.00 | 9.70 | 0.30 | 20.50 | (2) |
|  | U: | 60 | 30.00 | 26.70 | 3.30 | 21.50 | (2) |
|  |  | 100 | 50.00 | 46.16 | 3.84 | 22.50 | (2) |
|  |  | 500 | 245.00 | 242.90 | 2.10 | 32.25 | (2) |

|  |  | RPM | cm/s | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|---|
| Vert WS 10 meters (cm/s) |  | 0 | 0.00 | 0.00 | 0.00 | below threshold |  |
| **(CCW)** |  | 20 | -10.00 | -9.70 | 0.30 | 20.50 | (2) |
|  | U: | 60 | -30.00 | -29.10 | 0.90 | 21.50 | (2) |
|  |  | 100 | -50.00 | -49.80 | 0.20 | 22.50 | (2) |
|  |  | 500 | -245.00 | -250.20 | 5.20 | 32.25 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

## Notes, Recommendations

Datalogger taken off line at 0841 MST and returned on-line 0942 MST.
Adjusted WD alingment, changed bearings.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining
Audit Date: 22-Mar-10
Audit Performed By: D.Barkan, C. Medill - IML Air Science

| Sensor | Mfr./Model | Serial Number | Reference Device | Serial/ID Number |
|---|---|---|---|---|
| Vert. Wind Speed 10m: | RM Young Wind Monitor AQ | NA | quartz referenced drive motor | IML 0855 |
| Wind Speed (WS): | RM Young Wind Monitor AQ | WM75308 | quartz referenced drive motor | IML 0856 |
| Wind Direction (WD): | RM Young Wind Monitor AQ | WM75308 | transit, compass | IML 0942 |
| Temperature @ 2 Meters: | Fenwall 107 | NA | digital thermistor | IML 0888 |
| Relative Humidity: | Vaisala HMP50 | C4240028 | digital psychrometer | IML 0892 |
| Barometric Pressure: | Vaisala PTB101B | C4240018 | digital barometer | IML 0904 |
| Solar Radiation: | LI-COR LI200X | PY57681 | Li-Cor | PY54289 |
| Data acquisition system: | CSI CR1000 datalogger | 13147 | N/A | N/A |

## Audit Results

| | RPM | MPH | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | 0 | 0.00 | 0.00 | 0.00 | below threshold | |
| | 300 | 3.44 | 3.43 | 0.00 | 0.56 | (2) |
| | 800 | 9.16 | 9.16 | 0.00 | 0.56 | (2) |
| | 3000 | 34.35 | 34.35 | 0.00 | 1.72 | (2) |
| | 8000 | 91.60 | 91.60 | 0.00 | 4.58 | (2) |
| | | Reference | DAS Value | \|Difference\| | Specification | |
| WS start torque (gm-cm) | | <.1 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 0.1 | 0.1 | 5.0 | (2) |
| | | 90.0 | 88.9 | 1.1 | 5.0 | (2) |
| | | 180.0 | 180.2 | 0.2 | 5.0 | (2) |
| | | 270.0 | 271.0 | 1.0 | 5.0 | (2) |
| | | Reference | DAS Value | \|Difference\| | Specification | |
| Temp. 2 meter (°F): | | 0.06 | 0.14 | 0.08 | 0.5 | (2) |
| | | 19.60 | 19.54 | 0.06 | 0.5 | (2) |
| | | 35.03 | 35.12 | 0.09 | 0.5 | (2) |
| Temp. 10 meter (°F): | | 0.06 | 0.13 | 0.07 | 0.5 | (2) |
| | | 19.60 | 19.59 | 0.01 | 0.5 | (2) |
| | | 35.03 | 35.15 | 0.12 | 0.5 | (2) |
| | | Upper Sensor | Lower Sensor | \|Difference\| | Specification | |
| Delta T. (°C) | | 0.14 | 0.13 | 0.01 | 0.10 | (2) |
| | | 19.54 | 19.59 | 0.05 | 0.10 | (2) |
| | | 35.12 | 35.15 | 0.03 | 0.10 | (2) |
| | | Reference | DAS Value | \|Difference\| | Specification | |
| Relative Humidity (%) | | 33.5 | 33.1 | 0.4 | 7.0 | (2) |
| Barometric Pressure ("Hg) | | 25.43 | 25.43 | 0.00 | 0.09 | (2) |

| | | Reference RPM | Reference cm/s | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|---|
| Vert WS 10 meters (cm/s) | | 0 | 0.00 | 0.00 | 0.00 | below threshold | |
| **(CW)** | | 20 | 10.00 | 9.71 | 0.29 | 20.50 | (2) |
| | U: | 60 | 30.00 | 29.14 | 0.86 | 21.50 | (2) |
| | | 100 | 50.00 | 47.36 | 2.64 | 22.50 | (2) |
| | | 500 | 245.00 | 247.78 | 2.78 | 32.25 | (2) |

| | | RPM | cm/s | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|---|
| Vert WS 10 meters (cm/s) | | 0 | 0.00 | 0.00 | 0.00 | below threshold | |
| **(CCW)** | | 20 | -10.00 | -9.71 | 0.29 | 20.50 | (2) |
| | U: | 60 | -30.00 | -30.36 | 0.36 | 21.50 | (2) |
| | | 100 | -50.00 | -49.47 | 0.53 | 22.50 | (2) |
| | | 500 | -245.00 | -250.20 | 5.20 | 32.25 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications
(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

## Notes, Recommendations

Datalogger taken off line at 08:30 MST and returned on-line 12:58 MST.
Replaced wind direction tail coupler and wind speed bearings.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining
Audit Date: 20-Aug-10
Audit Performed By: T. Mendenhall, S. Hansen - IML Air Science

| Sensor | Mfr./Model | Serial Number | Reference Device | Serial/ID Number |
|---|---|---|---|---|
| Vert. Wind Speed 10m: | RM Young Wind Monitor AQ | N/A | quartz referenced drive motor | IML 1407 |
| Wind Speed (WS): | RM Young Wind Monitor AQ | WM75308 | quartz referenced drive motor | IML 0889 |
| Wind Direction (WD): | RM Young Wind Monitor AQ | WM75308 | transit, compass | IML 1405 |
| Temperature @ 2 Meters: | RM Young RTD | NA | digital thermistor | IML 1402 |
| Temperature @ 10 Meters: | RM Young RTD | NA | digital thermistor | IML 1402 |
| Relative Humidity: | Vaisala HMP50 | C4240028 | digital hygrometer | IML 0892 |
| Barometric Pressure: | Vaisala PTB101B | C4240018 | digital barometer | IML 0887 |
| Solar Radiation: | LI-COR LI200X | PY57681 | Li-Cor | N/A |
| Data acquisition system: | CSI CR1000 datalogger | 13147 | N/A | N/A |

## Audit Results

| | RPM | MPH | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | 0 | 0.00 | 0.00 | 0.00 | below threshold | |
| | 300 | 3.44 | 3.44 | 0.00 | 0.56 | (2) |
| | 800 | 9.16 | 9.16 | 0.00 | 0.56 | (2) |
| | 3000 | 34.35 | 34.35 | 0.00 | 0.56 | (2) |
| | 8000 | 91.60 | 91.60 | 0.00 | 0.56 | (2) |

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS start torque (gm-cm) | | <1 | 1 | 0 | 1.0 | (3) |
| Crossarm Alignment | | 235° | 241° | 6 | 5.0 | |
| WD (degrees) | Clockwise | 0.0 | 0.1 | 0.1 | 5.0 | (2) |
| | | 90.0 | 90.6 | 0.6 | 5.0 | (2) |
| | | 180.0 | 179.9 | 0.1 | 5.0 | (2) |
| | | 270.0 | 269.1 | 0.9 | 5.0 | (2) |
| | Counter Clockwise | 0.0 | 0.9 | 0.9 | 5.0 | (2) |
| | | 90.0 | 90.4 | 0.4 | 5.0 | (2) |
| | | 180.0 | 180.1 | 0.1 | 5.0 | (2) |
| | | 270.0 | 269.8 | 0.2 | 5.0 | (2) |

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| Temp. 2 meter (°F): | 1.09 | 1.12 | 0.03 | 0.5 | (2) |
| | 54.90 | 54.84 | 0.06 | 0.5 | (2) |
| | 22.90 | 22.74 | 0.16 | 0.5 | (2) |
| Temp. 10 meter (°F): | 1.09 | 1.10 | 0.01 | 0.5 | (2) |
| | 54.90 | 54.91 | 0.01 | 0.5 | (2) |
| | 22.90 | 22.80 | 0.10 | 0.5 | (2) |

| | Upper Sensor | Lower Sensor | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| Delta T. (°C) | 1.12 | 1.10 | 0.02 | 0.10 | (2) |
| | 54.84 | 54.91 | 0.07 | 0.10 | (2) |
| | 22.74 | 22.80 | 0.06 | 0.10 | (2) |

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| Relative Humidity (%) | 19.2 | 16.7 | 2.5 | 7.0 | (2) |
| Barometric Pressure ("Hg) | 25.55 | 25.56 | 0.01 | 0.09 | (2) |

|  |  | Reference<br>RPM | Reference<br>cm/s | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|---|
| Vert WS 10 meters (cm/s) |  | 0 | 0.00 | 0.00 | 0.00 | below threshold |  |
| **(CW)** |  | 20 | 10.00 | 9.11 | 0.89 | 20.50 | (2) |
|  | U: | 60 | 30.00 | 24.69 | 5.31 | 21.50 | (2) |
|  |  | 200 | 100.00 | 99.49 | 0.51 | 25.00 | (2) |
|  |  | 500 | 245.00 | 248.60 | 3.60 | 32.25 | (2) |

|  |  | RPM | cm/s | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|---|
| Vert WS 10 meters (cm/s) |  | 0 | 0.00 | 0.00 | 0.00 | below threshold |  |
| **(CCW)** |  | 20 | -10.00 | -10.33 | 0.33 | 20.50 | (2) |
|  | U: | 60 | -30.00 | -24.91 | 5.09 | 21.50 | (2) |
|  |  | 200 | -100.00 | -101.45 | 1.45 | 25.00 | (2) |
|  |  | 500 | -245.00 | -248.60 | 3.60 | 32.25 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

## Notes, Recommendations

Datalogger taken off line at 08:20 MST and returned on-line 09:20 MST.

## METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining
Audit Date: 3-Mar-11
Audit Performed By: S. Hansen, J. Masters -- IML Air Science

| Sensor | Mfr./Model | Serial Number | Reference Device | Serial/ID Number |
|---|---|---|---|---|
| Vert. Wind Speed 10m: | RM Young Wind Monitor AQ | N/A | quartz referenced drive motor | IML 1407 |
| Wind Speed (WS): | RM Young Wind Monitor AQ | WM75308 | quartz referenced drive motor | IML 1407 |
| Wind Direction (WD): | RM Young Wind Monitor AQ | WM75308 | transit, compass | IML 1405 |
| Temperature @ 2 Meters: | RM Young RTD | NA | digital thermistor | IML 1401 |
| Temperature @ 10 Meters: | RM Young RTD | NA | digital thermistor | IML 1401 |
| Relative Humidity: | Vaisala HMP50 | C4240028 | digital hygrometer | IML 0890 |
| Barometric Pressure: | Vaisala PTB101B | C4240018 | digital barometer | IML 0968 |
| Data acquisition system: | CSI CR1000 datalogger | 13147 | N/A | N/A |

### Audit Results

| | | RPM | MPH | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|---|
| WS (mph) | | 0 | 0.00 | 0.00 | 0.00 | below threshold | |
| | | 300 | 3.44 | 3.44 | 0.00 | 0.56 | (2) |
| | | 800 | 9.16 | 9.16 | 0.00 | 0.56 | (2) |
| | | 3000 | 34.35 | 34.35 | 0.00 | 0.56 | (2) |
| | | 8000 | 91.60 | 91.60 | 0.00 | 0.56 | (2) |
| WS start torque (gm-cm) | | | 1.0 | t<1.0 | N/A | 1.0 | (3) |
| WD (degrees) | Clockwise | | 0.0 | 0.1 | 0.1 | 5.0 | (2) |
| | | | 90.0 | 90.8 | 0.8 | 5.0 | (2) |
| | | | 180.0 | 180.6 | 0.6 | 5.0 | (2) |
| | | | 270.0 | 268.7 | 1.3 | 5.0 | (2) |
| | Counter Clockwise | | 0.0 | 0.1 | 0.1 | 5.0 | (2) |
| | | | 90.0 | 90.3 | 0.3 | 5.0 | (2) |
| | | | 180.0 | 180.5 | 0.5 | 5.0 | (2) |
| | | | 270.0 | 270.4 | 0.4 | 5.0 | (2) |
| | | | Reference | DAS Value | \|Difference\| | Specification | |
| Temp. 2 meter (°F): | | | 18.91 | 18.72 | 0.19 | 0.5 | (2) |
| | | | 0.27 | 0.00 | 0.27 | 0.5 | (2) |
| | | | 45.70 | 45.56 | 0.14 | 0.5 | (2) |
| Temp. 10 meter (°F): | | | 18.91 | 18.79 | 0.12 | 0.5 | (2) |
| | | | 0.27 | 0.02 | 0.25 | 0.5 | (2) |
| | | | 45.70 | 45.59 | 0.11 | 0.5 | (2) |
| | | | Upper Sensor | Lower Sensor | \|Difference\| | Specification | |
| Delta T. (°C) | | | 18.72 | 18.79 | 0.07 | 0.10 | (2) |
| | | | 0.00 | 0.02 | 0.02 | 0.10 | (2) |
| | | | 45.56 | 45.59 | 0.03 | 0.10 | (2) |
| Relative Humidity (%) | | | 48.7 | 48.2 | 0.5 | 7.0 | (2) |
| Barometric Pressure ("Hg) | | | 25.49 | 25.51 | 0.02 | 0.09 | (2) |

|  |  | Reference<br>RPM | Reference<br>cm/s | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|---|
| Vert WS 10 meters (cm/s) |  | 0 | 0.00 | 0.00 | 0.00 | below threshold |  |
| **(CW)** |  | 20 | 10.00 | 9.72 | 0.28 | 20.50 | (2) |
|  | U: | 60 | 30.00 | 29.15 | 0.85 | 21.50 | (2) |
|  |  | 200 | 50.00 | 47.30 | 2.70 | 22.50 | (2) |
|  |  | 500 | 250.00 | 248.60 | 1.40 | 32.50 | (2) |

|  |  | RPM | cm/s | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|---|
| Vert WS 10 meters (cm/s) |  | 0 | 0.00 | 0.00 | 0.00 | below threshold |  |
| **(CCW)** |  | 20 | -10.00 | -9.72 | 0.28 | 20.50 | (2) |
|  | U: | 60 | -30.00 | -29.15 | 0.85 | 21.50 | (2) |
|  |  | 200 | -50.00 | -49.77 | 0.23 | 22.50 | (2) |
|  |  | 500 | -250.00 | -247.30 | 2.70 | 32.50 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

## Notes, Recommendations

Datalogger taken off line at 12:11 MST and returned on-line 12:59 MST.

## METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining
Audit Date: 1-Sep-11
Audit Performed By: C. Cottom, J. Masters -- IML Air Science

| Sensor | Mfr./Model | Serial Number | Reference Device | Serial/ID Number |
|---|---|---|---|---|
| Vert. Wind Speed 10m: | RM Young Wind Monitor AQ | N/A | quartz referenced drive motor | IML 0856 |
| Wind Speed (WS): | RM Young Wind Monitor AQ | WM75308 | quartz referenced drive motor | IML 0896 |
| Wind Direction (WD): | RM Young Wind Monitor AQ | WM75308 | transit, compass | IML 0894 |
| Temperature @ 2 Meters: | RM Young RTD | NA | digital thermistor | IML 1401 |
| Temperature @ 10 Meters: | RM Young RTD | NA | digital thermistor | IML 1401 |
| Relative Humidity: | Vaisala HMP50 | C4240028 | digital hygrometer | IML 0899 |
| Barometric Pressure: | Vaisala PTB101B | C4240018 | digital barometer | IML 0968 |
| Solar Radiation | LI-COR LI200X | PY57681 | LI-COR 200X | PY68877 |
| Data acquisition system: | CSI CR1000 datalogger | 13147 | N/A | N/A |

### Audit Results

| | RPM | MPH | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | 0 | 0.00 | 0.00 | 0.00 | below threshold | |
| | 300 | 3.44 | 3.44 | 0.00 | 0.56 | (2) |
| | 800 | 9.16 | 9.16 | 0.00 | 0.56 | (2) |
| | 3000 | 34.35 | 34.35 | 0.00 | 0.56 | (2) |
| | 8000 | 91.60 | 91.60 | 0.00 | 0.56 | (2) |
| Crossarm Alignment | | 232.0 | 230.0 | 2.0 | 5.0 | (3) |
| WS start torque (gm-cm) | | 1.0 | t<1.0 | N/A | 1.0 | (3) |
| WD (degrees) | Clockwise | 0.0 | 0.1 | 0.1 | 5.0 | (2) |
| | | 90.0 | 91.0 | 1.0 | 5.0 | (2) |
| | | 180.0 | 180.1 | 0.1 | 5.0 | (2) |
| | | 270.0 | 269.9 | 0.1 | 5.0 | (2) |
| | Counter Clockwise | 0.0 | 0.1 | 0.1 | 5.0 | (2) |
| | | 90.0 | 90.5 | 0.5 | 5.0 | (2) |
| | | 180.0 | 180.4 | 0.4 | 5.0 | (2) |
| | | 270.0 | 269.0 | 1.0 | 5.0 | (2) |

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| Temp. 2 meter (°F): | 0.20 | 0.19 | 0.01 | 0.5 | (2) |
| | 34.46 | 34.53 | 0.07 | 0.5 | (2) |
| | 51.50 | 51.34 | 0.16 | 0.5 | (2) |
| Temp. 10 meter (°F): | 0.20 | 0.16 | 0.04 | 0.5 | (2) |
| | 34.46 | 34.55 | 0.09 | 0.5 | (2) |
| | 51.50 | 51.37 | 0.13 | 0.5 | (2) |

| | Upper Sensor | Lower Sensor | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| Delta T. (°C) | 0.19 | 0.16 | 0.03 | 0.10 | (2) |
| | 34.53 | 34.55 | 0.02 | 0.10 | (2) |
| | 51.34 | 51.37 | 0.03 | 0.10 | (2) |
| Relative Humidity (%) | 33.9 | 33.3 | 0.6 | 7.0 | (2) |
| Barometric Pressure ("Hg) | 25.59 | 25.59 | 0.00 | 0.09 | (2) |

|  |  | Reference<br>RPM | Reference<br>cm/s | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|---|
| Vert WS 10 meters (cm/s) |  | 0 | 0.00 | 0.00 | 0.00 | below threshold |  |
| **(CW)** |  | 20 | 10.00 | 9.72 | 0.28 | 20.50 | (2) |
|  | U: | 60 | 30.00 | 29.16 | 0.84 | 21.50 | (2) |
|  |  | 200 | 50.00 | 46.17 | 3.83 | 22.50 | (2) |
|  |  | 500 | 250.00 | 243.00 | 7.00 | 32.50 | (2) |

|  |  | RPM | cm/s | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|---|
| Vert WS 10 meters (cm/s) |  | 0 | 0.00 | 0.00 | 0.00 | below threshold |  |
| **(CCW)** |  | 20 | -10.00 | -9.72 | 0.28 | 20.50 | (2) |
|  | U: | 60 | -30.00 | -29.16 | 0.84 | 21.50 | (2) |
|  |  | 200 | -50.00 | -48.60 | 1.40 | 22.50 | (2) |
|  |  | 500 | -250.00 | -245.00 | 5.00 | 32.50 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

## Notes, Recommendations

System taken off-line at 12:36 MST and returned on-line 13:13 MST.

# Antelope Mine Meteorological Station Audit Reports

# METEOROLOGICAL STATION AUDIT SUMMARY

|  |  |
|---|---|
| Met Station: | Antelope Coal Company |
| Audit Date: | 17-Feb-97 |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Insitu WTS-100 | Hg-in-glass thermometer, or t-couple |
| Barometric Pressure (BP): | Insitu WBS-360 | Altimeter |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10 & storage module | N/A |

## Audit Results

|  |  | Reference | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|
| WS (mph) |  | 0.00 | 0.00 | 0.00 |  |  |
|  |  | 3.44 | 3.43 | 0.00 | 0.56 | (1) |
|  |  | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
|  |  | 34.35 | 34.25 | 0.10 | 1.72 | (1) |
|  |  | 91.60 | 91.46 | 0.14 | 4.58 | (1) |
| WS start torque (gm-cm) |  | τ<0.7 | N/A | N/A | 1.0 | (3) |
| WD (degrees) |  | 0.0 | 1.0 | 1.0 | 5.0 | (1) |
|  |  | 90.0 | 91.2 | 1.2 | 5.0 | (1) |
|  |  | 180.0 | 179.9 | 0.1 | 5.0 | (1) |
|  |  | 270.0 | 270.1 | 0.1 | 5.0 | (1) |
| WD start torque (gm-cm) |  | τ<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ambient | 51.7 | 52.0 | 0.3 | 1.8 | (1) |
|  | ice bath | 32.0 | 32.8 | 0.8 | 1.8 | (1) |
|  | warm bath | 102.5 | 102.2 | 0.3 | 1.8 | (1) |
| Precipitation (0.05" equiv.) |  | 92.7 | 90.0 | 2.7 | 9.3 | (1) |
|  |  | 92.7 | 93.0 | 0.3 | 9.3 | (1) |
|  |  | 92.7 | 95.0 | 2.3 | 9.3 | (1) |
| Pressure (in. Hg) |  | 25.06 | 25.10 | 0.04 | N/A | N/A |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 1220 MST -- returned on-line at 1300 MST.

Wind screen is torn.

Wind direction alignment is OK.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 21-Mar-97

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor |
| Barometric Pressure (BP): | Vaisala PTB 101B | aneroid barometer |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10X & storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.05 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | τ<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 1.5 | 1.5 | 5.0 | (1) |
| | | 90.0 | 89.0 | 1.0 | 5.0 | (1) |
| | | 180.0 | 180.0 | 0.0 | 5.0 | (1) |
| | | 270.0 | 271.0 | 1.0 | 5.0 | (1) |
| WD start torque (gm-cm) | | τ<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ambier | 59.4 | 60.1 | 0.7 | 1.8 | (1) |
| | ice bath | 37.0 | 38.1 | 1.1 | 1.8 | (1) |
| | warm batl | 78.4 | 78.2 | 0.2 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 74.2 | 74.0 | 0.2 | 7.4 | (1) |
| | | 74.2 | 74.0 | 0.2 | 7.4 | (1) |
| | | 74.2 | 74.0 | 0.2 | 7.4 | (1) |
| Pressure (in. Hg) | | 25.25 | 25.23 | 0.02 | 0.25 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 1030 MST -- returned on-line at 1455 DST.
Installed new CR10X datalogger, pressure sensor, enclosure, surge protection, precipitation senor cable and wind sensor cable.

# METEOROLOGICAL STATION AUDIT SUMMARY

**Met Station:** Antelope Coal Company
**Audit Date:** 11-Mar-98

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Insitu WTS-100 | Hg-in-glass thermometer, or thermistor |
| Barometric Pressure (BP): | Insitu WBS-360 | aneroid barometer |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10 & storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.40 | 0.05 | 1.72 | (1) |
| | | 91.60 | 91.65 | 0.05 | 4.58 | (1) |
| WS start torque (gm-cm) | | τ<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 0.3 | 0.3 | 5.0 | (1) |
| | | 90.0 | 91.5 | 1.5 | 5.0 | (1) |
| | | 180.0 | 182.2 | 2.2 | 5.0 | (1) |
| | | 270.0 | 272.1 | 2.1 | 5.0 | (1) |
| WD start torque (gm-cm) | | τ<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ambient | 16.0 | 14.6 | 1.4 | 1.8 | (1) |
| | ice bath | 32.0 | 31.9 | 0.1 | 1.8 | (1) |
| | warm bat | 119.1 | 119.8 | 0.7 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 74.2 | 76.0 | 1.8 | 7.4 | (1) |
| | | 74.2 | 77.0 | 2.8 | 7.4 | (1) |
| | | 74.2 | 76.0 | 1.8 | 7.4 | (1) |
| Pressure (in. Hg) | | 25.47 | 25.51 | 0.04 | N/A | N/A |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 1310 MST -- returned on-line at 1353 MST.

System time, date and battery voltage are OK.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 18-Aug-98

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Insitu WTS-100 | Hg-in-glass thermometer, or thermistor |
| Barometric Pressure (BP): | Insitu WBS-360 | aneroid barometer |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10 & storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.40 | 0.05 | 1.72 | (1) |
| | | 91.60 | 91.65 | 0.05 | 4.58 | (1) |
| WS start torque (gm-cm) | | τ<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 0.1 | 0.1 | 5.0 | (1) |
| | | 90.0 | 88.0 | 2.0 | 5.0 | (1) |
| | | 180.0 | 179.0 | 1.0 | 5.0 | (1) |
| | | 270.0 | 271.0 | 1.0 | 5.0 | (1) |
| WD start torque (gm-cm) | | τ<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ambient | 78.6 | 78.5 | 0.1 | 1.8 | (1) |
| | ice bath | 32.0 | 32.1 | 0.1 | 1.8 | (1) |
| | warm bat | 116.2 | 116.3 | 0.1 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 74.2 | 76.0 | 1.8 | 7.4 | (1) |
| | | 74.2 | 76.0 | 1.8 | 7.4 | (1) |
| | | 74.2 | 76.0 | 1.8 | 7.4 | (1) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 0848 MST -- returned on-line at 0923 MST.
System time, date and battery voltage are OK.

# METEOROLOGICAL STATION AUDIT SUMMARY

|  |  |
|---|---|
| Met Station: | Antelope Coal Company |
| Audit Date: | 9-Mar-99 |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Insitu WTS-100 | Hg-in-glass thermometer, or thermistor |
| Barometric Pressure (BP): | Insitu WBS-360 | aneroid barometer |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10 & storage module | N/A |

## Audit Results

|  |  | Reference | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|
| WS (mph) |  | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
|  |  | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
|  |  | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
|  |  | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
|  |  | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) |  | τ<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) |  | 0.0 | 1.3 | 1.3 | 5.0 | (1) |
|  |  | 90.0 | 90.6 | 0.6 | 5.0 | (1) |
|  |  | 180.0 | 179.8 | 0.2 | 5.0 | (1) |
|  |  | 270.0 | 270.8 | 0.8 | 5.0 | (1) |
| WD start torque (gm-cm) |  | τ<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ambient | 41.9 | 42.0 | 0.1 | 1.8 | (1) |
|  | ice bath | 32.0 | 32.0 | 0.0 | 1.8 | (1) |
|  | warm bat | 177.8 | 117.0 | 60.8 | 1.8 | (1) |
| Precipitation (0.04" equiv.) |  | 74.2 | 76.0 | 1.8 | 7.4 | (1) |
|  |  | 74.2 | 74.0 | 0.2 | 7.4 | (1) |
|  |  | 74.2 | 73.0 | 1.2 | 7.4 | (1) |
| Pressure (in. Hg) |  | 25.1 | 25.23 | 0.13 | 0.25 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 1031 MST -- returned on-line at 1130 MST.

System time, date and battery voltage are OK.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 1-Sep-99

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Insitu WTS-100 | Hg-in-glass thermometer, or thermistor |
| Barometric Pressure (BP): | Insitu WBS-360 | aneroid barometer |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10 & storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | τ<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 1.6 | 1.6 | 5.0 | (1) |
| | | 90.0 | 90.5 | 0.5 | 5.0 | (1) |
| | | 180.0 | 180.0 | 0.0 | 5.0 | (1) |
| | | 270.0 | 269.0 | 1.0 | 5.0 | (1) |
| WD start torque (gm-cm) | | τ<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ambient | 67.0 | 66.3 | 0.7 | 1.8 | (1) |
| | ice bath | 32.2 | 32.3 | 0.1 | 1.8 | (1) |
| | warm bath | 85.3 | 85.3 | 0.0 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 74.2 | 76.0 | 1.8 | 7.4 | (1) |
| | | 74.2 | 74.0 | 0.2 | 7.4 | (1) |
| | | 74.2 | 74.0 | 0.2 | 7.4 | (1) |
| Pressure (in. Hg) | | 25.35 | 25.26 | 0.09 | 0.25 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed in EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 1255 DST -- returned on-line at 1340 DST.
Battery voltage at 13.38.
System operating in daylight savings time.

# METEOROLOGICAL STATION AUDIT SUMMARY

| | |
|---|---|
| Met Station: | Antelope Coal Company |
| Audit Date: | 14-Mar-00 |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Insitu WTS-100 | Hg-in-glass thermometer, or thermistor |
| Barometric Pressure (BP): | Insitu WBS-360 | aneroid barometer |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10 & storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.05 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | τ<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 1.3 | 1.3 | 5.0 | (1) |
| | | 90.0 | 89.0 | 1.0 | 5.0 | (1) |
| | | 180.0 | 179.0 | 1.0 | 5.0 | (1) |
| | | 270.0 | 270.0 | 0.0 | 5.0 | (1) |
| WD start torque (gm-cm) | | τ<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ambient | 44.6 | 44.5 | 0.1 | 1.8 | (1) |
| | ice bath | 32.0 | 32.1 | 0.1 | 1.8 | (1) |
| | warm bath | 112.0 | 111.0 | 1.0 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 74.2 | 77.0 | 2.8 | 7.4 | (1) |
| | | 74.2 | 75.0 | 0.8 | 7.4 | (1) |
| | | 74.2 | 74.3 | 0.1 | 7.4 | (1) |
| Pressure (in. Hg) | | 25.05 | 25.23 | 0.18 | 0.25 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 1105 DST -- returned on-line at 1255 DST.

Battery voltage at 13.64.

System operating in daylight savings time.

# METEOROLOGICAL STATION AUDIT SUMMARY

| | |
|---|---|
| Met Station: | Antelope Coal Company |
| Audit Date: | 12-Sep-00 |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Insitu WTS-100 | Hg-in-glass thermometer, or thermistor |
| Barometric Pressure (BP): | Insitu WBS-360 | aneroid barometer |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10 & storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.05 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | τ<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 0.6 | 0.6 | 5.0 | (1) |
| | | 90.0 | 92.5 | 2.5 | 5.0 | (1) |
| | | 180.0 | 181.9 | 1.9 | 5.0 | (1) |
| | | 270.0 | 271.7 | 1.7 | 5.0 | (1) |
| WD start torque (gm-cm) | | τ<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ambient | 80.2 | 79.2 | 1.0 | 1.8 | (1) |
| | ice bath | 36.7 | 35.6 | 1.1 | 1.8 | (1) |
| | warm bath | 97.0 | 96.0 | 1.0 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 74.2 | 74.0 | 0.2 | 7.4 | (1) |
| | | 74.2 | 74.0 | 0.2 | 7.4 | (1) |
| | | 74.2 | 74.0 | 0.2 | 7.4 | (1) |
| Pressure (in. Hg) | | 25.32 | 25.40 | 0.08 | 0.25 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 1315 DST -- returned on-line at 1414 DST.

Battery voltage at 13.04.

System operating in daylight savings time.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 29-Aug-01
Audit Performed by: D. Black, W. Adler - iml Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor |
| Barometric Pressure (BP): | Vaisala PTB 101B | aneroid barometer |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10X & storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.04 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.50 | 0.06 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | τ<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 1.4 | 1.4 | 5.0 | (1) |
| | | 90.0 | 91.6 | 1.6 | 5.0 | (1) |
| | | 180.0 | 181.6 | 1.6 | 5.0 | (1) |
| | | 270.0 | 270.9 | 0.9 | 5.0 | (1) |
| WD start torque (gm-cm) | | τ<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ambier | 77.6 | 76.0 | 1.6 | 1.8 | (1) |
| | ice bath | 32.8 | 32.8 | 0.0 | 1.8 | (1) |
| | warm batt | 117.8 | 116.1 | 1.7 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 74.2 | 73.5 | 0.7 | 7.4 | (1) |
| | | 74.2 | 73.4 | 0.8 | 7.4 | (1) |
| | | 74.2 | 73.6 | 0.6 | 7.4 | (1) |
| Pressure (in. Hg) | | 25.25 | 25.27 | 0.02 | 0.25 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 1127 MST -- returned on-line at 1240 DST.

Temperature sensor was not working upon arrival. Wire was chewed on and shorted. Spliced wire.

Time was set to Daylight time. At the office, we re-set to Mountain Standard Time. (Time went from 1304 to 1203.)

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 25-Mar-02
Audit Performed by: D. Black, J. Rogers - iml Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor |
| Barometric Pressure (BP): | Vaisala PTB 101B | aneroid barometer |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10X & storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.77 | 3.70 | 0.07 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | τ<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 1.0 | 1.0 | 5.0 | (1) |
| | | 90.0 | 90.9 | 0.9 | 5.0 | (1) |
| | | 180.0 | 180.3 | 0.3 | 5.0 | (1) |
| | | 270.0 | 269.8 | 0.2 | 5.0 | (1) |
| WD start torque (gm-cm) | | τ<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ambient | 15.6 | 16.4 | 0.8 | 1.8 | (1) |
| | ice bath | 32.0 | 31.2 | 0.8 | 1.8 | (1) |
| | warm bath | 82.6 | 81.4 | 1.2 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 74.1 | 71.6 | 2.5 | 7.4 | (1) |
| | | 74.1 | 72.0 | 2.1 | 7.4 | (1) |
| | | 74.1 | 72.0 | 2.1 | 7.4 | (1) |
| Pressure (in. Hg) | | 25.3 | 25.32 | 0.02 | 0.25 | (2) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 1031 MST -- returned on-line at 1101 MST.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 21-Jan-03
Audit Performed by: W. Adler, T. Shaw - iml Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor |
| Barometric Pressure (BP): | Vaisala PTB 101B | aneroid barometer |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10X & storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.50 | 0.06 | 0.56 | (1) |
| | | 9.16 | 9.20 | 0.04 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | τ<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 0.7 | 0.7 | 5.0 | (1) |
| | | 90.0 | 90.5 | 0.5 | 5.0 | (1) |
| | | 180.0 | 179.9 | 0.1 | 5.0 | (1) |
| | | 270.0 | 270.0 | 0.0 | 5.0 | (1) |
| WD start torque (gm-cm) | | τ<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ambient | 18.6 | 19.1 | 0.5 | 1.8 | (1) |
| | ice bath | 79.7 | 79.1 | 0.6 | 1.8 | (1) |
| | warm bath | 31.7 | 32.5 | 0.8 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 74.1 | 74.8 | 0.7 | 7.4 | (1) |
| | | 74.1 | 74.2 | 0.1 | 7.4 | (1) |
| | | 74.1 | 73.8 | 0.3 | 7.4 | (1) |
| Pressure (in. Hg) | | 25.34 | 25.29 | 0.05 | 0.25 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 1336 MST -- returned on-line at 1421 MST.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 30-Jul-03
Audit Performed by: D. Lindberg, K. Jahnke - *iml Air Science*

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor |
| Barometric Pressure (BP): | Vaisala PTB 101B | aneroid barometer |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10X & storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 0.0 | 0.0 | 5.0 | (1) |
| | | 90.0 | 90.0 | 0.0 | 5.0 | (1) |
| | | 180.0 | 180.0 | 0.0 | 5.0 | (1) |
| | | 270.0 | 270.0 | 0.0 | 5.0 | (1) |
| WD start torque (gm-cm) | | t<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ambient | 83.9 | 83.2 | 0.7 | 1.8 | (1) |
| | ice bath | 32.2 | 32.3 | 0.1 | 1.8 | (1) |
| | warm bath | 120.6 | 119.6 | 1.0 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 74.1 | 75.1 | 1.0 | 7.4 | (1) |
| | | 74.1 | 74.8 | 0.7 | 7.4 | (1) |
| | | 74.1 | 73.6 | 0.5 | 7.4 | (1) |
| Pressure (in. Hg) | | 25.46 | 25.43 | 0.03 | 0.25 | (2) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 0940 -- returned on-line at 1044.
Wind Direction adjusted 15 degrees east of south.

## METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 8-Mar-04
Audit Performed by: W. Adler, T. Shaw - *iml Air Science*

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor |
| Barometric Pressure (BP): | Vaisala PTB 101B | aneroid barometer |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10X & storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.13 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 0.4 | 0.4 | 5.0 | (1) |
| | | 90.0 | 90.2 | 0.2 | 5.0 | (1) |
| | | 180.0 | 180.6 | 0.6 | 5.0 | (1) |
| | | 270.0 | 270.3 | 0.3 | 5.0 | (1) |
| WD start torque (gm-cm) | | t<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ambient | 52.8 | 51.2 | 1.6 | 1.8 | (1) |
| | ice bath | 32.6 | 33.0 | 0.4 | 1.8 | (1) |
| | warm bath | 86.8 | 85.7 | 1.1 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 74.1 | 73.2 | 0.9 | 7.4 | (1) |
| | | 74.1 | 73.4 | 0.7 | 7.4 | (1) |
| | | 74.1 | 73.2 | 0.9 | 7.4 | (1) |
| Pressure (in. Hg) | | 25.57 | 25.62 | 0.05 | 0.26 | (2) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 1106 -- returned on-line at 1143.
Precipitation tipping bucket was not registering upon arrival. The connection to the surge protector was re-established and working properly upon departure.
Replaced bearings on wind speed sensor.
The raptor protection needs to be extended another 6 inches.
Will need a new tail next time.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 2-Sep-04
Audit Performed by: K. Jahnke, T. Shaw - *iml Air Science*

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor |
| Barometric Pressure (BP): | Vaisala PTB 101B | aneroid barometer |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10X & storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.13 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.30 | 0.05 | 1.72 | (1) |
| | | 91.60 | 91.51 | 0.09 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 0.1 | 0.1 | 5.0 | (1) |
| | | 90.0 | 89.8 | 0.2 | 5.0 | (1) |
| | | 180.0 | 180.9 | 0.9 | 5.0 | (1) |
| | | 270.0 | 270.2 | 0.2 | 5.0 | (1) |
| WD start torque (gm-cm) | | t<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ambient | 71.5 | 71.0 | 0.5 | 1.8 | (1) |
| | ice water bath | 33.1 | 34.0 | 0.9 | 1.8 | (1) |
| | warm water bath | 126.4 | 125.5 | 0.9 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 74.1 | 73.2 | 0.9 | 7.4 | (1) |
| | | 74.1 | 73.2 | 0.9 | 7.4 | (1) |
| | | 74.1 | 73.2 | 0.9 | 7.4 | (1) |
| Pressure (in. Hg) | | 25.16 | 25.21 | 0.04 | 0.25 | (2) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 0947 -- returned on-line at 1024.
The raptor protection needs to be extended another 6 inches.
A new tail will be installed in the next few weeks.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 22-Mar-05
Audit Performed by: W. Adler, D. Tarver - iml Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor |
| Barometric Pressure (BP): | Vaisala PTB 101B | aneroid barometer |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10X & storage module | N/A |

## Audit Results

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| WS (mph) | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | 34.35 | 34.32 | 0.03 | 1.72 | (1) |
| | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | 0.0 | 0.0 | 0.0 | 5.0 | (1) |
| | 90.0 | 90.2 | 0.2 | 5.0 | (1) |
| | 180.0 | 181.2 | 1.2 | 5.0 | (1) |
| | 270.0 | 270.4 | 0.4 | 5.0 | (1) |
| WD start torque (gm-cm) | t<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) ambient | 42.3 | 40.9 | 1.4 | 1.8 | (1) |
| ice water bath | 33.1 | 34.2 | 1.1 | 1.8 | (1) |
| warm water bath | 125.2 | 123.9 | 1.3 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | 74.1 | 69.0 | 5.1 | 7.4 | (1) |
| | 74.1 | 74.0 | 0.1 | 7.4 | (1) |
| | 74.1 | 75.5 | 1.4 | 7.4 | (1) |
| Pressure (in. Hg) | 25.29 | 25.24 | 0.05 | 0.25 | (2) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 1020 -- returned on-line at 1048.
The raptor protection needs to be extended another 6 inches.
Replaced tail and wind speed bearings.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 27-Sep-05
Audit Performed by: K. Jahnke, T. Shaw - *iml Air Science*

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor |
| Barometric Pressure (BP): | Vaisala PTB 101B | aneroid barometer |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10X & storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.45 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.32 | 0.03 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 0.7 | 0.7 | 5.0 | (1) |
| | | 90.0 | 90.8 | 0.8 | 5.0 | (1) |
| | | 180.0 | 179.9 | 0.1 | 5.0 | (1) |
| | | 270.0 | 271.0 | 1.0 | 5.0 | (1) |
| WD start torque (gm-cm) | | t<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ambient | 79.6 | 81.2 | 1.6 | 1.8 | (1) |
| | ice water bath | 35.8 | 34.4 | 1.4 | 1.8 | (1) |
| | warm water bath | 97.3 | 96.3 | 1.0 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 74.1 | 73.0 | 1.1 | 7.4 | (1) |
| | | 74.1 | 71.2 | 2.9 | 7.4 | (1) |
| | | 74.1 | 70.1 | 4.0 | 7.4 | (1) |
| Pressure (in. Hg) | | 25.22 | 25.28 | 0.06 | 0.25 | (2) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 1020 MST -- returned on-line at 1053 MST.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 7-Mar-06
Audit Performed by: Steven Engel & Tim Mendenhall--IML *Air Science*

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor |
| Barometric Pressure (BP): | Vaisala PTB 101B | aneroid barometer |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10X & storage module | N/A |

## Audit Results

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| WS (mph) | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | 3.44 | 3.48 | 0.05 | 0.56 | (1) |
| | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | 0.0 | 0.8 | 0.8 | 5.0 | (1) |
| | 90.0 | 90.5 | 0.5 | 5.0 | (1) |
| | 180.0 | 181.1 | 1.1 | 5.0 | (1) |
| | 270.0 | 269.8 | 0.2 | 5.0 | (1) |
| WD start torque (gm-cm) | t<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) ambient | 51.2 | 51.4 | 0.2 | 1.8 | (1) |
| ice water bath | 40.6 | 41.4 | 0.8 | 1.8 | (1) |
| warm water bath | 88.5 | 87.9 | 0.6 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | 74.1 | 78.2 | 4.1 | 7.4 | (1) |
| | 74.1 | 76.2 | 2.1 | 7.4 | (1) |
| | 74.1 | 77.2 | 3.1 | 7.4 | (1) |
| Pressure (in. Hg) | 25.08 | 25.07 | 0.01 | 0.25 | (2) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 1139 MST -- returned on-line at 1245 MST.
Replaced windspeed bearings/ Needs O-ring for Youngs/ Precip bucket needs jewel bearings

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 19-Dec-06
Audit Performed by: Shane Hansen and Steven Engel--IML *Air Science*

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor |
| Barometric Pressure (BP): | Vaisala PTB 101B | aneroid barometer |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10X & storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | | |
|---|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) | |
| | | 3.66 | 3.66 | 0.00 | 0.56 | (1) | |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) | |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) | |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) | |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) | |
| WD (degrees) | | 0.0 | 0.4 | 0.4 | 5.0 | (1) | |
| | | 90.0 | 90.4 | 0.4 | 5.0 | (1) | |
| | | 180.0 | 179.5 | 0.5 | 5.0 | (1) | |
| | | 270.0 | 270.4 | 0.4 | 5.0 | (1) | |
| WD start torque (gm-cm) | | t<11.0 | N/A | N/A | 11.0 | (3) | |
| Temperature (°F) | ambient | 31.9 | 31.8 | 0.1 | 1.8 | (1) | |
| | ice water bath | 86.8 | 87.1 | 0.3 | 1.8 | (1) | |
| | warm water bath | 75.6 | 75.7 | 0.1 | 1.8 | (1) | |
| Precipitation (0.1" equiv.) | | 186.0 | 185.0 | 1.0 | 18.5 | (1) | Start Precip:1.09 |
| | | 186.4 | 185.0 | 1.4 | 18.5 | (1) | End Precip: 1.51 |
| | | 186.8 | 185.0 | 1.8 | 18.5 | (1) | |
| Pressure (in. Hg) | | 25.42 | 25.40 | 0.02 | 0.25 | (2) | |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

## Notes, Recommendations

System offline at 0950 mdt and online at 1040 mdt

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 22-Mar-07
Audit Performed by: Kevin Jahnke and Steven Engel--*IML Air Science*

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor |
| Barometric Pressure (BP): | Vaisala PTB 101B | aneroid barometer |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10X & storage module | N/A |

## Audit Results

| | Reference | DAS Value | \|Difference\| | Specification | | |
|---|---|---|---|---|---|---|
| WS (mph) | 0.00 | 0.00 | 0.00 | 0.56 | (1) | |
| | 3.44 | 3.44 | 0.00 | 0.56 | (1) | |
| | 9.16 | 9.16 | 0.00 | 0.56 | (1) | |
| | 34.35 | 34.35 | 0.00 | 1.72 | (1) | |
| | 91.60 | 91.60 | 0.00 | 4.58 | (1) | |
| WS start torque (gm-cm) | t<0.2 | N/A | N/A | 1.0 | (3) | |
| WD (degrees) | 0.0 | 0.4 | 0.4 | 5.0 | (1) | |
| | 90.0 | 90.4 | 0.4 | 5.0 | (1) | |
| | 180.0 | 179.5 | 0.5 | 5.0 | (1) | |
| | 270.0 | 270.4 | 0.4 | 5.0 | (1) | |
| WD start torque (gm-cm) | t<11.0 | N/A | N/A | 11.0 | (3) | |
| Temperature (°F) hot water bath | 121.5 | 120.1 | 1.4 | 1.8 | (1) | |
| ice water bath | 33.2 | 33.0 | 0.2 | 1.8 | (1) | |
| warm water bath | 56.0 | 56.4 | 0.4 | 1.8 | (1) | |
| Precipitation (0.1" equiv.) | 182.2 | 185.2 | 3.0 | 18.5 | (1) | Start Precip:1.68 |
| | 182.6 | 185.2 | 2.6 | 18.5 | (1) | End Precip: 2.01 |
| | 182.0 | 185.2 | 3.2 | 18.5 | (1) | |
| Pressure (in. Hg) | 25.21 | 25.22 | 0.01 | 0.25 | (2) | |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

## Notes, Recommendations

System offline at 0948 MST and online at 1107 MST

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 10-Jul-07
Audit Performed by: Kevin Jahnke and Steven Engel--IML Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor |
| Barometric Pressure (BP): | Vaisala PTB 101B | aneroid barometer |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10X & storage module | N/A |

## Audit Results

| | Reference | DAS Value | \|Difference\| | Specification | | |
|---|---|---|---|---|---|---|
| WS (mph) | 0.00 | 0.00 | 0.00 | 0.56 | (1) | |
| | 3.44 | 3.44 | 0.00 | 0.56 | (1) | |
| | 9.16 | 9.16 | 0.00 | 0.56 | (1) | |
| | 34.35 | 34.35 | 0.00 | 1.72 | (1) | |
| | 91.60 | 91.60 | 0.00 | 4.58 | (1) | |
| WS start torque (gm-cm) | t<0.2 | N/A | N/A | 1.0 | (3) | |
| WD (degrees) | 0.0 | 0.1 | 0.1 | 5.0 | (1) | |
| | 90.0 | 90.1 | 0.1 | 5.0 | (1) | |
| | 180.0 | 180.5 | 0.5 | 5.0 | (1) | |
| | 270.0 | 270.0 | 0.0 | 5.0 | (1) | |
| WD start torque (gm-cm) | t<11.0 | N/A | N/A | 11.0 | (3) | |
| Temperature (°F) hot water bath | 90.1 | 89.5 | 0.6 | 0.9 | (1) | |
| ice water bath | 37.6 | 37.3 | 0.3 | 0.9 | (1) | |
| warm water bath | 67.3 | 67.2 | 0.1 | 0.9 | (1) | |
| Precipitation (0.1" equiv.) | 181.2 | 185.2 | 4.0 | 18.5 | (1) | Start Precip:5.32 |
| | 183.4 | 185.2 | 1.8 | 18.5 | (1) | End Precip:5.62 |
| | 182.6 | 185.2 | 2.6 | 18.5 | (1) | |
| Pressure (in. Hg) | 25.43 | 25.46 | 0.03 | 0.25 | (2) | |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

## Notes, Recommendations

System offline at 1348 MST and online at 1425 MST

# METEOROLOGICAL STATION AUDIT SUMMARY

| | |
|---|---|
| Met Station: | Antelope Coal Company |
| Audit Date: | 11-Mar-08 |
| Audit Performed by: | Shane Hansen and Steven Engel--IML Air Science |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor |
| Barometric Pressure (BP): | Vaisala PTB 101B | aneroid barometer |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10X & storage module | N/A |

## Audit Results

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| WS (mph) | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | 0.0 | 0.0 | 0.0 | 5.0 | (1) |
| | 90.0 | 90.0 | 0.0 | 5.0 | (1) |
| | 180.0 | 179.2 | 0.8 | 5.0 | (1) |
| | 270.0 | 269.1 | 0.9 | 5.0 | (1) |
| WD start torque (gm-cm) | t<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) hot water bath | 114.9 | 114.4 | 0.5 | 0.9 | (1) |
| ice water bath | 32.1 | 32.6 | 0.5 | 0.9 | (1) |
| warm water bath | 67.7 | 67.6 | 0.1 | 0.9 | (1) |
| Precipitation (0.1" equiv.) | 183.7 | 185.2 | 1.5 | 18.5 | (1) |
| | 183.9 | 185.2 | 1.3 | 18.5 | (1) |
| | 182.9 | 185.2 | 2.3 | 18.5 | (1) |
| Pressure (in. Hg) | 25.31 | 25.32 | 0.01 | 0.25 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

## Notes, Recommendations

System offline at 1202 MST and online at 1250 MST

# METEOROLOGICAL STATION AUDIT SUMMARY

| | |
|---|---|
| Met Station: | Antelope Coal Company |
| Audit Date: | 31-Mar-09 |
| Audit Performed by: | R. Campbell, M. Butler -- IML Air Science |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor |
| Barometric Pressure (BP): | Vaisala PTB 101B | aneroid barometer |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR1000 | N/A |

## Audit Results

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| WS (mph) | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | 0.0 | 0.5 | 0.5 | 5.0 | (1) |
| | 90.0 | 90.5 | 0.5 | 5.0 | (1) |
| | 180.0 | 180.8 | 0.8 | 5.0 | (1) |
| | 270.0 | 271.3 | 1.3 | 5.0 | (1) |
| WD start torque (gm-cm) | t<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) hot water bath | 95.3 | 95.0 | 0.3 | 0.9 | (1) |
| ice water bath | 31.9 | 31.9 | 0.0 | 0.9 | (1) |
| warm water bath | 83.9 | 83.5 | 0.3 | 0.9 | (1) |
| Precipitation (0.1" equiv.) | 188.0 | 185.2 | 2.8 | 18.5 | (1) |
| | 186.0 | 185.2 | 0.8 | 18.5 | (1) |
| | 186.0 | 185.2 | 0.8 | 18.5 | (1) |
| Pressure (in. Hg) | 24.98 | 25.00 | 0.02 | 0.09 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

## Notes, Recommendations

System offline at 1200 MST and returned online at 1316 MST.
Replaced bearings, replaced prop

# METEOROLOGICAL STATION AUDIT SUMMARY

| | |
|---|---|
| Met Station: | Antelope Coal Company |
| Audit Date: | 17-Sep-09 |
| Audit Performed by: | R. Campbell, J. Goldsmith -- IML Air Science |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor |
| Barometric Pressure (BP): | Vaisala PTB 101B | aneroid barometer |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR1000 | N/A |

## Audit Results

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| WS (mph) | 0.00 | N/A | N/A | 0.56 | (1) |
| | 3.44 | N/A | N/A | 0.56 | (1) |
| | 9.16 | N/A | N/A | 0.56 | (1) |
| | 34.35 | N/A | N/A | 1.72 | (1) |
| | 91.60 | N/A | N/A | 4.58 | (1) |
| WS start torque (gm-cm) | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | 0.0 | N/A | N/A | 5.0 | (1) |
| | 90.0 | N/A | N/A | 5.0 | (1) |
| | 180.0 | N/A | N/A | 5.0 | (1) |
| | 270.0 | N/A | N/A | 5.0 | (1) |
| WD start torque (gm-cm) | t<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) hot water bath | 110.7 | 109.3 | **1.4** | 0.9 | (1) |
| ice water bath | 32.3 | 32.8 | 0.5 | 0.9 | (1) |
| warm water bath | 71.5 | 70.8 | 0.7 | 0.9 | (1) |
| Precipitation (0.1" equiv.) | 187.1 | 185.2 | 1.9 | 18.5 | (1) |
| | 184.8 | 185.2 | 0.4 | 18.5 | (1) |
| | 185.5 | 185.2 | 0.3 | 18.5 | (1) |
| Pressure (in. Hg) | 25.5 | 25.47 | 0.03 | 0.09 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

## Notes, Recommendations

System offline at 0807 MST and returned online at 0844 MST.

Wind speed and wind direction audit was not completed due to safety concerns.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 31-Mar-10
Audit Performed By: M. Butler, R. Campbell -- IML Air Science

| Sensor | Mfr./Model | Reference Device | Serial ID |
|---|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz drive motor | IML 0855 |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass | IML 0942 |
| Temperature (T): | Fenwal 107 | Digital Thermistor | IML 0888 |
| Barometric Pressure (BP): | Vaisala PTB 101B | aneroid barometer | IML 0904 |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette | N/A |
| Data acquisition system (DAS): | Campbell Scientific CR1000 | N/A | N/A |

## Audit Results

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| WS (mph) | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | 0.0 | 0.1 | 0.1 | 5.0 | (1) |
| | 90.0 | 90.4 | 0.4 | 5.0 | (1) |
| | 180.0 | 179.5 | 0.5 | 5.0 | (1) |
| | 270.0 | 270.3 | 0.3 | 5.0 | (1) |
| WD start torque (gm-cm) | t<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) hot water bath | 148.4 | 147.7 | 0.7 | 0.9 | (1) |
| ice water bath | 31.9 | 32.0 | 0.1 | 0.9 | (1) |
| warm water bath | 85.5 | 85.3 | 0.2 | 0.9 | (1) |
| Precipitation (0.1" equiv.) | 178.6 | 185.3 | 6.7 | 18.5 | (1) |
| | 183.0 | 185.3 | 2.3 | 18.5 | (1) |
| | 182.6 | 185.3 | 2.7 | 18.5 | (1) |
| Pressure (in. Hg) | 25.01 | 24.99 | 0.02 | 0.09 | (2) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

## Notes, Recommendations

System taken offline at 08:30 MST and returned online at 09:24 MST.
Changed wind speed bearings.

## After Adjustment

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| WS (mph) | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | 91.60 | 91.60 | 0.00 | 4.58 | (1) |

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 22-Sep-10
Audit Performed By: M. Butler, J. Masters -- IML Air Science

| Sensor | Mfr./Model | Reference Device | Serial ID |
|---|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz drive motor | IML 0896 |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass | IML 0942 |
| Temperature (T): | Fenwal 107 | Digital Thermistor | IML 0885 |
| Barometric Pressure (BP): | Vaisala PTB 101B | aneroid barometer | IML 1404 |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette | N/A |
| Data acquisition system (DAS): | Campbell Scientific CR1000 | N/A | N/A |

## Audit Results

| | Reference | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | 0 | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | 300 | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | 800 | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | 3000 | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | 8000 | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| Crossarm Alignment (°) | | 266.0 | 264.0 | 2.0 | 5.0 | (2) |
| WS start torque (gm-cm) | | 1.0 | t<1.0 | N/A | 1.0 | (3) |
| WD (degrees) | Clockwise | 0.0 | 0.2 | 0.2 | 5.0 | (1) |
| | | 90.0 | 88.7 | 1.3 | 5.0 | (1) |
| | | 180.0 | 180.4 | 0.4 | 5.0 | (1) |
| | | 270.0 | 270.7 | 0.7 | 5.0 | (1) |
| | Counter Clockwise | 0.0 | 2.1 | 2.1 | 5.0 | (1) |
| | | 90.0 | 89.6 | 0.4 | 5.0 | (1) |
| | | 180.0 | 179.6 | 0.4 | 5.0 | (1) |
| | | 270.0 | 270.1 | 0.1 | 5.0 | (1) |
| WD start torque (gm-cm) | Clockwise | 11.0 | t<11.0 | N/A | 11.0 | (3) |
| | Counter Clockwise | 11.0 | t<11.0 | N/A | 11.0 | (3) |
| Temperature (°F) | | 32.5 | 32.9 | 0.4 | 0.9 | (1) |
| | | 70.4 | 70.5 | 0.1 | 0.9 | (1) |
| | | 92.3 | 92.2 | 0.1 | 0.9 | (1) |
| Precipitation (0.1" equiv.) | | 186.0 | 185.3 | 0.7 | 18.5 | (1) |
| | | 183.8 | 185.3 | 1.5 | 18.5 | (1) |
| | | 183.6 | 185.3 | 1.7 | 18.5 | (1) |
| Pressure (in. Hg) | | 25.05 | 25.07 | 0.02 | 0.09 | (2) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorological Measurements Version 2.0, 2008
(3)= Manufacturer's Specifications

## Notes, Recommendations

System taken offline at 07:42 MST and returned online at 08:26 MST.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 25-Mar-11
Audit Performed By: M. Butler, J. Masters -- IML Air Science

| Sensor | Mfr./Model | Reference Device | Serial ID |
|---|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz drive motor | IML 0896 |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass | IML 0900 |
| Temperature (T): | Fenwal 107 | Digital Thermistor | IML 1403 |
| Barometric Pressure (BP): | Vaisala PTB 101B | aneroid barometer | IML 1404 |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette | N/A |
| Data acquisition system (DAS): | Campbell Scientific CR1000 | N/A | N/A |

## Audit Results

| | | Reference | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|---|
| WS (mph) | | 0 | 0.00 | 0.00 | 0.00 | 0.45 | (1) |
| | | 300 | 3.44 | 3.44 | 0.00 | 0.45 | (1) |
| | | 800 | 9.16 | 9.16 | 0.00 | 0.45 | (1) |
| | | 3000 | 34.35 | 34.35 | 0.00 | 0.45 | (1) |
| | | 8000 | 91.60 | 91.60 | 0.00 | 0.45 | (1) |
| Crossarm Alignment (°) | | | 85.0 | 83.6 | 1.4 | 5.0 | (2) |
| WS start torque (gm-cm) | | | 1.0 | t<1.0 | N/A | 1.0 | (3) |
| WD (degrees) | Clockwise | | 0.0 | 0.1 | 0.1 | 5.0 | (1) |
| | | | 90.0 | 90.7 | 0.7 | 5.0 | (1) |
| | | | 180.0 | 179.7 | 0.3 | 5.0 | (1) |
| | | | 270.0 | 269.1 | 0.9 | 5.0 | (1) |
| | Counter Clockwise | | 0.0 | 0.1 | 0.1 | 5.0 | (1) |
| | | | 90.0 | 90.2 | 0.2 | 5.0 | (1) |
| | | | 180.0 | 180.9 | 0.9 | 5.0 | (1) |
| | | | 270.0 | 269.7 | 0.3 | 5.0 | (1) |
| WD start torque (gm-cm) | Clockwise | | 11.0 | t<11.0 | N/A | 11.0 | (3) |
| | Counter Clockwise | | 11.0 | t<11.0 | N/A | 11.0 | (3) |
| Temperature (°F) | | | 32.8 | 32.7 | 0.1 | 0.9 | (1) |
| | | | 51.6 | 51.6 | 0.0 | 0.9 | (1) |
| | | | 122.5 | 122.4 | 0.2 | 0.9 | (1) |
| Precipitation (0.1" equiv.) | | | 170.0 | 185.3 | 15.3 | 18.5 | (1) |
| | | | 178.2 | 185.3 | 7.1 | 18.5 | (1) |
| | | | 178.4 | 185.3 | 6.9 | 18.5 | (1) |
| Pressure (in. Hg) | | | 24.95 | 25.03 | 0.08 | 0.09 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorological Measurements Version 2.0, 2008

(3)= Manufacturer's Specifications

## Notes, Recommendations

System taken offline at 08:22 MST and returned online at 09:06 MST.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 22-Sep-11
Audit Performed By: Z. Heid, J. Masters -- IML Air Science

| Sensor | Mfr./Model | Reference Device | Serial ID |
|---|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz drive motor | IML 0896 |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass | IML 0894 |
| Temperature (T): | Fenwal 107 | Digital Thermistor | IML 1411 |
| Barometric Pressure (BP): | Vaisala PTB 101B | aneroid barometer | IML 0968 |
| Precipitation (Ppt.): | Met One 12" tipping bucket with WY screen | lab grade burette | N/A |
| Data acquisition system (DAS): | Campbell Scientific CR1000 | N/A | N/A |

## Audit Results

| | Reference RPM | Reference MPH | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | 0 | 0.00 | 0.00 | 0.00 | 0.45 | (1) |
| | 300 | 3.44 | 3.44 | 0.00 | 0.45 | (1) |
| | 800 | 9.16 | 9.16 | 0.00 | 0.45 | (1) |
| | 3000 | 34.35 | 34.35 | 0.00 | 0.45 | (1) |
| | 8000 | 91.60 | 91.60 | 0.00 | 0.45 | (1) |
| Crossarm Alignment (°) | | 87.0 | 87.0 | 0.0 | 5.0 | (2) |
| WS start torque (gm-cm) | | 1.0 | t<1.0 | N/A | 1.0 | (3) |
| WD (degrees) | Clockwise | 0.0 | 0.1 | 0.1 | 5.0 | (1) |
| | | 90.0 | 89.3 | 0.7 | 5.0 | (1) |
| | | 180.0 | 179.7 | 0.3 | 5.0 | (1) |
| | | 270.0 | 270.4 | 0.4 | 5.0 | (1) |
| | Counter Clockwise | 0.0 | 0.1 | 0.1 | 5.0 | (1) |
| | | 90.0 | 89.6 | 0.4 | 5.0 | (1) |
| | | 180.0 | 179.7 | 0.3 | 5.0 | (1) |
| | | 270.0 | 270.4 | 0.4 | 5.0 | (1) |
| WD start torque (gm-cm) | Clockwise | 11.0 | t<11.0 | N/A | 11.0 | (3) |
| | Counter Clockwise | 11.0 | t<11.0 | N/A | 11.0 | (3) |
| Temperature (°F) | | 130.0 | 129.6 | 0.4 | 0.9 | (1) |
| | | 66.2 | 66.2 | 0.0 | 0.9 | (1) |
| | | 31.9 | 32.1 | 0.2 | 0.9 | (1) |
| Precipitation (0.1" equiv.) | | 186.0 | 185.3 | 0.7 | 18.5 | (1) |
| | | 179.4 | 185.3 | 5.9 | 18.5 | (1) |
| | | 185.2 | 185.3 | 0.1 | 18.5 | (1) |
| Pressure (in. Hg) | | 25.42 | 25.40 | 0.02 | 0.09 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorological Measurements Version 2.0, 2008

(3)= Manufacturer's Specifications

## Notes, Recommendations

System taken offline at 08:01 MST and returned online at 08:33 MST.

# Buckskin Mine Meteorological Station Audit Reports

# METEOROLOGICAL STATION AUDIT SUMMARY

| | |
|---|---|
| Met Station: | Buckskin Mine |
| Audit Date: | 10-Feb-97 |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | CSci 107 thermistor with 6-plate shield | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Met One, Inc. 12 " tipping bucket | lab grade burette |
| Data acquisition system (DAS): | CSci CR-10 datalogger with storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.43 | 0.01 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.44 | 0.09 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<1.0 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 1.7 | 1.7 | 5.0 | (1) |
| | | 90.0 | 89.0 | 1.0 | 5.0 | (1) |
| | | 180.0 | 179.0 | 1.0 | 5.0 | (1) |
| | | 270.0 | 271.0 | 1.0 | 5.0 | (1) |
| WD start torque, CW (gm-cm) | | N/A | N/A | N/A | 9.0 | (3) |
| WD start torque, CCW (gm-cm) | | N/A | N/A | N/A | 9.0 | (3) |
| Temperature (°F) | ambient | 68.0 | 68.5 | 0.5 | 1.8 | (1) |
| | ice bath | 32.0 | 32.0 | 0.0 | 1.8 | (1) |
| | warm bath | 109.4 | 109.4 | 0.0 | 1.8 | (1) |
| Precipitation (0.05" equiv.) | | 92.7 | 94 | 1.3 | 9.3 | (1) |
| | | 92.7 | 93 | 0.3 | 9.3 | (1) |
| | | 92.7 | 95 | 2.3 | 9.3 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

## Notes, Recommendations

Replaced wind speed bearings.

Inaccurate styrofoam propeller on anemometer, replaced with correct propeller on 2/17/96.

Heater in precipitation gauge not working.

System taken off-line at 1545 MST -- returned on-line at 1645 MST

# METEOROLOGICAL STATION AUDIT SUMMARY

| | |
|---|---|
| Met Station: | Buckskin Mine |
| Audit Date: | 13-Aug-97 |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | CSI 107 thermistor with 6-plate shield | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Met One, Inc. 12 " tipping bucket | lab grade burette |
| Data acquisition system (DAS): | CSI CR-10 datalogger with storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 5.0 | 5.0 | 5.0 | (1) |
| | | 90.0 | 90.0 | 0.0 | 5.0 | (1) |
| | | 180.0 | 180.0 | 0.0 | 5.0 | (1) |
| | | 270.0 | 270.0 | 0.0 | 5.0 | (1) |
| WD start torque, CW (gm-cm) | | OK | N/A | N/A | 9.0 | (3) |
| WD start torque, CCW (gm-cm) | | OK | N/A | N/A | 9.0 | (3) |
| Temperature (°F) | ambient | 70.6 | 72.9 | **2.3** | 1.8 | (1) |
| | ice bath | 32.0 | 32.2 | 0.2 | 1.8 | (1) |
| | warm bath | 91.3 | 91.2 | 0.1 | 1.8 | (1) |
| Precipitation (0.08" equiv.) | | 148.3 | 85.8 | **62.5** | 14.8 | (1) |
| | | 148.3 | 81.0 | **67.3** | 14.8 | (1) |
| | | 148.3 | 82.4 | **65.9** | 14.8 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

## Notes, Recommendations

System taken off-line at 1530 MST – returned on-line at 1558MST

Day was sunny and still, ambient temperature reading difference of 2.3°F is not out of control

Precipitation gauge was found to be greatly overestimating precipitation. Gauge was dissassembled and one bucket was found to be filled with a sticky dirt, throwing the balance off the tipping buckets. Gauge was cleaned, and then found to be measuring accurately. It is not known how long gauge was dirty, and overestimating precipitation.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 19-Mar-98

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | CSI 107 thermistor with 6-plate shield | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Met One, Inc. 12 " tipping bucket | lab grade burette |
| Data acquisition system (DAS): | CSI CR-10 datalogger with storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.43 | 0.08 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 0.0 | 0.0 | 5.0 | (1) |
| | | 90.0 | 90.2 | 0.2 | 5.0 | (1) |
| | | 180.0 | 179.4 | 0.6 | 5.0 | (1) |
| | | 270.0 | 271.0 | 1.0 | 5.0 | (1) |
| WD start torque, CW (gm-cm) | | OK | N/A | N/A | 9.0 | (3) |
| WD start torque, CCW (gm-cm) | | OK | N/A | N/A | 9.0 | (3) |
| Temperature (°F) | ambient | 33.1 | 33.4 | 0.3 | 1.8 | (1) |
| | ice bath | 32.0 | 32.5 | 0.5 | 1.8 | (1) |
| | warm bath | 103.5 | 104.2 | 0.7 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 74.1 | 76.0 | 1.9 | 7.4 | (2) |
| | | 74.1 | 74.0 | 0.1 | 7.4 | (2) |
| | | 74.1 | 74.0 | 0.1 | 7.4 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

## Notes, Recommendations

System taken off-line at 1553 MST -- returned on-line at 1625 MST

Installed new wind speed bearings

2.29" precipitation since last reset

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 28-Sep-98

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | CSI 107 thermistor with 6-plate shield | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Met One, Inc. 12 " tipping bucket | lab grade burette |
| Data acquisition system (DAS): | CSI CR-10 datalogger with storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 2.9 | 2.9 | 5.0 | (1) |
| | | 90.0 | 89.5 | 0.5 | 5.0 | (1) |
| | | 180.0 | 180.8 | 0.8 | 5.0 | (1) |
| | | 270.0 | 272.0 | 2.0 | 5.0 | (1) |
| WD start torque, CW (gm-cm) | | OK | N/A | N/A | 9.0 | (3) |
| WD start torque, CCW (gm-cm) | | OK | N/A | N/A | 9.0 | (3) |
| Temperature (°F) | ambient | 68.4 | 68.0 | 0.4 | 1.8 | (1) |
| | ice bath | 32.0 | 33.2 | 1.2 | 1.8 | (1) |
| | warm bath | 90.0 | 89.6 | 0.4 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 74.1 | 74.0 | 0.1 | 7.4 | (2) |
| | | 74.1 | 74.0 | 0.1 | 7.4 | (2) |
| | | 74.1 | 74.0 | 0.1 | 7.4 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed in EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

## Notes, Recommendations

System taken off-line at 0840 MST -- returned on-line at 0903 MST

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 9-Mar-99

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | CSI 107 thermistor with 6-plate shield | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Met One, Inc. 12 " tipping bucket | lab grade burette |
| Data acquisition system (DAS): | CSI CR-10 datalogger with storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 2.0 | 2.0 | 5.0 | (1) |
| | | 90.0 | 90.0 | 0.0 | 5.0 | (1) |
| | | 180.0 | 178.0 | 2.0 | 5.0 | (1) |
| | | 270.0 | 269.0 | 1.0 | 5.0 | (1) |
| WD start torque, CW (gm-cm) | | OK | N/A | N/A | 9.0 | (3) |
| WD start torque, CCW (gm-cm) | | OK | N/A | N/A | 9.0 | (3) |
| Temperature (°F) | ambient | 41.7 | 41.6 | 0.1 | 1.8 | (1) |
| | ice bath | 34.5 | 34.3 | 0.2 | 1.8 | (1) |
| | warm bath | 69.9 | 70.5 | 0.6 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 74.1 | 73.5 | 0.6 | 7.4 | (2) |
| | | 74.1 | 75.0 | 0.9 | 7.4 | (2) |
| | | 74.1 | 75.0 | 0.9 | 7.4 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

## Notes, Recommendations

System taken off-line at 1620 MST -- returned on-line at 1655 MST
Time was 15 minutes too slow

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 23-Sep-99

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | CSI 107 thermistor with 6-plate shield | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Met One, Inc. 12 " tipping bucket | lab grade burette |
| Data acquisition system (DAS): | CSI CR-10 datalogger with storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 1.0 | 1.0 | 5.0 | (1) |
| | | 90.0 | 89.0 | 1.0 | 5.0 | (1) |
| | | 180.0 | 179.0 | 1.0 | 5.0 | (1) |
| | | 270.0 | 269.7 | 0.3 | 5.0 | (1) |
| WD start torque, CW (gm-cm) | | OK | N/A | N/A | 9.0 | (3) |
| WD start torque, CCW (gm-cm) | | OK | N/A | N/A | 9.0 | (3) |
| Temperature (°F) | ambient | 82.2 | 82.1 | 0.1 | 1.8 | (1) |
| | ice bath | 40.8 | 40.9 | 0.1 | 1.8 | (1) |
| | warm bath | 87.0 | 86.8 | 0.2 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 74.1 | 74.0 | 0.1 | 7.4 | (2) |
| | | 74.1 | 75.0 | 0.9 | 7.4 | (2) |
| | | 74.1 | 74.0 | 0.1 | 7.4 | (2) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed in EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

## Notes, Recommendations

System taken off-line at 1605 MST -- returned on-line at 1640 MST
2.43" precipitation since last reset

# METEOROLOGICAL STATION AUDIT SUMMARY

| | |
|---|---|
| Met Station: | Buckskin Mine |
| Audit Date: | 16-Mar-00 |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | CSI 107 thermistor with 6-plate shield | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Met One, Inc. 12 " tipping bucket | lab grade burette |
| Data acquisition system (DAS): | CSI CR-10 datalogger with storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 0.5 | 0.5 | 5.0 | (1) |
| | | 90.0 | 89.2 | 0.8 | 5.0 | (1) |
| | | 180.0 | 179.5 | 0.5 | 5.0 | (1) |
| | | 270.0 | 270.3 | 0.3 | 5.0 | (1) |
| WD start torque, CW (gm-cm) | | OK | N/A | N/A | 9.0 | (3) |
| WD start torque, CCW (gm-cm) | | OK | N/A | N/A | 9.0 | (3) |
| Temperature (°F) | ambient | 50.2 | 50.1 | 0.1 | 1.8 | (1) |
| | ice bath | 32.0 | 32.4 | 0.4 | 1.8 | (1) |
| | warm bath | 111.0 | 110.8 | 0.2 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 74.1 | 75.0 | 0.9 | 7.4 | (2) |
| | | 74.1 | 75.0 | 0.9 | 7.4 | (2) |
| | | 74.1 | 75.0 | 0.9 | 7.4 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

## Notes, Recommendations

System taken off-line at 1655 MST -- returned on-line at 1730 MST

Replaced tail and wind speed bearings.

