

Relative age dating of  
groundwater in the Palouse  
Aquifer and Moscow Subbasin  
using tritium and 0-18  
concentrations

September 16, 2010

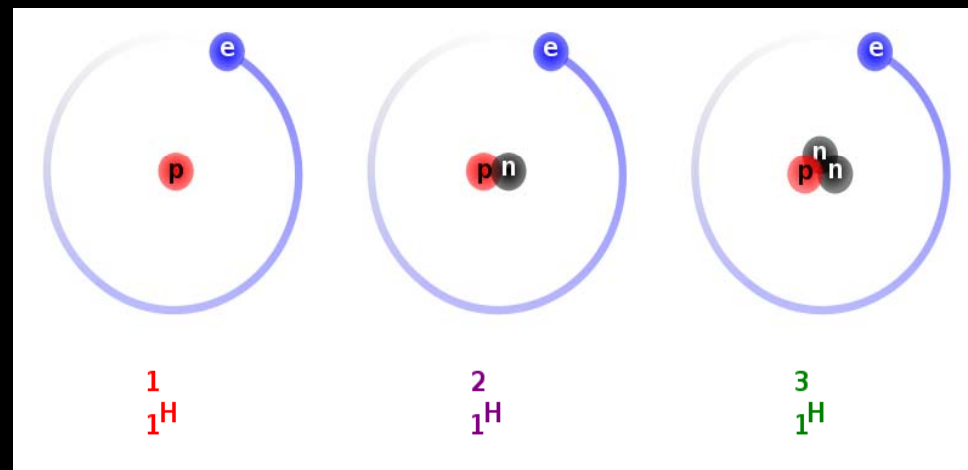
Lauren Carey

# Objectives

- Evaluate the existing  $^{14}\text{C}$  and  $^{18}\text{O}/^2\text{H}$  database to help delineate optimal target wells for Tritium sampling
- Conduct basin-wide, Tritium sampling in the Grande Ronde/Wanapum aquifer system(s) and, collect, synthesize, analyze and interpret the data to evaluate potential recharge areas in the Palouse Basin.

# Tritium

- Radioactive form of hydrogen ( $^3\text{H}$ )
  - Half Life = 12.32 years
- Incorporates itself into water molecules before entering subsurface



