Gas Well Study, 2012

Large partially filled impoundment at 47-097-03716, a well plugged in May 2011. Besides this impoundment, there was also an open drill waste pit with torn liner. The plugged well's monument was improper and for some reason had a valved vent on top. The pad is almost bare of vegetation and a soil sample had a chloride concentration of 384 ppm. State law requires final reclamation of a plugged well's site within six months after plugging. Photo taken on 1 July 2012.

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Gas Well Study is the examination of natural gas wells in West Virginia.

Well sites are surveyed for compliance with state and federal regulations.

Well sites are also surveyed for environmental issues.

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Introduction

Besides examining well sites (sixteen this year), we looked at the Office's practices relating to complaints received, Notifications of Violation (NOVs) issued to operators, and abandoned wells. We began a program of testing domestic water sources near gas wells. We conducted the first Gas Well Workshop for the West Virginia Sierra Club, an effort toward training citizen gas well monitors (another Workshop is scheduled for spring 2013). And we continue to have grave concerns about the state's program of land application of liquid drill and fracture waste for some wells and burial of solid waste.[1] This program has been carried out since 1988 under the same, unaltered, General Water Pollution Control Permit.[2]

An added emphasis in this report will be given to erosion and sediment control. We'll look at one permit application for a well and discuss common notable deficiencies at other well sites.

First we'll discuss well sites grouped as geographic clusters. We'll then turn to the erosion and sediment control program; water testing results near well sites; Office of Oil and Gas' handling of complaints, issuing of NOVs, and abandoned wells; and the extension of the general water pollution control permit. Our report finishes with a short discussion of our Gas Well Workshop.

Well Sites

Long Road sites, Putnam county

The Long Road is the name we've given to a well access road, which lies between Harmon's and Heizer's Creeks, that serves a number of wells (since 2008 we've looked at nine wells amongst those served by the road). At the north end there's a gate next to a residence on Harmon's Creek Road.

Photo 1. Long Road looking north. This is at A on the permit application drawing shown in photo 17. The steep grade on the left is about 30% and is an alternate route (red line on drawing). Pipeline right of way to the right is, at times, passable. This route wasn't useable by our ATV in 2012 though this is the access road shown on the drawing. The alternate route is always open for access. Photo from video shot on 7 June 2012.

There's another residence on the Long Road a few hundred feet from this gate and at least three camps whose owners use the Long Road to access their properties. Other access points to the Long Road exist and are not gated, especially to ATV and dirt bike traffic. Because access to the wells isn't restricted this is a party area. It's not unusual to find signs of bonfires and alcohol consumption at unfenced well sites.[3]

The Long Road is graveled only for a short distance of its length at the north end. A six inch pipeline is partially buried under a portion of the road (exposed pipe in the roadbed is visible in several places). Most of the road, including the graveled section, is in poor condition with little or no drainage. We'll return to this road later when we discuss erosion and sediment control.

We looked at four wells in 2012 whose access is by the Long Road. We filmed two of the wells for Gas Well Workshop videos. Two other well sites, looked at more closely, were filmed for a video for

[1] Burial of solid waste on horizontal well sites is allowed under the new Horizontal Well Act (§22-6A) with surface owner's written permission. At vertical well sites no permission is required.

[2] West Virginia Office of Oil and Gas, *General Water Pollution Control Permit*, GP-WV-1-88 (referred to as general permit). Note that there is a different General Water Pollution Control Permit (GP-WV-1-07) that is for coalbed methane wells.

[3] Maintenance of the Long Road and well sites is exacerbated by damage caused by off road vehicles, ATVs and dirt bikes. This is in contrast to access to wells on nearby private property which is severely restricted by gates and barbed wire installed by the operator at the surface owner's request.

Photo 2. 47-079-00702 casing head with vent pipe on lower right hand side. Vent pipe (painted green) rises about 8 feet. Photo from video shot on 7 June 2012.

Photo 3. Barely vegetated pad for 47-079-01314. Tape measure follows line of exposed pit liner east of wellhead. See satellite photo of well site (photo 4) for comparison of location of pits in 2005. Photo from video shot on 7 June 2012.

presentation at the 2012 West Virginia Sierra Club's Marcellus Academy. These four wells were first visited in 2008 and examined again in 2010. One was revisited and filmed in 2011.

We tested for chloride at two sites, 47-079-01288 and 47-079-01299, for demonstrating soil and water sampling techniques for the Workshop. 47-079-01288 had remediation resulting from our 2011 visit. In 2011 we noted a large bare area on the pad just east of a substantial piece of black pit liner sticking up out of the ground.[4] The bare area had been reseeded when we looked at the site in early 2012. The piece of pit liner sticking up out of the ground had been cut off. A much larger piece of pit liner sticking up out of the ground east of the bare area, not noted in the caption for the photo in our 2011 report, still remained. When collecting a soil sample where pit liner had been cut off we encountered more pit liner below the surface. This we did not pierce. The sample collected showed normal background level chloride. Background chloride concentrations for soil and water are very low. We consider concentrations below 30 ppm acceptable for soil or water.

Water samples tested at low spots on the pad of 47-079-01299 showed no chloride above expected background levels.

[4] See photo 6 in George Monk and Molly Schaffnit, 2012, *Gas Well Study, 2011.*

An older well, 47-079-00702, is in a low gap just above a small stream, about halfway between 47-079-01299 and 47-079-01314. The pad is bare of vegetation except around well equipment. This well is exceptional because it has a vent from the surface casing head to relieve pressure caused by inadequate casing and cementing of the well. Gases vent continuously from an open pipe end about eight feet above the ground.

A more recent well, 47-079-01314, is one where we've encountered a number of problems. The well on 2008 and 2010 visits was a member of a group of five wells on the Long Road that did not have an API number on the wellhead. In 2012 we found an incorrect API number on the wellhead (470-790-1283, as on the tag) for a well that was never drilled.

On 47-079-01314's pad there is an 85-foot long line of outcroppings of pit liner apparently following the western edge of a pit shown in satellite photos of the well site. In 2010, at the northeastern end of this line of pit liner, we tested standing recent rainwater in what would have been the pit area and found a chloride concentration of 356 ppm. A soil sample collected nearby in 2012 had a chloride concentration of 536 ppm. Both soil and water samples were many times expected background levels for chloride and show persistent contamination of the site. Chloride doesn't naturally

Photo 4. Satellite photo taken in 2005 of 47-079-01314. Line of exposed pit liner visible in 2012 is along western edge of large pit. Pieces of loose liner now lie on the surface near where the smaller pit is shown in the photo.

remain in soil; it has the same mobility as water. High concentrations of chloride years after the well was drilled in 2005 points to contamination from buried pit waste rather than a one time spill.

There's a spring a few feet from the wellhead and a seep north of the well.[5] Location of a well this close to ground/surface water is ill advised but apparently permitted by the Office of Oil and Gas. Burial of pit waste in a locale such as this is also ill advised but not restricted under the general permit.

The operator originally applied to drill a well in this area, 47-079-01283, but had to move the location because of slips encountered during construction.[6] A new application was filed and 47-079-01314 was drilled nearby. The operator failed to report production for 47-079-01314 for four years, forcing the Office of Oil and Gas to find it abandoned.[7] Under law abandoned wells require

Photo 5. Large piece of exposed pit liner at 47-079-01314. Fragment of orange pit fencing is also visible. Photo from video shot on 7 June 2012.

prompt plugging but the Office of Oil and Gas apparently doesn't enforce compliance by operators.[8]

In the case of 47-079-01314 the problem in reporting seems to be due to the operator's confusion in record keeping for the permitted but not drilled well and another permitted well drilled nearby. This operator, unlike some, doesn't normally have a large backlog of abandoned wells and does plug nonproducing wells.