# METEOROLOGICAL STATION AUDIT SUMMARY

| | |
|---|---|
| Met Station: | Buckskin Mine |
| Audit Date: | 13-Sep-00 |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | CSI 107 thermistor with 6-plate shield | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Met One, Inc. 12 " tipping bucket | lab grade burette |
| Data acquisition system (DAS): | CSI CR-10 datalogger with storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 211.0 | **211.0** | 5.0 | (1) |
| | | 90.0 | 230.0 | **140.0** | 5.0 | (1) |
| | | 180.0 | 250.0 | **70.0** | 5.0 | (1) |
| | | 270.0 | 273.0 | 3.0 | 5.0 | (1) |
| WD start torque, CW (gm-cm) | | OK | N/A | N/A | 9.0 | (3) |
| WD start torque, CCW (gm-cm) | | OK | N/A | N/A | 9.0 | (3) |
| Temperature (°F) | ambient | 74.5 | 74.3 | 0.2 | 1.8 | (1) |
| | ice bath | 32.0 | 32.9 | 0.9 | 1.8 | (1) |
| | warm bath | 101.1 | 100.9 | 0.2 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 74.1 | 76.8 | 2.7 | 7.4 | (2) |
| | | 74.1 | 74.7 | 0.6 | 7.4 | (2) |
| | | 74.1 | 74.4 | 0.3 | 7.4 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1995

(3)= Manufacturer's Specifications

## Notes, Recommendations

System taken off-line at 0801 MST -- returned on-line at 1339 MST

A new PROM upgrading the logger software capabilities was installed in the logger

The system evidentally had taken a lightining strike sometime prior to arrival

Precipitation was not being recorded by logger, and wind direction was not working

Bypassing the "fried" signal surge protection corrected the lack of a precipitation signal reaching the logger

New signal surge protection will be installed during an upcoming visit

Replacement of the wind direction potentiometer an vertical wind direction bearings fixed the erroneous wind direction readings

All sensors were audited again and operating properly at the conclusion of the service

# METEOROLOGICAL STATION AUDIT SUMMARY

| | |
|---|---|
| Met Station: | Buckskin Mine |
| Audit Date: | 10-Mar-04 |
| Audit Performed by: | J. Rogers, K. Jahnke - iml Air Science |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | CSI 107 thermistor with 6-plate shield | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Met One, Inc. 12 " tipping bucket | lab grade burette |
| Data acquisition system (DAS): | CSI CR-10 datalogger with storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 0.1 | 0.1 | 5.0 | (1) |
| | | 90.0 | 90.8 | 0.8 | 5.0 | (1) |
| | | 180.0 | 180.7 | 0.7 | 5.0 | (1) |
| | | 270.0 | 270.4 | 0.4 | 5.0 | (1) |
| WD start torque, CW (gm-cm) | | OK | N/A | N/A | 9.0 | (3) |
| WD start torque, CCW (gm-cm) | | OK | N/A | N/A | 9.0 | (3) |
| Temperature (°F) | ambient | 38.7 | 38.4 | 0.3 | 1.8 | (1) |
| | ice bath | 32.1 | 32.4 | 0.3 | 1.8 | (1) |
| | warm bath | 74.2 | 73.0 | 1.2 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 74.1 | 73.2 | 0.9 | 7.4 | (2) |
| | | 74.1 | 74.2 | 0.1 | 7.4 | (2) |
| | | 74.1 | 74.4 | 0.3 | 7.4 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1995

(3)= Manufacturer's Specifications

## Notes, Recommendations

System taken off-line at 1337 -- returned on-line at 1403.

# METEOROLOGICAL STATION AUDIT SUMMARY

| | |
|---|---|
| Met Station: | Buckskin Mine |
| Audit Date: | 2-Sep-04 |
| Audit Performed by: | T. Shaw, W. Adler - iml Air Science |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | transit, compass |
| Temperature (T): | CSI 107 thermistor with 6-plate shield | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Met One, Inc. 12 " tipping bucket | lab grade burette |
| Data acquisition system (DAS): | CSI CR-10 datalogger with storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.20 | 0.40 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 0.2 | 0.2 | 5.0 | (1) |
| | | 90.0 | 90.0 | 0.0 | 5.0 | (1) |
| | | 180.0 | 180.1 | 0.1 | 5.0 | (1) |
| | | 270.0 | 270.1 | 0.1 | 5.0 | (1) |
| WD start torque, CW (gm-cm) | | OK | N/A | N/A | 9.0 | (3) |
| WD start torque, CCW (gm-cm) | | OK | N/A | N/A | 9.0 | (3) |
| Temperature (°F) | ambient | 74.4 | 73.4 | 1.0 | 1.8 | (1) |
| | ice water bath | 32.8 | 32.7 | 0.1 | 1.8 | (1) |
| | warm water bath | 111.3 | 111.2 | 0.1 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 74.1 | 75.4 | 1.3 | 7.4 | (2) |
| | | 74.1 | 75.8 | 1.7 | 7.4 | (2) |
| | | 74.1 | 74.4 | 0.3 | 7.4 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1995

(3)= Manufacturer's Specifications

## Notes, Recommendations

System taken off-line at 1551 – returned on-line at 1612.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 31-Mar-05
Audit Performed by: K. Jahnke, D. Tarver - iml Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor |
| Precipitation (Ppt.): | Met One 12" tipping bucket with wind screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10X & storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 0.1 | 0.1 | 5.0 | (1) |
| | | 90.0 | 90.0 | 0.0 | 5.0 | (1) |
| | | 180.0 | 180.8 | 0.8 | 5.0 | (1) |
| | | 270.0 | 271.4 | 1.4 | 5.0 | (1) |
| WD start torque (gm-cm) | | t<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ambient | 47.0 | 46.9 | 0.1 | 1.8 | (1) |
| | ice water bath | 33.7 | 32.7 | 1.0 | 1.8 | (1) |
| | warm water bath | 84.5 | 84.5 | 0.0 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 75.0 | 74.1 | 0.9 | 7.4 | (1) |
| | | 73.8 | 74.1 | 0.3 | 7.4 | (1) |
| | | 76.2 | 74.1 | 2.1 | 7.4 | (1) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed in EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 1601 -- returned on-line at 1700.
Replaced tail and wind speed bearings.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 30-Sep-05
Audit Performed by: B. Hanewald, T. Shaw - *iml Air Science*

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor |
| Precipitation (Ppt.): | Met One 12" tipping bucket with wind screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10X & storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | -0.5 | 0.5 | 5.0 | (1) |
| | | 90.0 | 89.9 | 0.1 | 5.0 | (1) |
| | | 180.0 | 179.8 | 0.2 | 5.0 | (1) |
| | | 270.0 | 271.8 | 1.8 | 5.0 | (1) |
| WD start torque (gm-cm) | | t<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ambient | 84.5 | 83.6 | 0.9 | 1.8 | (1) |
| | ice water bath | 44.8 | 45.3 | 0.5 | 1.8 | (1) |
| | warm water bath | 86.6 | 87.0 | 0.4 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 74.8 | 74.1 | 0.7 | 7.4 | (1) |
| | | 74.6 | 74.1 | 0.5 | 7.4 | (1) |
| | | 73.8 | 74.1 | 0.3 | 7.4 | (1) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 1410 -- returned on-line at 1432.

## METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 7-Mar-06
Audit Performed by: B. Hanewald, T. Shaw - *iml Air Science*

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor |
| Precipitation (Ppt.): | Met One 12" tipping bucket with wind screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10X & storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 0.6 | 0.6 | 5.0 | (1) |
| | | 90.0 | 90.4 | 0.4 | 5.0 | (1) |
| | | 180.0 | 179.9 | 0.1 | 5.0 | (1) |
| | | 270.0 | 270.5 | 0.4 | 5.0 | (1) |
| WD start torque (gm-cm) | | t<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ambient | 50.6 | 49.2 | 1.4 | 1.8 | (1) |
| | ice water bath | 81.3 | 80.6 | 0.7 | 1.8 | (1) |
| | warm water bath | 38.2 | 38.2 | 0.0 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 73.0 | 74.1 | 1.1 | 7.4 | (1) |
| | | 74.0 | 74.1 | 0.1 | 7.4 | (1) |
| | | 74.0 | 74.1 | 0.1 | 7.4 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 1440 -- returned on-line at 1512.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 1-Aug-06
Audit Performed by: K. Jahnke & S. Engel - *iml Air Science*

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor |
| Precipitation (Ppt.): | Met One 12" tipping bucket with wind screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10X & storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 0.2 | 0.2 | 5.0 | (1) |
| | | 90.0 | 90.1 | 0.1 | 5.0 | (1) |
| | | 180.0 | 180.2 | 0.2 | 5.0 | (1) |
| | | 270.0 | 270.1 | 0.1 | 5.0 | (1) |
| WD start torque (gm-cm) | | t<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ice water bath | 33.6 | 34.3 | 0.7 | 1.8 | (1) |
| | warm water bath | 70.7 | 70.9 | 0.2 | 1.8 | (1) |
| | hot water bath | 115.1 | 114.7 | 0.4 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 74.0 | 74.1 | 0.1 | 7.4 | (1) |
| | | 74.6 | 74.1 | 0.5 | 7.4 | (1) |
| | | 74.4 | 74.1 | 0.3 | 7.4 | (1) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 1009 MST -- returned on-line at 1110 MST.
7 mice found living in logger enclosure. Fixed entry point of enclosure. Prop on RM Young was dinged up a little bit and will need to be replaced next time it is audited.

## METEOROLOGICAL STATION AUDIT SUMMARY

| | |
|---|---|
| Met Station: | Buckskin Mine |
| Audit Date: | 23-Mar-07 |
| Audit Performed by: | K. Jahnke & S. Engel - iml Air Science |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor |
| Precipitation (Ppt.): | Met One 12" tipping bucket with wind screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10X & storage module | N/A |

### Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 0.5 | 0.5 | 5.0 | (1) |
| | | 90.0 | 90.5 | 0.5 | 5.0 | (1) |
| | | 180.0 | 179.9 | 0.1 | 5.0 | (1) |
| | | 270.0 | 269.9 | 0.1 | 5.0 | (1) |
| WD start torque (gm-cm) | | t<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ice water bath | 32.4 | 32.5 | 0.1 | 1.8 | (1) |
| | warm water bath | 52.6 | 52.8 | 0.2 | 1.8 | (1) |
| | hot water bath | 116.9 | 117.4 | 0.5 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 191.6 | 185.2 | 6.4 | 18.5 | (1) |
| | | 194.8 | 185.2 | 9.6 | 18.5 | (1) |
| | | 191.6 | 185.2 | 6.4 | 18.5 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

### Notes, Recommendations

System was taken off-line at 0849 MDT -- returned on-line at 0945 MDT.

Prop was replaced

Reloaded program and Adjusted time

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 10-Jul-07
Audit Performed by: K. Jahnke & S. Engel - iml Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor |
| Precipitation (Ppt.): | Met One 12" tipping bucket with wind screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10X & storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 0.1 | 0.1 | 5.0 | (1) |
| | | 90.0 | 90.1 | 0.1 | 5.0 | (1) |
| | | 180.0 | 180.6 | 0.6 | 5.0 | (1) |
| | | 270.0 | 270.6 | 0.6 | 5.0 | (1) |
| WD start torque (gm-cm) | | t<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ice water bath | 33.2 | 33.2 | 0.0 | 1.8 | (1) |
| | warm water bath | 70.5 | 70.2 | 0.3 | 1.8 | (1) |
| | hot water bath | 115.8 | 114.7 | 1.1 | 1.8 | (1) |
| Precipitation (0.04" equiv.) | | 186.0 | 185.2 | 0.8 | 18.5 | (1) |
| | | 185.8 | 185.2 | 0.6 | 18.5 | (1) |
| | | 185.8 | 185.2 | 0.6 | 18.5 | (1) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 0847 MST -- returned on-line at 0922 MST.

## METEOROLOGICAL STATION AUDIT SUMMARY

|  |  |
|---|---|
| Met Station: | Buckskin Mine |
| Audit Date: | 12-Mar-08 |
| Audit Performed by: | C. Medill & S. Hansen - iml Air Science |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor |
| Precipitation (Ppt.): | Met One 12" tipping bucket with wind screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10X & storage module | N/A |

### Audit Results

|  |  | Reference | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|
| WS (mph) |  | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
|  |  | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
|  |  | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
|  |  | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
|  |  | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) |  | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) |  | 0.0 | 0.8 | 0.8 | 5.0 | (1) |
|  |  | 90.0 | 90.1 | 0.1 | 5.0 | (1) |
|  |  | 180.0 | 180.4 | 0.4 | 5.0 | (1) |
|  |  | 270.0 | 269.8 | 0.2 | 5.0 | (1) |
| WD start torque (gm-cm) |  | t<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ice water bath | 42.4 | 42.5 | 0.1 | 1.8 | (1) |
|  | warm water bath | 75.7 | 75.8 | 0.1 | 1.8 | (1) |
|  | hot water bath | 90.9 | 90.8 | 0.1 | 1.8 | (1) |
| Precipitation (0.04" equiv.) |  | 191.4 | 185.2 | 6.2 | 18.5 | (1) |
|  |  | 187.2 | 185.2 | 2.0 | 18.5 | (1) |
|  |  | 190.2 | 185.2 | 5.0 | 18.5 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

### Notes, Recommendations

System was taken off-line at 2030 MST -- returned on-line at 2106 MST.

Replaced broken CS107 temp probe.

## METEOROLOGICAL STATION AUDIT SUMMARY

| | |
|---|---|
| Met Station: | Buckskin Mine |
| Audit Date: | 3-Sep-08 |
| Audit Performed by: | S. Hansen & K. Chartier - IML Air Science |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor |
| Precipitation (Ppt.): | Met One 12" tipping bucket with wind screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10X & storage module | N/A |

### Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 0.0 | 0.0 | 5.0 | (1) |
| | | 90.0 | 89.0 | 1.0 | 5.0 | (1) |
| | | 180.0 | 182.0 | 2.0 | 5.0 | (1) |
| | | 270.0 | 269.0 | 1.0 | 5.0 | (1) |
| WD start torque (gm-cm) | | t<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ice water bath | 32.1 | 31.9 | 0.2 | 0.9 | (1) |
| | warm water bath | 59.2 | 59.3 | 0.1 | 0.9 | (1) |
| | hot water bath | 86.2 | 85.8 | 0.4 | 0.9 | (1) |
| Precipitation (0.01" equiv.) | | 201.4 | 185.2 | 16.2 | 18.5 | (1) |
| | | 195.5 | 185.2 | 10.3 | 18.5 | (1) |
| | | 196.0 | 185.2 | 10.8 | 18.5 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

### Notes, Recommendations

System was taken off-line at 1339 MST & returned on-line at 1420 MST

# METEOROLOGICAL STATION AUDIT SUMMARY

| | |
|---|---|
| Met Station: | Buckskin Mine |
| Audit Date: | 20-Mar-09 |
| Audit Performed by: | R. Campbell, J. Goldsmith - IML Air Science |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor |
| Precipitation (Ppt.): | Met One 12" tipping bucket with wind screen | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-10X & storage module | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 0.2 | 0.2 | 5.0 | (1) |
| | | 90.0 | 90.5 | 0.5 | 5.0 | (1) |
| | | 180.0 | 179.7 | 0.3 | 5.0 | (1) |
| | | 270.0 | 270.4 | 0.4 | 5.0 | (1) |
| WD start torque (gm-cm) | | t<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ice water bath | 36.8 | 36.9 | 0.1 | 0.9 | (1) |
| | warm water bath | 66.5 | 65.9 | 0.6 | 0.9 | (1) |
| | hot water bath | 87.5 | 87.1 | 0.4 | 0.9 | (1) |
| Precipitation (0.01" equiv.) | | 191.6 | 185.2 | 6.4 | 18.5 | (1) |
| | | 192.9 | 185.2 | 7.7 | 18.5 | (1) |
| | | 191.0 | 185.2 | 5.8 | 18.5 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 1236 MST & returned on-line at 1248 MST

## METEOROLOGICAL STATION AUDIT SUMMARY

|  |  |
|---|---|
| Met Station: | Buckskin Mine |
| Audit Date: | 9-Sep-09 |
| Audit Performed by: | R. Campbell, C. Medill - IML Air Science |

| Sensor | Mfr./Model | Reference Device | Serial ID |
|---|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor | IML 0895 |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass | IML 0895 |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer, or thermistor | IML 0888 |
| Precipitation (Ppt.): | Met One 12" tipping bucket with wind screen | lab grade burette | N/A |
| Data acquisition system (DAS): | Campbell Scientific CR-10X & storage module | N/A | N/A |

### Audit Results

|  |  | Reference | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|
| WS (mph) |  | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
|  |  | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
|  |  | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
|  |  | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
|  |  | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) |  | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) |  | 0.0 | 0.8 | 0.8 | 5.0 | (1) |
|  |  | 90.0 | 90.4 | 0.4 | 5.0 | (1) |
|  |  | 180.0 | 179.9 | 0.1 | 5.0 | (1) |
|  |  | 270.0 | 270.6 | 0.6 | 5.0 | (1) |
| WD start torque (gm-cm) |  | t<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ice water bath | 32.9 | 33.0 | 0.1 | 0.9 | (1) |
|  | warm water bath | 74.5 | 74.4 | 0.1 | 0.9 | (1) |
|  | hot water bath | 108.2 | 107.9 | 0.3 | 0.9 | (1) |
| Precipitation (0.01" equiv.) |  | 191.4 | 185.2 | 6.2 | 18.5 | (1) |
|  |  | 192.0 | 185.2 | 6.8 | 18.5 | (1) |
|  |  | 189.0 | 185.2 | 3.8 | 18.5 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

### Notes, Recommendations

System was taken off-line at 1022 MST and returned on-line at 1055 MST

# METEOROLOGICAL STATION AUDIT SUMMARY

| | |
|---|---|
| Met Station: | Buckskin Mine |
| Audit Date: | 9-Mar-10 |
| Audit Performed by: | R. Campbell, S. Warner -- IML Air Science |

| Sensor | Mfr./Model | Reference Device | Serial ID |
|---|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | quartz referenced drive motor | IML 0896 |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | transit, compass | |
| Temperature (T): | Fenwal 107 | Hg-in-glass thermometer | IML 1402 |
| Precipitation (Ppt.): | Met One 12" tipping bucket with wind screen | lab grade burette | N/A |
| Data acquisition system (DAS): | Campbell Scientific CR-10X & storage module | N/A | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | t<0.2 | N/A | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 0.9 | 0.9 | 5.0 | (1) |
| | | 90.0 | 90.4 | 0.4 | 5.0 | (1) |
| | | 180.0 | 179.2 | 0.8 | 5.0 | (1) |
| | | 270.0 | 270.0 | 0.0 | 5.0 | (1) |
| WD start torque (gm-cm) | | t<11.0 | N/A | N/A | 11.0 | (3) |
| Temperature (°F) | ice water bath | 32.8 | 32.6 | 0.2 | 0.9 | (1) |
| | warm water bath | 54.2 | 54.7 | 0.5 | 0.9 | (1) |
| | hot water bath | 64.1 | 63.9 | 0.1 | 0.9 | (1) |
| Precipitation (0.01" equiv.) | | 188.2 | 185.2 | 3.0 | 18.5 | (1) |
| | | 189.4 | 185.2 | 4.2 | 18.5 | (1) |
| | | 187.8 | 185.2 | 2.6 | 18.5 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 15:28 MST and returned on-line at 16:09 MST

Changed wind speed bearings.

## After Adjustment

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| WS (mph) | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WD (degrees) | 0.0 | 0.1 | 0.1 | 5.0 | (1) |
| | 90.0 | 90.3 | 0.3 | 5.0 | (1) |
| | 180.0 | 180.1 | 0.1 | 5.0 | (1) |
| | 270.0 | 269.9 | 0.1 | 5.0 | (1) |

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 17-Sep-10
Audit Performed By: S. Hansen, T. Mendenhall -- IML Air Science

| Sensor | Mfr./Model | Serial Number | Reference Device | Serial ID |
|---|---|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | 37074 | quartz drive motor | IML 1407 |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | 37074 | transit, compass | IML 1405 |
| Temperature (T): | Fenwal 107 | N/A | Hg-in-glass thermometer | IML 1402 |
| Precipitation (Ppt.): | Met One 12" tipping bucket | Illegible | lab grade burette | N/A |
| Data acquisition system (DAS): | Campbell Scientific CR-10X | 19256 | N/A | N/A |

## Audit Results

| | Reference RPM | Reference MPH | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | 0 | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | 300 | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | 800 | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | 3000 | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | 8000 | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| Crossarm Alignment (°) | | 3.0 | 3.2 | 0.2 | 5.0 | (2) |
| WS start torque (gm-cm) | | 1.0 | t<1.0 | N/A | 1.0 | (3) |
| WD (°) | Clockwise | 0.0 | 0.1 | 0.1 | 5.0 | (1) |
| | | 90.0 | 89.6 | 0.4 | 5.0 | (1) |
| | | 180.0 | 179.4 | 0.6 | 5.0 | (1) |
| | | 270.0 | 269.8 | 0.2 | 5.0 | (1) |
| | Counter Clockwise | 0.0 | 0.2 | 0.2 | 5.0 | (1) |
| | | 90.0 | 90.5 | 0.5 | 5.0 | (1) |
| | | 180.0 | 180.7 | 0.7 | 5.0 | (1) |
| | | 270.0 | 269.2 | 0.8 | 5.0 | (1) |
| WD start torque (gm-cm) | Clockwise | 11.0 | t<11.0 | N/A | 11.0 | (3) |
| | Counter Clockwise | 11.0 | t<11.0 | N/A | 11.0 | (3) |
| Temperature (°F) | | 32.5 | 31.9 | 0.6 | 0.9 | (1) |
| | | 127.8 | 127.2 | 0.6 | 0.9 | (1) |
| | | 68.4 | 67.9 | 0.4 | 0.9 | (1) |
| Precipitation (0.01" equiv.) | | 189.2 | 185.2 | 4.0 | 18.5 | (1) |
| | | 190.4 | 185.2 | 5.2 | 18.5 | (1) |
| | | 186.0 | 185.2 | 0.8 | 18.5 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorlogical Measurements Version 2.0, 2008

(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 08:30 MST and returned on-line at 09:22 MST

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 10-Mar-11
Audit Performed By: T. Mendenhall -- IML Air Science

| Sensor | Mfr./Model | Serial Number | Reference Device | Serial ID |
|---|---|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | 37074 | quartz drive motor | IML 1407 |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | 37074 | transit, compass | IML 1405 |
| Temperature (T): | Fenwal 107 | N/A | digital thermistor | IML 0885 |
| Precipitation (Ppt.): | Met One 12" tipping bucket | Illegible | lab grade burette | N/A |
| Data acquisition system (DAS): | Campbell Scientific CR-10X | 19256 | N/A | N/A |

## Audit Results

|  | Reference RPM | Reference MPH | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|
| WS (mph) | 0 | 0.00 | 0.00 | 0.00 | 0.45 | (1) |
|  | 300 | 3.44 | 3.44 | 0.00 | 0.45 | (1) |
|  | 800 | 9.16 | 9.16 | 0.00 | 0.45 | (1) |
|  | 3000 | 34.35 | 34.35 | 0.00 | 0.45 | (1) |
|  | 8000 | 91.60 | 91.60 | 0.00 | 0.45 | (1) |
| Crossarm Alignment (°) |  | 194.0 | 192.5 | 1.5 | 5.0 | (2) |
| WS start torque (gm-cm) |  | 1.0 | t<1.0 | N/A | 1.0 | (3) |
| WD (°) | Clockwise | 0.0 | 0.1 | 0.1 | 5.0 | (1) |
|  |  | 90.0 | 90.0 | 0.0 | 5.0 | (1) |
|  |  | 180.0 | 178.8 | 1.2 | 5.0 | (1) |
|  |  | 270.0 | 268.8 | 1.2 | 5.0 | (1) |
|  | Counter Clockwise | 0.0 | 0.2 | 0.2 | 5.0 | (1) |
|  |  | 90.0 | 90.4 | 0.4 | 5.0 | (1) |
|  |  | 180.0 | 180.1 | 0.1 | 5.0 | (1) |
|  |  | 270.0 | 270.9 | 0.9 | 5.0 | (1) |
| WD start torque (gm-cm) | Clockwise | 11.0 | t<11.0 | N/A | 11.0 | (3) |
|  | Counter Clockwise | 11.0 | t<11.0 | N/A | 11.0 | (3) |
| Temperature (°F) |  | 34.0 | 34.2 | 0.2 | 0.9 | (1) |
|  |  | 84.0 | 83.9 | 0.1 | 0.9 | (1) |
|  |  | 117.3 | 117.5 | 0.2 | 0.9 | (1) |
| Precipitation (0.01" equiv.) |  | 188.8 | 185.2 | 3.6 | 18.5 | (1) |
|  |  | 187.4 | 185.2 | 2.2 | 18.5 | (1) |
|  |  | 187.8 | 185.2 | 2.6 | 18.5 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorlogical Measurements Version 2.0, 2008
(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken offline at 09:09 MST and returned online at 09:55 MST.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 16-Sep-11
Audit Performed By: C. Cottom, J. Masters -- IML Air Science

| Sensor | Mfr./Model | Serial Number | Reference Device | Serial ID |
|---|---|---|---|---|
| Wind Speed (WS): | R.M. Young Wind Monitor AQ | 37074 | quartz drive motor | IML 0896 |
| Wind Direction (WD): | R.M. Young Wind Monitor AQ | 37074 | transit, compass | IML 0894 |
| Temperature (T): | Fenwal 107 | N/A | digital thermistor | IML 1411 |
| Precipitation (Ppt.): | Met One 12" tipping bucket | Illegible | lab grade burette | N/A |
| Data acquisition system (DAS): | Campbell Scientific CR-10X | 19256 | N/A | N/A |

## Audit Results

| | Reference RPM | Reference MPH | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | 0 | 0.00 | 0.00 | 0.00 | 0.45 | (1) |
| | 300 | 3.44 | 3.44 | 0.00 | 0.45 | (1) |
| | 800 | 9.16 | 9.16 | 0.00 | 0.45 | (1) |
| | 3000 | 34.35 | 34.35 | 0.00 | 0.45 | (1) |
| | 8000 | 91.60 | 91.60 | 0.00 | 0.45 | (1) |
| Crossarm Alignment (°) | | 189.0 | 191.0 | 2.0 | 5.0 | (2) |
| WS start torque (gm-cm) | | 1.0 | t<1.0 | N/A | 1.0 | (3) |
| WD (°) | Clockwise | 0.0 | 0.2 | 0.2 | 5.0 | (1) |
| | | 90.0 | 90.4 | 0.4 | 5.0 | (1) |
| | | 180.0 | 179.8 | 0.2 | 5.0 | (1) |
| | | 270.0 | 270.0 | 0.0 | 5.0 | (1) |
| | Counter Clockwise | 0.0 | 0.1 | 0.1 | 5.0 | (1) |
| | | 90.0 | 90.8 | 0.8 | 5.0 | (1) |
| | | 180.0 | 179.2 | 0.8 | 5.0 | (1) |
| | | 270.0 | 269.3 | 0.7 | 5.0 | (1) |
| WD start torque (gm-cm) | Clockwise | 11.0 | t<11.0 | N/A | 11.0 | (3) |
| | Counter Clockwise | 11.0 | t<11.0 | N/A | 11.0 | (3) |
| Temperature (°F) | | 0.7 | 0.8 | 0.1 | 0.9 | (1) |
| | | 24.0 | 23.4 | 0.6 | 0.9 | (1) |
| | | 42.7 | 42.4 | 0.3 | 0.9 | (1) |
| Precipitation (0.01" equiv.) | | 172.0 | 185.2 | 13.2 | 18.5 | (1) |
| | | 184.2 | 185.2 | 1.0 | 18.5 | (1) |
| | | 185.0 | 185.2 | 0.2 | 18.5 | (1) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorlogical Measurements Version 2.0, 2008
(3)= Manufacturer's Specifications

## Notes, Recommendations

System was taken off-line at 13:13 MST and returned on-line at 13:42 MST.