## Tritium, cont.

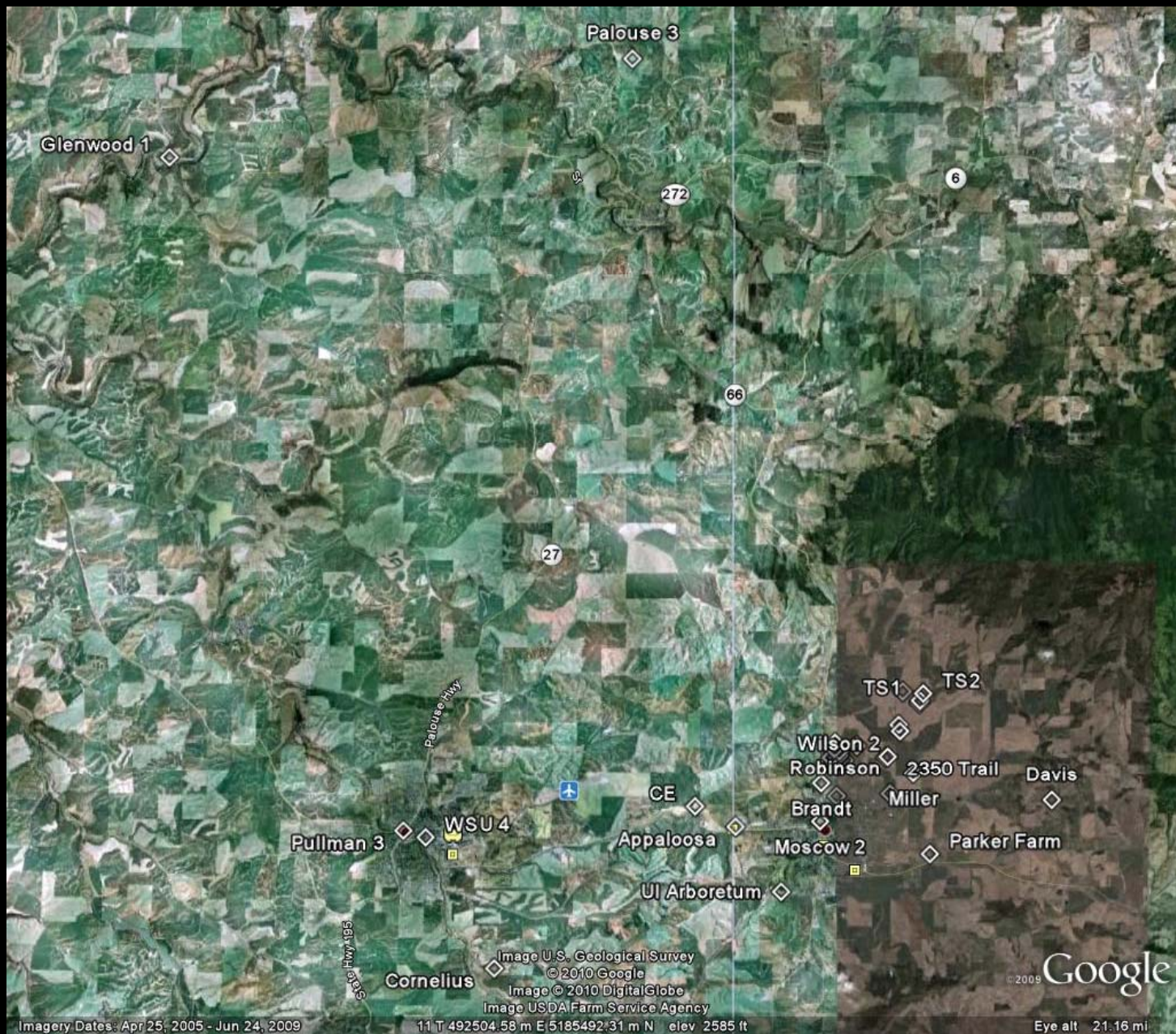
- Naturally produced in upper atmosphere
- Nuclear testing during 1950s and 1960s
- Presence of tritium indicates water younger than 50-60 years old

# Oxygen-18

- Fractionation
  - Evaporation (remaining water enriched)
  - Temperature (cooler temperature → depleted)
  - Continentality (more inland → depleted)
  - Elevation (higher elevation → depleted)
- Reported in per mil (‰)

# Simulated Annealing

- Simulations more representative of reality
  - Kriging smoothes data
- Conditioned to data
- Reproduces data statistics
- Trial-and-error swapping of values
- Multiple results, all equally probable

