- The borehole was filled solidly with mud to just below the surface pipe (set to 294 ft BGL).
- 5 sacks of cement were placed on top of the mud in the hole from 300-286 feet BGL.
- Hole was filled with mud to approximately 20' from surface
- Another 5 sacks of cement were placed on top of the mud in the hole, and the hole was cemented to surface.

The glacial drift and Marshall Sandstone were isolated by pipe cemented in place from surface to 294 feet; formation thicknesses are shown in Figure B.7-4. Because the Marshall and Glacial drift are isolated behind pipe cemented into place and because the entire borehole was filled with both drilling mud and cement to ground surface, there exists no pathway for fluid to move from any proposed injection zone into the USDW at PN 21759.

As shown in Tables B.4-1 and B.6-2, and discussed above, a single well penetrates the confining zone in the AOR, and it poses no threat to endangerment of the USDW. Therefore, the only well potentially requiring corrective action would be the IW-1 well. The following summarizes the plan to address failure of the well to protect the surface environment and prevent migration of injected fluids into any USDW:

Waste Management Autumn Hills RDF
IW-1 Contingency Plan

Monitoring and periodic routine investigative procedures will be performed on the disposal well as required by applicable laws, permits and regulations, but not less frequently than once every five years as discussed in Section A.11 and A.14 of this document. Pertinent data will be forwarded to the agencies as required. This monitoring and testing is required to ensure well integrity and safe operations.

1. If the well fails required monitoring or periodic testing standards, the well will be shut-in and the agency notified according to applicable regulations and permit conditions. After investigation into the cause for the failure, work plans will be prepared and reviewed with the regulators for repairing the problem.

2. If a workover is performed on the well, copies of all work reports and logs will be forwarded to the regulatory agencies within 45 days.

3. During the period of time required for a well workover or for shut-ins due to MIT failure, the contingency plans of the facility will include the following:

    a. If shut-in period is sufficiently brief, the fluid generated during this period of time will be held in storage at the facility.

    b. If well shut-in is required for a longer period of time, some of the fluid may be shifted to another facility.

c. If required, fluids will be removed from the facility via licensed waste transport vehicles and managed according to applicable regulations.

Although the IW-1 construction and, as necessary, implementation of a Corrective Action Plan would preclude the potential for endangerment of the USDW, further documentation is provided here as a calculation of the rise pressure in this reservoir that might have the potential to cause upward flow in a hypothetical pathway. The cone-of-influence (COI) for injection is defined as that area around a well within which increased injection zone pressures caused by injection could be sufficient to drive fluids into an underground source of drinking water (USDW). The pathway for this theoretical fluid movement is assumed to be a hypothetical, open abandoned well which penetrates the confining zone for injection. Information used in the following calculations has been estimated from logs and available neighboring well information summarized in this document.

Critical Pressure Rise

To calculate the COI, a value must first be assigned for the pressure increase in the injection interval that would be sufficient to cause injection zone brine to rise in an open pathway to the base of the lowermost USDW. This critical pressure rise, Pc, is assigned as indicated in Figure B.6-3.

The pressure required at the top of the injection interval to support injection zone brine in the configuration indicated is, in psi units:

$$P = 0.433\ [y_B D_B + y_w(D_w - L)]$$

where: $D_B = D_x - D_w$

and the pressure rise is then:

$$Pc = 0.433\ [\ y_B D_B + y_w(D_w - L)] - Po$$

where Po is the original, pre-injection value for pressure at the top of the injection interval expressed in psi units.