# Dry Fork Mine Meteorological Station Audit Reports

# METEOROLOGICAL STATION AUDIT SUMMARY

| | |
|---|---|
| Met Station: | Dry Fork Coal Company |
| Audit Date: | 16-May-97 |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit |
| Temperature (T): | Met ONE 064-2, naturally aspirated | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Met One 12" tipping bucket | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR 10 w/ storage module | N/A |

## Audit Results

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| WS (mph) | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | 3.44 | 3.43 | 0.01 | 0.56 | (1) |
| | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | 91.6 | 91.6 | 0.00 | 4.58 | |
| WS start torque (gm-cm) | t<1.00 | N/A | N/A | 1.00 | (3) |
| WD (degrees) | 0.0 | 0.1 | 0.1 | 5.0 | (1) |
| | 90.0 | 90.7 | 0.7 | 5.0 | (1) |
| | 180.0 | 176.0 | 4.0 | 5.0 | (1) |
| | 270.0 | 270.2 | 0.2 | 5.0 | (1) |
| WD start torque (gm-cm) | t<11.0 | N/A | N/A | 11.00 | (3) |
| Temperature (C) | 28.8 | 28.0 | 0.8 | 1.0 | (1) |
| | 2.5 | 3.0 | 0.5 | 1.0 | (1) |
| | 32.3 | 32.2 | 0.1 | 1.0 | (1) |
| Precipitation (0.1" equiv.) | 92.7 | 99.0 | 6.3 | 8.2 | (1) |
| | 92.7 | 96.3 | 3.6 | 8.2 | (1) |
| | 92.7 | 96.0 | 3.3 | 8.2 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

## Notes, Recommendations

System not operating upon arrival
Battery voltage at 13.4.
System off-line at 0800 MST and returned on-line at 1054 MST.
New datalogger installed with new program.
Installed new wind speed bearings.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 5-Nov-97

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit |
| Temperature (T): | Met ONE 064-2, naturally aspirated | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Met One 12" tipping bucket | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR 10 w/ storage module | N/A |

## Audit Results

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| WS (mph) | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | 91.6 | 91.6 | 0.00 | 4.58 | |
| WS start torque (gm-cm) | $\tau<0.2$ | N/A | N/A | 1.00 | (3) |
| WD (degrees) | 0.0 | 0.0 | 0.0 | 5.0 | (1) |
| | 90.0 | 91.0 | 1.0 | 5.0 | (1) |
| | 180.0 | 181.0 | 1.0 | 5.0 | (1) |
| | 270.0 | 270.0 | 0.0 | 5.0 | (1) |
| WD start torque (gm-cm) | $\tau<5.0$ | N/A | N/A | 11.00 | (3) |
| Temperature (°C) | 16.0 | 16.1 | 0.1 | 1.0 | (1) |
| | 44.5 | 44.2 | 0.3 | 1.0 | (1) |
| | 9.0 | 9.3 | 0.3 | 1.0 | (1) |
| Precipitation (0.1" equiv.) | 92.7 | 92.0 | 0.7 | 8.2 | (1) |
| | 92.7 | 98.0 | 5.3 | 8.2 | (1) |
| | 92.7 | 95.0 | 2.3 | 8.2 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

## Notes, Recommendations

Battery voltage at 13.9
System off-line at 1148 MST and returned on-line at 1255 MST.
Removed bug screen from ppt. gauge for winter

# METEOROLOGICAL STATION AUDIT SUMMARY

| | |
|---|---|
| Met Station: | Dry Fork Coal Company |
| Audit Date: | 23-Jun-98 |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit |
| Temperature (T): | Met ONE 064-2, naturally aspirated | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Met One 12" tipping bucket | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR 10 w/ storage module | N/A |

## Audit Results

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| WS (mph) | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | 91.6 | 91.6 | 0.00 | 4.58 | |
| WS start torque (gm-cm) | $\tau<0.2$ | N/A | N/A | 1.00 | (3) |
| WD (degrees) | 0.0 | 0.2 | 0.2 | 5.0 | (1) |
| | 90.0 | 89.0 | 1.0 | 5.0 | (1) |
| | 180.0 | 178.0 | 2.0 | 5.0 | (1) |
| | 270.0 | 270.0 | 0.0 | 5.0 | (1) |
| WD start torque (gm-cm) | $\tau<5.0$ | N/A | N/A | 11.00 | (3) |
| Temperature (°C) | 26.5 | 25.6 | 0.9 | 1.0 | (1) |
| | 32.0 | 31.1 | 0.9 | 1.0 | (1) |
| | 0.0 | 1.6 | 1.6 | 1.0 | (1) |
| Precipitation (0.1" equiv.) | 74.1 | 73.0 | 1.1 | 8.2 | (1) |
| | 74.1 | 73.0 | 1.1 | 8.2 | (1) |
| | 74.1 | 74.0 | 0.1 | 8.2 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

## Notes, Recommendations

Battery voltage at 13.39

System off-line at 1250 MST and returned on-line at 1317 MST.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 30-Dec-98

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit |
| Temperature (T): | Met ONE 064-2, naturally aspirated | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Met One 12" tipping bucket | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR 10 w/ storage module | N/A |

## Audit Results

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| WS (mph) | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | 91.6 | 91.6 | 0.00 | 4.58 | |
| WS start torque (gm-cm) | 0.2<τ<0.3 | N/A | N/A | 1.00 | (3) |
| WD (degrees) | 0.0 | 1.0 | 1.0 | 5.0 | (1) |
| | 90.0 | 89.0 | 1.0 | 5.0 | (1) |
| | 180.0 | 180.0 | 0.0 | 5.0 | (1) |
| | 270.0 | 270.0 | 0.0 | 5.0 | (1) |
| Temperature (°C) | -1.0 | -1.0 | 0.0 | 1.0 | (1) |
| | 45.1 | 44.2 | 0.9 | 1.0 | (1) |
| | 0.1 | 0.0 | 0.1 | 1.0 | (1) |
| Precipitation (0.1" equiv.) | 74.1 | 69.0 | 5.1 | 8.2 | (1) |
| | 74.1 | 75.5 | 1.4 | 8.2 | (1) |
| | 74.1 | 75.8 | 1.7 | 8.2 | (1) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line at 0942 MST and returned on-line at 1031MST
Precipitation gauge heater not operable as found; breaker was turned off. Returned breaker to on position
Cleaned precipitation gauge

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 30-Jun-99

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit |
| Temperature (T): | Met ONE 2066, naturally aspirated | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Sierra Misco 099R tipping bucket | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR-21XL | N/A |

## Audit Results

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| WS (mph) | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | 0.2<T<0.3 | N/A | N/A | 1.00 | (3) |
| WD (degrees) | 0.0 | 0.3 | 0.3 | 5.0 | (1) |
| | 90.0 | 89.3 | 0.7 | 5.0 | (1) |
| | 180.0 | 179.7 | 0.3 | 5.0 | (1) |
| | 270.0 | 271.8 | 1.8 | 5.0 | (1) |
| Temperature (°C) | 18.6 | 18.4 | 0.2 | 1.0 | (1) |
| | 0.0 | 0.8 | 0.8 | 1.0 | (1) |
| | 46.3 | 45.8 | 0.5 | 1.0 | (1) |
| Precipitation (0.1" equiv.) | 74.1 | 72.0 | 2.1 | 7.4 | (1) |
| | 74.1 | 72.0 | 2.1 | 7.4 | (1) |
| | 74.1 | 73.0 | 1.1 | 7.4 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line at 1117 MST and on-line at 1143 MST
31.781 since last reset
Battery voltage at 13.86

# METEOROLOGICAL STATION AUDIT SUMMARY

| | |
|---|---|
| Met Station: | Dry Fork Coal Company |
| Audit Date: | 22-Jun-00 |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit |
| Temperature (T): | Met ONE 064-2, naturally aspirated | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Met One 12" tipping bucket | lab grade burette |
| Data acquisition system (DAS): | Campbell Scientific CR 10 w/ storage module | N/A |

## Audit Results

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| WS (mph) | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | 91.6 | 91.6 | 0.00 | 4.58 | |
| WS start torque (gm-cm) | 0.2<τ<0.3 | N/A | N/A | 1.00 | (3) |
| WD (degrees) | 0.0 | 0.2 | 0.2 | 5.0 | (1) |
| | 90.0 | 89.8 | 0.2 | 5.0 | (1) |
| | 180.0 | 180.3 | 0.3 | 5.0 | (1) |
| | 270.0 | 269.8 | 0.2 | 5.0 | (1) |
| Temperature (°C) | 32.1 | 33.0 | 0.9 | 1.0 | (1) |
| | 0.3 | 0.8 | 0.5 | 1.0 | (1) |
| | 45.6 | 45.3 | 0.3 | 1.0 | (1) |
| Precipitation (0.1" equiv.) | 74.1 | 73.0 | 1.1 | 8.2 | (1) |
| | 74.1 | 74.0 | 0.1 | 8.2 | (1) |
| | 74.1 | 74.0 | 0.1 | 8.2 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line at 1530 MST and returned on-line at 1555MST.
Changed year on DAS from 9- to 00.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 27-Dec-00

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit |
| Temperature (T): | Met ONE 2066, naturally aspirated | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Sierra Misco 099R tipping bucket | lab grade burette |
| Data acquisition system: | Campbell Scientific CR-21XL | N/A |

## Audit Results

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| WS (mph) | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | 3.66 | 3.66 | 0.00 | 0.56 | (1) |
| | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | 0.2<T<0.3 | N/A | N/A | 1.00 | (3) |
| WD (degrees) | 0.0 | 1.4 | 1.4 | 5.0 | (1) |
| | 90.0 | 91.0 | 1.0 | 5.0 | (1) |
| | 180.0 | 181.0 | 1.0 | 5.0 | (1) |
| | 270.0 | 271.0 | 1.0 | 5.0 | (1) |
| Temperature (°C) | 6.0 | 6.3 | 0.3 | 1.0 | (1) |
| | 0.4 | 0.5 | 0.1 | 1.0 | (1) |
| | 20.2 | 20.1 | 0.1 | 1.0 | (1) |
| Precipitation (0.1" equiv.) | 74.1 | 74.0 | 0.1 | 7.4 | (1) |
| | 74.1 | 73.0 | 1.1 | 7.4 | (1) |
| | 74.1 | 73.0 | 1.1 | 7.4 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line at 1329 MST and on-line at 1358 MST

Battery voltage at 13.8

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 26-Jun-02
Audit Performed by: D. Black, W. Adler - *iml Air Science*

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit |
| Temperature (T): | Met ONE 2066, naturally aspirated | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Sierra Misco 099R tipping bucket | lab grade burette |
| Data acquisition system: | Campbell Scientific CR-21XL | N/A |

## Audit Results

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| WS (mph) | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | 0.2<T<0.3 | N/A | N/A | 1.00 | (3) |
| WD (degrees) | 0.0 | 0.3 | 0.3 | 5.0 | (1) |
| | 90.0 | 90.0 | 0.0 | 5.0 | (1) |
| | 180.0 | 180.0 | 0.0 | 5.0 | (1) |
| | 270.0 | 271.0 | 1.0 | 5.0 | (1) |
| Temperature (°C) | 35.8 | 36.4 | 0.6 | 1.0 | (1) |
| | 0.6 | 1.3 | 0.7 | 1.0 | (1) |
| | 15.7 | 15.8 | 0.1 | 1.0 | (1) |
| Precipitation (0.1" equiv.) | 74.1 | 75.0 | 0.9 | 7.4 | (1) |
| | 74.1 | 71.4 | 2.7 | 7.4 | (1) |
| | 74.1 | 71.6 | 2.5 | 7.4 | (1) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1995
(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line at 1551 MST and on-line at 1620 MST
Battery voltage at 13.092

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 12, Nov. 2002
Audit Performed by: S. Heil, T. Shaw - iml Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit |
| Temperature (T): | Met ONE 2066, naturally aspirated | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Sierra Misco 099R tipping bucket | lab grade burette |
| Data acquisition system: | Campbell Scientific CR-21XL | N/A |

## Audit Results

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| WS (mph) | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | 0.2<T<0.3 | N/A | N/A | 1.00 | (3) |
| WD (degrees) | 0.0 | 0.0 | 0.0 | 5.0 | (1) |
| | 90.0 | 90.6 | 0.6 | 5.0 | (1) |
| | 180.0 | 180.0 | 0.0 | 5.0 | (1) |
| | 270.0 | 271.4 | 1.4 | 5.0 | (1) |
| Temperature (°C) | 35.8 | 34.8 | 1.0 | 1.0 | (1) |
| | 0.3 | 0.0 | 0.3 | 1.0 | (1) |
| | 3.9 | 4.1 | 0.2 | 1.0 | (1) |
| Precipitation (0.1" equiv.) | 74.1 | 74.4 | 0.3 | 7.4 | (1) |
| | 74.1 | 73.8 | 0.3 | 7.4 | (1) |
| | 74.1 | 74.2 | 0.1 | 7.4 | (1) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995
(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line at 1708 MST and on-line at 1744 MST
Battery voltage at 13.733

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 24-Apr-03
Audit Performed by: S. Heil, K. Jahnke - iml Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit |
| Temperature (T): | Met ONE 2066, naturally aspirated | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Sierra Misco 099R tipping bucket | lab grade burette |
| Data acquisition system: | Campbell Scientific CR-21XL | N/A |

## Audit Results

| | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|
| WS (mph) | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | 0.2<T<0.3 | N/A | N/A | 1.00 | (3) |
| WD (degrees) | 0.0 | 0.1 | 0.1 | 5.0 | (1) |
| | 90.0 | 89.9 | 0.1 | 5.0 | (1) |
| | 180.0 | 180.1 | 0.1 | 5.0 | (1) |
| | 270.0 | 270.0 | 0.0 | 5.0 | (1) |
| Temperature (°C) | N/A | N/A | NA | 1.0 | (1) |
| | N/A | N/A | N/A | 1.0 | (1) |
| | N/A | N/A | N/A | 1.0 | (1) |
| Precipitation (0.1" equiv.) | 74.1 | 70.6 | 3.5 | 7.4 | (1) |
| | 74.1 | 72.2 | 1.9 | 7.4 | (1) |
| | 74.1 | 72.4 | 1.7 | 7.4 | (1) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1995
(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line at 1800 MST and on-line at 1834 MST
Battery voltage at 13.660
Met One temperature sensor was broken during the audit and will require replacement.

# METEOROLOGICAL STATION AUDIT SUMMARY

| | |
|---|---|
| Met Station: | Dry Fork Coal Company |
| Audit Date: | 15-Oct-03 |
| Audit Performed by: | T. Shaw, K. Jahnke - iml Air Science |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit |
| Temperature (T): | Met ONE 2066, naturally aspirated | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Sierra Misco 099R tipping bucket | lab grade burette |
| Data acquisition system: | Campbell Scientific CR-21XL | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | 0.2<T<0.3 | N/A | N/A | 1.00 | (3) |
| WD (degrees) | | 0.0 | 0.3 | 0.3 | 5.0 | (1) |
| | | 90.0 | 90.1 | 0.1 | 5.0 | (1) |
| | | 180.0 | 180.2 | 0.2 | 5.0 | (1) |
| | | 270.0 | 270.3 | 0.3 | 5.0 | (1) |
| Temperature (°C) | ambient | 12.6 | 12.5 | 0.1 | 1.0 | (1) |
| | ice bath | 0.5 | 1.6 | 1.1 | 1.0 | (1) |
| | warm bath | 24.2 | 24.0 | 0.2 | 1.0 | (1) |
| Precipitation (0.1" equiv.) | | 72.8 | 74.1 | 1.3 | 7.4 | (1) |
| | | 72.2 | 74.1 | 1.9 | 7.4 | (1) |
| | | 73.2 | 74.1 | 0.9 | 7.4 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1995

(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line at 1443 MST and on-line at 1505 MST

Battery voltage at 13.685

Replaced propeller

# METEOROLOGICAL  STATION  AUDIT  SUMMARY

| | |
|---|---|
| Met Station: | Dry Fork Coal Company |
| Audit Date: | 11-Jun-04 |
| Audit Performed by: | T. Shaw, T. Mendenhall - iml Air Science |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit |
| Temperature (T): | Met ONE 2066, naturally aspirated | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Sierra Misco 099R tipping bucket | lab grade burette |
| Data acquisition system: | Campbell Scientific CR-21XL | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.12 | 0.23 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | 0.2<T<0.3 | N/A | N/A | 1.00 | (3) |
| WD (degrees) | | 0.0 | 0.0 | 0.0 | 5.0 | (1) |
| | | 90.0 | 91.8 | 1.8 | 5.0 | (1) |
| | | 180.0 | 183.0 | 3.0 | 5.0 | (1) |
| | | 270.0 | 270.0 | 0.0 | 5.0 | (1) |
| Temperature (°C) | ambient | 14.9 | 14.0 | 0.9 | 1.0 | (1) |
| | ice bath | 0.5 | 0.9 | 0.4 | 1.0 | (1) |
| | warm bath | 36.4 | 36.6 | 0.2 | 1.0 | (1) |
| Precipitation (0.1" equiv.) | | 72.6 | 74.1 | 1.5 | 7.4 | (1) |
| | | 72.4 | 74.1 | 1.7 | 7.4 | (1) |
| | | 72.8 | 74.1 | 1.3 | 7.4 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1995

(3)= Manufacturer's Specifications

## Notes, Recommendations

System on-line at 1235 MST

Precipitation bucket was not working upon arrival, adjusted reed switch & both set screws.

Precipitation bucket was working upon depature.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 19-Nov-04
Audit Performed by: D. Powers, K. Jahnke - iml Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit |
| Temperature (T): | Met ONE 2066, naturally aspirated | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Sierra Misco 099R tipping bucket | lab grade burette |
| Data acquisition system: | Campbell Scientific CR-21XL | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | | | 0.00 | 0.56 | (1) |
| | | | | 0.00 | 0.56 | (1) |
| | | | | 0.00 | 0.56 | (1) |
| | | | | 0.00 | 0.56 | (1) |
| | | | | 0.00 | 0.56 | (1) |
| WS start torque (gm-cm) | | 0.2<T<0.3 | N/A | N/A | 1.00 | (3) |
| WD (degrees) | | | | 0.0 | 5.0 | (1) |
| | | | | 0.0 | 5.0 | (1) |
| | | | | 0.0 | 5.0 | (1) |
| | | | | 0.0 | 5.0 | (1) |
| Temperature (°C) | ambient | | | 0.0 | 1.0 | (1) |
| | ice bath | | | 0.0 | 1.0 | (1) |
| | warm bath | | | 0.0 | 1.0 | (1) |
| Precipitation (0.1" equiv.) | | 74.0 | 74.1 | 0.1 | 7.4 | (1) |
| | | 74.0 | 74.1 | 0.1 | 7.4 | (1) |
| | | 74.0 | 74.1 | 0.1 | 7.4 | (1) |

**BOLD difference values exceed performance specifications**
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995
(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line at 1200 MST, on-line at 1222 MST.
Installed new read switch on the precipitation bucket.

# METEOROLOGICAL STATION AUDIT SUMMARY

| | |
|---|---|
| Met Station: | Dry Fork Coal Company |
| Audit Date: | 14-Jun-05 |
| Audit Performed by: | W. Adler, K. Jahnke - iml Air Science |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit |
| Temperature (T): | Met ONE 2066, naturally aspirated | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Sierra Misco 099R tipping bucket | lab grade burette |
| Data acquisition system: | Campbell Scientific CR-21XL | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | 0.2<T<0.3 | N/A | N/A | 1.00 | (3) |
| WD (degrees) | | 0.0 | 0.0 | 0.0 | 5.0 | (1) |
| | | 90.0 | 89.8 | 0.2 | 5.0 | (1) |
| | | 180.0 | 180.2 | 0.2 | 5.0 | (1) |
| | | 270.0 | 270.9 | 0.9 | 5.0 | (1) |
| Temperature (°C) | ambient | 24.4 | 25.5 | 1.1 | 1.0 | (1) |
| | ice bath | 0.5 | 1.0 | 0.5 | 1.0 | (1) |
| | warm bath | 60.0 | 59.8 | 0.2 | 1.0 | (1) |
| Precipitation (0.1" equiv.) | | 72.2 | 74.1 | 1.9 | 7.4 | (1) |
| | | 71.8 | 74.1 | 2.3 | 7.4 | (1) |
| | | 72.4 | 74.1 | 1.7 | 7.4 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1995

(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line at 1001 MST, on-line at 1119 MST.

The wind direction was not working upon arrival, stuck between 315 and 345 degrees.

Replaced the wind direction potentimometer, wind direction bearings, wind speed bearings, tail, and nose cone. System running following the repairs.

# METEOROLOGICAL STATION AUDIT SUMMARY

| | |
|---|---|
| Met Station: | Dry Fork Coal Company |
| Audit Date: | 12-Dec-05 |
| Audit Performed by: | B. Hanewald, S. Hansen - iml Air Science |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit |
| Temperature (T): | Met ONE 2066, naturally aspirated | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Sierra Misco 099R tipping bucket | lab grade burette |
| Data acquisition system: | Campbell Scientific CR-21XL | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | 0.2<T<0.3 | N/A | N/A | 1.00 | (3) |
| WD (degrees) | | 0.0 | 0.6 | 0.6 | 5.0 | (1) |
| | | 90.0 | 90.2 | 0.2 | 5.0 | (1) |
| | | 180.0 | 179.3 | 0.7 | 5.0 | (1) |
| | | 270.0 | 269.6 | 0.4 | 5.0 | (1) |
| Temperature (°C) | ambient | 2.3 | 2.9 | 0.6 | 1.0 | (1) |
| | ice bath | 0.3 | 0.8 | 0.5 | 1.0 | (1) |
| | warm bath | 13.2 | 13.0 | 0.2 | 1.0 | (1) |
| Precipitation (0.1" equiv.) | | 73.2 | 74.1 | 0.9 | 7.4 | (1) |
| | | 71.8 | 74.1 | 2.3 | 7.4 | (1) |
| | | 71.6 | 74.1 | 2.5 | 7.4 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995

(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line at 1553 MST, on-line at 1627 MST.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 12-Apr-06
Audit Performed by: S.Engel & T.Shaw--- IML Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit |
| Temperature (T): | Met ONE 2066, naturally aspirated | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Sierra Misco 099R tipping bucket | lab grade burette |
| Data acquisition system: | Campbell Scientific CR-21XL | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | 0.2<T<0.3 | N/A | N/A | 1.00 | (3) |
| WD (degrees) | | 0.0 | 0.2 | 0.2 | 5.0 | (1) |
| | | 90.0 | 90.6 | 0.6 | 5.0 | (1) |
| | | 180.0 | 181.0 | 1.0 | 5.0 | (1) |
| | | 270.0 | 270.7 | 0.7 | 5.0 | (1) |
| Temperature (°C) | ambient | 21.6 | 20.2 | **1.4** | 1.0 | (1) |
| | ice bath | 2.2 | 1.2 | 1.0 | 1.0 | (1) |
| | warm bath | 49.8 | 48.9 | 0.9 | 1.0 | (1) |
| Precipitation (0.1" equiv.) | | 69.8 | 74.1 | 4.3 | 7.4 | (1) |
| | | 71.0 | 74.1 | 3.1 | 7.4 | (1) |
| | | 70.8 | 74.1 | 3.3 | 7.4 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995
(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line at 0925 MST, on-line at 0957 MST.

# METEOROLOGICAL STATION AUDIT SUMMARY

| | |
|---|---|
| Met Station: | Dry Fork Coal Company |
| Audit Date: | 20-Dec-06 |
| Audit Performed by: | S.Engel & S. Hansen--- IML Air Science |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit |
| Temperature (T): | Met ONE 2066, naturally aspirated | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Sierra Misco 099R tipping bucket | lab grade burette |
| Data acquisition system: | Campbell Scientific CR-21XL | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | 0.2<T<0.3 | N/A | N/A | 1.00 | (3) |
| WD (degrees) | | 0.0 | 0.2 | 0.2 | 5.0 | (1) |
| | | 90.0 | 89.7 | 0.3 | 5.0 | (1) |
| | | 180.0 | 179.7 | 0.3 | 5.0 | (1) |
| | | 270.0 | 270.4 | 0.4 | 5.0 | (1) |
| Temperature (°C) | ambient | 12.0 | 12.9 | 0.9 | 1.0 | (1) |
| | ice bath | 0.3 | 0.0 | 0.3 | 1.0 | (1) |
| | warm bath | 32.9 | 32.1 | 0.8 | 1.0 | (1) |
| Precipitation (0.1" equiv.) | | 180.4 | 185.3 | 4.8 | 18.5 | (1) |
| | | 179.4 | 185.3 | 5.8 | 18.5 | (1) |
| | | 176.6 | 185.3 | 8.7 | 18.5 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1995

(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line at 1244 MST, on-line at 1317 MST.

Battery voltage was 14.18 v

# METEOROLOGICAL STATION AUDIT SUMMARY

| | |
|---|---|
| Met Station: | Dry Fork Coal Company |
| Audit Date: | 20-Jun-07 |
| Audit Performed by: | C. Medill & K. Jahnke--- IML Air Science |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit |
| Temperature (T): | Met ONE 2066, naturally aspirated | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Sierra Misco 099R tipping bucket | lab grade burette |
| Data acquisition system: | Campbell Scientific CR-10 | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | 0.2<T<0.3 | N/A | N/A | 1.00 | (3) |
| WD (degrees) | | 0.0 | 0.6 | 0.6 | 5.0 | (1) |
| | | 90.0 | 90.4 | 0.4 | 5.0 | (1) |
| | | 180.0 | 179.8 | 0.2 | 5.0 | (1) |
| | | 270.0 | 270.1 | 0.1 | 5.0 | (1) |
| Temperature (°C) | hot bath | 50.9 | 50.4 | 0.5 | 1.0 | (1) |
| | ice bath | 1.3 | 2.1 | 0.8 | 1.0 | (1) |
| | warm bath | 22.0 | 22.4 | 0.4 | 1.0 | (1) |
| Precipitation (0.1" equiv.) | | 181.8 | 185.3 | 3.4 | 18.5 | (1) |
| | | 177.0 | 185.3 | 8.3 | 18.5 | (1) |
| | | 178.2 | 185.3 | 7.1 | 18.5 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995

(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line at 844 MST, on-line at 931 MST.

Tail on R.M. Young was not lined up with cuppler, WD was off by about 40 degrees.

Battery voltage was 11.033 v

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 20-Dec-07
Audit Performed by: C. Medill & S. Hansen--- IML Air Science

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit |
| Temperature (T): | Met ONE 2066, naturally aspirated | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Sierra Misco 099R tipping bucket | lab grade burette |
| Data acquisition system: | Campbell Scientific CR-10 | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.23 | 0.23 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | >.5 | N/A | N/A | <0.5 | (3) |
| WS (mph) after adjustment | | 0.00 | 0.23 | 0.23 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | 0.2<T<0.3 | N/A | N/A | <0.5 | (3) |
| WD (degrees) | | 0.0 | 0.2 | 0.2 | 5.0 | (1) |
| | | 90.0 | 89.4 | 0.6 | 5.0 | (1) |
| | | 180.0 | 179.1 | 0.9 | 5.0 | (1) |
| | | 270.0 | 270.3 | 0.3 | 5.0 | (1) |
| Temperature (°C) | hot bath | 35.6 | 35.9 | 0.3 | 1.0 | (1) |
| | ice bath | 0.1 | 0.6 | 0.5 | 1.0 | (1) |
| | warm bath | 20.3 | 20.2 | 0.1 | 1.0 | (1) |
| Precipitation (0.1" equiv.) | | 175.7 | 185.3 | 9.6 | 18.5 | (1) |
| | | 173.8 | 185.3 | 11.5 | 18.5 | (1) |
| | | 173.6 | 185.3 | 11.7 | 18.5 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995
(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line at 1602 MST, on-line at 1656 MST.
Start torque was greater than .5 gm-cm so bearings were replaced.

# METEOROLOGICAL STATION AUDIT SUMMARY

| | |
|---|---|
| Met Station: | Dry Fork Coal Company |
| Audit Date: | 20-Jun-08 |
| Audit Performed by: | C. Medill & S. Engel--- IML Air Science |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit |
| Temperature (T): | Met ONE 2066, naturally aspirated | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Sierra Misco 099R tipping bucket | lab grade burette |
| Data acquisition system: | Campbell Scientific CR-10 | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | >.5 | N/A | N/A | <0.5 | (3) |
| WD (degrees) | | 0.0 | 0.2 | 0.2 | 5.0 | (1) |
| | | 90.0 | 89.8 | 0.2 | 5.0 | (1) |
| | | 180.0 | 180.6 | 0.6 | 5.0 | (1) |
| | | 270.0 | 270.6 | 0.6 | 5.0 | (1) |
| Temperature (°C) | hot bath | 47.0 | 46.6 | 0.4 | 1.0 | (1) |
| | ice bath | 1.2 | 1.2 | 0.0 | 1.0 | (1) |
| | warm bath | 3.9 | 4.3 | 0.4 | 1.0 | (1) |
| Precipitation (0.1" equiv.) | | 196.4 | 185.3 | 11.2 | 18.5 | (1) |
| | | 197.2 | 185.3 | 12.0 | 18.5 | (1) |
| | | 185.4 | 185.3 | 0.2 | 18.5 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995

(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line at 0743 MST, on-line at 0835 MST.
16 extra tips for adjustment to bucket.

# METEOROLOGICAL STATION AUDIT SUMMARY

| | |
|---|---|
| Met Station: | Dry Fork Coal Company |
| Audit Date: | 14-Nov-08 |
| Audit Performed by: | J. Goldsmith - R. Campbell --- IML Air Science |

| Sensor | Mfr./Model | Reference Device |
|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit |
| Temperature (T): | Met ONE 2066, naturally aspirated | Hg-in-glass thermometer, or t-couple |
| Precipitation (Ppt.): | Sierra Misco 099R tipping bucket | lab grade burette |
| Data acquisition system: | Campbell Scientific CR-10 | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | >.5 | N/A | N/A | <0.5 | (3) |
| WD (degrees) | | 0.0 | 0.1 | 0.1 | 5.0 | (1) |
| | | 90.0 | 88.5 | 1.5 | 5.0 | (1) |
| | | 180.0 | 179.3 | 0.7 | 5.0 | (1) |
| | | 270.0 | 270.0 | 0.0 | 5.0 | (1) |
| Temperature (°C) | hot bath | 30.2 | 30.2 | 0.0 | 1.0 | (1) |
| | ice bath | -0.1 | 0.2 | 0.3 | 1.0 | (1) |
| | warm bath | 8.2 | 8.3 | 0.1 | 1.0 | (1) |
| Precipitation (0.1" equiv.) | | 174.4 | 185.3 | 10.9 | 18.5 | (1) |
| | | 173.7 | 185.3 | 11.6 | 18.5 | (1) |
| | | 174.0 | 185.3 | 11.3 | 18.5 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995

(3)= Manufacturer's Specifications

## Notes, Recommendations

System off-line at 0944 MST, on-line at 1105 MST.
No torque due to high winds

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 19-May-09
Audit Performed By: J. Goldsmith -- IML Air Science

| Sensor | Mfr./Model | Reference Device | Serial ID |
|---|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor | IML 0943 |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit | |
| Temperature (T): | Met ONE 2066, naturally aspirated | Hg-in-glass thermometer | IML 1403 |
| Precipitation (Ppt.): | Sierra Misco 099R tipping bucket | lab grade burette | N/A |
| Data acquisition system: | Campbell Scientific CR-10 | N/A | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | >.5 | N/A | N/A | <0.5 | (3) |
| WD (degrees) | | 0.0 | 0.2 | 0.2 | 5.0 | (1) |
| | | 90.0 | 90.7 | 0.7 | 5.0 | (1) |
| | | 180.0 | 178.7 | 1.3 | 5.0 | (1) |
| | | 270.0 | 270.7 | 0.7 | 5.0 | (1) |
| Temperature (°C) | hot bath | 37.1 | 36.9 | 0.1 | 1.0 | (1) |
| | ice bath | 0.6 | 1.0 | 0.4 | 1.0 | (1) |
| | warm bath | 22.0 | 22.4 | 0.4 | 1.0 | (1) |
| Precipitation (0.1" equiv.) | | 183.3 | 185.3 | 1.9 | 18.5 | (1) |
| | | 185.7 | 185.3 | 0.4 | 18.5 | (1) |
| | | 186.0 | 185.3 | 0.8 | 18.5 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995
(3)= Manufacturer's Specifications

## Notes, Recommendations

System taken offline at 07:34MST and returned online at 09:17 MST.
Changed wind speed bearings
Tipping bucket was broken off hinges, reset the precip bucket and then audited

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 7-Oct-09
Audit Performed By: J. Goldsmith, R. Campbell -- IML Air Science

| Sensor | Mfr./Model | Reference Device | Serial ID |
|---|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor | IML 0896 |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit | IML 0896 |
| Temperature (T): | Met ONE 2066, naturally aspirated | Hg-in-glass thermometer | IML 1403 |
| Precipitation (Ppt.): | Sierra Misco 099R tipping bucket | lab grade burette | N/A |
| Data acquisition system: | Campbell Scientific CR-10 | N/A | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | >.5 | N/A | N/A | <0.5 | (3) |
| WD (degrees) | | 0.0 | 0.1 | 0.1 | 5.0 | (1) |
| | | 90.0 | 89.7 | 0.3 | 5.0 | (1) |
| | | 180.0 | 179.0 | 1.0 | 5.0 | (1) |
| | | 270.0 | 269.2 | 0.8 | 5.0 | (1) |
| Temperature (°C) | hot bath | 38.3 | 38.1 | 0.2 | 1.0 | (1) |
| | ice bath | 1.8 | 1.6 | 0.2 | 1.0 | (1) |
| | warm bath | 26.2 | 26.1 | 0.1 | 1.0 | (1) |
| Precipitation (0.1" equiv.) | | 177.0 | 185.3 | 8.3 | 18.5 | (1) |
| | | 177.4 | 185.3 | 7.8 | 18.5 | (1) |
| | | 176.4 | 185.3 | 8.8 | 18.5 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1995

(3)= Manufacturer's Specifications

## Notes, Recommendations

System taken offline at 1125 MST and returned online at 1206 MST.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 9-Jun-10
Audit Performed By: R. Campbell, S. Warner -- IML Air Science

| Sensor | Mfr./Model | Reference Device | Serial ID |
|---|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor | IML 0856 |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit | |
| Temperature (T): | Met ONE 2066, naturally aspirated | Hg-in-glass thermometer | IML 0885 |
| Precipitation (Ppt.): | Sierra Misco 099R tipping bucket | lab grade burette | N/A |
| Data acquisition system: | Campbell Scientific CR-10 | N/A | N/A |

## Audit Results

| | | Reference | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | >.5 | N/A | N/A | <0.5 | (3) |
| WD (degrees) | | 0.0 | 1.1 | 1.1 | 5.0 | (1) |
| | | 90.0 | 89.4 | 0.6 | 5.0 | (1) |
| | | 180.0 | 179.9 | 0.2 | 5.0 | (1) |
| | | 270.0 | 269.8 | 0.2 | 5.0 | (1) |
| Temperature (°C) | Ice bath | 2.8 | 3.1 | 0.3 | 1.0 | (1) |
| | warm bath | 22.2 | 22.0 | 0.2 | 1.0 | (1) |
| | hot bath | 36.8 | 36.6 | 0.2 | 1.0 | (1) |
| Precipitation (0.1" equiv.) | | 183.8 | 185.3 | 1.4 | 18.5 | (1) |
| | | 180.3 | 185.3 | 5.0 | 18.5 | (1) |
| | | 179.9 | 185.3 | 5.4 | 18.5 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995

(3)= Manufacturer's Specifications

## Notes, Recommendations

System taken offline at 14:53 MST and returned online at 16:02 MST.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 8-Dec-10
Audit Performed By: K. Jahnke, J. Rogers -- IML Air Science

| Sensor | Mfr./Model | Reference Device | Serial ID |
|---|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor | IML 0896 |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit | IML 0942 |
| Temperature (T): | Met ONE 2066, naturally aspirated | Hg-in-glass thermometer | T050906 |
| Precipitation (Ppt.): | Sierra Misco 099R tipping bucket | lab grade burette | N/A |
| Data acquisition system: | Campbell Scientific CR-10 | N/A | N/A |

## Audit Results

| | Reference RPM | Reference MPH | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (mph) | 0 | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
| | 300 | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
| | 800 | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
| | 3000 | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
| | 8000 | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) | | 1.0 | t<1.0 | N/A | 1.0 | (3) |
| WD (degrees) | | 0.0 | 0.1 | 0.1 | 5.0 | (1) |
| | | 90.0 | 90.2 | 0.2 | 5.0 | (1) |
| | | 180.0 | 180.1 | 0.1 | 5.0 | (1) |
| | | 270.0 | 270.4 | 0.4 | 5.0 | (1) |
| Temperature (°C) | | 0.0 | 0.0 | 0.0 | 0.5 | (1) |
| | | 68.4 | 68.0 | 0.4 | 0.5 | (1) |
| | | 49.1 | 48.8 | 0.3 | 0.5 | (1) |
| Precipitation (0.1" equiv.) | | 182.0 | 185.3 | 3.25 | 18.5 | (1) |
| | | 184.5 | 185.3 | 0.75 | 18.5 | (1) |
| | | 181.6 | 185.3 | 3.65 | 18.5 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995

(3)= Manufacturer's Specifications

## Notes, Recommendations

System taken offline at 12:18 MST and returned online at 12:55 MST.

## METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 28-Apr-11
Audit Performed By: S. Hansen, Z. Heid -- IML Air Science

| Sensor | Mfr./Model | Reference Device | Serial ID |
|---|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | quartz referenced drive motor | IML 1407 |
| Wind Direction (WD): | RM Young Wind Monitor AQ | Brunton transit | IML 1405 |
| Temperature (T): | Met ONE 2066, naturally aspirated | Hg-in-glass thermometer | IML 0885 |
| Precipitation (Ppt.): | Sierra Misco 099R tipping bucket | lab grade burette | N/A |
| Data acquisition system: | Campbell Scientific CR-10 | N/A | N/A |

## Audit Results

|  | Reference RPM | Reference MPH | DAS Value | \|Difference\| | Specification |  |
|---|---|---|---|---|---|---|
| WS (mph) | 0 | 0.00 | 0.00 | 0.00 | 0.56 | (1) |
|  | 300 | 3.44 | 3.44 | 0.00 | 0.56 | (1) |
|  | 800 | 9.16 | 9.16 | 0.00 | 0.56 | (1) |
|  | 3000 | 34.35 | 34.35 | 0.00 | 1.72 | (1) |
|  | 8000 | 91.60 | 91.60 | 0.00 | 4.58 | (1) |
| WS start torque (gm-cm) |  | 1.0 | t<1.0 | N/A | 1.0 | (3) |
| Crossarm Alignment |  | 1.00 | 0.40 | 0.60 | 5.0 | (3) |
| WD (degrees) | Clockwise | 0.0 | 0.4 | 0.4 | 5.0 | (1) |
|  |  | 90.0 | 90.3 | 0.3 | 5.0 | (1) |
|  |  | 180.0 | 179.8 | 0.2 | 5.0 | (1) |
|  |  | 270.0 | 269.7 | 0.3 | 5.0 | (1) |
|  | Counter Clockwise | 0.0 | 0.2 | 0.2 | 5.0 | (1) |
|  |  | 90.0 | 90.0 | 0.0 | 5.0 | (1) |
|  |  | 180.0 | 179.1 | 0.9 | 5.0 | (1) |
|  |  | 270.0 | 270.0 | 0.0 | 5.0 | (1) |
| Temperature (°C) |  | 1.6 | 1.4 | 0.2 | 0.5 | (1) |
|  |  | 38.9 | 39.1 | 0.2 | 0.5 | (1) |
|  |  | 16.1 | 16.5 | 0.4 | 0.5 | (1) |
| Precipitation (0.1" equiv.) |  | 185.2 | 185.3 | 0.05 | 18.5 | (1) |
|  |  | 185.6 | 185.3 | 0.35 | 18.5 | (1) |
|  |  | 185.0 | 185.3 | 0.25 | 18.5 | (1) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995
(3)= Manufacturer's Specifications

## Notes, Recommendations

System taken offline at 12:03 MST and returned online at 12:57 MST.
Temp probe needs replaced.

# METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Mine
Audit Date: 16-Nov-11
Audit Performed By: C. Cottom, Z. Heid -- IML Air Science

| Sensor | Mfr./Model | Serial Number | Reference Device | Serial/ID Number |
|---|---|---|---|---|
| Wind Speed (WS): | RM Young Wind Monitor AQ | | quartz drive motor | IML 0855 |
| Wind Direction (WD): | RM Young Wind Monitor AQ | | transit, compass | IML 0894 |
| Temperature @ 2 Meters: | RM Young 41342, power aspirated | TS20278 | digital thermistor | IML 1402 |
| Temperature @ 10 Meters: | RM Young 41342, power aspirated | TS20279 | digital thermistor | IML 1402 |
| Precipitation: | Sierra Misco 099R tipping bucket | | lab grade burette | N/A |
| Data acquisition system: | CSI CR1000 Datalogger | 43527 | N/A | N/A |

## Audit Results

| | Reference RPM | Reference m/sec | DAS Value | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| WS (m/sec) | 0 | 0.00 | 0.00 | 0.00 | below threshold | |
| | 300 | 1.54 | 1.54 | 0.00 | 0.20 | (2) |
| | 800 | 4.10 | 4.10 | 0.00 | 0.20 | (2) |
| | 3000 | 15.36 | 15.36 | 0.00 | 0.20 | (2) |
| | 8000 | 40.96 | 40.96 | 0.00 | 0.20 | (2) |
| Crossarm Alignment | | 180.0 | 180.0 | 0.0 | 5.0 | (2) |
| WS start torque (gm-cm) | | 1.0 | t<1.0 | N/A | 1.0 | (3) |
| WD (degrees) | Clockwise | 0.0 | 0.1 | 0.1 | 5.0 | (2) |
| | | 90.0 | 90.2 | 0.2 | 5.0 | (2) |
| | | 180.0 | 180.1 | 0.1 | 5.0 | (2) |
| | | 270.0 | 270.4 | 0.4 | 5.0 | (2) |
| | Counter clockwise | 0.0 | 0.1 | 0.1 | 5.0 | (2) |
| | | 90.0 | 89.8 | 0.2 | 5.0 | (2) |
| | | 180.0 | 180.5 | 0.5 | 5.0 | (2) |
| | | 270.0 | 269.9 | 0.1 | 5.0 | (2) |
| Temp. (°C): Upper Sensor | | 0.0 | 0.0 | 0.0 | 0.5 | (2) |
| | | 9.8 | 9.9 | 0.1 | 0.5 | (2) |
| | | 12.8 | 12.8 | 0.0 | 0.5 | (2) |
| Temp. (°C): Lower Sensor | | 0.0 | 0.0 | 0.0 | 0.5 | (2) |
| | | 9.8 | 9.8 | 0.1 | 0.5 | (2) |
| | | 12.8 | 12.8 | 0.0 | 0.5 | (2) |

| | DAS Value (in) | Reference (ml) | DAS Equivalent | \|Difference\| | Specification | |
|---|---|---|---|---|---|---|
| Precipitation (0.1" equiv.) | 0.10 | 194.0 | 185.3 | 8.7 | 18.5 | (2) |
| | 0.10 | 185.0 | 185.3 | 0.3 | 18.5 | (2) |
| | 0.10 | 185.5 | 185.3 | 0.2 | 18.5 | (2) |
| | | | Average Diff: | 3.1 | 8.2 | (2) |

| | | DAS Value | | | | |
|---|---|---|---|---|---|---|
| | Reference (°C) | Lower Sensor | Upper Sensor | ΔT | Specification | |
| Delta Temperature (°C): | 0.0 | 0.0 | 0.0 | 0.03 | 0.10 | (2) |
| | 9.8 | 9.8 | 9.9 | 0.05 | 0.10 | (2) |
| | 12.8 | 12.8 | 12.8 | 0.00 | 0.10 | (2) |

**BOLD difference values exceed performance specifications**

(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorlogical Measurements Version 2.0, 2008
(3)= Manufacturer's Specifications
(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

## Notes, Recommendations

System returned on-line at 17:42 MST.
Upgraded to AERMOD system.
Bearings were replaced prior to start up.

# Standard Operating Procedures

# Standard Operating Procedure
For Meteorological Monitoring Station Audit

## 1.0 Scope and Application

1.1 Accurate meteorological measurements are critical to interpretation of ambient air pollution data. The proper operation and accuracy of measurements must be assessed on a periodic basis.

1.2 The objective of this procedure is to ensure that recorded meteorological data match readings provided by known inputs within specified limits.

1.3 This procedure applies to meteorological monitoring stations that measure ambient air temperature, wind speed, wind direction, barometric pressure, relative humidity, solar radiation, and precipitation (tipping bucket method).

## 2.0 Summary of Method

2.1 The accuracy of meteorological measurements is assessed by stimulating meteorological measurement sensors with known inputs. Sensor outputs, as translated and recorded by the system data acquisition system, are compared to the known values. The differences are compared to the specified limits to assess system accuracy.

## 3.0 Health and Safety Warnings

3.1 General safety precautions related to electrical hazards must be observed at all times when working with electronic equipment. Electrical receptacles and equipment must be properly grounded. Use caution when servicing or operating electrical equipment in wet conditions.

3.2 General precautions for working with heavy equipment and electro-mechanical equipment should be taken.

3.3 Meteorological towers present a serious physical hazard. Great care must be taken when lower, raising, or climbing towers.

## 4.0 Cautions

4.1 Damage to the instrument may result if caution is not taken to properly install and maintain the device. Follow the manufacturer's instructions for maintenance of all equipment and for safe, secure installation.

## 5.0 Personnel Qualifications

5.1 Persons performing this SOP must be familiar with the operation of environmental measurement instrumentation.

5.2 Instrumentation skills are necessary for interacting with the data acquisition system.

5.3 Familiarity with electronic and mechanical test equipment is required.

## 6.0 Equipment

6.1 Quartz-referenced motor, with adaptors

6.2 Starting torque measurement disc and weights

6.3 NIST traceable thermometer, accurate to ±0.1°C

6.4 Two insulated containers (one with ice water and the other with hot water)

6.5 Engineer’s transit

6.6 Class B pipette

6.7 NIST traceable digital pressure standard

6.8 Reference relative humidity sensor/instrument, or psychrometer

6.9 Solar radiation sensor/instrument & independent datalogger

6.10 Field data sheet

6.11 Time piece

6.12 Miscellaneous tools

## 7.0 Procedure

7.1 Record date and time, station ID, name of person(s) performing the procedure, on field data sheet.

7.2 Compare the datalogger's readings with your own assessment of the ambient weather conditions. Note any anomalies on the field data sheet.

7.3 Check the initial alignment of the wind direction sensor using the transit, being sure to adjust for local declination.

7.4 Record the following information on the audit data: site ID, auditors, date, time, and system components.

7.5 Record the current time as *time system off line* on the field data sheet.

7.6 Remove the appropriate restraints and ***carefully*** lower the tower to a point where sensors are at a safe working height.

7.7 Remove the anemometer propeller. Attach the propeller torque disc to shaft. Measure and record the starting torque in the counter-clockwise direction.

7.8 Attach the anemometer drive motor to the shaft and rotate at speeds corresponding to approximately 3 mph, 9 mph, 30 mph, and 90 mph recording the motor speeds and wind speed readings from the data logger.

7.9 Assess the linearity of the wind direction sensor by physically aligning the body of the anemometer with the base at angles corresponding to 0°, 90°, 180°, and 270°, recording the corresponding readings from the data logger.

7.10 Remove each temperature sensor from its radiation shield and immerse the sensor in an ice water bath along with the reference thermometer. Allow the sensor and thermometer to attain equilibrium and record both measurements.

7.11 Immerse each temperature sensor in a warm water bath (80° - 100°F) along with the reference thermometer. Allow the sensor and thermometer to attain equilibrium and record both measurements.

7.12 Create a reference-temperature midpoint by mixing ice water and warm water. Immerse each temperature sensor in the water bath along with the reference thermometer. Allow the sensor and thermometer to attain equilibrium and record both measurements.

7.13 Inspect all sensors, cables, and mounting hardware. Conduct any repairs or scheduled preventive maintenance **to only those sensors audited to this point**.

7.14 Make sure all cables and mounting hardware are secure. ***Carefully*** raise the tower, secure the base, and equalize the guy wire tensions.

7.15 Mount the independent datalogger (or RH reference) in a safe and secure place, and collocate the audit sensors for solar radiation and relative humidity. Allow the sensors time to equilibrate. Record the solar radiation and RH measurements from the system and the reference.

7.16 Using the pipette, admit water slowly into the inlet of the precipitation gauge (*as found, i.e. do not clean)* until the bucket tips 10 times (0.10” precipitation equivalent). Record the amount of water required for the 10 tips and the amount registered on the data logger. Repeat the procedure two more times.

7.17 Clean the precipitation gauge inlet and perform any indicated adjustments and/or repairs can be performed and noted. If adjustments are made, repeat step 7.15. Note the condition of the gauge prior to, and after the audit. If the ambient temperature is cold enough, assess whether the heater is working.

7.18 Record and compare pressure measurements from the station logger and the pressure standard. Record both values.

7.19 Display and record the data acquisition system time. Record the time displayed by the reference time piece. Note: the data acquisition system operates on Standard Time year round.

7.20 Display and record the data acquisition battery voltage.

7.21 Record any findings, repairs, replacements, and any other anomalies in the field data sheet. Record the time the station was returned to normal operating condition.

## 8.0 References

8.1 Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV. Meteorological Measurements; EPA/600/4-90/003; August 1989; U.S. Environmental Protection Agency

8.2 Quality Assurance Handbook for Air Pollution Measurement Systems: Volume V. Precipitation Measurement Systems; EPA/600/R-94/038e; April; U.S. Environmental Protection Agency

8.3 On-Site Meteorological Program Guidance for Regulatory Modeling Applications; EPA-450/4-87-013; June, 1987; U.S. Environmental Protection Agency

8.4 Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD); EPA-450/4-87-007; May, 1987; U.S. Environmental Protection Agency

## 9.0 Attachments

9.1 Meteorological Station Audit Field Data Sheet

*IML Air Science*
a division of Inter-Mountain Laboratories, Inc.
555 Absaraka, Sheridan, WY 82801

# Meteorological Station Audit

Page 1 of 2

Network:

Date: Auditors: DAS time off-line:

Notes; system as found:

## Standards

| Parameter | Reference Device | Mfr./Model | SN/ID |
|---|---|---|---|
| Wind Speed | Quartz Drive Motor | | |
| Wind Direction Alignment | Compass | | |
| Temperature | Digital Thermistor | | |
| Relative Humidity | Collocated Sensor | | |
| Pressure | Digital Barometer | | |
| Precipitation | Lab Grade Burette | N/A | N/A |
| Solar Radiation | Collocated Sensor | | |

## Sensors

| Sensors | Mfr./Model | SN/ID |
|---|---|---|
| DAS: | | |
| Wind Speed: | | |
| Wind Direction: | | |
| Temp/Asp 2m: | | |
| Temp/Asp 10m: | | |
| Precipitation: | | |
| Barometric Pressure : | | |
| Relative Humidity: | | |
| Solar Radiation: | | |

# System Audit

**Temperature**

| | | |
|---|---|---|
| Height: | 2m | 10m |
| Reference | DAS | DAS |
| °C | | |
| °C | | |
| °C | | |

**Barometric Pressure**

| |
|---|
| ref. |
| DAS |

**Relative Humidity**

| | |
|---|---|
| ref. RH | ref. RH Temp |
| DAS RH | DAS RH Temp |

Page 2 of 2

**Wind Speed**

| | | |
|---|---|---|
| starting torque | | gm-cm |
| reference | DAS | after adj. |
| 0 rpm | | |
| rpm<br>mph | | |
| rpm<br>mph | | |
| rpm<br>mph | | |
| rpm<br>mph | | |

**Wind Direction**

| | | | |
|---|---|---|---|
| starting torque<br>ccw: cw: gm-cm | | | DAS Reading |
| initial alignment: | | | |
| reference | CW | CCW | After Adj |
| **360** | | | |
| 060 | | | |
| **090** | | | |
| 120 | | | |
| **180** | | | |
| 240 | | | |
| **270** | | | |
| 300 | | | |

**Precipitation (Tipping Bucket)**

| mls/weight | tips | in. equiv. |
|---|---|---|
| | 10 | 0.10 |
| | 10 | 0.10 |
| | 10 | 0.10 |
| Heater working? | | |
| Inspection | | |
| DAS precip start: | | |
| DAS precip end: | | |

| **Solar Radiation** | Ref | DAS |
|---|---|---|
| Covered | | |
| Un-covered | | |

DAS Day: ____________

DAS Time: ____________

DAS Year: ____________

DAS Battery: ____________

SM Battery OK ? ____________

Enclosure Humidity OK? ____________

WS Channel: ____________

WD Channel: ____________

Ta Channel: ____________

Precip. Channel: ____________

RH Channel: ____________

Pa Channel: ____________

Batt. Channel: ____________

Solar Radiation Channel: ____________

Notes: ____________________________________________

____________________________________________

____________________________________________

____________________________________________

End System Audit

DAS time on-line: ____________________________________________

# Standard Operating Procedure
# For Meteorological Monitoring Station Calibration

## 1.0 Scope and Application

1.1 Accurate meteorological measurements are critical to interpretation of ambient air pollution data. The proper operation and accuracy of measurements must be assessed on a periodic basis.

1.2 The objective of this procedure is to ensure that recorded meteorological data match readings provided by known inputs within specified limits.

1.3 This procedure applies to meteorological monitoring stations that measure ambient air temperature, wind speed, wind direction, barometric pressure, relative humidity, solar radiation, and precipitation (tipping bucket method).

## 2.0 Summary of Method

2.1 The accuracy of meteorological measurements is assessed by stimulating meteorological measurement sensors with known inputs. Sensor outputs, as translated and recorded by the system data acquisition system, are compared to the known values. The differences are compared to the specified limits to assess system accuracy. If any differences between reference standard and sensor are discovered, corrective actions must be taken.

## 3.0 Health and Safety Warnings

3.1 General safety precautions related to electrical hazards must be observed at all times when working with electronic equipment. Electrical receptacles and equipment must be properly grounded. Use caution when servicing or operating electrical equipment in wet conditions.

3.2 General precautions for working with heavy equipment and electro-mechanical equipment should be taken.

3.3 Meteorological towers present a serious physical hazard. Great care must be taken when lower, raising, or climbing towers.

## 4.0 Cautions

4.1 Damage to the instrument may result if caution is not taken to properly install and maintain the device. Follow the manufacturer's instructions for maintenance of all equipment and for safe, secure installation.

## 5.0 Personnel Qualifications

5.1 Persons performing this SOP must be familiar with the operation of environmental measurement instrumentation.

5.2 Instrumentation skills are necessary for interacting with the data acquisition system.

5.3 Familiarity with electronic and mechanical test equipment is required.

## 6.0 Equipment

6.1 Quartz-referenced motor, with adaptors

6.2 Starting torque measurement disc and weights

6.3 NIST traceable thermometer, accurate to ±0.1°C

6.4 Two insulated containers (one with ice water and the other with hot water)

6.5 Engineer’s transit

6.6 Class B pipette

6.7 NIST traceable digital pressure standard

6.8 Reference relative humidity sensor/instrument

6.9 Solar radiation sensor/instrument & independent datalogger

6.10 Field data sheet

6.11 Time piece

6.12 Miscellaneous tools

## 7.0 Procedure

7.1 Record date and time, station ID, name of person(s) performing the procedure, on field data sheet.

7.2 Compare the datalogger's readings with your own assessment of the ambient weather conditions. Note any anomalies on the field data sheet.

7.3 Check the initial alignment of the wind direction sensor and orientation of mounting crossarm using the transit, being sure to adjust for local declination.

7.4 Record the following information on the calibration data: site ID, auditors, date, time, and system components.

7.5 Record the current time as *time system off line* on the field data sheet.

7.6 Remove the appropriate restraints and ***carefully*** lower the tower to a point where sensors are at a safe working height if calibrating a “tip down” system. For towers where climbing is required to access mounted sensors, put on climbing harness with appropriate safety equipment including fall protection and lanyard. All climbing apparatus must be inspected for safety before each use and all safety guidelines specific to the site must be followed.

7.7 Remove the anemometer propeller. Attach the propeller torque disc to shaft. Measure and record the starting torque in the counter-clockwise direction.

7.8 Attach the anemometer drive motor to the shaft and rotate at speeds corresponding to approximately 3 mph, 9 mph, 30 mph, and 90 mph recording the motor speeds and wind speed readings from the data logger.

7.9 Assess the linearity of the wind direction sensor by physically aligning the body of the anemometer with the base at angles corresponding to 0°, 90°, 180°, and 270°, recording the corresponding readings from the data logger. The checks must be performed in both a clockwise and counterclockwise rotation.

7.10 Remove each temperature sensor from its radiation shield and immerse the sensor in an ice water bath along with the reference thermometer. Allow the sensor and thermometer to attain equilibrium and record both measurements.

7.11 Immerse each temperature sensor in a warm water bath (90° - 110°F) along with the reference thermometer. Allow the sensor and thermometer to attain equilibrium and record both measurements.

7.12 Create a reference-temperature midpoint by mixing ice water and warm water. Immerse each temperature sensor in the water bath along with the reference thermometer. Allow the sensor and thermometer to attain equilibrium and record both measurements.

7.13 Inspect all sensors, cables, and mounting hardware. Conduct any repairs or scheduled preventive maintenance **to only those sensors assessed to this point**.

7.14 Make sure all cables and mounting hardware are secure. ***Carefully*** raise the tower, secure the base, and equalize the guy wire tensions.

7.15 Mount the independent datalogger (or RH reference) in a safe and secure place, and collocate the reference sensors for solar radiation and relative humidity. Allow the sensors time to equilibrate. Record the solar radiation and RH measurements from the system and the reference.

7.16 Using the pipette, admit water slowly into the inlet of the precipitation gauge (*as found, i.e. do not clean)* until the bucket tips 10 times (0.10” precipitation equivalent). Record the amount of water required for the 10 tips and the amount registered on the data logger. Repeat the procedure two more times.

7.17 Clean the precipitation gauge inlet and perform and note any indicated adjustments and/or repairs. If adjustments are made, repeat step 7.16. Note the condition of the gauge prior to, and after the assessment. If the ambient temperature is cold enough, assess whether the heater is working.

7.18 Record and compare pressure measurements from the station logger and the pressure standard. Record both values.

7.19 Display and record the data acquisition system time. Record the time displayed by the reference time piece. Note: the data acquisition system operates on Standard Time year round.

7.20 Display and record the data acquisition battery voltage.

7.21 Record any findings, repairs, replacements, and any other anomalies in the field data sheet. Should any sensor not meet specifications of sensor or calibration criteria, appropriate action must be performed including onsite sensor calibration/adjustment, removal for factory recalibration, or replacement if deemed necessary. Record the time the station was returned to normal operating condition.

## 8.0 References

8.1 Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV. Meteorological Measurements; EPA/600/4-90/003; August 1989; U.S. Environmental Protection Agency

8.2 Quality Assurance Handbook for Air Pollution Measurement Systems: Volume V. Precipitation Measurement Systems; EPA/600/R-94/038e; April; U.S. Environmental Protection Agency

8.3 On-Site Meteorological Program Guidance for Regulatory Modeling Applications; EPA-450/4-87-013; June, 1987; U.S. Environmental Protection Agency

8.4 Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD); EPA-450/4-87-007; May, 1987; U.S. Environmental Protection Agency

## 9.0 Attachments

9.1 Meteorological Station Calibration Field Data Sheet

# Standard Operating Procedure for Meteorological Data Processing

## 1.0 Scope and Application

1.1 The objective of this procedure is to ensure that all data collected, processed, and reported by IML Air Science are of similar high quality. The transformation of raw meteorological data to validated, reportable data is critical to the ability of a client to meet QAPP requirements, and to the ability of IML Air Science to meet contractual requirements to the client. This procedure also ensures that time-sensitive work, e.g. quarterly reporting needed to satisfy EPA, state, and network QAPP requirements, is performed.

1.2 This procedure applies to those ambient air monitoring networks for which IML Air Science has been contracted to perform routine meteorological data collection and/or processing.

1.3 This SOP describes the method for handling, reviewing, verifying, and validating data collected by clients' meteorological systems.

## 2.0 Summary of Method

2.1 Clients are responsible for operation of meteorological systems. Actual data collection/transmittal may be performed by customers' personnel or contracted to IML Air Science.

2.2 Once collected, meteorological data are transmitted to IML headquarters in Sheridan, WY, where the data are processed (imported, reviewed, verified, and validated).

2.3 Each reviewer is responsible for verifying each of the parts that are designated for their review and for completing the log/checklist (Attachment 1) associated with the data package.

2.4 Data qualifiers are used where they are appropriate. Data qualifiers used during data processing and reporting are included in Attachment 2.

## 3.0 Definitions

3.1 Data processing refers to the generic procedures used to transform raw data into validated data, and the subsequent steps taken to summarize, format, and report validated data.

3.2 Data review refers to the overall process of verifying that a meteorological system is functioning properly, data are being accurately logged and transmitted, and QA/QC procedures are being followed.

3.3 Data verification is the process of evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method, procedural, and/or contractual requirements.

3.4 Data validation is the data-specific process that extends the evaluation of data beyond method, procedural, or contractual compliance to determine the analytical quality of a specific data set. Data validation includes the determination, where possible, of the reasons for any failure to meet method, procedural, or contractual requirements, and an evaluation of the impact of such failure on the overall data set. Data validation applies to activities in the field as well as data processing activities.

3.5 Quality Assurance Project Plan (QAPP) is a document that describes project - specific information such as quality assurance, quality control, and other technical activities that must be implemented to ensure that the results of the work performed will satisfy the stated acceptance criteria.

3.6 Acceptance criteria: the specific quality objectives for a given project, described in the QAPP.

3.7 Screening criteria: suggested or preliminary upper and lower limits for data values based on instrument thresholds, experience, or historical data.

## 4.0 Personnel Qualifications

4.1 Persons performing this SOP must be familiar with the operation of meteorological measurement instrumentation.

4.2 These persons must also be trained in the use of IML's proprietary database to process and report meteorological data.

4.3 Further, personnel will be trained in general QA/QC requirements and procedures pertaining to the measurement of environmental data.

## 5.0 Raw Data Requirements

5.1 The reviewer must verify that all information necessary for data review is present. This includes not only raw electronic data files, but other hard copy or electronic information used to review and verify the data.

5.2 Electronic raw data: Comma-delimited text files, spreadsheet files, or similarly formatted files containing raw data to be imported into the processing database.

5.3 QA/QC raw data: These include field notes, audit field sheets, client correspondence, and any other data used to verify proper operation of the system and establish the validity of the data.

## 6.0 Data Review

6.1 In those cases where Air Science is contracted to initiate data retrieval/transmittal on-site, preliminary data review and verification occurs in the field or at a satellite office. Data are examined for completeness and reasonableness. Meteorological instruments are physically examined on a routine basis to detect failures that could impact data accuracy and validity.

6.2 Data transmitted directly to Air Science is also examined for completeness and reasonableness before import into the processing database.

## 7.0 Data Verification and Validation

Detailed instructions for users of IML Air Science's meteorological database contain proprietary information. General procedural steps are outlined below. Screening and acceptance criteria used to verify, qualify, and invalidate data are shown in Attachment 3.

7.1 Raw data are imported into a client-specific database to preserve data integrity and eliminate the possibility of data crossover between clients.

7.2 During the import process, records are checked for the proper station (client) ID, and the time stamp is examined to prevent importing duplicate records.

7.3 As an aid to the reporting process, the database allows for the automatic insertion of blank, invalid records in place of missing data. The data reviewer must determine if the data are actually lost, or if an error has occurred during downloading, transmission, or importing that led to the missing records.

7.4 The database has provision for both automatic and manual data flagging and invalidation. It is important to ***perform automatic invalidations prior to manual invalidations***. Reversing this order could result in overwriting a manual invalidation code. Manual invalidation codes should be inserted in reverse order of preference, so that the last code entered is the highest priority (i.e. most accurate diagnostic) code for a given record. Any attempt to manually invalidate one or more already flagged records, will result in a warning and a list of the affected records. The user may cancel the operation at this point to preserve existing flags, or elect to overwrite these records.

7.5 Automated Step 1 flags records indicating instrument failure (logger error codes) or low battery voltage.

7.6 Automated Step 2 flags records with any met values outside pre-established limits (screening criteria).

7.7 Automated Step 3 flags records with either minimal or inordinately large changes in the various met parameters from hour to hour.

7.8 Using professional judgment and experience, the data reviewer must examine the results of Steps 2 and 3 and accept or reject the data. Rejected data are manually coded with the appropriate qualifier.

7.9 After automated results have been evaluated and accepted, the reviewer must verify the overall quality of the dataset by examining field notes, audit results, and any other pertinent documentation.

7.10 Records/data deemed invalid must be manually coded by the reviewer. Qualifiers can be inserted at the field level (i.e. for a particular parameter in a record), or at the record level (i.e. all parameters recorded during the period).

7.11 Additional checks of the data qualifying/invalidation process occur when report products are generated. Irregularities in meteorological summaries, wind roses, and other summary products may lead to a re-examination of the data

## 8.0 Records Management

8.1 Data transmittal can occur along a variety of routes, and a particular network may use more than one route. Example routes include:

Datalogger → storage module → Air Science PC (direct connect)

Datalogger → field laptop→ office PC→ Air Science PC (disc, e-mail)

Datalogger → Air Science PC (phone or radio telemetry)

Datalogger → Client PC (direct connect, telemetry, etc.) → Air Science PC (disc, e-mail)

8.2 Upon receipt of data at IML offices, an entry is made into a hard-copy or electronic log. Date of receipt, data-range received, date data is QC'd, and any additional notes are recorded.

8.3 Raw data are archived electronically in their original format on the IML network. The network has automated data back-up and recovery functions to prevent data loss.

8.4 Raw data contain a client-specific ID number recognized by the processing database. Raw and processed data for each client are stored separately from that of other clients.

8.5 A common processing database is used by all reviewers in Air Science. This common interface links to the client-specific database and tables needed by the data reviewer to import, process, and report specific data.

## 9.0 References

9.1 Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV. Meteorological Measurements Version 2.0 (Final); EPA/454/B-08-002; March 2008; U.S. Environmental Protection Agency

9.2 Quality Assurance Handbook for Air Pollution Measurement Systems: Volume V. Precipitation Measurement Systems; EPA/600/R-94/038e; April 1994; U.S. Environmental Protection Agency

9.3 On-Site Meteorological Program Guidance for Regulatory Modeling Applications; EPA-450/4-87-013; June, 1987; U.S. Environmental Protection Agency

9.4 Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD); EPA-450/4-87-007; May, 1987; U.S. Environmental Protection Agency

## 10.0 Attachments

### 10.1 Meteorological data processing log and checklist

Station: ____________________

|  |  |  |  |  | Database |  |  |  |
|---|---|---|---|---|---|---|---|---|
| Date Rec'd | Dates Recorded | Field Activities/ Audits? | Complete YTD? | Data Archived? | Imported? | QC'd? | Validated? | Notes |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
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|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |

## 10.2 Meteorological data qualifiers

| AIRS Numeric | AQS Alpha | Description |
|---|---|---|
| 0 | 0 | Valid Record |
| 9967 | AA | Sample Pressure Out of Limits - 9967 - AA |
| 9968 | AB | Technician Unavailable - 9968 - AB |
| 9969 | AC | Construction/Repairs in Area - 9969 - AC |
| 9970 | AD | Shelter Storm Damage - 9970 - AD |
| 9971 | AE | Shelter Temperature Out of Limits - 9971 - AE |
| 9972 | AF | Scheduled But Not Collected - 9972 - AF |
| 9975 | AI | Insufficient Data (Can't Calculate) - 9975 - AI |
| 9978 | AL | Voided by Operator - 9978 - AL |
| 9979 | AM | Miscellaneous Void - 9979 - AM |
| 9980 | AN | Machine Malfunction - 9980 - AN |
| 9981 | AO | Bad Weather - 9981 - AO |
| 9982 | AP | Vandalism - 9982 - AP |
| 9983 | AQ | Collection Error - 9983 - AQ |
| 9984 | AR | Lab Error - 9984 - AR |
| 9985 | AS | Poor Quality Assurance Results - 9985 - AS |
| 9986 | AT | Calibration - 9986 - AT |
| 9987 | AU | Monitoring Waived - 9987 - AU |
| 9988 | AV | Power Failure (Powr) - 9988 - AV |
| 9989 | AW | Wildlife Damage - 9989 - AW |
| 9992 | AZ | QC Audit (Audit) - 9992 - AZ |
| 9993 | BA | Maintenance/Routine Repairs - 9993 - BA |
| 9994 | BB | Unable to Reach Site - 9994 - BB |
| 9995 | BC | Multi-Point Calibration - 9995 - BC |
| 9996 | BD | Auto Calibration - 9996 - BD |
| 9997 | BE | Building/Site Repair - 9997 - BE |

## 10.3 Meteorological screening and acceptance criteria

| **Variable** | **Screening Criteria: Flag data if the value** |
|---|---|
| Wind Speed | - is less than zero or greater than 25 m/s (56 mph) |
| | - does not vary by more than 0.1 m/s (0.2 mph) for 3 consecutive hours |
| | - does not vary by more than 0.5 m/s (1.1 mph) for 12 consecutive hours |
| Wind Direction | - is less than zero or greater than 360 degrees |
| | - does not vary by more than 1 degree for more than 3 consecutive hours |
| | - does not vary by more than 10 degrees for 18 consecutive hours |
| Temperature | - is greater than the local record high |
| | - is less than the local record low |
| | (The above limits could be applied on a monthly basis.) |
| | - is greater than a 5° C change from the previous hour |
| | - does not vary by more than 0.5° C for 12 consecutive hours |
| Temperature Difference | - is greater than 0.1° C/m during the daytime |
| | - is less than – 0.1° C/m during the night time |
| | - is greater than 5.0° C or less than -3.0° C |
| Dew Point Temp. | - is greater than the ambient temperature for the given time period |
| | - is greater than a 5° C change from the previous hour |
| | - does not vary by more than 0.5° C for 12 consecutive hours |
| | - equals the ambient temperature for 12 consecutive hours |
| Precipitation | - is greater than 25 mm (1 inch) in one hour |
| | - is greater than 100 mm (4 inches) in 24 hours |
| | - is less than 50 mm (2 inches) in three months |
| | (The above values can be adjusted based on local climate.) |
| Pressure | - is greater than 1060 mb (sea level) |
| | - is less than 940 mb (sea level) |
| | (The above values should be adjusted for elevations other than sea level.) |
| | - changes by more than 6 mb in three hours |
| Radiation | - is greater than zero at night |
| | - is greater than the maximum possible for the date and latitude |

# Standard Operating Procedure for Meteorological Monitoring Station Inspection

## 1.0 Scope and Application

1.1 Accurate meteorological measurements are critical to interpretation of ambient air pollution data. Proper operation must be assessed on a periodic basis.

1.2 The objective of this procedure is to inspect operations of the meteorological sensors and recording device, and conduct repairs as needed.

1.3 This procedure applies to meteorological monitoring stations that measure ambient air temperature, wind speed, and wind direction.

## 2.0 Summary of Method

2.1 Meteorological measurement sensors are inspected for proper operation, physical condition, and reasonableness.

## 3.0 Health and Safety Warnings

3.1 General safety precautions related to electrical hazards must be observed at all times when working with electronic equipment. Electrical receptacles and equipment must be properly grounded. Use caution when servicing or operating electrical equipment in wet conditions.

3.2 General precautions for working with heavy equipment and electro-mechanical equipment should be taken.

3.3 Meteorological towers present a serious physical hazard. Great care must be taken when lower, raising, or climbing towers.

## 4.0 Cautions

4.1 Damage to the instrument may result if caution is not taken to properly install and maintain the device. Follow the manufacturer's instructions for maintenance of all equipment and for safe, secure installation.

## 5.0 Personnel Qualifications

5.1 Persons performing this SOP must be familiar with the operation of environmental measurement instrumentation.

5.2 Instrumentation skills are necessary for interacting with the data acquisition system.

5.3 Familiarity with electronic and mechanical test equipment is required.

## 6.0 Equipment

6.1 Meteorological monitoring station log book

6.2 Time piece

6.3 Miscellaneous tools

## 7.0 Procedure

7.1 Register visit on the meteorological monitoring station log book, noting location, technician, date and time in STANDARD TIME (data acquisition system is not changed for daylight savings time). Verify that the data acquisition clock is accurate.