Camp Virgil Tate sites, Kanawha county

We looked at six sites near Camp Virgil Tate, three storage wells, two plugged wells and one abandoned well. We also saw from the road but didn't examine more closely four other wells.

[5] Water tests at these locations showed background concentrations of chloride.

[6] 47-079-01283 is Davison Fuel & Dock A-2 located at UTM 17 434181.5E 4261803.4N. 47-079-01314 is Davison Fuel & Dock A-2R located at UTM 17 434164.9E 4261739.2N.

[7] No production reports were filed for 2006, 2007, 2008 and 2009. After the 2010 production report was filed in 2011 the well was no longer considered abandoned.

[8] See §22-6-19: "Any well which is completed as a dry hole or which is not in use for a period of twelve consecutive months shall be presumed to have been abandoned and shall *promptly* [our emphasis] be plugged by the operator . . ." See also 35CSR4.15.1.d: "Failure to submit an annual report of oil or gas as required by this rule or to provide proof of an existing use or a bona-fide future use under 35 CSR 5 shall constitute a rebuttable presumption that the well is abandoned by the operator." For the law's idea of what promptly means, see 35CSR4.13.3: "The owner or operator of every well presumed to have been abandoned under the provisions of W. Va. Code §22-6-19 shall file Form WW-4 within sixty (60) days after such abandonment, unless the Office waives this requirement for good cause shown."

Photo 6. Wellhead for 47-039-01046 storage well, just north of Route 622, near Camp Virgil Tate. Photo taken on 6 September 2012.

Photo 7. Large plastic condensate storage tank serving pipeline just north of Camp Virgil Tate Road. Tank doesn't have required secondary containment with rainwater drain. Pocatalico River is nearby to the south. Photo taken on 6 September 2012.

The wells we looked at were in two groups. Wells directly off of Route 622 and Camp Virgil Tate Road formed one group. The other group was wells at the north end of Campbell's Branch, just north and west of Camp Virgil Tate, which we accessed through the woods.

We examined two storage wells belonging to the first group, 47-039-01552 and 47-039-01046. These storage wells, converted from formerly producing wells, had nicely maintained and identified sites. Three other similar wells were visible from the road but were not examined closely (47-039-01031, 47-039-001043, and 47-039-001544 – all with the same operator). 47-039-01031 is visible from Camp Virgil Tate Road and is close to a residence. 47-039-02204 is a different operator's producing well, also near a residence. A vessel that appears to be an abandoned tank rests on its side next to the wellhead.

Three pipelines (two owned by operators and a third by Columbia Transmission) serving Columbia Transmission's Lanham Station are found along Camp Virgil Tate Road. At one point, where Cranberry Pipeline comes down the ridge toward the road, there's a condensate storage tank serving it. This tank doesn't have required secondary containment.[9]

We looked at four well sites at the north end of Campbell's Branch. We approached these sites through the woods rather than by using access roads. One access road, on the west side of Campbell's Branch is apparently in useable condition (this road serves 47-039-01198). The other access roads were poor or severely damaged. We approached these sites roughly from east to west and that is how they'll be described here.

The first well, 47-039-01168, has been abandoned since 2005 with zero production being reported for 2007, 2008, 2009 and 2011. No production reports were filed for 2005, 2006 and 2010. The well, which lies next to a poorly maintained well access road, had no API number on the wellhead. The road appears to be too narrow for service trucks, such as a tender's or vac truck, though there was a condensate storage tank with proper containment. There was a small gas leak at or near the casing head.

There were two plugged wells. One, 47-039-02306, below 47-039-01168, had a proper monument

[9] The approximate location of the tank is UTM 17 437408E 4258665N. Secondary containment is required by 35CSR1.7 and 47CSR58.

Photo 8. Wellhead 47-039-01168 showing leaking oily fluid below flange on casing head. Audible gas leak was heard here. Photo taken on 12 November 2012.

Photo 9. Disconnected pipe and meter just north of 47-039-02306 plugged well monument. Photo taken on 12 November 2012.

with API number. Just north of this monument we found equipment and pipe that had been abandoned. At first glance this appeared to be part of a pipeline along with a meter but pipes had been disconnected. If this served 47-039-02306 this material should have been removed as part of the final reclamation when the well was plugged.[10]

Another plugged well, west of 47-039-02306, is 47-039-02319 which has a proper monument with API number, but again disconnected pipes sticking up out of the ground near the monument and other scrap pipe and equipment scattered about. This material should have been completely removed as part of final reclamation after plugging.

There was an abandoned rusted out 100 barrel storage tank about halfway between 47-039-02306 and 47-039-02319 which might have originally served one of these wells, or 47-039-01168 (replaced by the current plastic storage tank), or another well nearby.[11] The road connecting 47-039-02306 and 47-039-02319, just west of the tank, has been washed out and is impassable.

47-039-01198 is a production well that has been converted to a storage well. The pad is graveled and the well and site are nicely maintained and identified.

There was a hydrogen sulfide warning sign near the entrance of this well site and another, lying on the ground, between 47-039-02319 and the washed out section of road. These signs appear to have been for 47-039-02319 and should not have been left behind after plugging the well.

The location of 47-039-02319 on the Office's online map tool and West Virginia Geological and Economic Survey online Pipeline2 database is incorrect, being about 300 feet too far south. This error is due to the way well locations were determined for permit applications in the past before GPS was available.

Poca River Road sites, Putnam county

We revisited four wells, which we first looked at in 2009, that are next to North and South Poca River Roads. Three of the wells are operated by the same company. The fourth well is abandoned and doesn't have a known operator.

The abandoned well is 47-079-00615 and the site was essentially unchanged since we looked at it

[10] See §22-6-30b: "Within six months after a well that has produced oil or gas is plugged, or after the plugging of a dry hole, the operator shall remove all production and storage structures, supplies and equipment, and any oil, salt water and debris, and fill any remaining excavations. . . ."

[11] This tank is located at UTM 17 436786.3E 4261092.6N.

Photo 10. Steep grade for 47-079-01492 access road. Car is parked next to South Poca River Road. The Pocatalico River is just on the other side of paved road. Operator constructed a water bar part way up access road in 2009. This has not been maintained. Rain can wash sediment from access road directly into River. Photo taken on 12 October 2012.

Photo 11. Extensive deer tracking on site of buried pit waste for 47-079-01492. Liner and waste exposed by recent slip is just to the left (south) of this picture. Photo taken on 12 October 2012.

in 2009 except the leaking union joint has been repaired or the well has finally been shut down. The well was operated by a company that seems to have never reported production and is no longer in business. The condensate storage tank has no secondary containment and the well has no API number. Because of the well's close proximity to the Pocatalico River it should be a candidate for plugging by the state.

The three other wells are operated by the same company. We wanted to revisit these wells since the company had not reported production of any of its wells for 2008, 2009 and 2010. When we began planning to examine these wells it had not reported production in a timely fashion for 2011. The wells had been producing in 2009 and our expectation was to find no difference in 2012.

Two wells, 47-079-00731 and 47-079-01492, share the same access road. The sites were well grassed (unlike in 2009), except for the pad of 47-079-01492, but the sites continue to show the same problems we saw originally in 2009.[12] 47-079-00731 still had the wrong API number (wrong county) and the condensate storage tank's breached dike had only been partially repaired. Secondary containment was inadequate for the 200 barrel tank. Because of the site's proximity to the Pocatalico River this is a violation of federal SPCC regulations, along with state regulations.[13] There's a hole in the outer casing of 47-079-00731 below the casing head. Smaller diameter casing is visible within. A discarded separator still stands near its newer replacement.