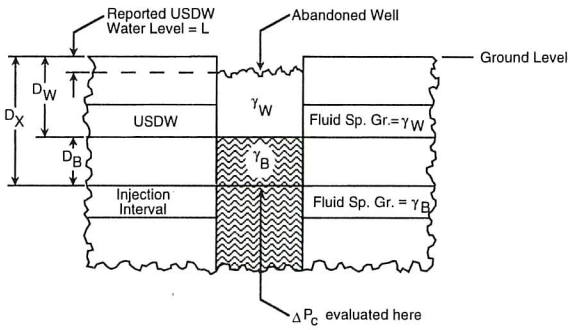


FIGURE B.6-3. CRITICAL PRESSURE RISE

At the top of the Mt. Simon injection interval at 5,578 feet below ground level (BGL), original pressure is estimated to be 2,566 psig (Table B.6-3). This estimate of original reservoir pressure is based on the measured pressure gradient in the Consumers Energy Station IW-2 well (located approximately 4.5 miles northwest of the proposed IW-1 well), where an original measured pressure of 2,429.5 psi was recorded at a depth of 5,280 feet RKB (5,267 feet BGL). This is equivalent to a gradient of approximately 0.46 psi/ft, and is consistent with expected Mt. Simon pressures in this part of Michigan. Original pressure at the top of the injection interval at the IW-1 well is calculated as 5,578 ft * 0.46 psi/ft = 2,566 psig. A specific gravity of 1.166 is assigned to the natural Mt. Simon injection interval brine based on typical sample data recovered from southwestern Michigan wells.

In assigning the critical pressure rise and calculating the cone-of-influence at this site, the base of the lowermost USDW is assigned as 350 feet BGS. The greatest thickness of the USDW in the vicinity of the Site is 348 feet (see Figure B.7-4), therefore a value of 350 feet is conservatively assigned, although available data indicate the USDW may be 220 feet thick below the proposed wellsite. Using 350 feet for critical pressure calculations is conservative. The lowest potentiometric surface of the water table within 2-miles of the Autumn Hills RDF well is projected to be approximately 45 feet below ground level but a depth of 50 feet has been used to ensure conservative calculations. Many local water wells within the area of review do not penetrate to a total depth of 200 feet BGL.

TABLE B.6-3. CRITICAL PRESSURE CALCULATION PARAMETERS

Parameter	Value
Original pressure, Po	2,566 psi @ 5,578 feet
Depth to base of USDW, D_w	350 feet
Depth to top of injection interval, D_X	5,578 feet
Depth to USDW fluid level, L	50 feet
Density (specific gravity) of USDW fluids, y_w	1.0
Density (specific gravity) injection zone brine, y_B	1.166

These values were used in the above equation to compute the critical pressure rise (Pc) as follows:

$$Pc = 0.433[1.166(5{,}578 - 350) + 1.0(350 - 50)] - 2{,}566 \text{ psi}$$
$$Pc = 203 \text{ psi}$$

Cone-of-Influence

Based on the critical pressure rise, the cone-of-influence can be calculated for the IW-1 well. At a maximum proposed injection rate of 150 gpm for 20-years, the cone-of-influence is less than 2 miles from the well location. At the maximum injection rate for the 20-year duration, the COI (i.e., radial distance of reservoir pressure rise due to injection greater than the calculated Pc value of 203 psi) is estimated to be approximately 13 feet.

The COI value can be confirmed by examination of the following estimate (oilfield units) of pressure rise in the reservoir at a distance of 10,560 feet (2 miles) from the disposal well:

$$dP = -70.6\ Bq\mu / kh * \ln ([1{,}688\ \phi\ \mu c_t r^2 / kt] - 2s)$$

Values utilized in the above calculation are listed in Table B.6-5 have been assigned based on site-specific information.

The above calculation can be solved for pressure rise due to 20 continuous years of injection using a rate of 150 gpm at the single proposed well, assumed to be located at the centroid of the site (Table B.6-4 and illustrated on Figure B.6-4). Using conservative geologic and injectate input values as summarized in the following table and discussed subsequently in this document, the calculation yields an increase of approximately 51 psi at a distance of 10,560 feet from the well, which is significantly less than the calculated critical pressure rise of 203 psi. In addition, the calculated radius of piston-like displacement of injected fluid is also shown on Figure B.6-4, which is detailed in Section B.12.