7.2 Visibly check each sensor for proper operation, lower tower if necessary.

7.3 Compare the datalogger's meteorological parameter outputs with your own assessment of the ambient weather conditions. Note any anomalies on the log book. Conduct any repairs or replacements if necessary.

7.4 Record concluding time of visit on field data sheet, noting any repairs or changes

## 8.0 References

8.1 Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV. Meteorological Measurements Version 2.0 (Final); EPA/454/B-08-002; March 2008; U.S. Environmental Protection Agency

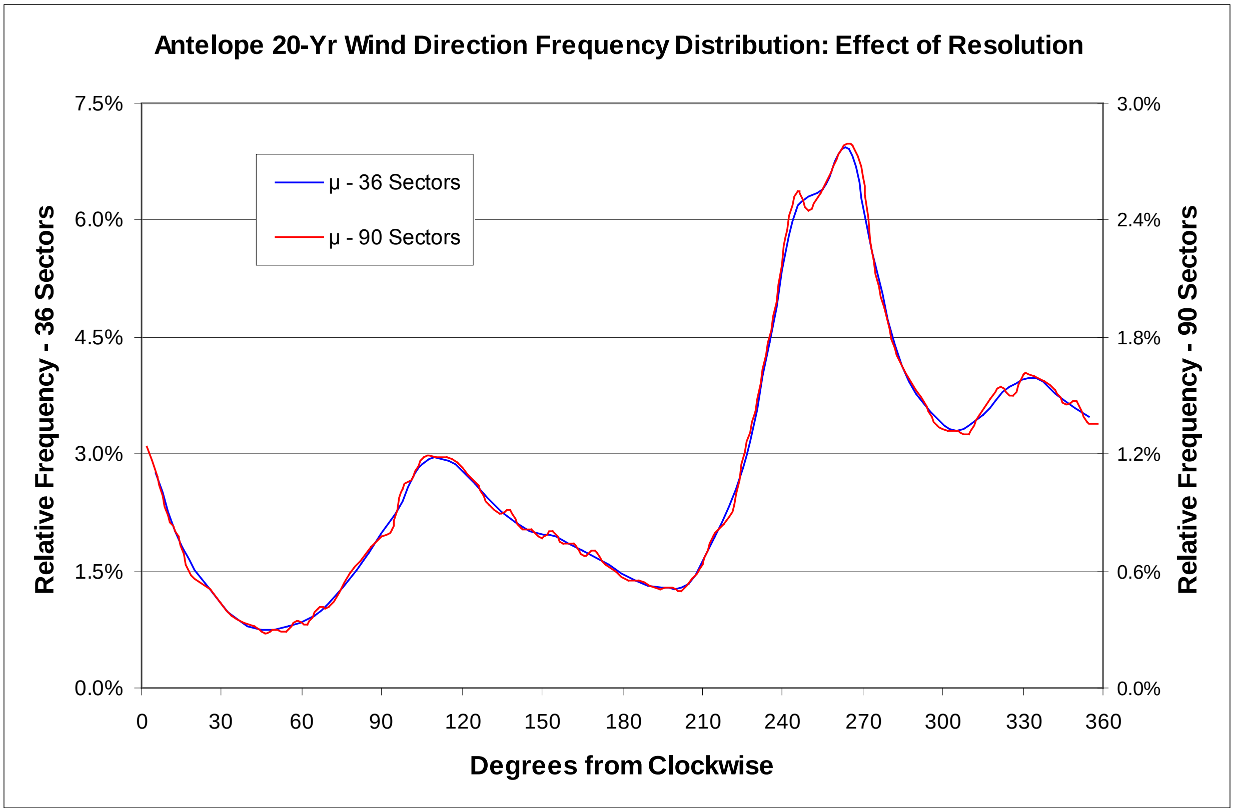
# APPENDIX 2.5-E

# Statistical Methodology for Assessing Representativeness of Wind Data

In this study, IML Air Science presents a methodology for assessing the degree to which the distribution of wind direction frequencies from one year of monitoring at a particular location represents the long-term wind direction distribution at that same location. The study considers four sites, some having generated more than 20 years of hourly meteorological data. The Dry Fork Mine and Buckskin Mine met stations are located near the Gillette Airport site in the northern Powder River Basin (PRB). The Antelope Mine met station is located in the southern PRB.

To balance the need for sufficiently large sample sizes with the need to minimize the artifacts of discrete classification, wind directions were divided into 36 sectors of 10º each (0º represents true North). Figure 1 compares 20 years of hourly wind direction data split into 90 sectors with the same data distributed among 36 sectors. It shows the latter to be a suitable representation without imparting the granular quality exhibited by the 90-sector distribution.

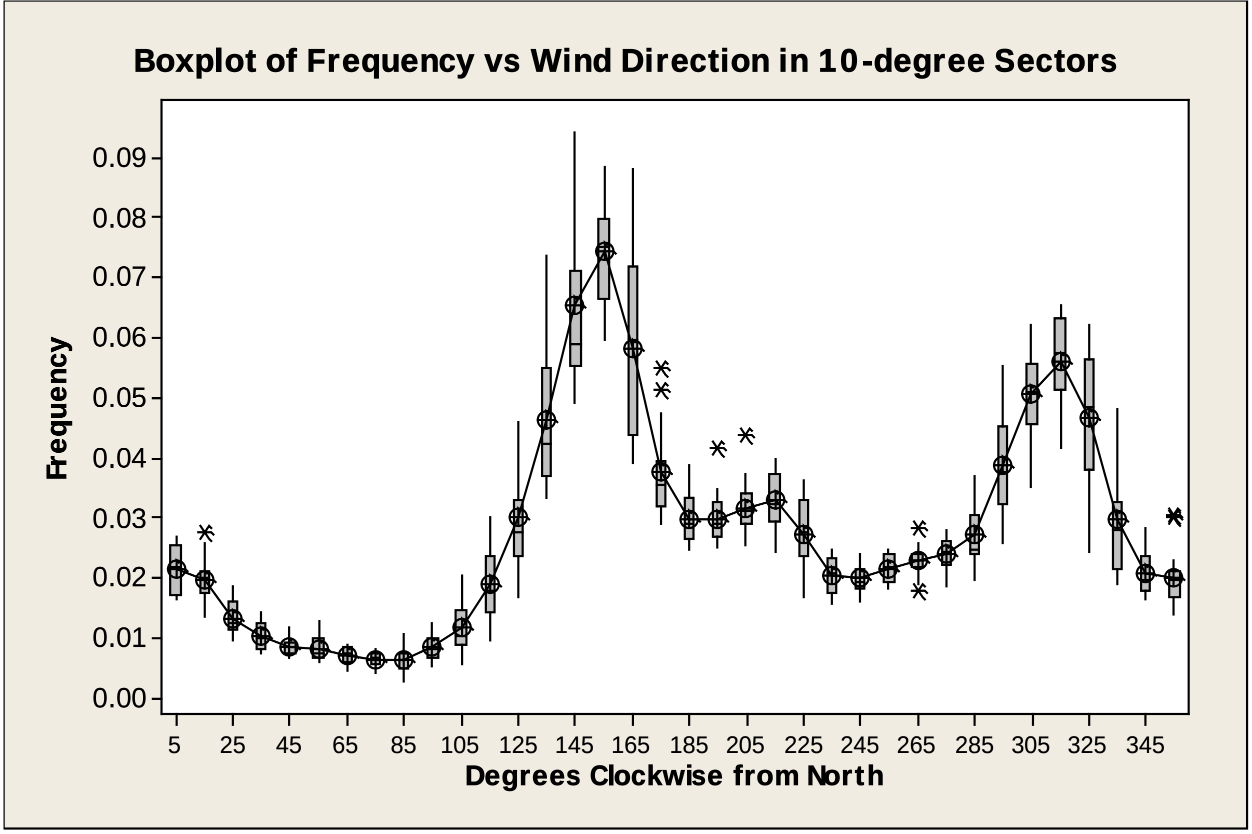
**Figure 1 – Antelope 1990-2009**



Dry Fork 15 -Year Wind Direction Distribution

Hourly wind directions were compiled from the Dry Fork Mine for the 15-year period from 1/1/1995 through 12/31/2009. Figure 2 shows the distribution of annual wind direction frequencies by sector, in the form of a box plot. The boxes represent frequencies from the 25th percentile to the 75th percentile. The lines represent the entire range of frequencies (excepting outliers), while the asterisks represent outliers.

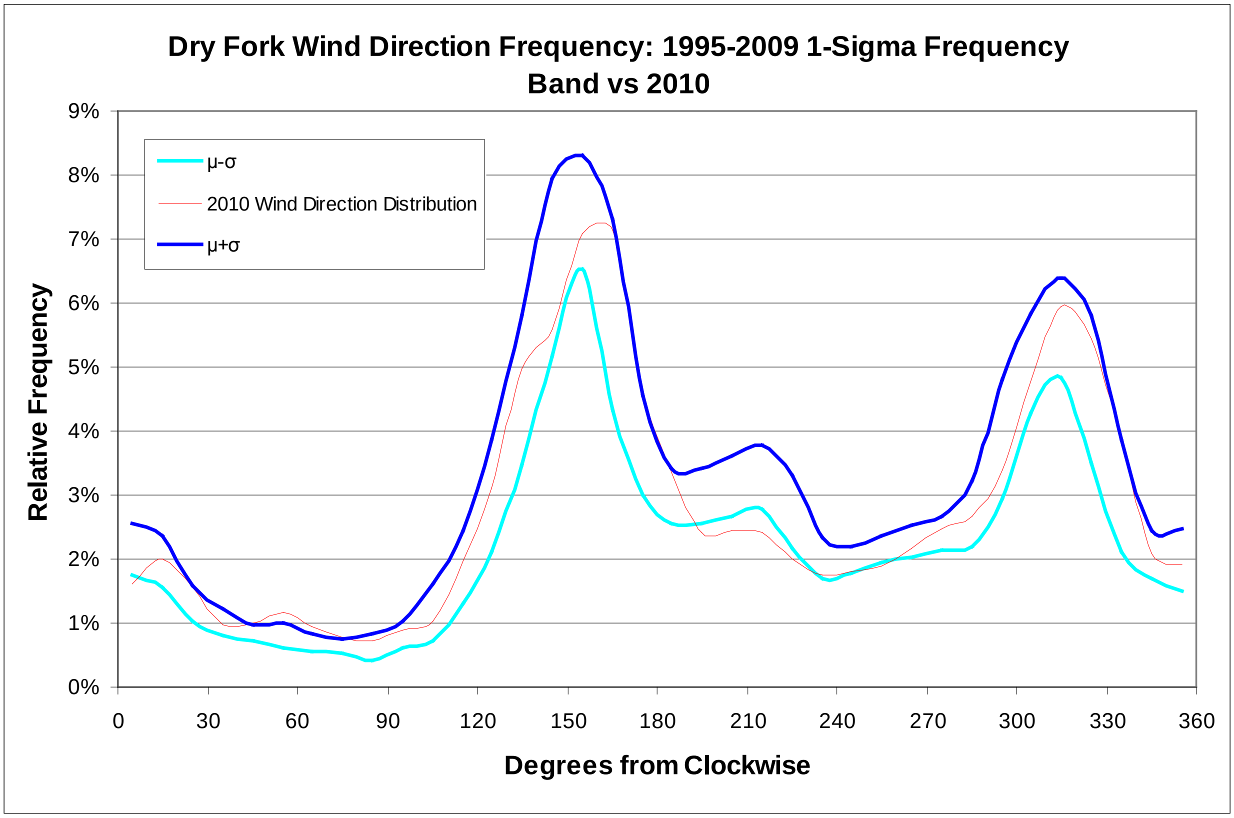
**Figure 2 – Dry Fork 1995-2009**



Dry Fork Year 2010 Compared to Long-Term Frequency Distribution

Figure 3 presents the Dry Fork 15-year wind direction frequency distribution in the form of a band of frequencies for each direction sector. This band ranges from one standard deviation below the 15-year mean frequency to one standard deviation above the mean frequency. Superimposed on this statistical plot is the 2010 actual direction frequency distribution. Figure 3 shows that nearly all of the 2010 frequencies fall within the 15-year band. This is not surprising, since the probability that the direction frequency for any given sector and year will fall within one standard deviation of the long-term mean is 68% (assuming normally distributed data).

## Figure 3 – Dry Fork 1995-2010



More significant than the adherence of one year to the 15-year frequency band is the width and shape of the band itself, which might be regarded as the "signature" for a given site. The narrower and more contoured the frequency band, the more distinctive the signature. It will be shown below that even a slight spatial difference between two monitoring stations can alter this signature significantly.

Hypothesis Testing

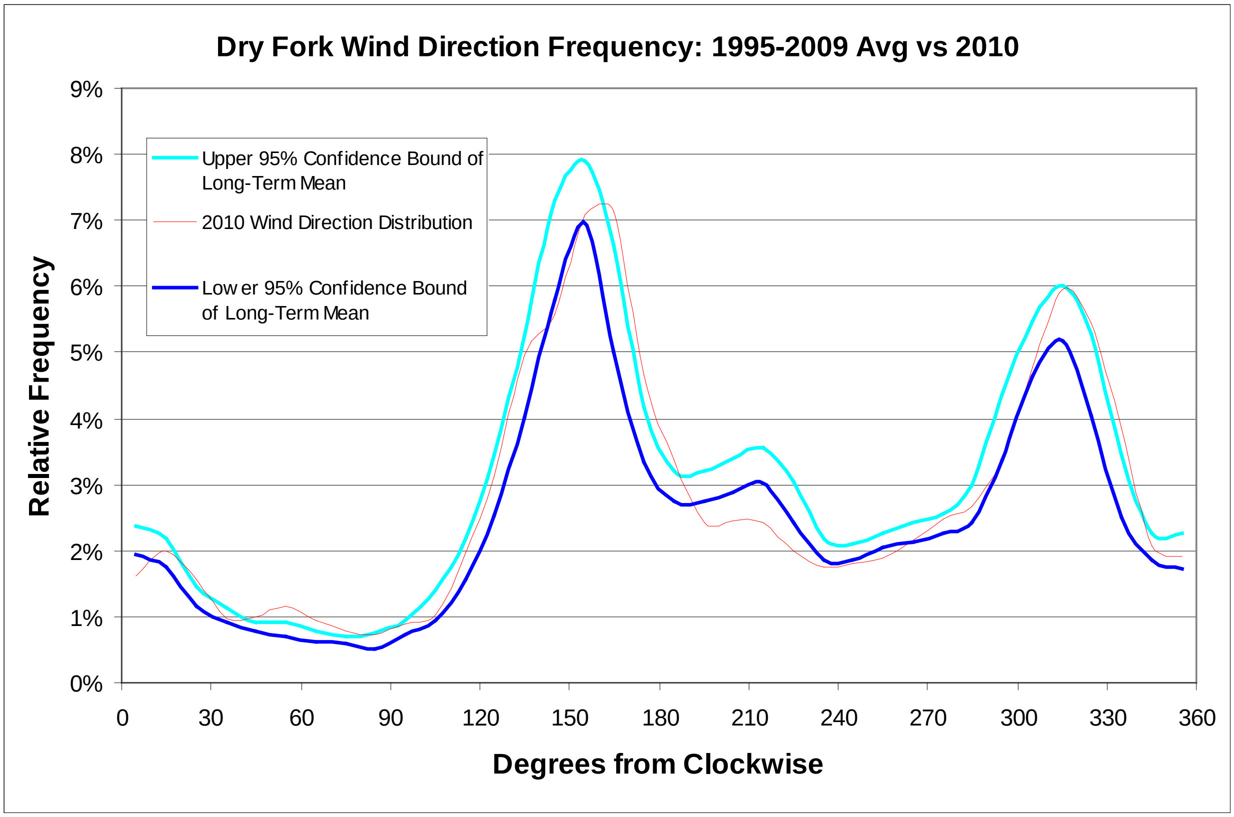
A series of hypothesis tests represents one approach to quantifying the goodness of fit between a one-year wind direction distribution and the long-term distribution. For the Dry Fork Mine example, the one-year direction frequency for each sector can be compared to the set of direction frequencies available from the previous 15 years (long-term). The null hypotheses are that the one-year frequencies do not belong to the long-term or "population" frequencies. Statistically, this can be accomplished through a one-sample t-test for each of the 36 sectors. Each t-test yields a p-value which predicts the probability of wrongly asserting a statistical difference between the one-year direction frequency and the long term frequency. Two such tests on the Dry Fork Mine data are shown below for the direction sectors centered on 5º and 15º respectively.

```
Test of mu = 0.0162367 vs not = 0.0162367
Variable    N       Mean      StDev   SE Mean          95% CI              T      P
5º         15  0.021532  0.004133  0.001067  (0.019243, 0.023821)  4.96  0.000
Test of mu = 0.020063 vs not = 0.020063
Variable    N       Mean      StDev   SE Mean          95% CI               T      P
15º       15  0.019560  0.003950  0.001020  (0.017372, 0.021747)  -0.49  0.629
```

At 5º the one-year (2010) frequency of 0.0162367 falls below the 95% confidence interval (CI) for the long-term mean frequency (0.019243 to 0.023821). A p-value of 0.000 confirms this point to be decidedly outside the CI. One might conclude (with 95% confidence) that 2010 was an atypical year for the direction sector centered on 5º. Conversely, the 15º test shows the 2010 frequency to be well within the 95% confidence interval for the long-term mean. A p-value of 0.629 indicates one cannot conclude any difference between the 2010 and long-term frequencies.

The t-test could be repeated for each of the 36 sectors, with some directions showing no statistical difference and others showing a slight difference. Figure 4 presents the results of a more efficient method, graphing the 95% confidence interval of frequencies as a function of wind direction. The confidence interval is calculated from the standard error of the mean frequency for each sector, and the two-tail t-value at 95% confidence. The 2010 frequency distribution is also shown on Figure 4.

**Figure 4 – Dry Fork 1995-2010**



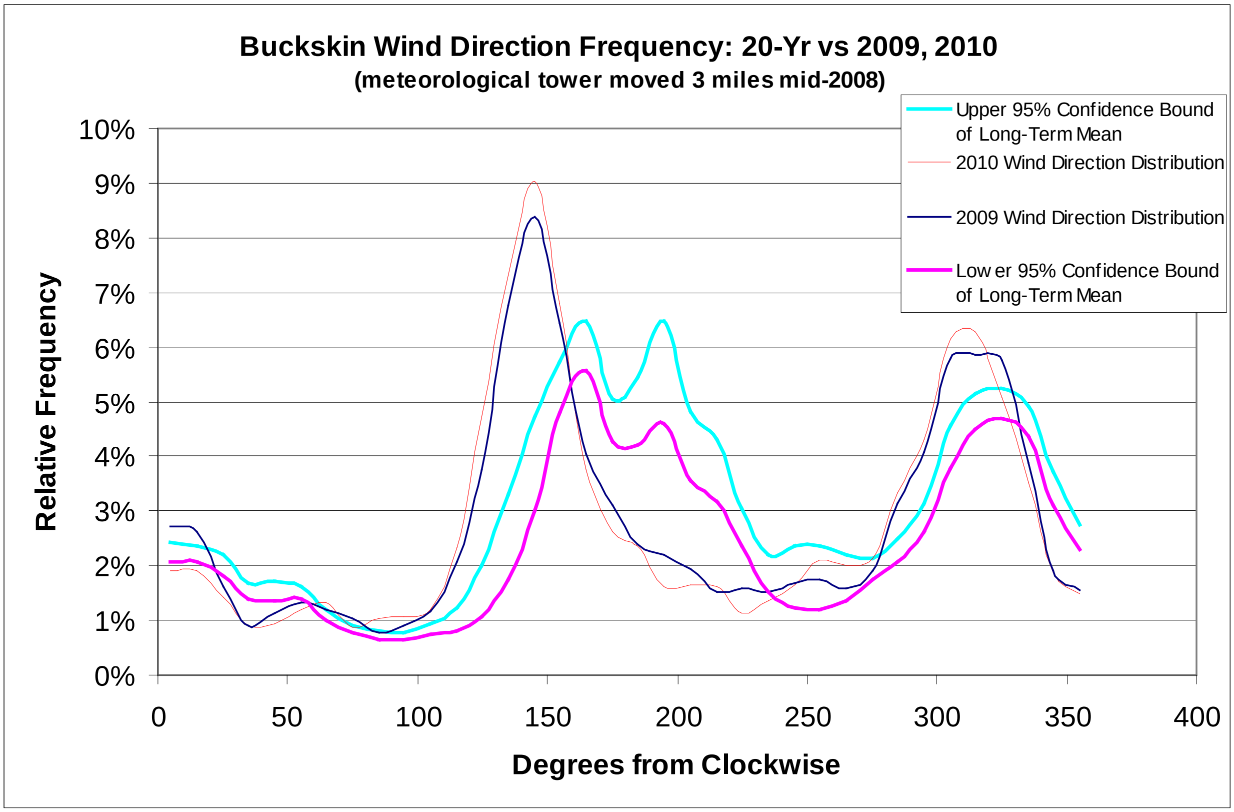
Roughly half of the 36 sectors used to produce Figure 4 show a slight departure of the 2010 frequency from the 95% confidence interval (CI) obtained from the previous

15 years. This result indicates that the occurrence of winds from half of the sectors in 2010 is not significantly different than the long-term occurrence. Moreover, among the sectors failing to meet this standard, the average departure from the 95% CI is only 11.5% of the mean frequency. The time-weighted average of all such departures is a mere 5% of the mean frequency (5 hours out of every 100 hours). Such minor deviations from the long-term pattern, illustrated in Figure 4, tend to confirm the concept of a site signature discussed above.

Influence of Meteorological Station Location

To corroborate the test results from Dry Fork Mine data, a similar study was conducted for the Buckskin Mine. Figure 5 graphs the results, which show a significant departure of annual frequencies in 2009 and 2010 from the 95% CI of long-term (20-year) mean frequencies. This result would tend to refute the applicability of a site signature to the Buckskin Mine. Further investigation, however, revealed that Buckskin moved the meteorological station approximately three miles to the northeast in mid-2008.

**Figure 5 – Buckskin 1990-2010**



Differences in elevation and terrain between the two sites may account for the change in wind direction patterns (note the similarity between 2009 and 2010 data sets, both of which were collected at the new location).

In order to test this theory, the effect of the met station move was eliminated by shifting the period of analysis back from 1990-2010 to 1986-2007. Figure 6 presents the revised

results, with years 2006 and 2007 graphed against the 95% CI for long-term mean direction frequencies. In this case, the confidence interval was developed using data from 1986 through 2005.

**Figure 6 – Buckskin 1986-2007**

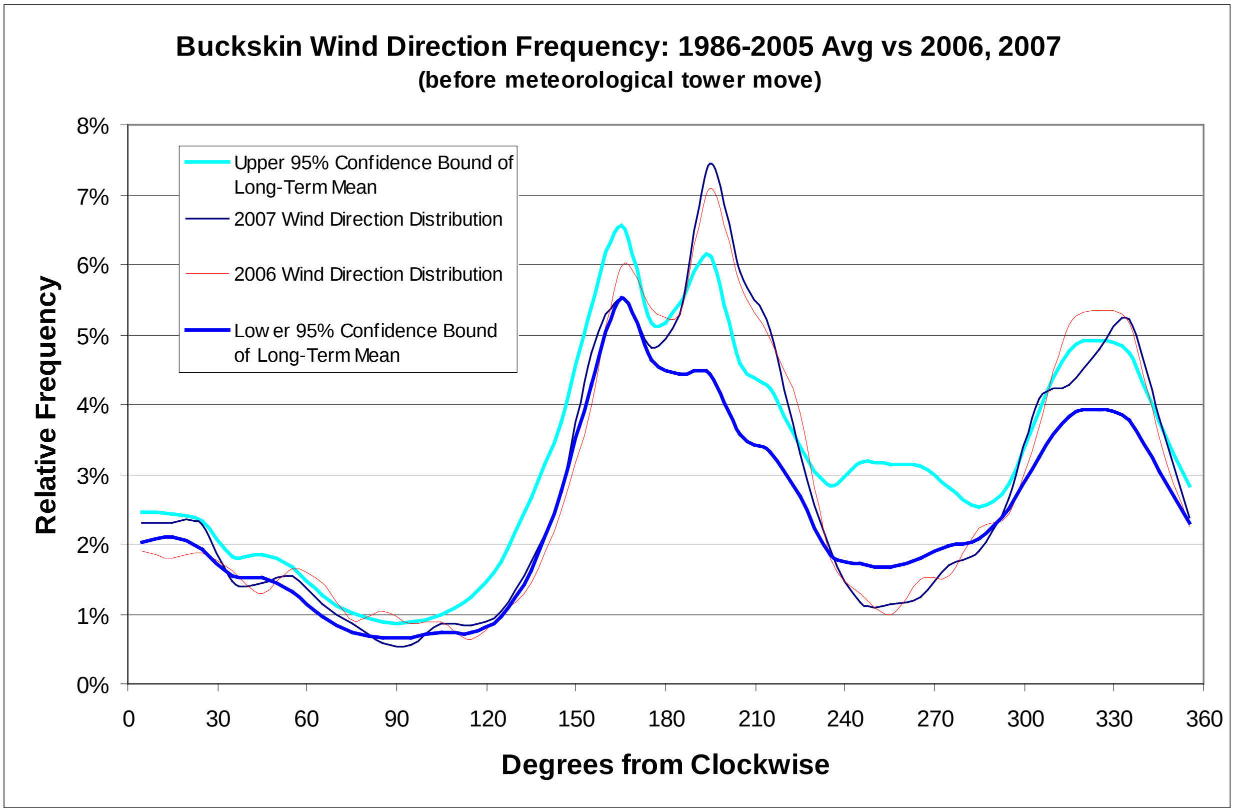


Figure 6 reflects only data collected at the original met station site. It shows a much stronger parallel between short-term and long-term data than Figure 5, which includes both sites. Although the departures from the CI are more pronounced for Buckskin than for Dry Fork (Figure 4), a site signature is certainly more apparent in Figure 6 than in Figure 5. It can be seen that the departures from the CI in Figure 6 actually accentuate that signature.

Regression Analysis

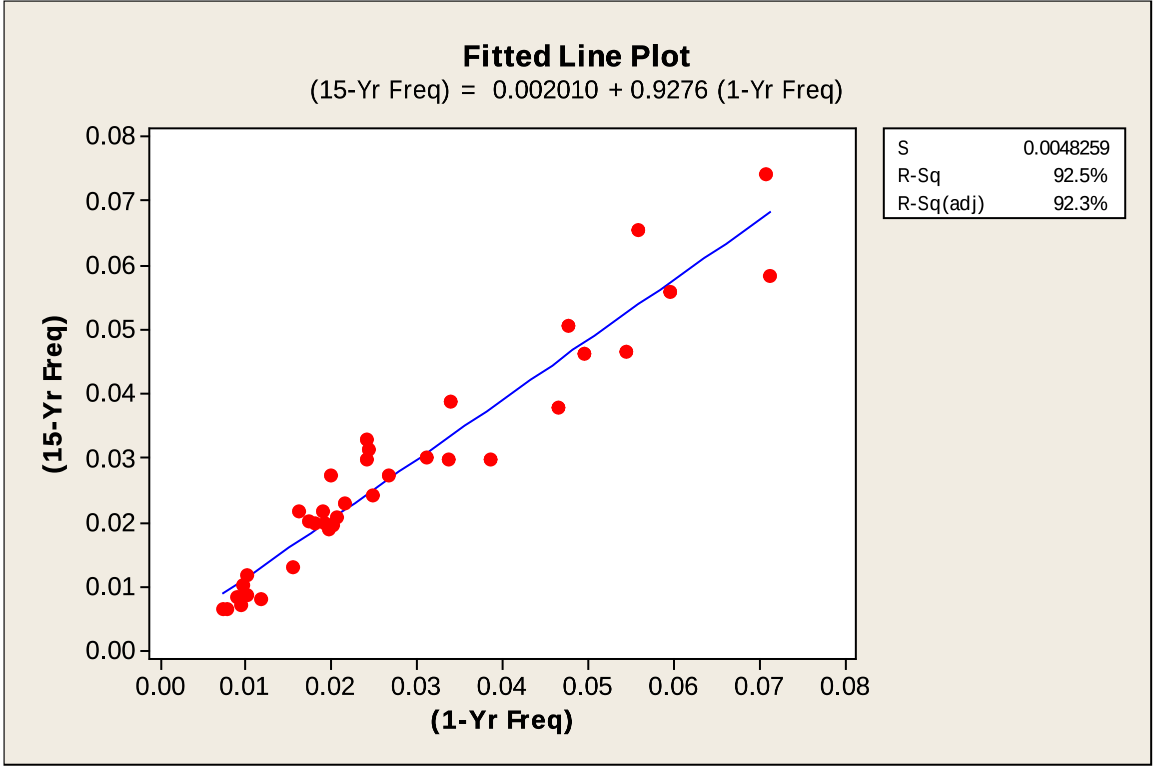
Hypothesis testing does not yield a single quantitative measure of how well one data set represents, or fits another. To overcome this limitation, a linear regression analysis was performed on 36 data pairs – each pair containing one value from the Dry Fork 15-year frequency distribution and one from the Dry Fork one-year (2010) distribution. With an $R^2$ value of 92.5%, the one-year frequency is a good predictor of the 20-year average frequency for any given sector (or vice versa). One interpretation of this result is that 92.5% of the variance in wind frequency between short and long-term data can be explained or predicted by knowing the direction sector (note that each data pair represents a specific sector). The other 7.5% of the frequency variance must be attributed to random differences in wind direction from year to year.

### Dry Fork Regression Analysis: (15-Yr Freq) versus (1-Yr Freq)

```
The regression equation is
(15-Yr Freq) = 0.00201 + 0.928 (1-Yr Freq)

Predictor         Coef   SE Coef      T      P
Constant      0.002010  0.001494   1.35  0.187
(1-Yr Freq)    0.92763   0.04531  20.47  0.000

S = 0.00482587   R-Sq = 92.5%   R-Sq(adj) = 92.3%

Analysis of Variance

Source          DF          SS          MS       F      P
Regression       1  0.0097620  0.0097620  419.17  0.000
Residual Error  34  0.0007918  0.0000233
Total           35  0.0105539
```

Figure 7 graphs these data pairs along with the straight line fit and confirms the $R^2$ value of 92.5%. In the fitted line equation, an intercept of 0 and a slope of 1 would indicate exact linear correlation. The actual, least-squares intercept of 0.00201 and slope of 0.9276 only approach this condition.

**Figure 7 – Dry Fork 1995-2010**



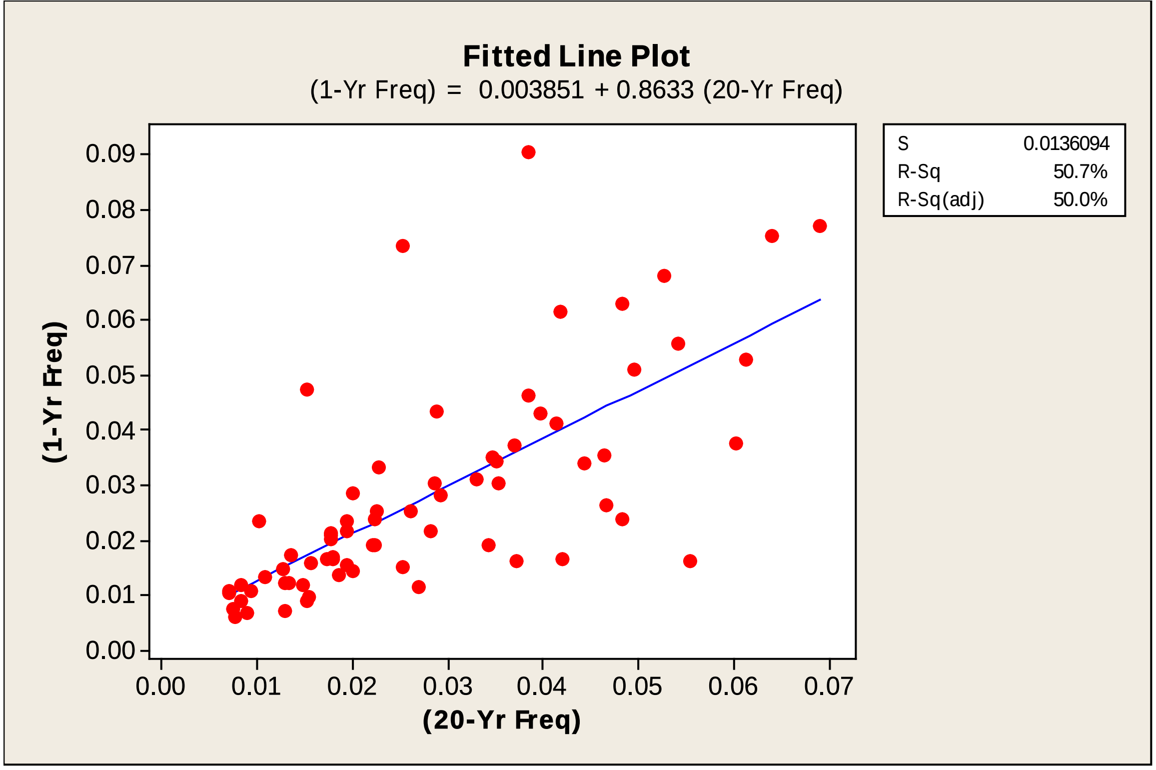
The linear correlation method shows 2010 to be representative of the long term at Dry Fork Mine. At Buckskin, where the met station was moved in 2008, one might expect a much weaker correlation between 2010 data and 1990-2009 data. Indeed that is the case, as shown below.