The access road for 47-079-01492 has a steep grade, close to 30%, and is deeply rutted. A stream that descended the cut slope in 2009 is no longer visible. The stream that runs through the site of buried pit waste is still present and its drainage down the fill slope is visible. The site slipped along the pad and fill slope affecting half the pit in 2008 when the well was drilled. Since we last saw the well in 2009 a further slip has occurred, of about three feet, exposing buried pit waste and liner. This lower, slipped, portion of the pad had a large number of

[12] We found a plume of measurable contamination in 2009 from the site of 47-079-01492's buried pit waste traveling down the fill slope, past 47-079-00731, eventually reaching the Pocatalico River. See George Monk and Molly Schaffnit, 2009, *Environmental Assessment for 47-079-00731 and 47-079-01492, Putnam County, West Virginia*.

[13] The state's regulations (35CSR1.7) are based on Federal Spill Prevention, Control and Countermeasure (SPCC) regulations but are broader in that they don't state a tank size above which containment is required, nor do the state's regulations have location requirements in terms of being close to a body of water (Federal SPCC regulations are 40CFR112). SPCC regulations cover a tank with a volume above 1320 gallons.

Photo 12. Buried liner and pit waste exposed in recent slip across pad of 47-079-01492. Photo taken on 12 October 2012.

Photo 13. Paved state road is on the left and well access road is on right for the Tall Trees site (47-097-03707 and 47-097-03708 horizontal Marcellus wells). Damage to state road can be seen in picture. Photo taken on 1 July 2012.

deer tracks in a large bare area. This was near the locations where, in 2009, we'd found high chloride contamination of soil and stream water.

The fourth well, 47-079-00739, is on North Poca River Road next to a pipeline. A change since 2009 was the possible construction of secondary containment for the condensate storage tank. We were not able, because of tall grass, to determine its size or if the containment is adequate. A tag has been added to the wellhead with the number 739 and well name on it. This is not a proper API number.

Of the three wells for this operator the last was the only well to have a meter shed. It's our belief that the other wells, 47-079-00731 and 47-079-01492, share a pipeline that other operators also use.[14] These two wells did not have meters.

Well Sites in Upshur county

We examined two well sites in Upshur county near Route 20. One site (the Tall Trees site) had two producing horizontal Marcellus wells on the pad. The other site had been recently drilled and then plugged. Over a year after plugging a large impoundment and waste pit remained on this site.

The Tall Trees site was examined from outside the pad's perimeter. This was only the second site we've seen over the years that had some sort of security fencing, in this case around the two wellheads and related equipment, for the public's protection. The pad was extremely large, completely graveled, with a gravel berm around part of the perimeter. A tall cut slope above the pad was inadequately grassed and still had a silt fence across the upper portion.

A local resident talked about how large trucks had severely damaged the state road that the operator uses to access the site. According to the completion report for 47-097-03707 well work began in August 2010 (the permit was issued in February 2010).[15] When we saw the site in early July 2012 the state road's pavement had buckled and collapsed in portions and was now repaired solely with gravel.

The resident described how part of the damage to the state road was caused by the large pad's drainage going onto the state road. A complaint had resulted in the company's construction of an armored drainage ditch along Route 20 to a culvert.

[14] Pipeline markers for 47-079-00731 and 47-079-01492 don't have a company name on them, unlike the operator's markers along Camp Virgil Tate Road. The pipeline marker to the west of the well site entrance on South Poca River Road has a Putnam county operator's name on it.

[15] The completion report for 47-097-03708 shows that the permit was issued in October 2010 but well work began in July 2010.

Photo 14. Portion of large graveled pad at Tall Trees site (47-097-03707 and 47-097-03708 horizontal Marcellus wells). Steep cut slope is not adequately grassed. Two vac trucks at left in photo were waiting while another was removing condensate from one of the large storage tanks on the site. We were told that the tanks were emptied daily. Photo taken on 1 July 2012.

Photo 15. Improper monument for 47-097-03716, plugged in May 2011. Casing behind monument has smaller pipe set in cement with a closed vent on top. It's not clear why a plugged well would need a vent. Photo taken on 1 July 2012.

This ditch construction was recent and bare soil was lightly covered with straw. There was no sediment barrier at the end of the ditch where water entered a large culvert that leads to the Little Kanawha River. Standing water in the culvert's sediment trap was bright orange.

The operator a in video on YouTube describes how the tall berm on the pad's perimeter prevents spills from leaving the pad.[16] Obviously, in this case, the access road entrance to the pad, where there was no berm, provides an outlet for contaminants. Properly designed site access would better control drainage and contain possible spills.[17]

The plugged well site, 47-097-03716, is above the freshwater trout pond at French Creek Wildlife Center and is next to a field where we saw cow patties but no cattle in July 2012. The well was plugged in May 2011 according to the operator's inappropriate monument. The site was bare of vegetation. There were two open pits -- a large impoundment partially filled with water whose fence was down on one corner and another smaller, almost empty drill waste pit with badly torn liner (this pit's fence was entirely down). A soil sample was taken from a spot on the pad that had a slightly different looking soil. Chloride in the sample was 384 ppm. Our guide described how when he visited the site during drilling there was fluid splashing and flowing everywhere. He showed us where still evident drainage from the site went down the hill toward the trout pond.

State law requires a plugged well's monument be a pipe filled with cement standing at least 30 inches tall above the ground.[18] In this case the pipe was cut off close to the ground and had a valve on top. The required API number was on a steel placard standing above the pipe but not nearly 30 inches tall.

Apparently the well was drilled and then plugged to retain the lease. We sent an email on 16 July to the inspector who reviewed the operator's plugging affidavit asking about the issues we noted:

[16] http://www.youtube.com/watch?v=PF3dzivVI-o&list=PL75C02A0B1F8CEF3F&index=2.

[17] 35CSR4.16.3 requires sites be constructed to retain spills and contaminants but where there is uncontrolled drainage this isn't possible. See David Wachal, 2008, *Characterizing Storm Water Runoff from Natural Gas Well Sites in Denton County, Texas*. Runoff from the Denton wells contained concentrations above MCL or SMCL for copper, iron, manganese, and chloride. Concentrations were much higher than for runoff from reference sites. See Tables 2.5 and 2.6.

[18] 35CSR4.5.5.b.

Photo 16. Smaller drill pit at 47-097-03716, a well plugged a year earlier. Liner is torn and fence is down even though cattle use field next to site. Pit appears to still retain fluid and cuttings. Photo taken on 1 July 2012.

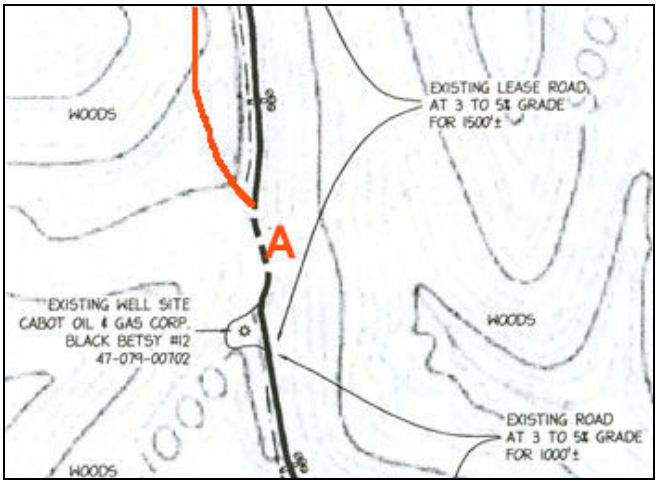

Photo 17. Part of permit application drawing for 47-079-01283, the access road constructed for 47-079-01314. The hatched road section is the location of the water filled ruts in photo 1. The red road segment on the drawing is the actual access road with a steep grade north of 47-079-00702. The route shown on the drawing is a pipeline right of way and is not always open for road access because of fallen trees or deep holes.

plugging without reclamation; drill waste with apparent fluid/cuttings still remaining in the smaller pit which had torn liner allowing contamination of soil and groundwater; and an improper monument with a vent pipe. We have yet to receive an answer.