Therefore the maximum cone-of-influence at this site is projected to be within a 2-mile radius around the well, even under a conservative scenario. Due to the relatively large permeability-thickness of the injection formation at this site, there exists no potential for contamination of USDW resources due to improperly completed or abandoned wells within the statutory minimum 2-mile radius area of review. It is noted that one well penetrates the upper confining zone within this distance but no wells penetrate through the injection zone. The nearest wells that penetrate both the confining or injection zone are located approximately 4.5 miles to the northwest at the Consumers Energy Generating Station where there are two non-hazardous injection wells completed to the Mt. Simon.

TABLE B.6-4. CONE-OF-INFLUENCE PARAMETERS

Parameter	Calculation	Value
Flow rate, q	150 gpm *1440 min/day* bbl/42 gal	5,143 bbl/d
Thickness, h	A fraction of the >1,000 foot thickness	350 feet
Formation Volume Factor, B	Correlation	1.01
Porosity, ϕ	Logs	0.13
Permeability, k	Well tests, typical, minimized historic value	60 millidarcies
Viscosity, μ	Correlation	0.65 centipoise @ 92 degrees F
Total Compressibility, C_t	3.2×10^{-6} psi^{-1} + 4.3×10^{-6} psi^{-1}	7.5×10^{-6} psi^{-1}
Radius, r	Illustrative assumption	10,560 feet
Time, t	20 years x 365.25 days/yr * 24hr/day	175,320 hours

A corrective action plan is not required for any of the artificial penetrations within the AOR because, based on calculations, there are no wells within the cone-of-influence and there are no artificial penetrations to the injection zone within the area of review that have the potential for allowing injection activities to have an impact on the USDW. If a corrective action plan for any neighboring well becomes necessary in the future, it will be developed according to appropriate regulatory requirements.

The corrective action plan which would be proposed by WM, should fluid migration occur through the confining layer, will include the following:

1. IW-1 disposal well will be shut-in.
2. The US EPA, Region 5 UIC Section and the MDEQ will be notified.
3. Following well shut-in, liquid waste will be shipped to alternative permitted facilities for off-site treatment and disposal as necessary.
4. A contingency plan will be prepared as follows:
    a. Locate well and identify present operator or owner, if any.
    b. Identify mode of failure.
    c. Prepare remedial plan outlining course of action.
    d. The remedial plan will be submitted to MDEQ and US EPA, Region 5 for approval.
    e. Upon authorization, the remediation plan will be implemented.

Area of Review Oil and Gas Well Data

As discussed above and presented in Section B.4, there is one well that penetrates the confining zone within the two-mile AOR. Figure B.4-1 shows the location of deep non-freshwater penetrations within the AOR and Table B.4-1 presents a summary of information for these wells located in the AOR.

Water Wells Within 1/4 Mile AOR

As shown on Figure A.4-6 and discussed in Section A.4, there are no water wells within 600 feet of the proposed IW-1 location, but there are four water wells within 1,750 feet of the proposed well location, and one of these is a Type IIb well that supplies water to landfill offices. Water quality at the Type IIb well is monitored annually by WM. There are 18 water wells within an approximately 1/4 mile radius of the property boundary, as shown in Figure A.4-6. Figure B.6-2 shows there are 16 monitoring wells in the area, most of which surround the western and southern boundaries of the landfill. Data water wells are included as Attachment C (CD-ROM).