### Buckskin Regression Analysis: (1-Yr Freq) versus (20-Yr Freq)

```
The regression equation is
(1-Yr Freq) = 0.00385 + 0.863 (20-Yr Freq)

Predictor          Coef   SE Coef     T      P
Constant       0.003851  0.003274  1.18  0.244
(20-Yr Freq)     0.8633    0.1025  8.42  0.000

S = 0.0136094   R-Sq = 50.7%   R-Sq(adj) = 50.0%

Analysis of Variance

Source          DF        SS        MS      F      P
Regression       1  0.013138  0.013138  70.94  0.000
Residual Error  69  0.012780  0.000185
Total           70  0.025918
```

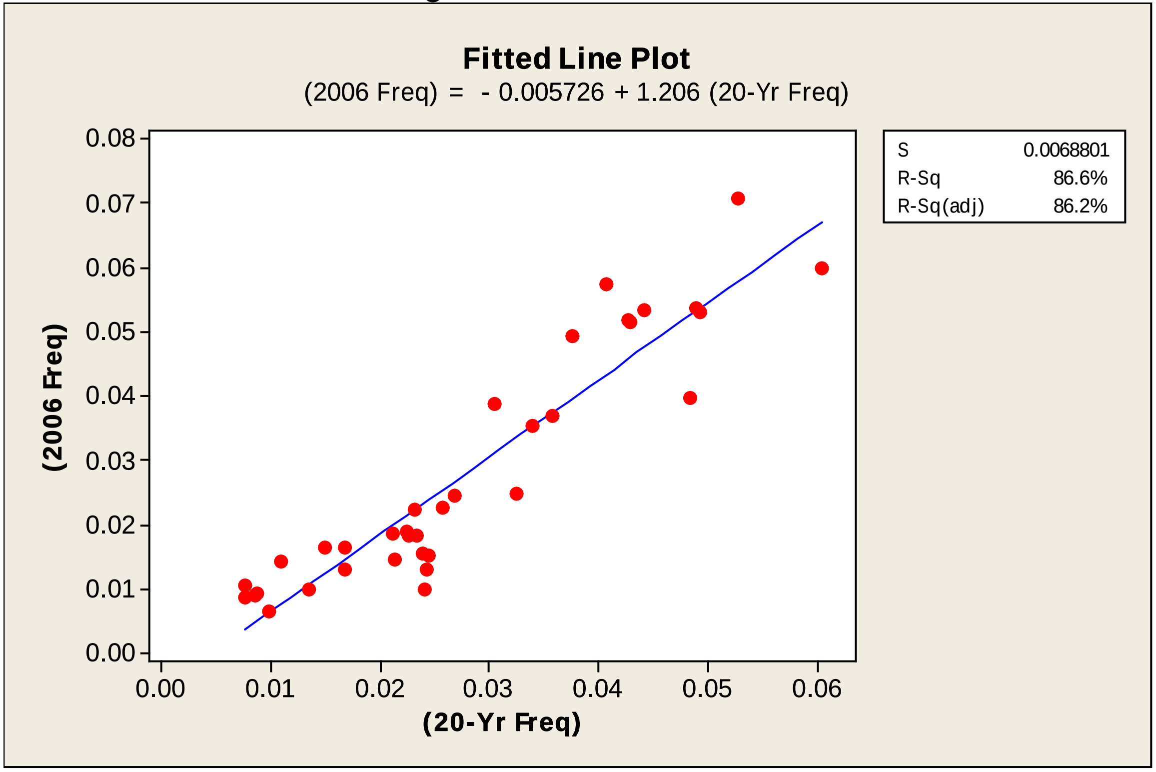
An $R^2$ value of 50% indicates very weak correlation between 1990-2009 data and 2010 data. Figure 8 illustrates this graphically.

**Figure 8 – Buckskin 1990-2010**

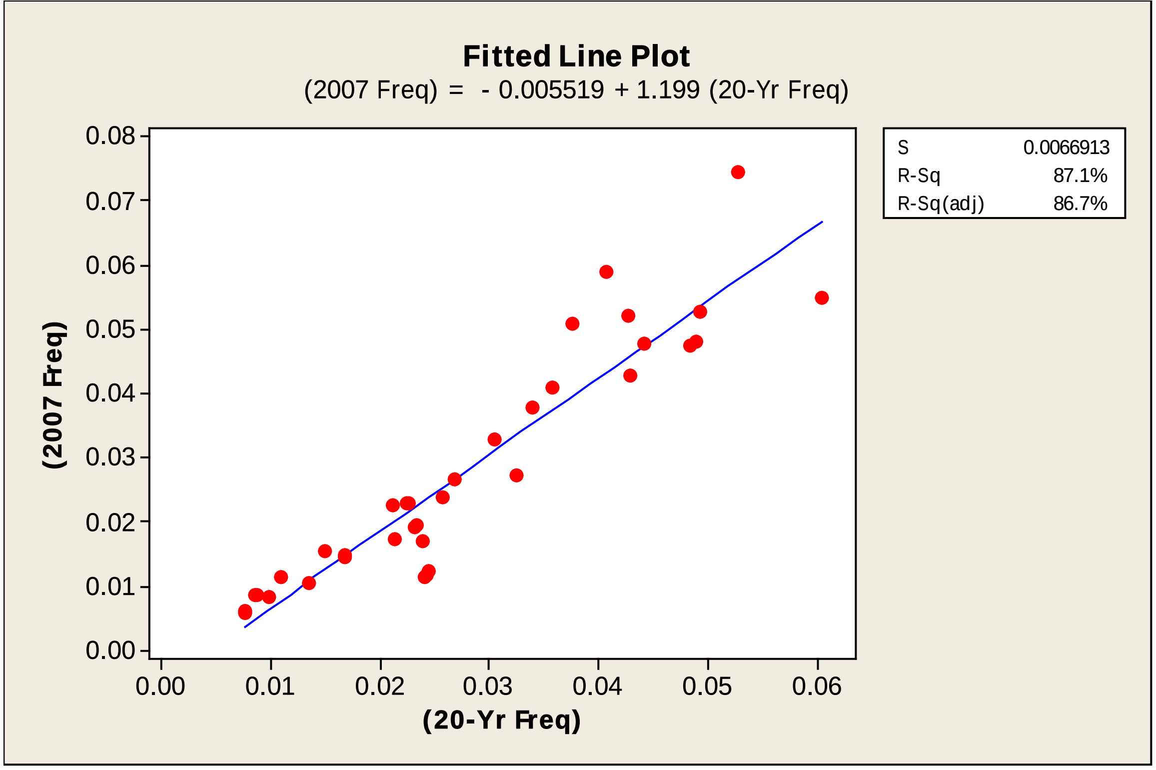


If this analysis is shifted backward in time to avoid data collected after the Buckskin met station move, the correlation improves markedly. Comparing wind direction data from 1986-2005 with either the 2006 or 2007 data sets yields an $R^2$ value of around 87% (Figures 9 and 10).

## Figure 9 – Buckskin 1986-2006



## Figure 10 – Buckskin 1986-2007



## Other Site Signatures

Wind direction data from Antelope Mine and the Gillette Airport were considered in an attempt to confirm the concept of a site signature and the linear correlation between short and long-term data. The wind data from Antelope Mine (southeast of Wright) spans a period of 21 years (1990 through 2010). For this site, the long-term average was computed from the first 20 years and compared to year 2010. Figure 11 reveals a wind direction signature for Antelope that is distinct from either Dry Fork or Buckskin.

**Figure 11 – Antelope 1990-2010**

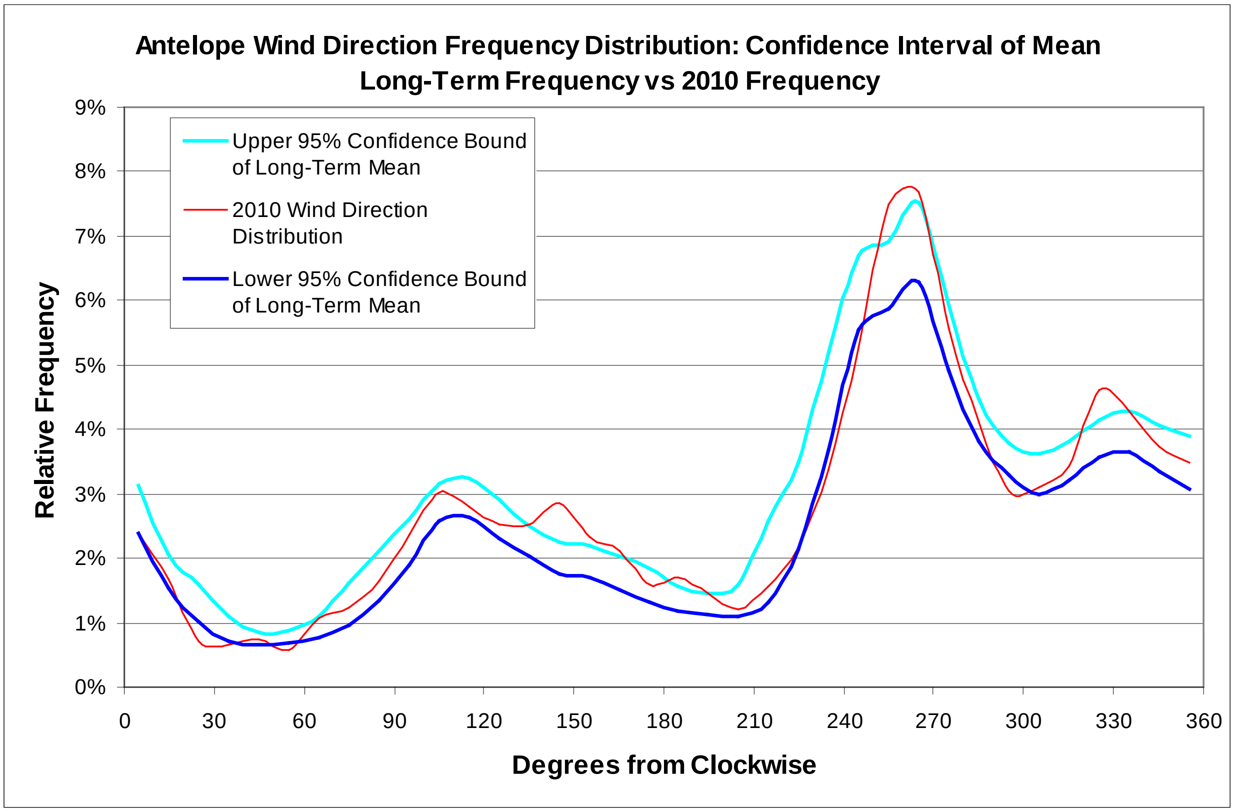


Figure 12 shows a correlation between short and long-term wind direction frequencies at Antelope. The $R^2$ value of 93.4% is nearly the same as that produced by the Dry Fork correlation, and denotes a strong relationship (or "fit") between 2010 and 1990-2009.

Figures 13 and 14 represent a similar analysis of wind data from the Gillette Airport. Data from a five-year period (2005 to 2009) were compiled to serve as long-term wind direction frequencies and compared to 2010 data. Once again, a site signature is apparent in Figure 13. The $R^2$ value of 74.2% signifies a weaker correlation, much of which may be explained by poor data resolution. The Gillette Airport wind directions are only available in 10º increments, whereas Antelope, Buckskin and Dry Fork instruments (all operated by IML Air Science) offer 0.1º precision.

**Figure 12 – Antelope 1990-2010**

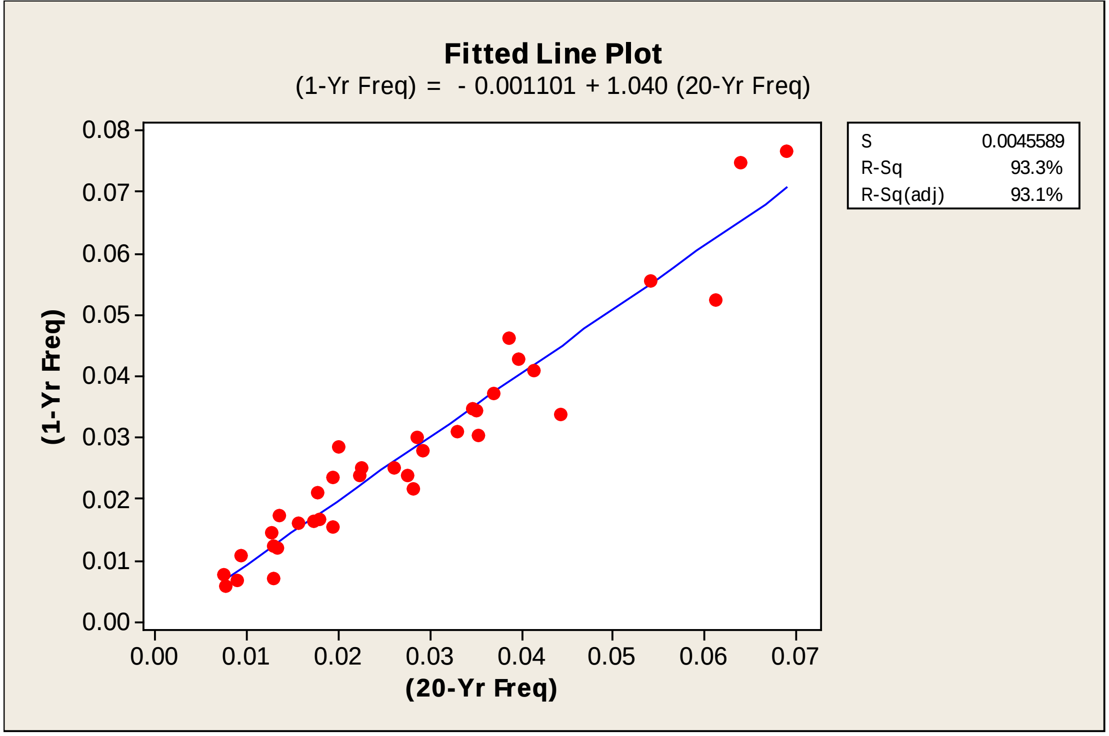
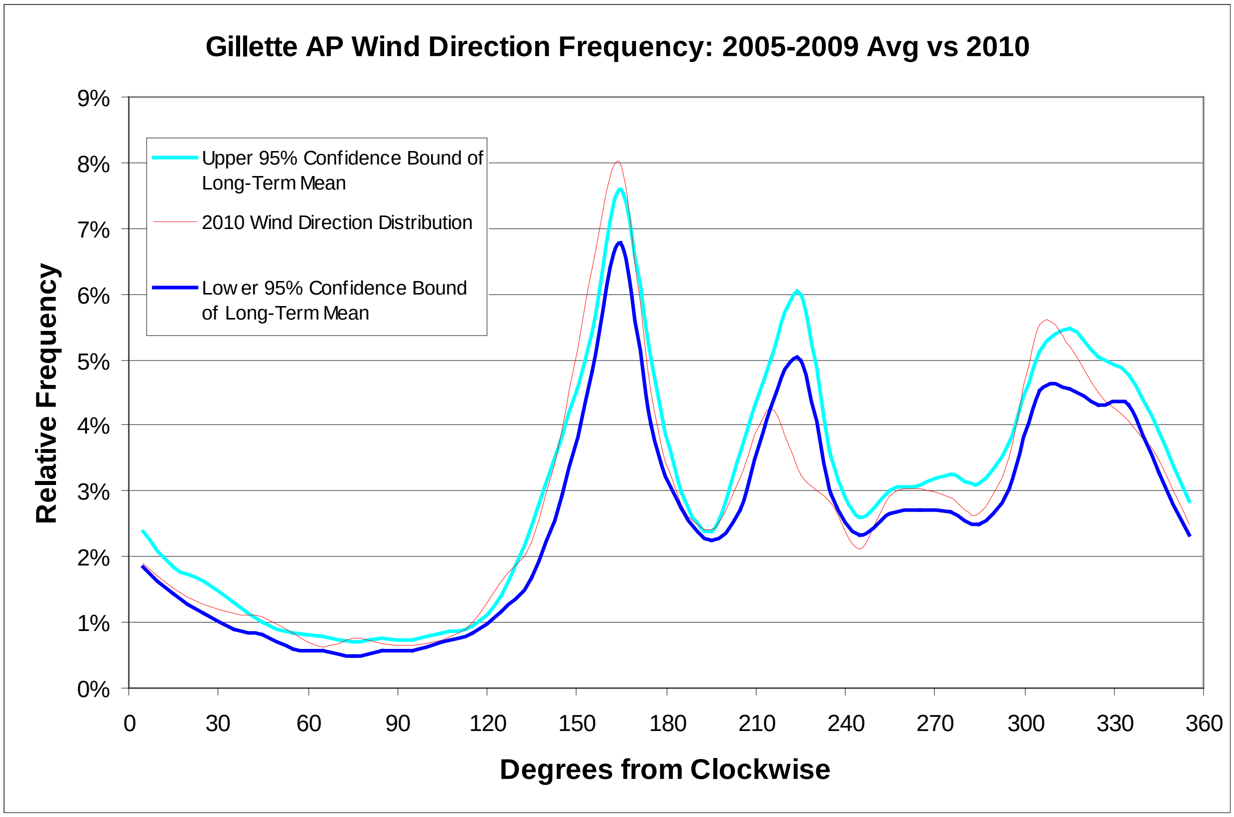
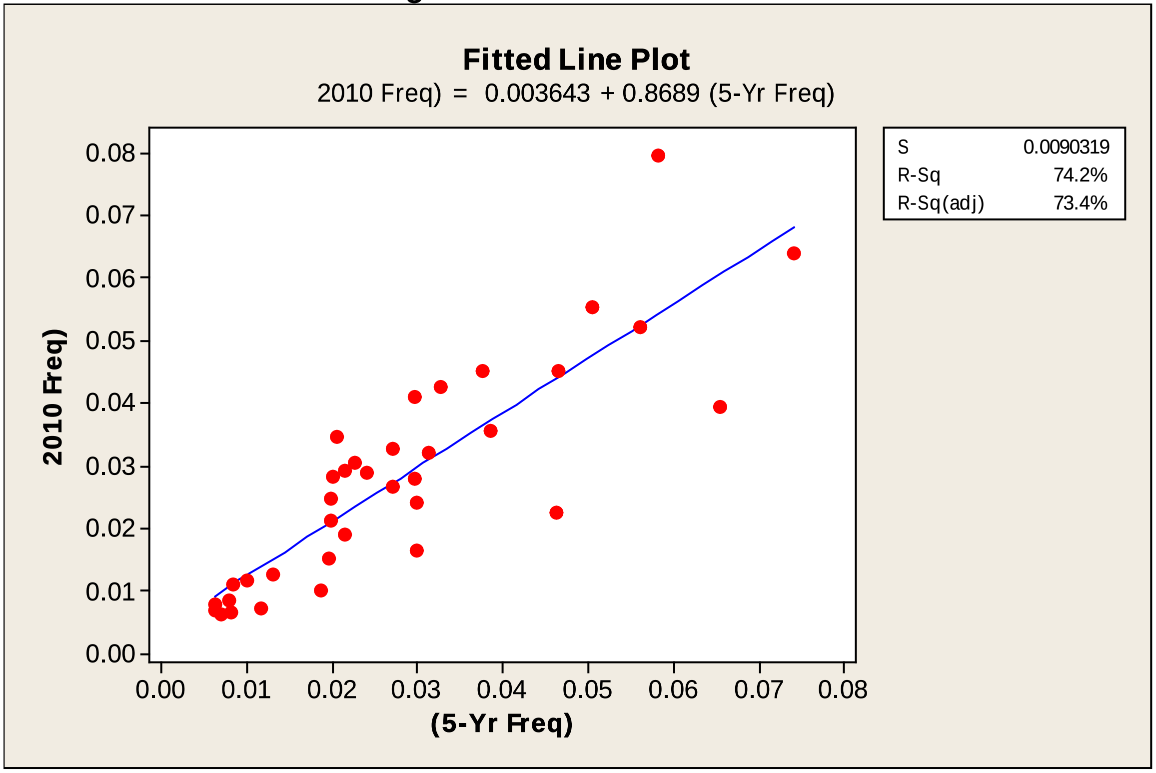


**Figure 13 – Gillette AP 2005-2010**



## Figure 14 – Gillette AP 2005-2010



Conclusion

This limited study indicates that at least in the Powder River Basin, the location of a wind monitor has greater influence on the distribution of wind directions than does the year in which data are collected. If true, this confirms the need for on-site meteorological monitoring. It also underscores the need to locate the monitoring tower in conditions representative of the anticipated air emission sources. At the same time, it suggests that one year of data is generally adequate to establish a site signature within the tolerance required to assure valid dispersion modeling and to determine appropriate locations for air quality monitoring instruments. Figure 15 shows the site signatures for all four sites in this study to be distinct from one another.

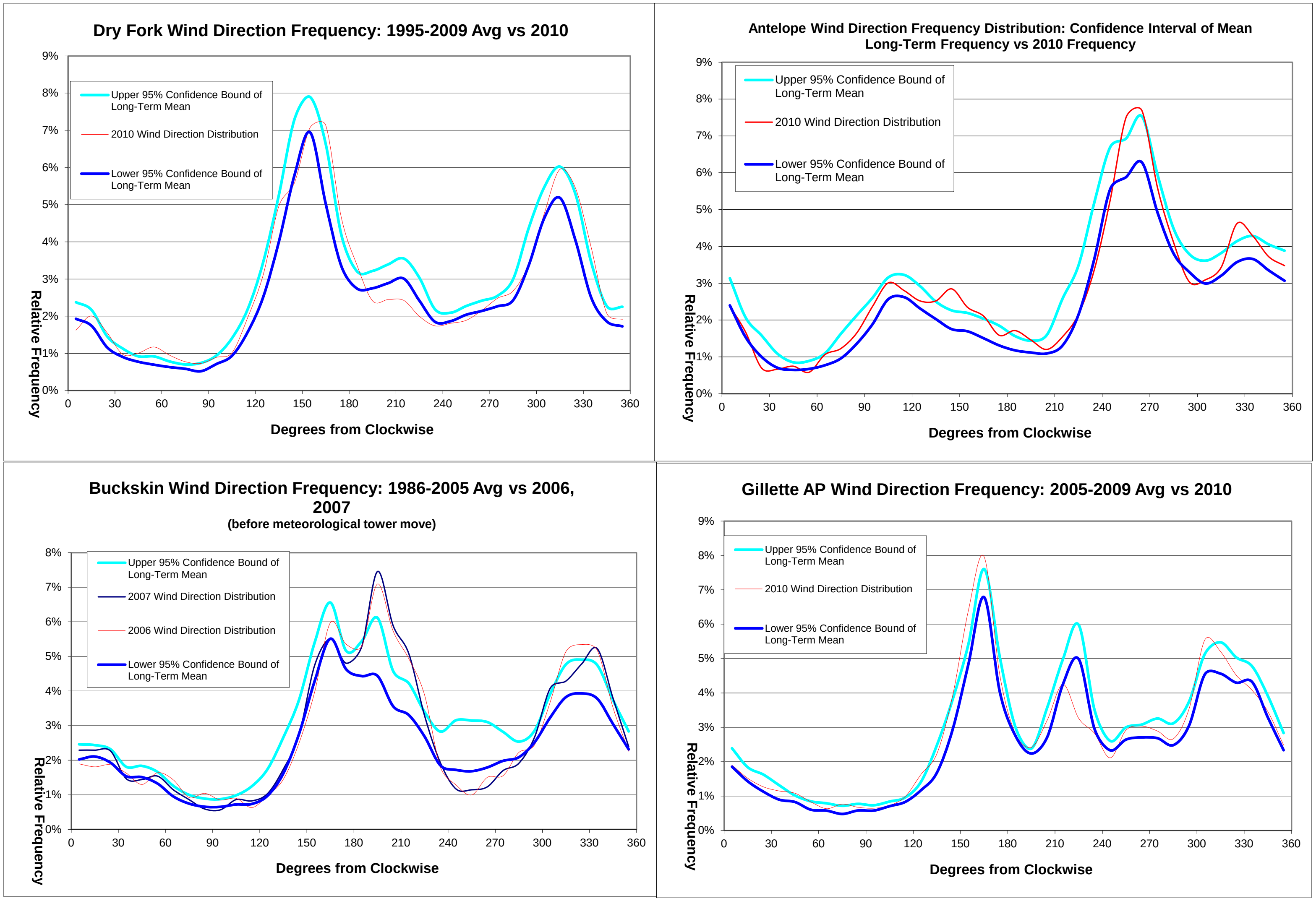


Figure 15 – Comparative Site Signatures

### Addendum to

# APPENDIX 2.5-E

# Statistical Methodology for Assessing Representativeness of Wind Data

# Addendum to Appendix 2.5-E
# Statistical Methodology for Assessing Representativeness of Wind Data

The purpose of Appendix 2.5-E was to illustrate minimal temporal variation in wind direction distributions in the Powder River Basin (PRB) of northeastern Wyoming, an area similar in topography and climate to the Dewey-Burdock Project site. At the same time Appendix 2.5-E showed the spatial variation in PRB wind direction distributions to be substantial, even for relatively small geographic displacements. Four sites were chosen to demonstrate these trends:

1. Antelope Coal Mine – 20 years of hourly average wind direction analyzed
2. Buckskin Coal Mine – 20 years of hourly wind direction analyzed
3. Dry Fork Coal Mine – 15 years of hourly wind direction analyzed
4. Gillette Airport – 13 years of hourly wind direction analyzed

The Air Science Division of Inter-Mountain Laboratories operates meteorological monitoring stations at the three mines, according to EPA-approved monitoring protocol. The Gillette Airport meteorological station is operated by the National Weather Service. The most recent full year of monitoring (2010) at these sites was originally chosen to represent short-term wind data in Appendix 2.5-E. In order to more closely tie the analysis in Appendix 2.5-E to the TR RAI 2.5-1(c) response, the following revised analysis replaces year 2010 with the Dewey-Burdock baseline monitoring year of July 18, 2007 through July 17, 2008. Long-term data for the mine sites remain the same as in the original Appendix 2.5-E; eight more years of data were obtained for the Gillette Airport. For each linear regression analysis using the baseline monitoring year for the short-term wind data source, p-values were documented to provide a degree of confidence in the regression results.

The following figures have been revised to reflect the Dewey-Burdock baseline monitoring year as the source of short-term wind direction data. In addition, the linear regression analyses are graphed with basic statistical parameters (including ANOVA and p-value) listed below each graph. As noted in Appendix 2.5-E, poor data resolution offered by the NWS may weaken the Gillette wind direction frequency correlation. Also, the Buckskin correlation is compromised by the meteorological station move in spring 2008 (near, but not at the end of the Dewey-Burdock baseline monitoring year). In both cases, however, unique site signatures and strong correlations between long-term and baseline-year direction frequencies are still apparent.

Results of linear regression analysis are summarized in Table 1.

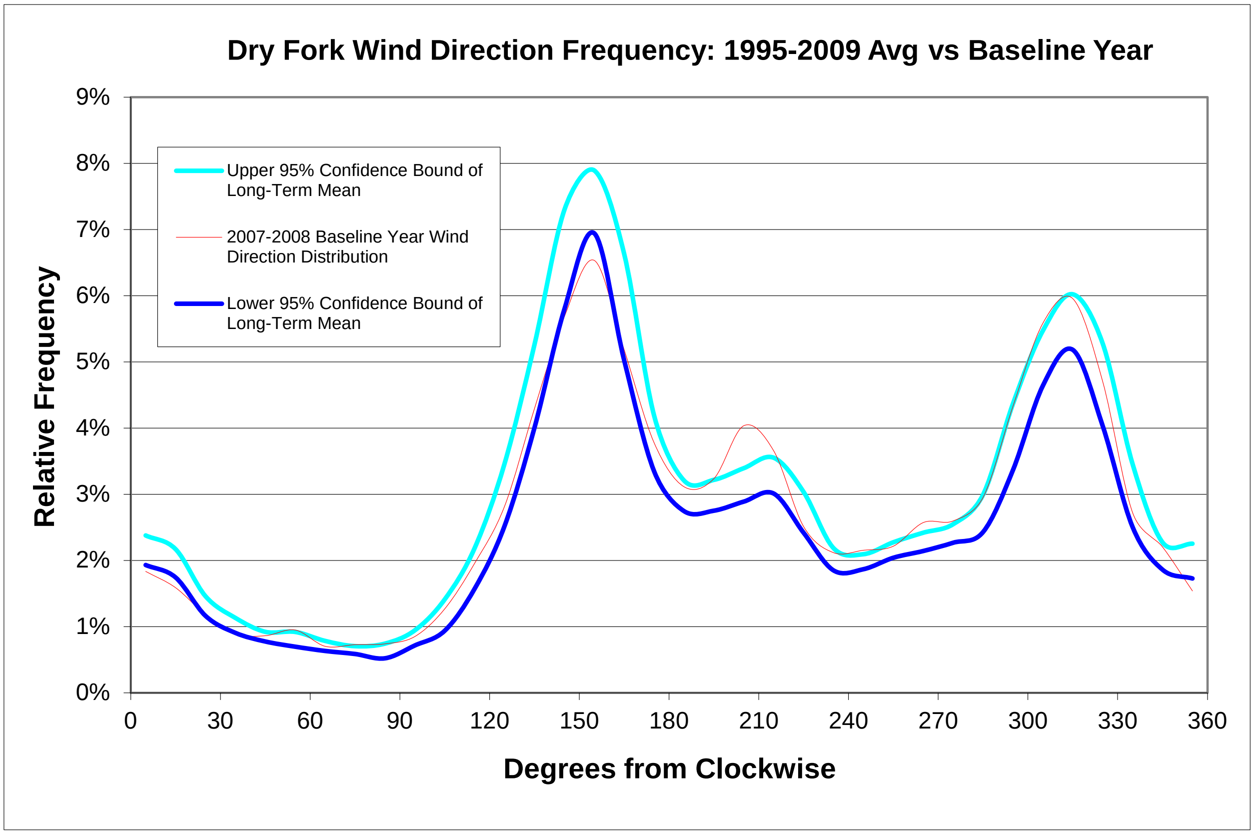
### Table 1 – Long-Term vs. Baseline Year Wind Direction Frequency Regression Analysis

| Site | Long-Term Data | Short-Term Data | $R^2$ Coefficient | p-value |
|---|---|---|---|---|
| Antelope Mine | 1990-2009 | Jul 2007 - Jul 2008 | 95.3% | 0.000 |
| Dry Fork Mine | 1995-2009 | Jul 2007 - Jul 2008 | 95.7% | 0.000 |
| Buckskin Mine | 1986-2005 | Jul 2007 - Jul 2008 | 87.0% | 0.000 |
| Gillette Airport | 1999-2011 | Jul 2007 - Jul 2008 | 93.6% | 0.000 |

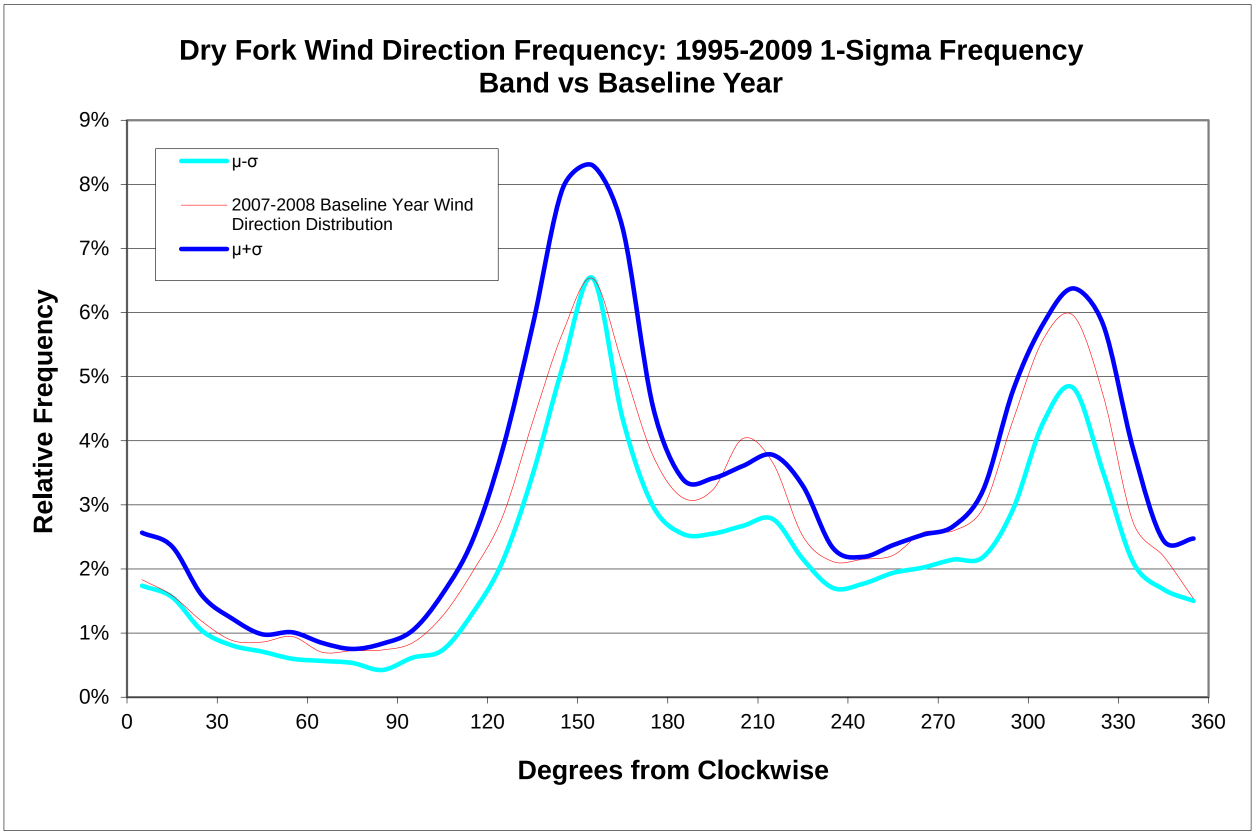
Table 1 demonstrates strong correlation between the 2007-2008 baseline-year wind direction frequencies and the longer term at each of these four monitoring sites. All four correlations produced a p-value of 0.000 indicating extremely high confidence in the correlations.

Appendix 2.5-E showed that for the Buckskin site, moving the meteorological monitoring tower a few miles to the north-northeast resulted in a different wind direction signature. The correlation between one year (2010) at the new site and 20 years (1990-2009) at primarily the old site was very weak, with an $R^2$ value of 50%. To further illustrate the spatial sensitivity of wind direction frequency distributions this addendum compares data from the baseline monitoring year at Buckskin and Gillette. The two sites are approximately eight miles apart. Figure 16 shows a faint linear relationship. The p-value of 0.015 indicates a fairly low probability that the two distributions are completely unrelated; however, the $R^2$ value of 17.6% does not justify the conclusion that a linear correlation exists. Thus, wind directions for the same time period are distributed differently between these two sites despite their close proximity.