Erosion and Sediment Control

The Office of Oil and Gas released, at long last, an updated *West Virginia Erosion and Sediment Control Field Manual* in May 2012.[19] The new manual is an improvement over its predecessor. Our discussion will focus not on the new manual's requirements but how operators fulfilled the requirements of its predecessor. We'll examine the Long Road and the permit application for never-drilled 47-079-01283 whose constructed road was used for 47-079-01314.

A permit application has attached drawings showing the access road to the site and basic sediment control features such as culverts and silt fencing. These drawings are in sketch form and not always to scale. The drawings for 47-079-01283 cover 3 sheets and are overlaid on a USGS topographical map background.

One of the things the drawings have to show is a road being constructed where no portion has more than 20% grade.[20] What this operator did, and other operators do, is measure road segments on the drawing so as to hide the fact there are steep grades. Segments are measured so that, on paper, enough relatively flat sections diminish the steep grades after determining average grade. Recommended practice in measuring grades is 50 foot or similarly short increments.[21] In this permit application the increments are as long as 1500 feet. This helps hide the long steep road grades found on the Long Road, about 30% in sections, such as just north of 47-079-00702 which lies next to the access road about halfway between 47-079-01299 and 47-079-01314. On the application this portion of the road is part of

[19] West Virginia Department of Environmental Protection, 2012, *West Virginia Erosion and Sediment Control Field Manual*. This replaces West Virginia Division of Environmental Protection, [1992], *West Virginia Erosion and Sediment Control Field Manual*.

[20] See manual's II-A.1.a.(1); old manual page 7 or new manual page 8.

[21] For instance, BLM, 2008, *Buffalo Field Office Oil and Gas Road Guidelines for Applications for Permit to Drill*. Improved Template Roads require where the route is perpendicular to contours of a hillside, that the average grade be 16% or less and that maximum grade of any 50-foot or longer segment be 16% or less. Roads (or sections of roads) not meeting these conditions have to be Improved Engineered Roads (page 4).

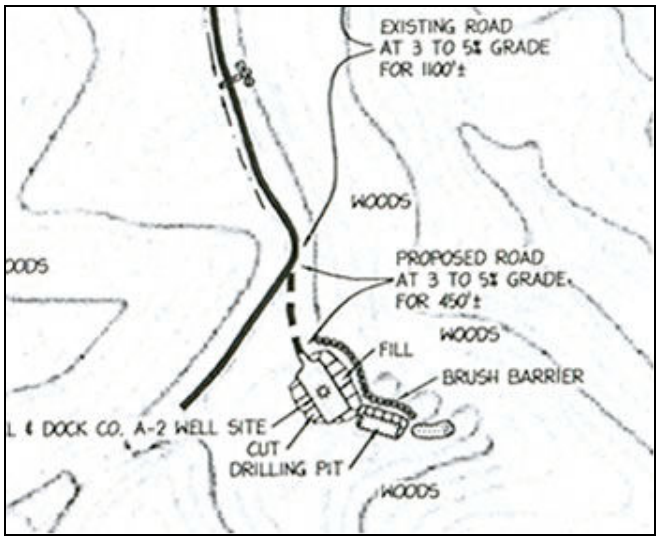

Photo 18. Part of drawing submitted for 47-079-01283 permit application showing sketch plan of well site, pit and sediment control. Another well was instead drilled nearby in almost the same location (47-079-01314). Compare this drawing with satellite photo of drilled well site in 2005 (photo 4). Hatched portion of access road is shown in photo 19.

Photo 19. Well access spur from Long Road to 47-079-01314. Deeply rutted, the road's side ditches are filled with sediment. Photo from video shot on 7 June 2012.

a segment (because of the segment's length) with 3 to 5% grade.[22] Drainage control is not shown on the sketch drawing and is in fact missing at the bottom of the steep grade just north of 47-079-00702 (see photo 1 and photo 17).

There is another steep grade where 47-079-01283's access road leaves the Long Road and goes up to where the well was to be located. There's no drainage control at this point on the drawing or in actuality. Today the ditch along the short section of access road is filled with sediment and water flow has cut into and across the road surface as it goes down the much steeper grade than the 3 to 5% grade shown on the drawing (according to the drawing this road segment is 450 feet long) to the Long Road (see photo 19).

Site construction plans are barely defined on the permit application drawings and the sketches show proposed pad, cut and fill slopes along with any pits. The land application area is also sketched as a stipple-filled oval and on some applications more than one option may be shown. Sites as finally constructed hardly ever match the drawing. The new requirements for horizontal wells are more stringent and the new manual has more and better requirements. Implementation is another matter.

The proof is in the pudding. The Long Road and short well access road for 47-079-01314 are poorly, if at all, drained. There are places where the road has bifurcated, where one route is no longer passable and a detour is used instead. There are serious questions as to whether all the well sites served by the Long Road can be accessed in all seasons without the aid of a bulldozer to drag equipment if there were an emergency. The old and new manual both require maintenance for the life of the well.[23] Maintenance of the Long Road has not been apparent to us since our first visits in 2008. Similarly, maintenance, by a different operator at a location above the Pocatalico River, of the well access road for 47-079-01492 is also not apparent. The well road for 47-039-01168 appears to be useable only by an ATV. The problem is not one company's alone.

After pad and road construction and drilling the well, pad and road are reclaimed. The manual's aim is a well-vegetated site with drainage for pad and roads in good condition with no blockage. We've

[22] Actually what is featured as the access road on the permit application drawing is a pipeline right of way that is sometimes also able to be used as a road. The actual access road is to the west.

[23] See manual's V-A.1; old manual page 35 or new manual page 41.

Photo 20. Sediment basin for culvert (not visible to the right). Photo was taken while standing on edge of newly constructed drainage ditch for the Tall Trees pad (47-097-03707 and 47-097-03708 horizontal Marcellus wells). Plastic pipes appear to carry drainage from cut slope to culvert. Photo taken on 1 July 2012.

visited some sites' pads which have good vegetation. Others are bare. Some roads are maintained, others show little or no maintenance.

The manual, both old and new versions, requires study to interpret text *and* illustrations which often don't complement one another. Specifics for silt fence installation are only given in illustration (figure II-11 in the new manual), for instance, where graphically the requirement for a trench to anchor the silt fence fabric is shown, but requires interpretation. Anchoring requires six inches of fabric across plus six inches of fabric in the trench (12 inches overall). In actuality, silt fencing we've seen has not been anchored at all so silt can pass under the fence freely.

Our survey of 2010 complaints to the Office (discussed below, see also Appendix 2) showed that most complaints received by the Office are for erosion and sediment or well access road issues. Looking at our tables in Appendix 4, a reader will see similar problems at many of the sites we've discussed in this paper.

Water Testing Near Well Sites

We had water tested near three active well sites in Putnam and Kanawha counties. Each drinking water source (a dug well, a drilled well and a spring fed cistern) had constituents above the EPA's Secondary Maximum Contamination Level (SMCL). Two sites were where surface owners reported drinking water contamination after drilling and fracturing (47-079-01288, a dug well, and 47-039-06155, a drilled well). The third site, 47-039-05714, was chosen because previous laboratory analysis of buried pit waste suggested a possibility of groundwater contamination. The results from the water tests are too limited to form any conclusions and we are hampered by the state's not having a publicly accessible database using test results from pre and post drilling testing required for drillers. As things stand now, drillers are not required to submit water test results to the state.[24] There's a publicly available U.S. Geological Survey database of water test results from sites that are not usually related to the natural gas drilling. This database provides no information as to why a site location was chosen. Some of the locations are obviously polluted (e.g., drainage from the Armed Forces Reserve Center in Cross Lanes, site USGS 382443081480203) and some locations don't have materials available online.