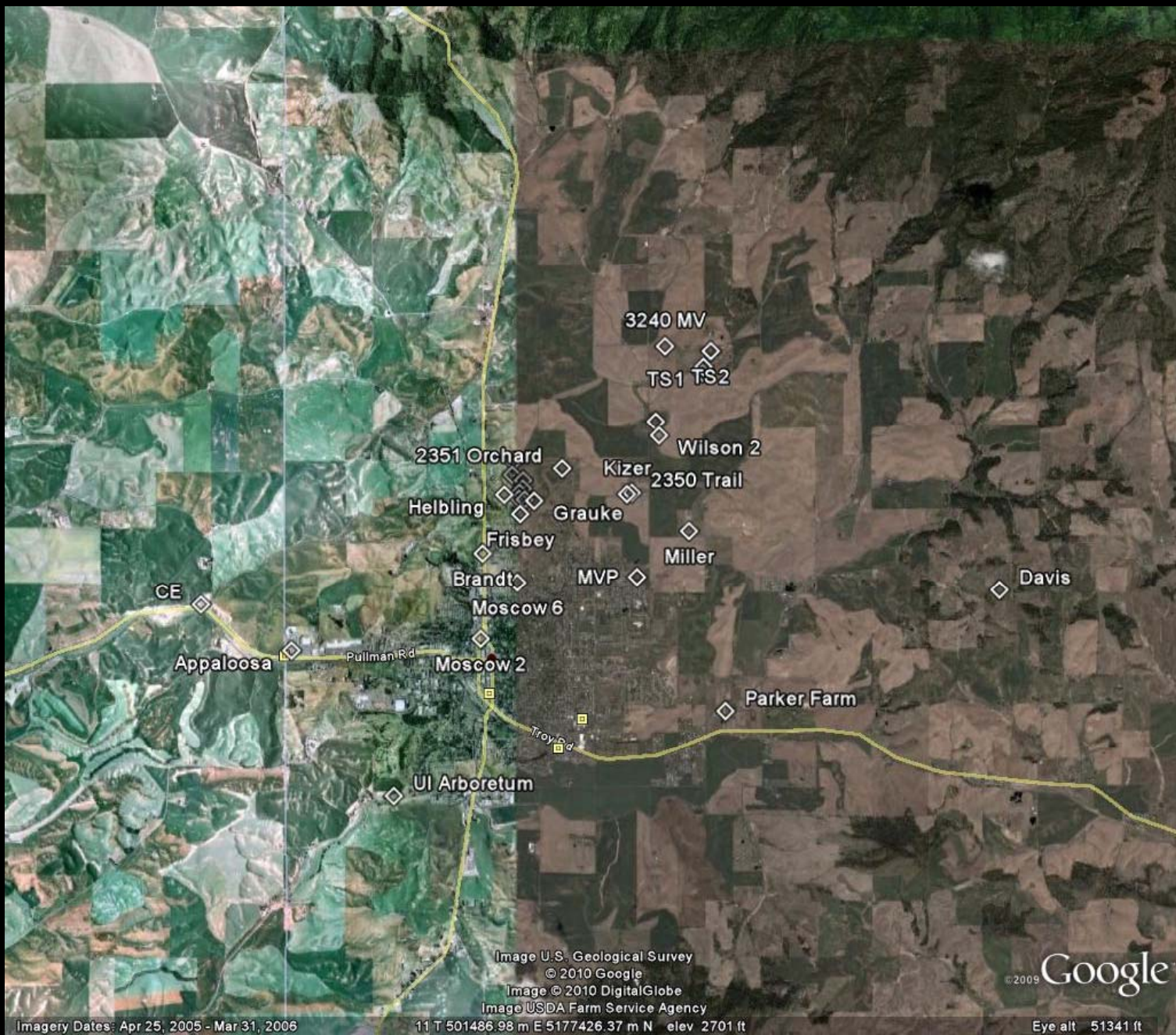


Imagery Dates: Apr 25, 2005 - Jun 24, 2009

11 T 492504.58 m E 5185492.31 m N elev 2585 ft

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Eye alt 21.16 mi



Imagery Dates: Apr 25, 2005 - Mar 31, 2006

Image U.S. Geological Survey  
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Image USDA Farm Service Agency  
11 T 501486.98 m E 5177426.37 m N elev 2701 ft