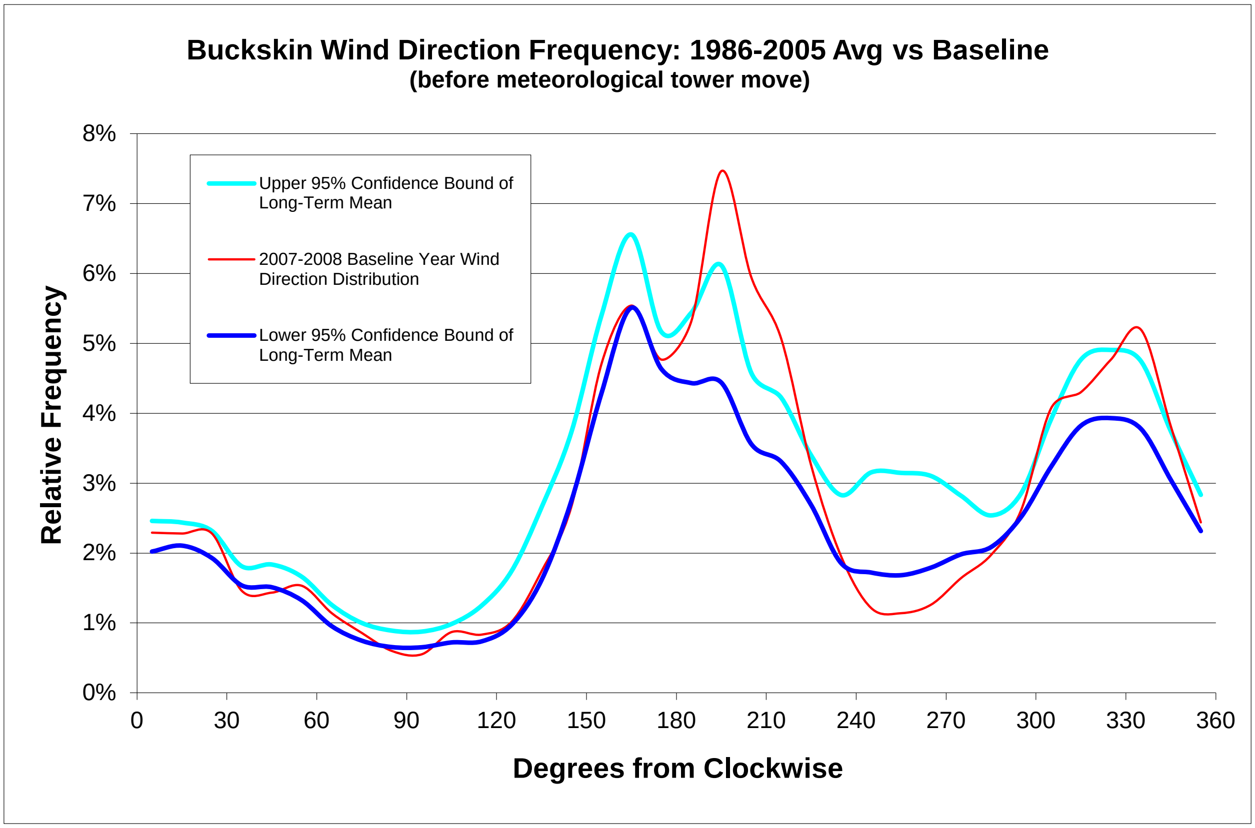
## Figure 3 Revised – Dry Fork 1995-2009 95% Confidence Interval



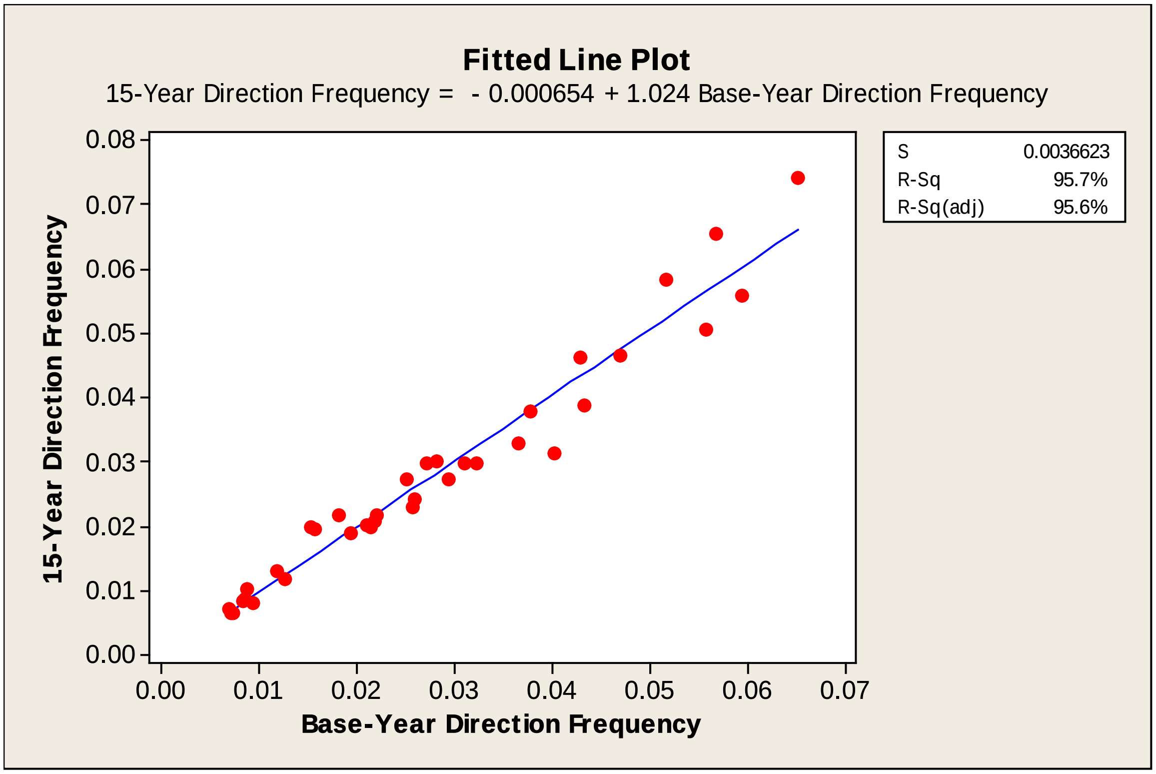
## Figure 4 Revised – Dry Fork 1995-2009 One Standard Deviation Band



## Figure 6 Revised – Buckskin 1986-2005 95% Confidence Interval



## Figure 7 Revised – Dry Fork Regression Analysis



From MINITAB: The regression equation is:

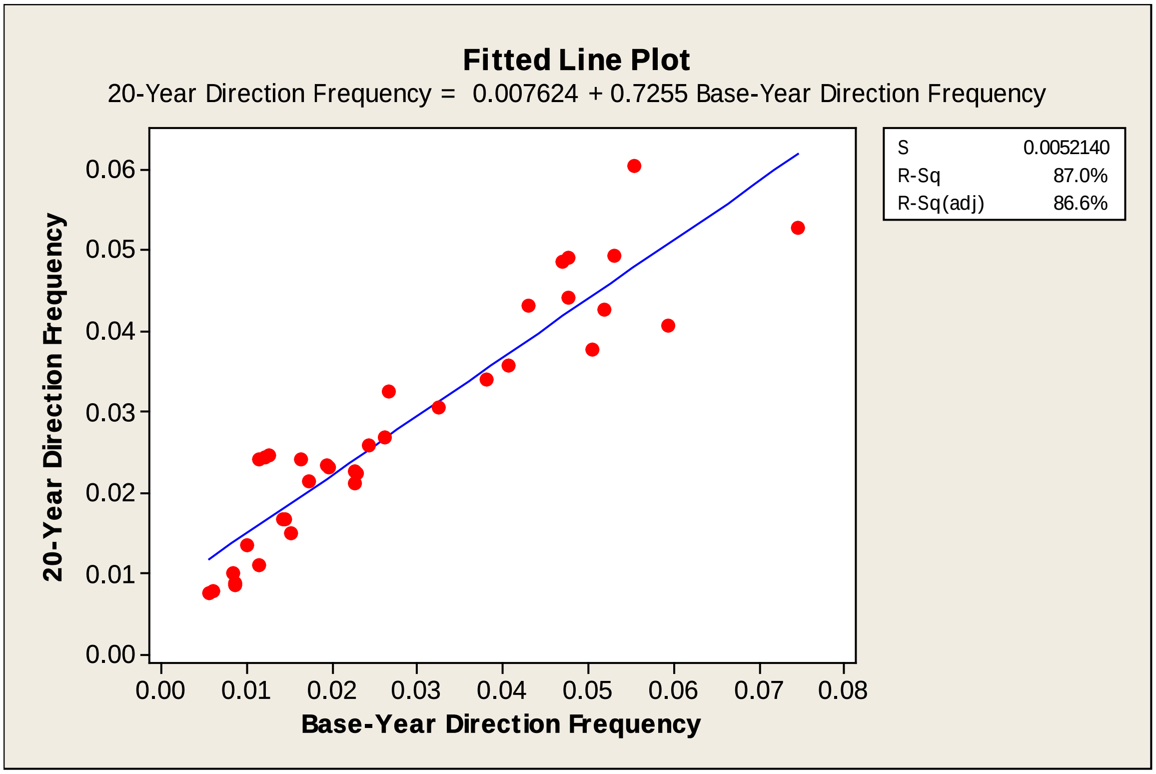
15-Year Direction Frequency = - 0.00065 + 1.02 Base-Year Direction Frequency

S = 0.00366230   $R^2$ = 95.7%   $R^2$ (adj.) = 95.6%

Analysis of Variance

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Regression | 1 | 0.010098 | 0.010098 | 752.87 | 0.000 |
| Residual Error | 34 | 0.000456 | 0.000013 | | |
| Total | 35 | 0.010554 | | | |

## Figure 8 Revised – Buckskin Regression Analysis



From MINITAB: The regression equation is:

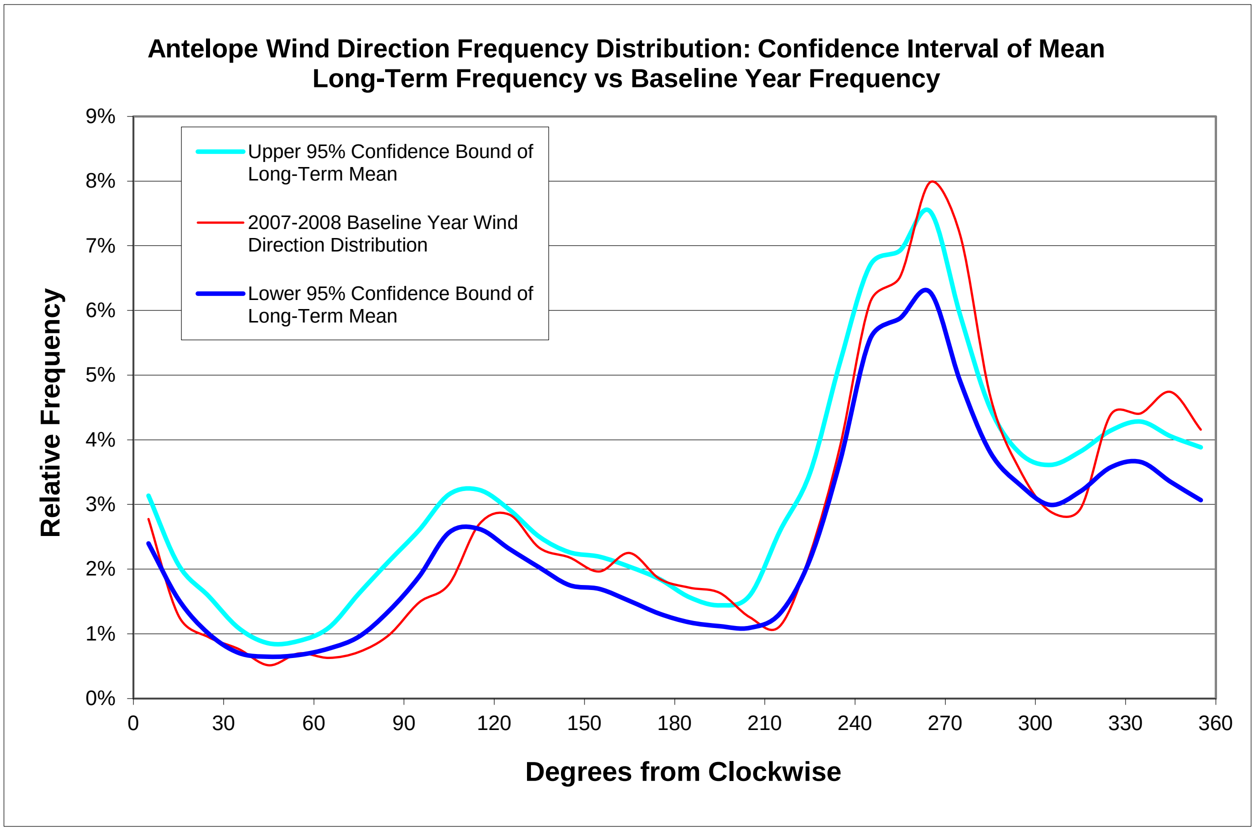
20-Year Direction Frequency = 0.00762 + 0.726 Base-Year Direction Frequency

S = 0.00521403 $R^2$ = 87.0% $R^2$ (adj.) = 86.6%

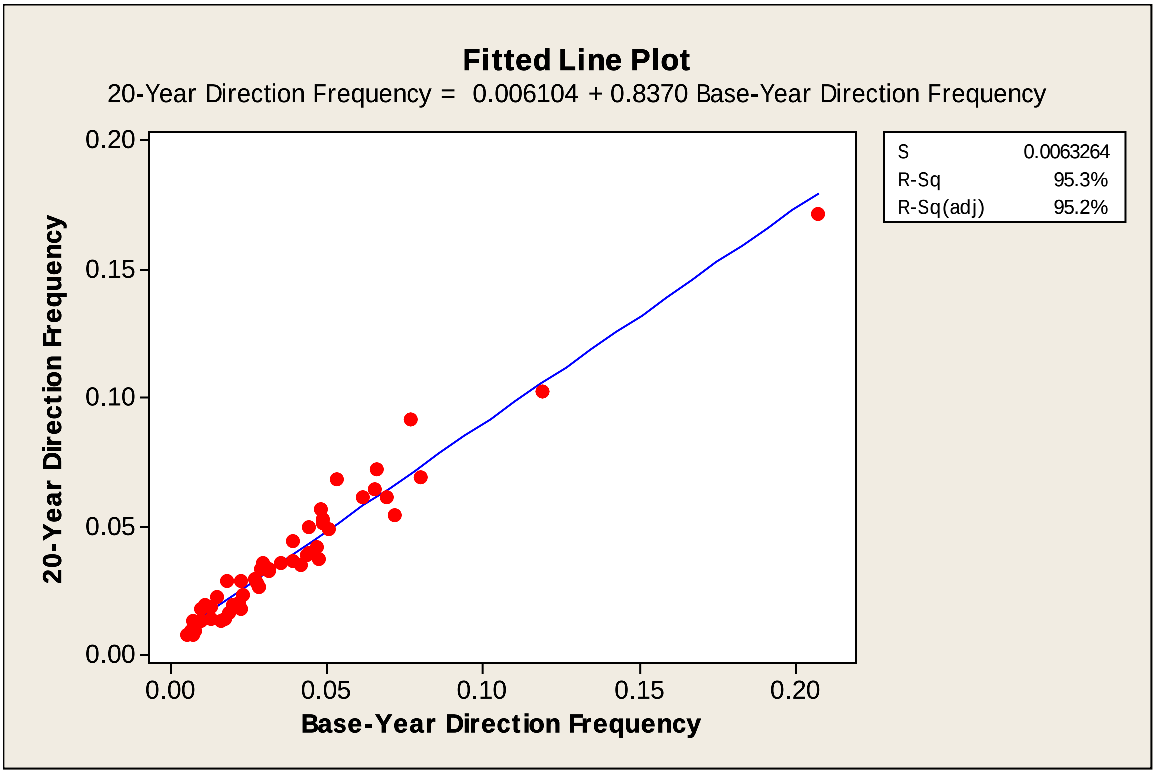
Analysis of Variance

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Regression | 1 | 0.0062003 | 0.0062003 | 228.07 | 0.000 |
| Residual Error | 34 | 0.0009243 | 0.0000272 | | |
| Total | 35 | 0.0071247 | | | |

# Figure 11 Revised – Antelope 1990-2009 95% Confidence Interval



## Figure 12 Revised – Antelope Regression Analysis



From MINITAB: The regression equation is:

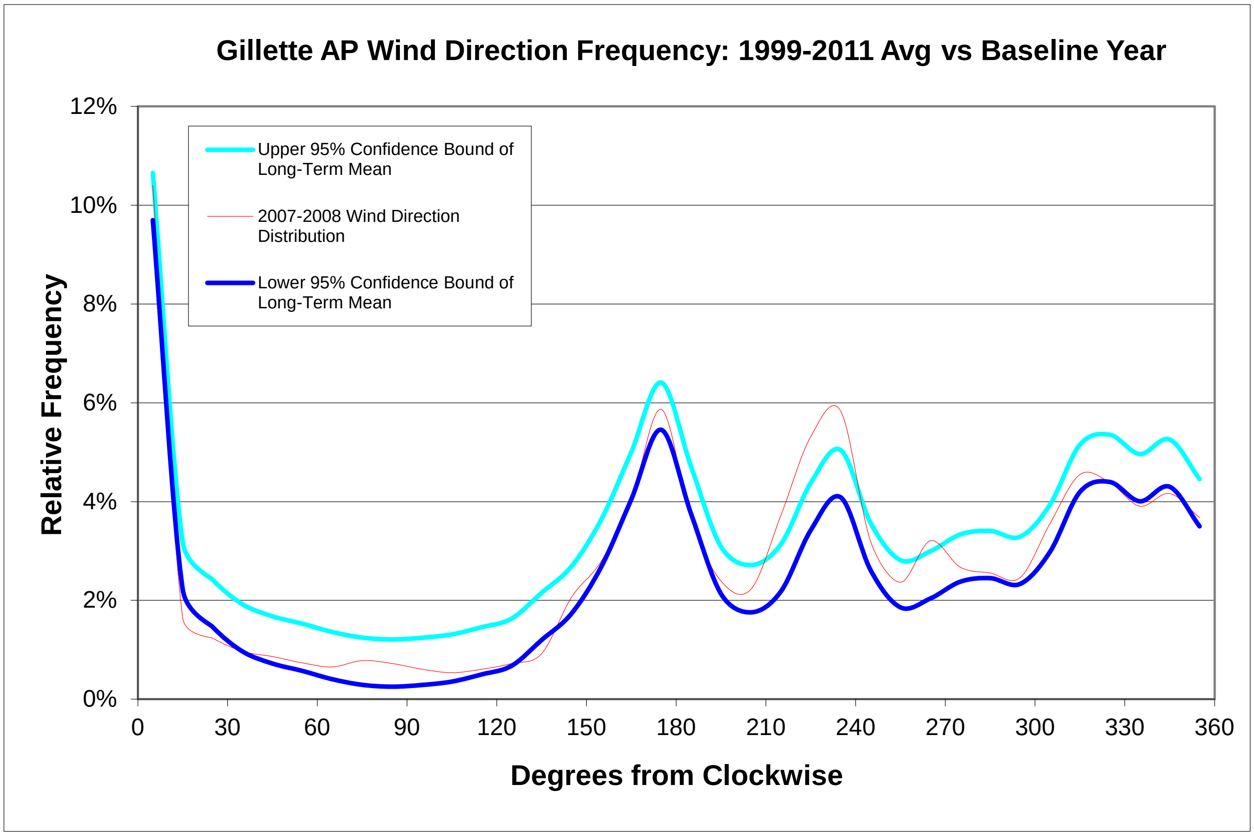
20-Year Direction Frequency = 0.00610 + 0.837 Base-Year Direction Frequency

S = 0.00632643 $R^2$ = 95.3% $R^2$ (adj.) = 95.2%

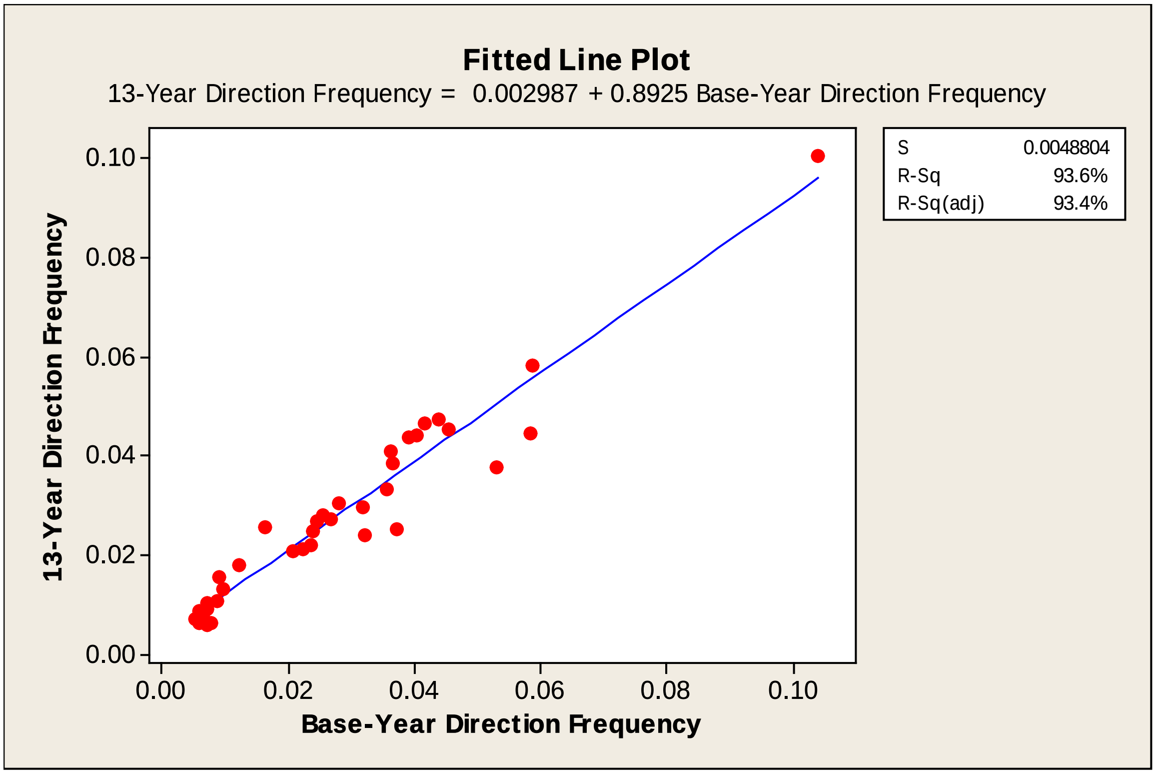
Analysis of Variance

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Regression | 1 | 0.039455 | 0.039455 | 985.80 | 0.000 |
| Residual Error | 49 | 0.001961 | 0.000040 | | |
| Total | 50 | 0.041417 | | | |

# Figure 13 Revised – Gillette 1999-2011 95% Confidence Interval



## Figure 14 Revised – Gillette Regression Analysis



From MINITAB: The regression equation is:

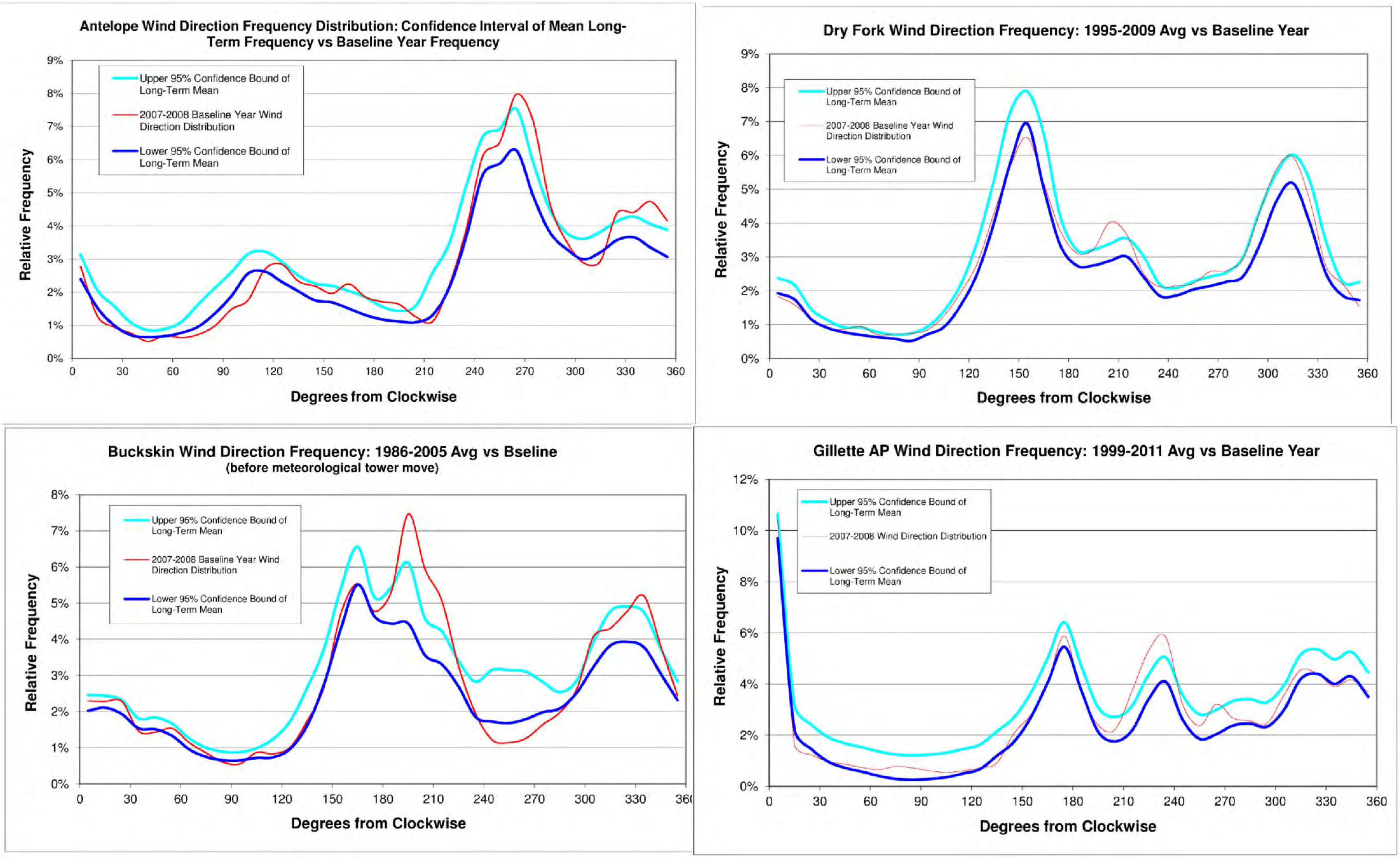
13-Year Direction Frequency = 0.00299 + 0.892 Base-Year Direction Frequency

S = 0.00488041 $R^2$ = 93.6% $R^2$ (adj.) = 93.4%

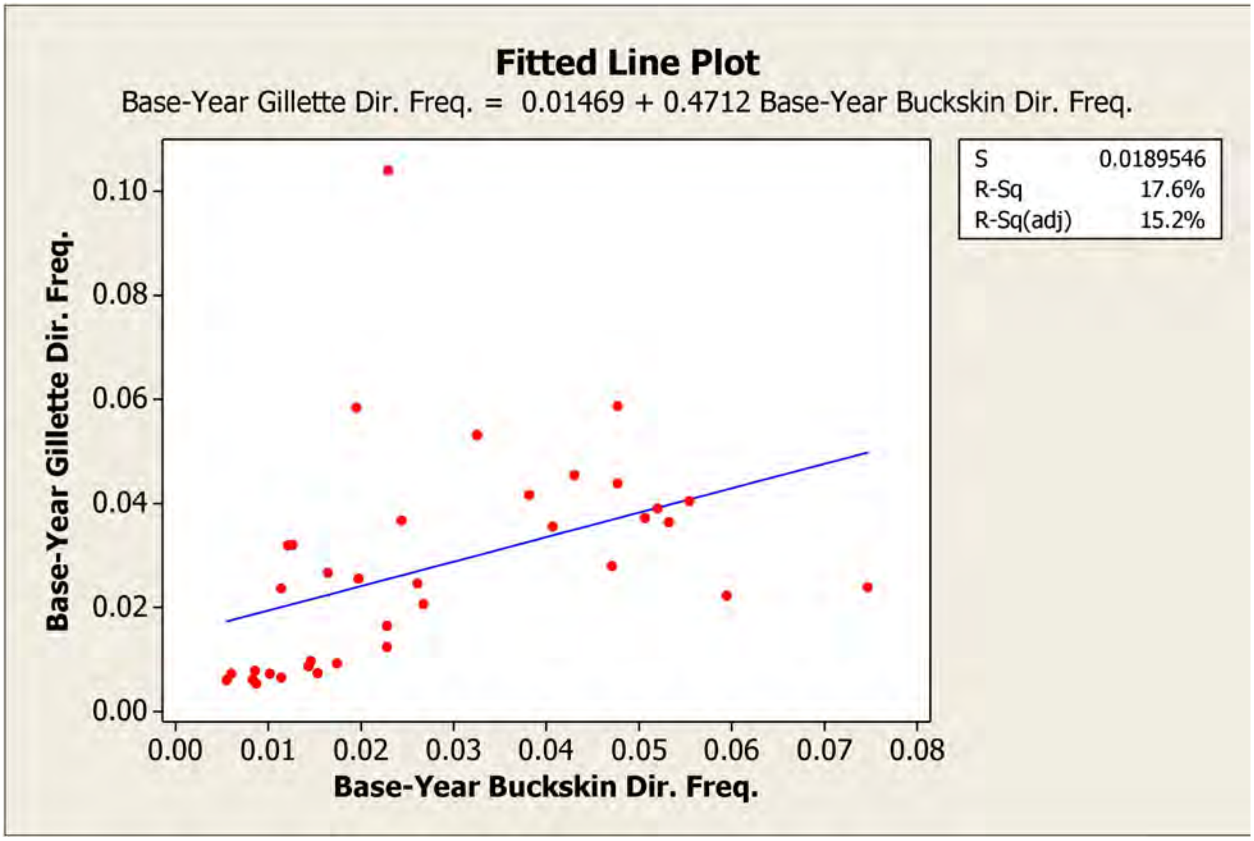
Analysis of Variance

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Regression | 1 | 0.011813 | 0.011813 | 495.94 | 0.000 |
| Residual Error | 34 | 0.000810 | 0.000024 | | |
| Total | 35 | 0.012622 | | | |

Figure 15 Revised – Comparative Site Signatures



## Figure 16 – Baseline-Year Wind Direction Frequency Correlation: Gillette vs. Buckskin



From MINITAB: The regression equation is:

Base-Year Gillette Dir. Freq. = 0.01469 + 0.4712 Base-Year Buckskin Dir. Freq.

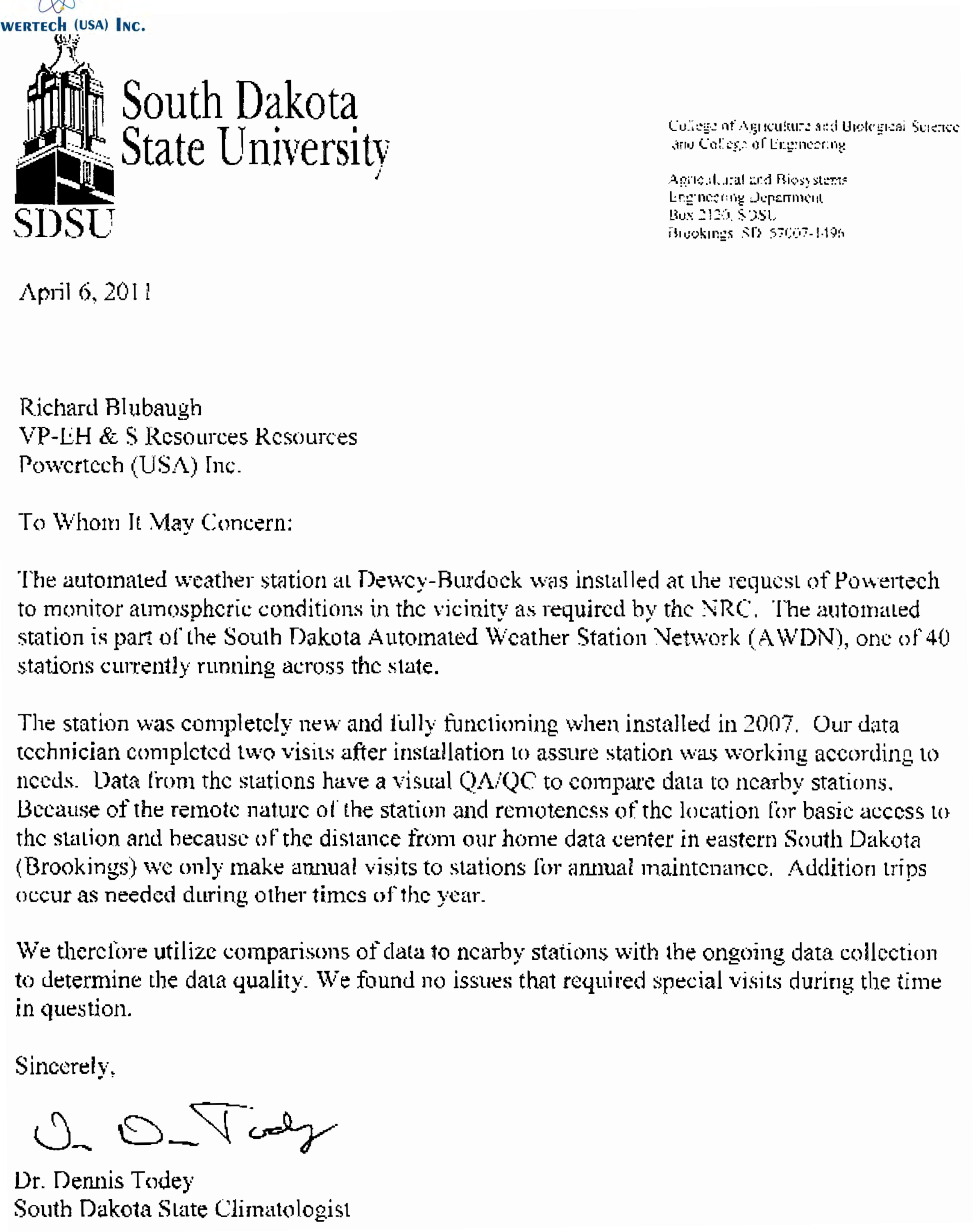
S = 0.0189546 $R^2$ = 17.6% $R^2$ (adj.) = 15.2%

Analysis of Variance

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Regression | 1 | 0.0026156 | 0.0026156 | 7.28 | 0.011 |
| Error | 34 | 0.0122154 | 0.0003593 | | |
| Total | 35 | 0.0148310 | | | |

# APPENDIX 2.5-F

## Dewey-Burdock Meteorological Station Operation and Maintenance



South Dakota
State University
SDSU

College of Agriculture and Biological Science
and College of Engineering

Agricultural and Biosystems
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Brookings, SD 57007-1496

April 6, 2011

Richard Blubaugh
VP-EH & S Resources Resources
Powertech (USA) Inc.

To Whom It May Concern:

The automated weather station at Dewey-Burdock was installed at the request of Powertech to monitor atmospheric conditions in the vicinity as required by the NRC. The automated station is part of the South Dakota Automated Weather Station Network (AWDN), one of 40 stations currently running across the state.

The station was completely new and fully functioning when installed in 2007. Our data technician completed two visits after installation to assure station was working according to needs. Data from the stations have a visual QA/QC to compare data to nearby stations. Because of the remote nature of the station and remoteness of the location for basic access to the station and because of the distance from our home data center in eastern South Dakota (Brookings) we only make annual visits to stations for annual maintenance. Addition trips occur as needed during other times of the year.

We therefore utilize comparisons of data to nearby stations with the ongoing data collection to determine the data quality. We found no issues that required special visits during the time in question.

Sincerely,

D. D. Todey

Dr. Dennis Todey
South Dakota State Climatologist