We are putting the tests' results in Appendix 1 (Table 1) with selected USGS data for comparison (Table 2). The USGS comparison sites were chosen based on location within a couple of miles of the sites we tested. Something to note when looking at Table 1 results is that each drinking water source shows different contaminating SMCLs, even though 47-079-01288 and 47-039-05714 are only about 2,000 feet apart and the aquifer may be the same. It's possible that the contamination seen near 47-039-05714 is due to buried pit waste. Analysis of pit waste on 47-039-05714's pad found a concentration of arsenic higher than the state's maximum background levels, high enough to impact groundwater.[25] The water's manganese

[24] The draft 35CSR8, yet to receive legislative approval, in 35CSR8.15.3.d, requires that water test results be sent to the Office, but this is only for horizontal wells.

[25] George Monk and Molly Schaffnit, 2009, *Environmental Assessment for 47-039-05714, Raymond City #11, Kanawha County, West Virginia*.

concentration is higher than the EPA's health advisory level of 300 ppb (manganese in drinking water is associated with children's severe IQ impairment).

All of these sites were tested years after hydraulic fracturing and the contamination doesn't seem directly to indicate contamination due to fracturing, though it's possible that well integrity was affected by fracturing pressures or pre-existing improper casing or cementing practices.

Anecdotal evidence for 47-079-01288 and 47-039-06155 indicates that something seriously wrong did occur at these wells.[26] The water source near 47-079-01288 had high coliform bacteria after the gas well was fractured. According to the surface owner of 47-039-06155, contamination of drinking water supplies affected 12 households in the area. When 47-039-05714 was drilled severe diminution of spring fed water supplies occurred for households within a radius of at least 2,000 feet.

The absence of availability of a water test database for results prior to drilling and the fact that these results are not held by the state means that it is impossible to study the impacts of drilling on an area's groundwater. This is a curious lapse by the Department of Environmental Protection and the Office of Oil and Gas, supposedly committed to protecting the state's waters, both surface and ground.

Complaints and Notifications of Violation

George spent a day at the Office of Oil and Gas examining the workings of the inspection process. Our hope was that the Office would have tabulated data providing information from inspections that would show types of problems found and give an idea how common these problems are. We've done our own analysis of local wells in our *Thirty Wells* report.[27] Unfortunately the Office doesn't appear to do this sort of review.

George looked at about three months worth of complaints made in 2010 (including spill reports and reports by EPA and other federal agencies) on the Office's intranet. The Office of Oil and Gas' process is to keep complaints and resulting actions by inspectors separate. Complaints are filed by date, and unless there is attached information or addenda written on the complaint, we don't (and the Office doesn't) know, in most cases, the well's API number, if there was a physical inspection of the site and what was found, or how the complaint was resolved. If an inspection occurs, that report is filed in an individual well's file and no copy is attached to the complaint. Once well files have been scanned and put on the Office's intranet it isn't easy for the Office to examine inspection reports for a particular well or see if there is a pattern of violation by an operator, much less if this is a common problem industry wide.[28]

Coming from business backgrounds we are used to seeing orders written up, associated materials attached to an order and everything kept together through the work process. Data as to what is ordered and when might be entered on a computer, often associated with a particular customer, customer's order number, or job number. Paperwork is kept together when invoiced and filed according to date, customer or some other category. Being able to generate some sort of totals at year's end is fundamental to planning next year's activities. This data should be immediately available at any time during the year and past years' data available for comparison by quarter or some other measure.

George also was able to look at available paper copies of NOVs for 2010 and 2011 for four counties (Doddridge, Kanawha, Putnam and Roane). Inspections can result in either an inspection report or a Notification of Violation. Like inspection reports, NOVs are separated from complaints so it was impossible to tell what caused the inspection and in many cases it wasn't possible to tell what the inspector actually saw during the inspection.[29] In these cases what exists is a form with a citation such

[26] Personal communication by the Bennett family for 47-079-01288 and the Phillips family for 47-039-06155.
[27] George Monk and Molly Schaffnit, 2011, *Thirty Wells*.

[28] Inspection reports are not searchable on the intranet. To find if there has been an inspection report filed for a site, a search based on the last four digits of an API number is made to bring up all files for all wells with that number.
[29] Paperwork for some NOVs was more extensive and did include photographs. This was not the norm, unfortunately, nor was the use of a standardized site inspection form.

as "polluting state's waters" and entries indicating the well API number, operator and inspector. In simple form like this information from NOVs is available online to the public. What isn't obvious is what actually polluted the state's waters or by what avenue it got there. The amount spilled and if remediation was done is unknown. Nor do the NOVs or online databases indicate if the operator was fined because of the violation.

Our spreadsheet for complaints is summarized in Appendix 2 and that for NOVs is summarized in Appendix 3.[30] This is draft data, not checked against the original complaints or NOVs. We're sure there are mistakes but even so the complaints spreadsheet gives an idea of the reasons complaints are made (these are our, not the Office of Oil and Gas' categories). The NOV spreadsheet again presents information in our, not the Office's, categories though two columns present typical NOV boilerplate. In the case of NOVs, a number of categories may be involved for NOVs written for a well.

Looking at the complaints summary in Appendix 2, categories are arranged in descending frequency. The column farthest to the right presents reasons for a specific complaint for that category with inspector's notes presented in square brackets. The most common cause for complaint was well road or sediment issues (19 complaints), with spills being the next most common reason for complaint (14). Drinking water issues caused seven complaints. There were complaints about state roads that the Office has no jurisdiction over. The Other category covers 11 complaints. In some cases a complaint may cover more than one category. The fact that 28% of complaints fell within problems with roads and erosion and sediment control (items covered by the *West Virginia Erosion and Sediment Control Field Manual*) shows that what we have been seeing on our visits to well sites isn't peculiar to a single region or group of operators.

The NOV summary in Appendix 3 presents in simplified form data for a small number of wells receiving NOVs, without categories found on our spreadsheet. The summary in Appendix 3 gives the NOV numbers and a very brief description of the problems found by the inspector for several wells. Many of the NOVs George saw resulted from activities directly related to actual site construction, drilling and reclamation. A group of Kanawha county NOVs were given to operators' oil wells that were leaking oil, had storage tanks without secondary containment, or had other issues of non-compliance. It should be noted that a different inspector wrote NOVs for each county George looked at and each inspector seems to be slightly different in their response to a situation.

Office of Oil and Gas' Abandoned Well Program

Two of the wells we looked at this year are listed as abandoned wells on the Office of Oil and Gas' online database. One well, 47-039-01168, has an operator (though incorrectly listed on the database); the other well's operator is not known, though it is not listed on the database as an orphaned well. This latter well, 47-079-00615, appears to never have had production reported.

According to law, a well becomes abandoned if either no production is reported for a year or if an operator fails to file a yearly production report. According to law an abandoned well must be promptly plugged.[31] The Office doesn't enforce this law as pointed out by the legislative audit for 2012. The Office's database, according to the audit, doesn't automatically notify the Office if no production is reported or if a production report has not been filed. [32]

Other wells we looked at have had periods of abandonment even though the wells were producing. The operator failed to file production reports for 47-079-01314 for 2006, 2007, 2008 and 2009. Three wells we looked at (47-079-00731, 47-079-00739 and 47-079-01492) did not have production reported by the operator for 2008 (the year 47-079-01492 was completed), 2009 and 2010. This operator failed to file production reports for any of its wells during these years.