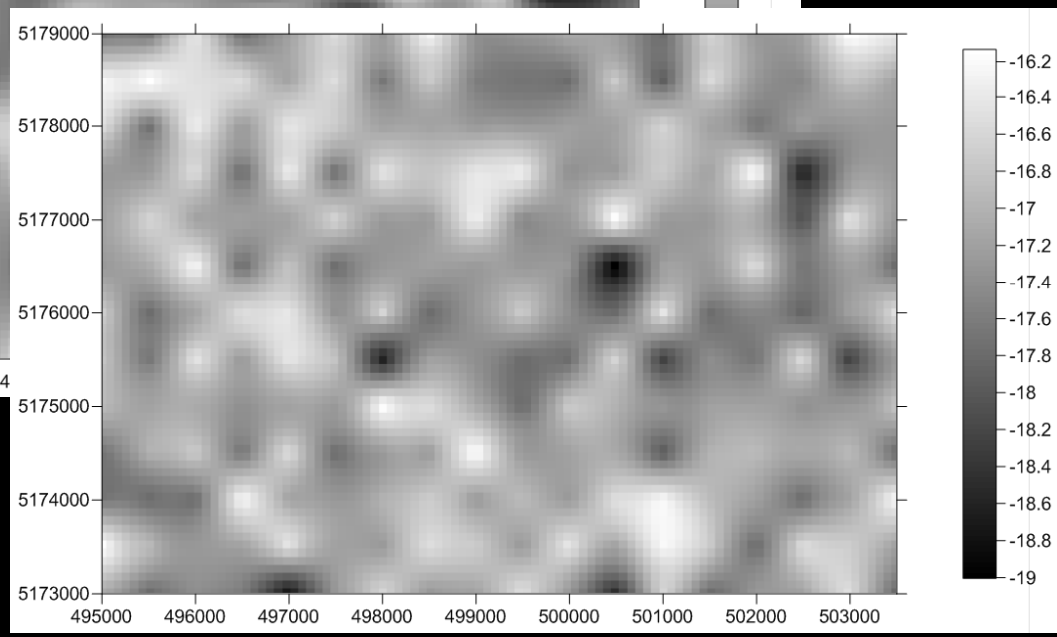
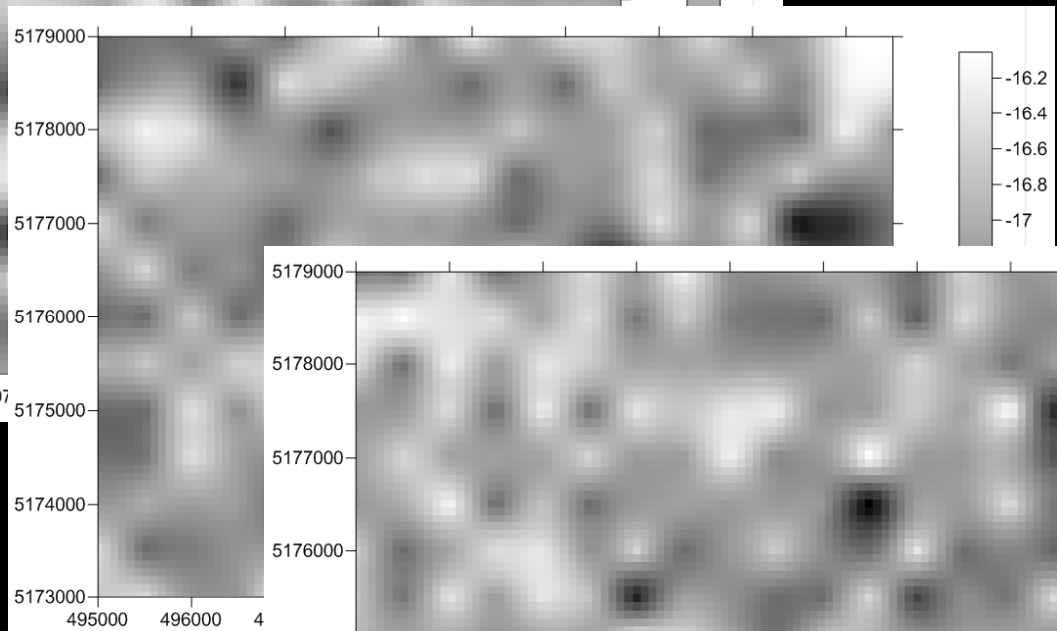