Table B.6-1. Property Owners within 1/4-Mile of the Autumn Hills RDF Boundary

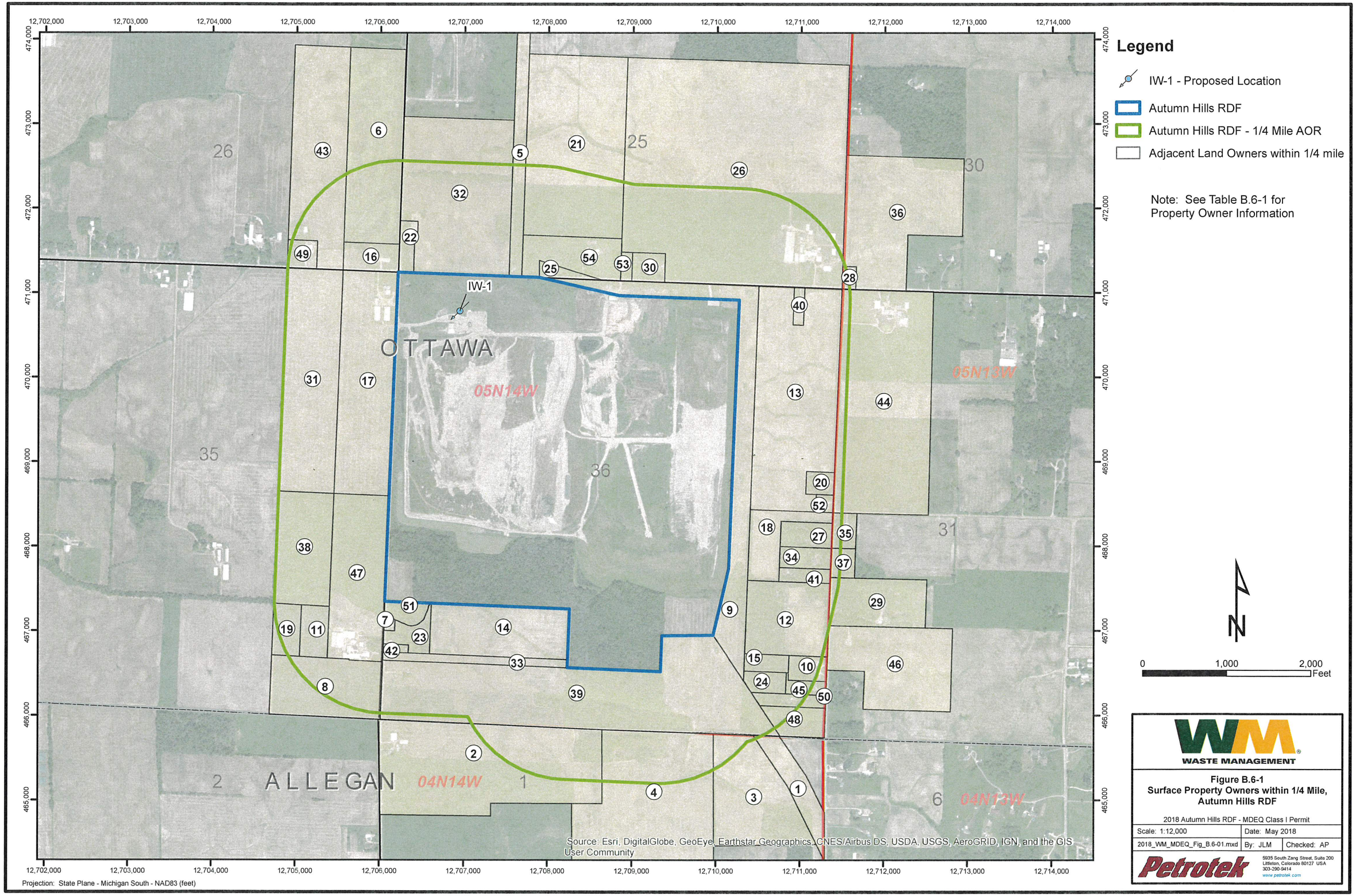
Figure Label	Owner Name	Prop Name	Prop Street	Property City	Prop State	Prop ZIP	Mailing Address	Mailing City	Mail State	Mail ZIP	Property_1	Governme_1
1	CONSUMERS ENERGY						ONE ENERGY PLAZA	JACKSON	MI	49201		
2	BROUWER DALE						5857 ADAMS ST	ZEELAND	MI	49464		
3	BROUWER KENNETH-DAWN-DALE-LAURA						5857 ADAMS ST	ZEELAND	MI	49464		
4	BROUWER FARMS LLC						5857 ADAMS ST	ZEELAND	MI	49464		
5	CONSUMERS ENERGY	ADAMS ST	5397 ADAMS ST	ZEELAND	MI	49464	ONE ENERGY PLAZA	JACKSON	MI	49201	INDUSTRIAL, VACANT-302	ZEELAND TWP
6	BROUWER KENNETH-DAWN-DALE-LAURA	56TH AVE	995 56TH AVE	ZEELAND	MI	49464	5857 ADAMS ST	ZEELAND	MI	49464	AGRICULTURAL, VACANT-102	ZEELAND TWP
7	KLEINJANS ROBERT	56TH AVE	166 56TH AVE	ZEELAND	MI	49464	166 56TH AVE	ZEELAND	MI	49464	RESIDENTIAL, IMPROVED-401	ZEELAND TWP
8	CONSUMERS ENERGY	64TH AVE		ZEELAND	MI	49464	ONE ENERGY PLAZA	JACKSON	MI	49201	INDUSTRIAL, VACANT-302	ZEELAND TWP
9	CONSUMERS ENERGY	56TH AVE	700 56TH AVE	ZEELAND	MI	49464	ONE ENERGY PLAZA	JACKSON	MI	49201	INDUSTRIAL, VACANT-302	ZEELAND TWP
10	ELENBAAS RICHARD D-MICHELE R	48TH AVE	125 48TH AVE	ZEELAND	MI	49464	125 48TH AVE	ZEELAND	MI	49464	RESIDENTIAL, IMPROVED-401	ZEELAND TWP