[30] Spreadsheets for complaints and NOVs are available online at http://members.citynet.net/sootypaws/gws/documents/complaints_NOVs.html.

[31] See footnote 8.

[32] West Virginia Legislative Auditor, 2012, *Agency Review: Office of Oil and Gas, Department of Environmental Protection*, page 13.

Photo 21. Condensate storage tank without secondary containment at 47-079-00615. This abandoned well lies just above South Poca River Road and is a short distance from the Pocatalico River. Photo taken on 12 October 2012.

Operators must also separately report cumulative annual production for all their wells when they file annual severance tax returns (forms WV/SEV-401 and WV/SEV-401V) to the West Virginia State Department of Taxation. Where no production reports are being filed with the Office of Oil and Gas, it is reasonable to assume no severance taxes are being paid. There's no way to check for individual wells and the disclosure rules absolutely inhibit investigation for cases where operators are not reporting for all their wells. The Department of Taxation isn't even able to divulge to the public if an operator reported production.

Some operators place meters on their wells, others don't, even when the well's production appears to be going into pipelines used by a number of different companies (e.g., 47-079-00731 and 47-079-01492). It's hard in these cases to believe that production figures reported to the Office of Oil and Gas and Department of Taxation have any basis.

General Water Pollution Control Permit

The general permit has not been revised since its creation in 1988. A new, revised permit was supposed to finally appear in 2012 (the permit expired in 2010) but did not materialize. The general permit's duration has been extended yet again.[33]

When the Division of Water created the permit for the Office they hoped to resolve several issues: drill and fracture liquid and solid waste management; pit construction; and incidents where waste entered the environment improperly through pit failures (about a third of pits at that time failed) and spills.

Their focus in liquid waste management was metals, especially iron, and the pretreatment of liquid waste was to take care of that issue.[34] The focus on iron over other metals, such as arsenic, is one of the flaws of the permit. The Division of Water was aware of the problem of chloride and load, the amount (not just concentration) of chloride poured onto vulnerable vegetation, but chose to base its chloride limit solely on concentration. The permit was designed for land application volumes of much less than today's typical vertical well's liquid waste. There's been no study, that we're aware of, since 1988, to verify that the permit was working properly or that operators were performing the required actions correctly.

The pit construction elements in the general permit were an attempt by the DEP to deal with incorrectly designed and constructed pits and resulting breaches. The Office, still, has dispersed requirements for pit construction and maintenance across 35CSR4, the general permit, and the *West Virginia Erosion and Sediment Control Field* Manual.[35] The requirements for the burial of pit waste were solely found in the general permit until the 2010 Pit Reclamation Memorandum (which only covers Marcellus waste) and a requirement in the 2012 *West Virginia Erosion and Sediment Control Field Manual*

[33] See the document extending the general permit's duration into 2013, http://members.citynet.net/sootypaws/gws/documents/generalpermit_addendum.pdf.

[34] The 1985 Fact Sheet for the predecessor of the 1988 general permit included tables showing how iron concentration decreased in treated waste. Strangely, the analysis of waste in five pits on Table C leaves out the results for arsenic.

[35] More detailed requirements for impoundments and large volume pits appear in the proposed 35CSR8 and *Design and Construction Standards for Centralized Pits*. In spite of this, we have yet to see a pit or impoundment where the liner is anchored in a proper anchor trench. Usually just some dirt is tossed onto the liner edge.

where the general permit's "adequate" depth becomes three feet (page 31, section III-A.1.b).

Until recently, the general permit's prohibition of the land application of waste containing diesel or kerosene was the only sign that the agency was aware such chemicals were being used. Now reporting of fracture chemicals used for horizontal wells is required and liquid fracture waste from those wells cannot be land applied.

The general permit's requirement for timely notice of bypasses and spills was reinforced by 35CSR1. In that regulation reportable discharges are those covered by the Clean Water Act, those which exceed the general permit's limitations, or those where pit failure releases substances that enter surface water.

What has happened in the past 24 years is that operators routinely violate the few and minimal requirements of the general permit. The permit requires that pit waste be buried at an "adequate" depth. Not doing so is a violation according to the permit.[36] A quarter of the sites we'd examined up to May 2011 had surface contamination and/or exposed pit liner present which can be attributed to improperly buried pit waste.[37]

Operators fail to report spills, bypasses or upsets. Where waste is sprayed into the environment instead of a pit (as at 47-017-05988 in Doddridge county where the material "bounced out of the pit" according to the inspector), pit breaches occur, or similar events (such as the operator's loss of control of the well at 47-093-00107 when flowback sprayed into the forest), an operator may receive a violation if the waste enters the state's waters, but almost never for failure to notify the Office.[38]

Operators for years have used diesel, as defined under Toxic Substances Control Act (TSCA), and diesel-like substances for drilling and fracturing and then land applied the waste, a violation of the permit.[39] Use of diesel and diesel-like substances for fracturing has been a violation of federal law since 2005.[40] In spite of this operators use diesel as solvents and lubricants underground. Operators have been able to do this because until recently there's been no requirement for product/chemical disclosure. Even where disclosure is present, the terminology is both vague and imprecise. Just what is diesel or kerosene? If it's called "petroleum distillates, hydrotreated light" (CAS 64742-47-8) or a variety of other names (such as hydrotreated kerosene or turbo fuel A) for the same CAS number, is this the same as the diesel or kerosene prohibited by both the permit and federal law?[41] Petroleum distillates is a commonly used ingredient present in disclosed hydraulic fracturing products reported to FracFocus as used in West Virginia.[42] This same chemical was used in one of the drilling products (New-Drill) disclosed after an operator's spill into Indian Run. There's no reason to believe diesel's and kerosene's use is new or that it is just used for horizontal well hydraulic fracturing.

The permit's limitations and testing criteria for liquid waste's land application are not protective and the Office knows this.[43]

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[36] See the general permit at G.4(f).

[37] See George Monk and Molly Schaffnit, 2011, *Thirty Wells*.

[38] Two wells in the NOVs summary in Appendix 3, 47-017-05918 and 47-017-05926, are examples of wells receiving violations for incidents concerning pits. The NOVs in our spreadsheet include other wells (47-017-05929, 47-017-05952, 47-017-05971 and 47-039-02446) with pit incidents, none of which received a violation for non-reporting. http://members.citynet.net/sootypaws/gws/documents/NOVs.pdf.

[39] See the permit at G.7(d). The TSCA definition of diesel is: "A complex combination of hydrocarbons produced by the distillation of crude oil. It consists of hydrocarbons having carbon numbers predominantly in the range of C9-C20 and boiling in the range of approximately 163-357 degrees C." This would include such substances as Petroleum Distillate (CAS 64741-44-2) and Gas Oils, Straight Run, High Boiling (CAS 68915-97-9).

[40] 42 U.S.C. §300h(d). The law exempts hydraulic fracturing fluids "other than diesel fuels."

[41] Synonyms for CAS 64742-47-8 are from National Institute of Health ChemlDplus Advanced website (http://chem.sis.nlm.nih.gov/chemidplus/). CAS 64742-47-8's TSCA definition is: "A complex combination of hydrocarbons obtained by treating a petroleum fraction with hydrogen in the presence of a catalyst. It consists of hydrocarbons having carbon numbers predominantly in the range of C9 through C16 and boiling in the range of approximately 150-290 degrees C."