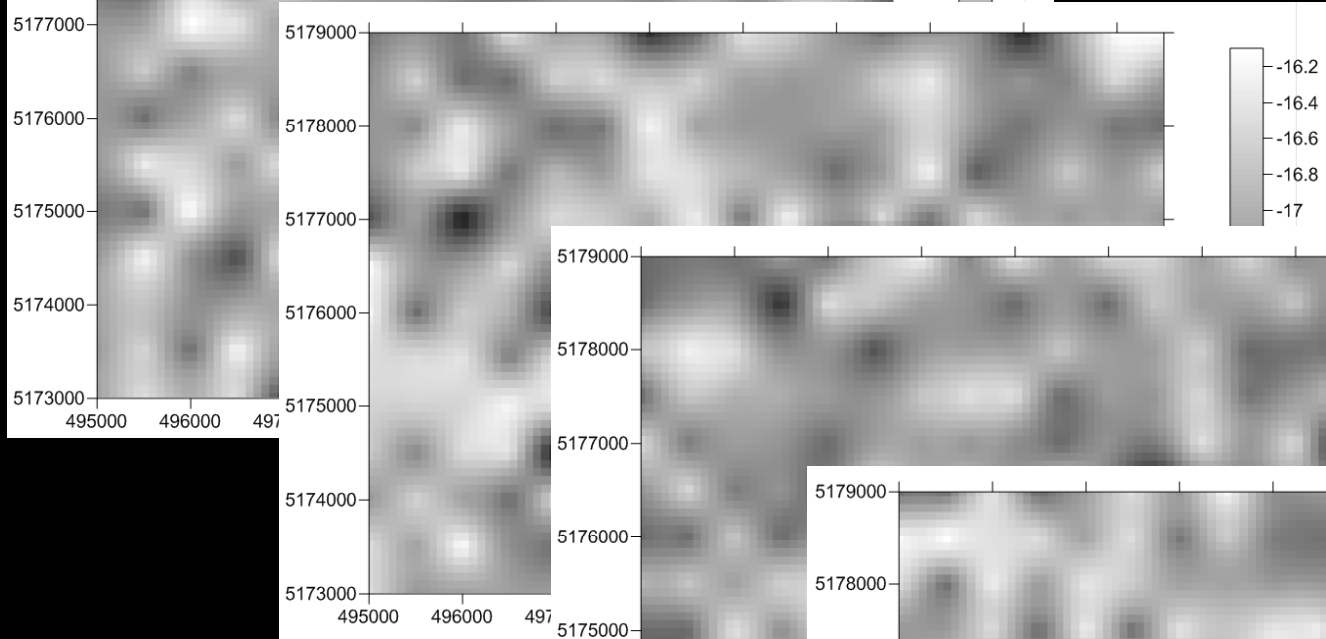
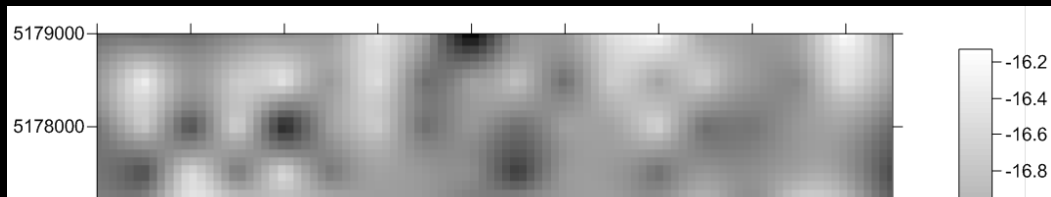
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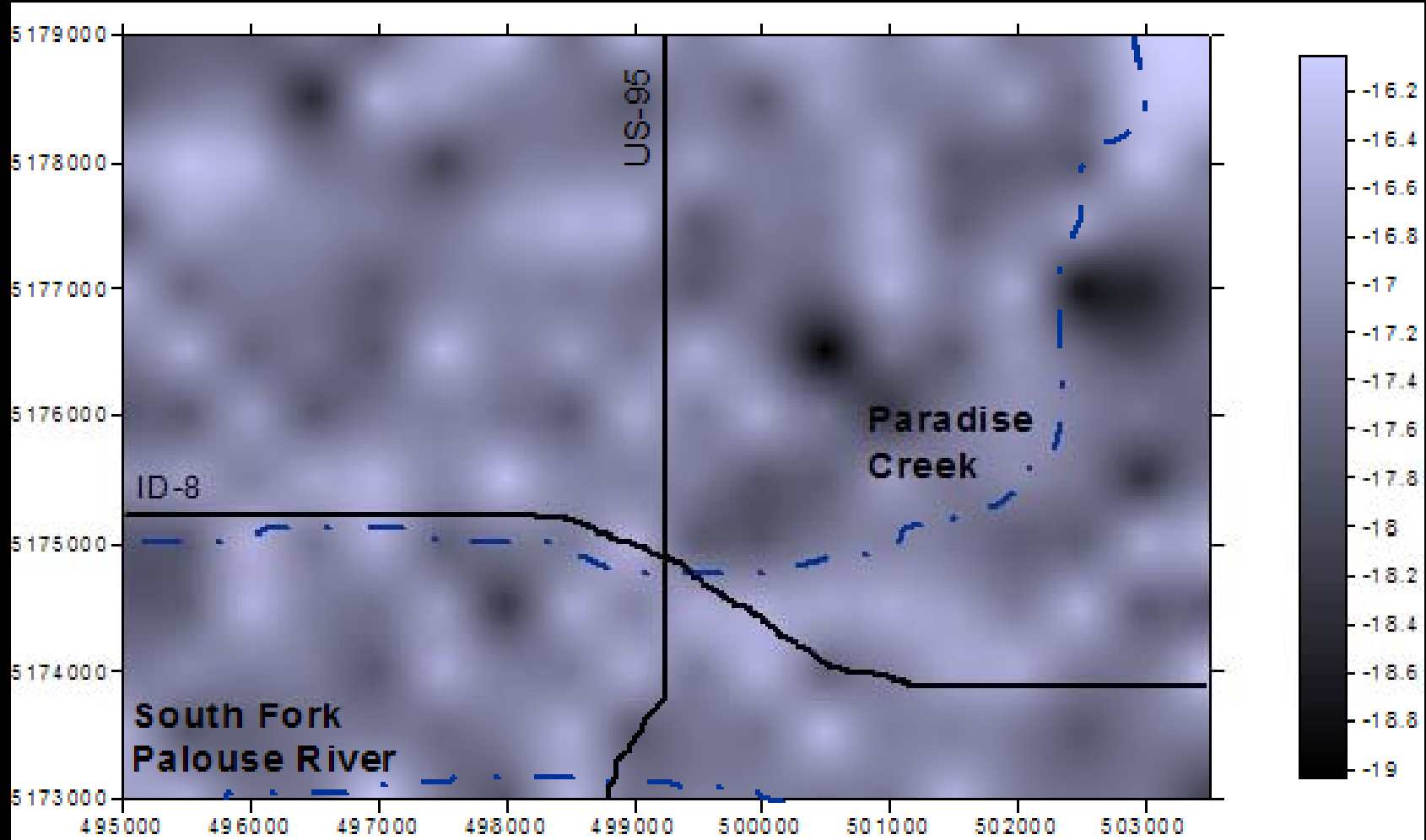
Eye alt 51341 ft