[42] Uses of CAS 64742-47-8 in West Virginia appearing on the FracFocus website include as "petroleum distillates" in FRW-18 and GW-3LDF at 47-051-01471 in Marshall county; "hydrotreated petroleum distillate" in Plexslick 921 E at 47-017-06084 in Doddridge county; and "hydrotreated light distillate" in Unislick ST-50 at 47-101-00122 in Webster county. The "paraffinic petroleum distillate" (CAS 64742-55-8) also in GW-3LDF used in the Marshall county well is an ingredient in at least one diesel fuel blend according to a Chevron Phillips MSDS but doesn't fall within the TSCA description of diesel.

[43] When George spoke to a Forest Service researcher in 2009 about the land application at 47-093-00107 in the Fernow

We won't go into detail here enumerating the permit's faults. The permit's age and Office's inaction in revision speak for themselves.

Gas Well Workshop

Our first Gas Well Workshop, sponsored by the West Virginia Sierra Club, was held spring 2012. The Workshop had three week-long sessions and utilized videos and handouts we created. All materials were available online for downloading or viewing on YouTube (or were sent on a CD for participants without a high speed internet connection). Each weekly session had two hour-long conference calls where participants asked questions or expanded on information covered for that session.

Workshop materials are available online at two websites: http://gaswellworkshop.wordpress.com and http://members.citynet.net/sootypaws/gws/class. The latter site also includes the text of follow-up emails sent after conference calls that go deeper into detail about matters raised during the conference call discussions.

There's an online reporting form where people can submit reports for wells they've looked at. Reports can be anonymous, though an email address for follow up is desirable.

The handouts for the Workshop were *The Basics* (covers chemical measurements, water quality standards and how to size storage tanks); *Making a Complaint* (contact information for the Office of Oil and Gas, EPA Natural Gas Drilling Tipline, and EPA's Region 3 office); *Online Databases* (covers Office's databases and map search and West Virginia Geological and Economic Survey's Pipeline2 and Pipeline Plus databases); *Chloride* (a discussion of the environmental effects of this ion); *Environmental Assessment – Chloride Testing* (how to use the Hach chloride test strips for water and soil testing); and *Looking at a Drill Site* (things to note when looking at an active drill site).

The videos for the Workshop give an overview of well types and infrastructure; state and federal laws; looking at gas wells, road and site construction; using Hach test strips; the variety of online databases available; and, finally, a review of a particular site with surface owner interview.

The two Workshop websites also have links to study documents that include state regulations and code, material safety data sheets for condensate, the new *West Virginia Erosion and Sediment Control Field Manual*, and industry YouTube videos on site construction and drilling.

There were 30 participants to the first Workshop and another is scheduled for March 2013.

Conclusion

A common thread in this report is the Office's lack of enforcement of state laws covering oil and gas industry activities. This lack is shown in a number of ways. A well plugged in Upshur county without final reclamation a year later and no response from the Office as to why there is still a large impoundment and smaller drill waste pit on the site or why the plugged well's monument is improper. Exposed pit liner and surface contamination at 47-079-01314 noted in our 2010 report confirmed again in 2012 – the well finally has an API number but it's wrong. Wells such as 47-079-00615, abandoned for years but still not plugged – its lack of secondary containment for the condensate storage tank and proximity to the Pocatalico River should have raised red flags at the Office when we first brought the well to its notice in our 2009 report. And so on.

We're deeply concerned that the Office of Oil and Gas seems proud of its being able to process permit applications 100% of the time within five to ten days after the comment period ends when it absolutely fails to enforce compliance with the state's laws the vast majority of the time.[44] The state

Experimental Forest, where liquid drill and fracture waste killed vegetation and trees, the researcher mentioned several times how calls to the Office received no meaningful response. According to the Discharge Monitoring Report, the operator violated requirements for Class 4 pit's treatment with activated carbon, not using enough for the 100,000 gallons of waste, but that doesn't seem to be the reason for the vegetation kill.

[44] West Virginia Legislative Auditor, 2012, *Agency Review: Office of Oil and Gas, Department of Environmental Protection*. See page 24 for information about processing well permit applications and Table 3, page 17 for slowness in plugging wells after abandonment.

does hand out NOVs (variably according to inspector) but it's not possible to see whether these have resulted in fines, much less compliance. The Office separates complaints from resulting actions by its staff so it is impossible to judge the efficiency of its complaint driven inspection program, much less to tie a complaint to a specific well or wells.

The Office's complaint/inspection program is deeply flawed. There is no transparency, which would not be so troubling if the Office had an annual well inspection program (and if that, at least, were transparent). The Office doesn't even conduct random well inspections. This means that the state's post-drilling regulatory compliance program for oil and gas, which depends entirely on complaints, is not working.

The Office has never found an operator in violation based on findings in our annual reports, environmental assessments, videos, or complaints made in 2008 and 2009. Violations of state and federal law and of the general permit have been, in our opinion, ignored. We don't expect NOVs will result from this report. We don't expect the abandoned wells noted here will be plugged any time soon.

We do expect to continue to find, as we look at well sites, problems such as no secondary containment for condensate storage tanks, no (or wrong) API numbers on wellheads, bad roads and well pads bare of vegetation (frequently because of improperly buried pit waste), and a general lack of even the simplest form of maintenance like a coat of paint on bare metal.

Industry doesn't care if the job is done right. The Department of Environmental Protection and Office of Oil and Gas don't seem to care either. Lucky West Virginia.

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Photo 22. One of two hydrogen sulfide (a gas that can be deadly) warning signs left near plugged well 47-039-02319. Photo taken on 12 November 2012.

Appendix 1
Water Tests Near Well Sites

Table 1 Presents analysis results for water samples from drinking water sources taken near well sites. All metals listed on the table were analyzed for. Where table cells have no data, no metal was detected. Samples were collected in September 2011 from a spring fed cistern near 47-039-05714, January 2012 from a dug well near 47-079-01288, and January 2012 from a drilled well near 47-039-06155.

Maximum and Secondary Maximum Contamination Levels along with EPA health advisory levels are shown on the right hand column. Manganese has both a SMCL (50 ppb) and an EPA health advisory level (300 ppb).

Table 2 presents data for selected sites near the water sources shown on Table 1 and are taken from the USGS online database. The Frog Creek location, a surface water sample, is about four miles from all three sites on Table 1. The other locations are all closer to the 47-039-06155 site and are all drilled water wells. Particulars and USGS site numbers follow Table 2. USGS testing did not include all the constituents on this table. Where tested and not detected, this is shown as ND on the table. Some of the samples were filtered before testing and where there are filtered and unfiltered results, those are indicated in the site particulars following the table.

Amounts shown on both tables are parts per billion.

Photo 23. Well, 47-039-02204, on north side of Camp Virgil Tate Road near a large outbuilding. Tank to left and behind well appears not to be used. Photo taken on 6 September 2012.

Table 1

Metals	Near 47-079-01288	Near 47-039-05714	Near 47-039-06155	MCLs
Arsenic		1.2		10.0
Antimony				6.0
Barium	32.0	100.0	305.0	2000.0
Beryllium				4.0
Cadmium				5.0
Chromium		1.2	1.9	100.0
Lead			10.0	15.0
Selenium				50.0
				SMCLs
Iron	90.0	180.0	1230.0	300.0
Manganese		390.0	160.0	50.0/300.0
Aluminum	90.1	13.7	678.1	200.0
Copper	1.0	2.0	13.0	1000.0
Silver		10.8	2.2	100.0
Zinc	59.0	40.0	342.0	5000.0
				Health Advisory
Nickel			3.7	100.0
Strontium	5330.0		1190.0	4000.0
Sodium	12300.0	12400.0	31900.0	20000.0
Calcium	10100.0	39800.0	50900.0	
Cobalt				
Magnesium	2200.0	7200.0	20900.0	
Potassium			2200.0	
Vanadium				

Table 2

Metals	Frog Creek	Kan-0849	Kan-0846	Kan-0592
Arsenic				
Antimony				
Barium	40.0			
Beryllium	<0.7			
Cadmium	ND			
Chromium				
Lead	<10.0			
Selenium				
Iron	100.0	ND	10.0	110.0
Manganese	60.0	ND	20.0	
Aluminum		400.0	<100.0	
Copper	<10.0			
Silver				
Zinc	20.0			
Nickel				
Strontium	50.0			
Sodium	1800.0	150000.0	140000.0	
Calcium	8800.0	38000.0	4100.0	
Cobalt	<3.0			
Magnesium	2200.0	22000.0	750.0	
Potassium		3700.0	1000.0	
Vanadium	<6.0			

Site Particulars for Table 2

Frog Creek, site number USGS 383058081423839.

Samples were taken four times at this location in 1979 and 1980. The table shows the last sample date's results (August 1980) which had the most metals tested for. Manganese concentrations seem to fluctuate at this location (and for the Pocatalico River at Sissonville) so that the highest concentrations are in August/September. Manganese's concentrations (figures are for unfiltered/filtered analysis) for each testing date were 50/50 ppb (April 1979), 330/310 ppb (September 1979), 30/30 ppb (March 1980), and 230/60 ppb (August 1980).

All samples were filtered for metal analysis, except for iron and manganese where unfiltered water was also analyzed. Unfiltered manganese was at 230 ppb and unfiltered iron was at 5100 ppb.

Kan-0849, site number USGS 383355081421001.

Sample taken in June 1982. All samples were filtered for metal analysis.

Kan-0846, site number USGS 383104081433801.

Sample taken in June 1982. All samples were filtered for metal analysis.

Kan-0592, site number USGS 383405081405701.

Sample taken in October 1957. Iron sample was unfiltered for metal analysis.

Appendix 2

Summary of 2010 Complaints to the Office of Oil and Gas

This summary is based on complaints made over approximately a three month period. This table is based on the complaints spreadsheet available at http://members.citynet.net/sootypaws/gws/documents/complaints.pdf. The table shows the number of complaints tabulated for each of our, not the Office's, complaint categories and also shows an example complaint in the right hand column for that category (some complaints cover more than one category). Inspector's comments are within square brackets.

Table 3

Category	Number of Complaints	Example County	Comments
Road or sediment issues	19	Putnam	Residents' road damaged by operator [will grade road]; residents complained also to governor which started a flurry of emails between governor's office and DEP
Spill	14	Doddridge	Oil leak in creek beside home, problem with gas in water well
Well or pipeline leak	13	Harrison	Strong gas odor coming into homes [swabbing wells, operator will check pipeline]
Drinking water	7	Harrison	Gas in home drinking water, smells bad
Abandoned well	4	Harrison	Abandoned wells on property
Site issues	4	Kanawha	Dead grass in meadow, smells gas [a plugged well with no monument]
Tank issues	3	Mason	Tank leak [new tank will be installed]
Permit issues	3	Cabell	Well rework without permit
State road issues	2	Upshur	Running bulldozer on state road [DOH has jurisdiction, operator will fix road]
Pit issues	1	Jackson	Reclamation and pit problems
Other	11	Harrison	Discharge area too near pond [inspector found okay]

Appendix 3

Example Wells and Notifications of Violations

This table presents a selection of wells and NOVs they received in 2010 and 2011 with a short description of the reasons for the NOVs. Material on Table 4 is taken from our spreadsheet for 2010 and 2011 NOVs for Doddridge (47-017), Kanawha (47-039), Putnam and Roane Counties which is available at http://members.citynet.net/sootypaws/gws/documents/ NOVs.pdf.

Table 4

API Number	NOVs	Comments
47-017-02416	8555, 8556, 8557	Bottom rusted out of tank polluting spring/creek; no SPCC plan
47-017-05918	8615, 8616, 8617, 8666	Spill of chemicals on site, no secondary containment, hazardous chemicals stored on freshwater impoundment, no DMR, no WR-35, reclamation of site and pit
47-017-05926	8484	Pit wall collapse, remove materials from pit
47-017-05957	8478	Hose break/spill; sampling required
47-039-04064	8475, 8476, 8477	No annual production report, no API number ["one of many wells I have found"], fix all wellhead and pipeline leaks
47-039-04903	8462, 8463, 8469-1, 8470-1, 8471, 8480	No dike for tanks, ruptured oil lines, no API number, not reporting discharge; operator attempted to bribe inspector

Appendix 4
Tables Showing Site Issues

Three tables below show issues for the sites we visited in 2012. Only one of the sites had fencing or other security measures to protect the public (Tall Tree site, 47-097-03707 and 47-097-03708).

Sites in the tables are indicated by API number. Sites organized according to sections of this report are:

Long Road sites, Putnam county
47-079-01288, 47-079-01299, 47-079-00702, 47-079-01314

Camp Virgil Tate sites, Kanawha county
47-039-01046, 47-039-01552, Cranberry Pipeline Tank, 47-039-01168, 47-039-02306, Abandoned Tank, 47-039-02319, 47-039-01198

Poca River Road sites, Putnam county
47-079-00615, 47-079-00731, 47-079-01492, 47-079-00739

Upshur county sites
47-097-03707, 47-097-03708, 47-097-03716

Photo 24. Pad bare of vegetation at 47-097-03716, plugged a year earlier. A soil sample collected at one of the lighter colored patches on the pad had chloride at 384 ppm. Photo taken on 1 July 2012.

Table 5

API Number	Missing or Incorrect API Number	Lacking or Inadequate Secondary Containment for Condensate Storage Tanks
Putnam County		
47-079-00615	**X**	**X**
47-079-00702		No rainwater drain
47-079-00731	**X**	**X**
47-079-00739	**X**	
47-079-01288		
47-079-01299		
47-079-01314	**X**	No rainwater drain
47-079-01492		
Kanawha County		
47-039-01046		
47-039-01168	**X**	
47-039-01198		
47-039-01552		
47-039-02306		
47-039-02319		
Cranberry Tank		**X**
Abandoned Tank		
Upshur County		
47-097-03707		
47-097-03708		
47-097-03716		

Table 6

API Number	Maintenance Issues	Trash	Leak or Spill
Putnam County			
47-079-00615	**X**		
47-079-00702	**X**	**X**	
47-079-00731	**X**	**X**	
47-079-00739	**X**	**X**	
47-079-01288			
47-079-01299	**X**		
47-079-01314	**X**		
47-079-01492	**X**		**X** oily leak
Kanawha County			
47-039-01046			
47-039-01168	**X**	**X**	**X** casing head
47-039-01198			
47-039-01552			
47-039-02306		**X**	
47-039-02319		**X**	
Cranberry Tank			
Abandoned Tank		**X**	
Upshur County			
47-097-03707			
47-097-03708			
47-097-03716	**X**	**X**	

Table 7

API Number	Vegetation Issues	Drainage and Sedimentation Control	Road Issues
Putnam County			
47-079-00615			
47-079-00702	X	X	X
47-079-00731			
47-079-00739			X
47-079-01288	X	X	X
47-079-01299	X	X	X
47-079-01314	X	X	X
47-079-01492	X	X	X
Kanawha County			
47-039-01046			
47-039-01168			X
47-039-01198			
47-039-01552			
47-039-02306			X
47-039-02319			X
Cranberry Tank			
Abandoned Tank			
Upshur County			
47-097-03707	X	X	X
47-097-03708	X	X	X
47-097-03716	X	X	