# Tritium Results

| Well Location     | Tritium Concentration (TU) | Uncertainty (eTU) |
|-------------------|----------------------------|-------------------|
| Palouse 3         | -0.01                      | 0.1               |
| Moscow 2          | 0.28                       | 0.1               |
| Moscow 6          | 0.04                       | 0.1               |
| Gregory's         | 0.16                       | 0.1               |
| Pullman 3         | 0.34                       | 0.1               |
| WSU 4             | 0.02                       | 0.1               |
| Cornelius         | 0.04                       | 0.1               |
| Glenwood 1        | 0.11                       | 0.1               |
| UI Arboretum      | 3.36                       | 0.12              |
| Brandt            | 0.01                       | 0.1               |
| Miller            | -0.01                      | 0.1               |
| Appaloosa         | 3.23                       | 0.11              |
| Champion Electric | 0.16                       | 0.1               |





Questions?

| Well Name              | Date Taken | Time Taken | UTM Coordinates |         |          | Tritium | d(18_16)Corr |
|------------------------|------------|------------|-----------------|---------|----------|---------|--------------|
|                        |            |            | Zone            | Easting | Northing |         |              |
| Palouse 3              | 1/29/2010  | 11:18      | 11              | 493694  | 5194707  | -0.01   | -19.349      |
| Moscow 2               | 1/29/2010  | 12:30      | 11              | 499831  | 5175711  | 0.28    | -17.797      |
| Moscow 6               | 1/29/2010  | 12:40      | 11              | 500366  | 5176529  | 0.04    | -19.072      |
| Gregory's              | 2/19/2010  | 13:10      | 11              | 503856  | 5174359  | 0.16    | -17.752      |
| Pullman 3              | 2/26/2010  | 10:05      | 11              | 486207  | 5175407  | 0.34    | -18.358      |
| WSU 4                  | 2/26/2010  | 11:00      | 11              | 486935  | 5175191  | 0.02    | -18.726      |
| Cornelius              | 2/26/2010  | 12:45      | 11              | 489176  | 5170922  | 0.04    | -17.909      |
| Glenwood 1             | 2/26/2010  | 14:15      | 11              | 478522  | 5197370  | 0.11    | -18.411      |
| UI Arboretum           | 3/5/2010   | 10:25      | 11              | 498561  | 5173429  | 3.36    | -16.467      |
| Wood                   | 3/31/2010  | 14:50      | 11              |         |          | -       | -17.475      |
| Brandt                 | 6/10/2010  | 10:30      | 11              | 499862  | 5176954  | 0.01    | -17.264      |
| Miller                 | 6/10/2010  | 10:50      | 11              | 502870  | 5177281  | -0.01   | -17.342      |
| Inn                    | 6/10/2010  | 12:15      | 11              | 503064  | 5179578  | -       | -16.742      |
| TS 1                   | 6/10/2010  | 12:35      | 11              | 503079  | 5179662  | -       | -17.337      |
| TS 2                   | 6/10/2010  | 13:00      | 11              | 503185  | 5179888  | -       | -16.063      |
| 3240 MV                | 6/10/2010  | 13:40      | 11              | 502519  | 5179957  | -       | -17.067      |
| 2350 Trail             | 6/10/2010  | 14:20      | 11              | 502035  | 5177835  | -       | -17.505      |
| Appaloosa              | 6/10/2010  | 10:00      | 11              | 497068  | 5175541  | 3.23    | -16.394      |
| Wilson 1               | 6/18/2010  | 12:30      | 11              | 502386  | 5178871  | -       | -17.196      |
| Wilson 2               | 6/18/2010  | 12:50      | 11              | 502433  | 5178668  | -       | -17.462      |
| 2485 Polk              | 6/22/2010  | 11:35      | 11              | 500313  | 5178292  | -       | -16.739      |
| 2295 Polk              | 6/22/2010  | 11:50      | 11              | 500294  | 5178095  | -       | -16.509      |
| 2200 Polk              | 6/22/2010  | 12:50      | 11              | 500453  | 5178015  | -       | -17.161      |
| 1990 Pavel             | 6/22/2010  | 13:30      | 11              | 500394  | 5177750  | -       | -16.7        |
| 568 Pavel              | 6/22/2010  | 13:45      | 11              | 500400  | 5177836  | -       | -17.198      |
| 2351 Orchard           | 6/22/2010  | 15:00      | 11              | 501022  | 5178188  | -       | -16.557      |
| CE (Champion Electric) | 6/22/2010  | 15:25      | 11              | 495742  | 5176207  | 0.16    | -17.819      |
| Kizer                  | 7/8/2010   | 17:10      | 11              | 501966  | 5177816  | -       | -17.672      |
| Frisbey                | 7/8/2010   | 17:25      | 11              | 500411  | 5177527  | -       | -17.292      |
| Helbling               | 7/8/2010   | 17:35      | 11              | 500179  | 5177807  | -       | -17.236      |
| Grauke                 | 7/8/2010   | 17:55      | 11              | 500614  | 5177719  | -       | -17.209      |
| Craig                  | 7/8/2010   | 18:00      | 11              | 500475  | 5177737  | -       | -17.265      |
| UI 5                   | 8/5/2010   | 16:20      | 11              | 497876  | 5175143  |         |              |
| UI 6                   | 8/5/2010   | 16:00      | 11              | 497876  | 5175109  |         |              |
| UI 7                   | 8/5/2010   | 16:05      | 11              | 497874  | 5175141  |         |              |
| Merrell                | 8/6/2010   | 12:00      | 11              | 500449  | 5177897  | -       |              |
| Parker Farm            | 8/9/2010   | 17:50      | 11              | 503402  | 5174671  |         |              |
| MVP                    | 8/11/2010  | 9:40       | 11              | 502112  | 5176611  |         |              |
| Davis                  | 8/13/2010  | 12:00      | 11              | 507364  | 5176428  | -       |              |
| GWFL 1                 | 8/17/2010  | 10:40      | 11              |         |          | -       |              |
| GWFL 2                 | 8/17/2010  | 10:14      | 11              |         |          | -       |              |
| GWFL 3                 | 8/17/2010  | 10:18      | 11              |         |          | -       |              |
| GWFL 4                 | 8/17/2010  | 10:35      | 11              |         |          | -       |              |
| GWFL 5                 | 8/17/2010  | 10:25      | 11              |         |          | -       |              |
| GWFL 6                 | 8/17/2010  | 9:42       | 11              |         |          | -       |              |
| GWFL 7                 | 8/17/2010  | 9:58       | 11              |         |          | -       |              |
| GWFL 8                 | 8/17/2010  | 9:53       | 11              |         |          | -       |              |
| GWFL 9                 | 8/17/2010  | 10:06      | 11              |         |          | -       |              |
| GWFL 10                | 8/17/2010  | 10:27      | 11              |         |          | -       |              |
| IDWR 4                 | 9/7/2010   | 11:55      | 11              |         |          |         |              |