11	BROUWER ALVIN	56TH AVE	133 56TH AVE	ZEELAND	MI	49464	133 56TH AVE	ZEELAND	MI	49464	AGRICULTURAL, VACANT-102	ZEELAND TWP
12	ELZINGA NANCY TRUST	48TH AVE	201 48TH AVE	ZEELAND	MI	49464	201 48TH AVE	ZEELAND	MI	49464	RESIDENTIAL, IMPROVED-401	ZEELAND TWP
13	D&J RUSSCHER PROPERTIES LLC	ADAMS ST	4840 ADAMS ST	HUDSONVILLE	MI	49426	5014 PERRY ST	ZEELAND	MI	49464	AGRICULTURAL, VACANT-102	ZEELAND TWP
14	BROUWER FARMS LLC	56TH AVE	114 56TH AVE	ZEELAND	MI	49464	5857 ADAMS ST	ZEELAND	MI	49464	AGRICULTURAL, VACANT-102	ZEELAND TWP
15	VANKOEVERING BRETT	48TH AVE		ZEELAND	MI	49464	95 48TH AVE	ZEELAND	MI	49464	RESIDENTIAL, VACANT-402	ZEELAND TWP
16	NORTH AMERICAN NATURAL RESOURCES	ADAMS ST	5615 ADAMS ST	ZEELAND	MI	49464	300 N 5TH AVE STE 100	ANN ARBOR	MI	48104	INDUSTRIAL, IMPROVED-301	ZEELAND TWP
17	BROUWER ALVIN	ADAMS ST	5644 ADAMS ST	ZEELAND	MI	49464	133 56TH AVE	ZEELAND	MI	49464	AGRICULTURAL, IMPRVD -101	ZEELAND TWP
18	SMALLEGAN PATRICIA TRUST	48TH AVE		ZEELAND	MI	49464	1663 48TH AVE	HUDSONVILLE	MI	49426	RESIDENTIAL, VACANT-402	ZEELAND TWP
19	BROUWER ALVIN	56TH AVE	133 56TH AVE	ZEELAND	MI	49464	133 56TH AVE	ZEELAND	MI	49464	AGRICULTURAL, VACANT-102	ZEELAND TWP
20	BRINK ANDREW F	48TH AVE	475 48TH AVE	ZEELAND	MI	49464	475 48TH AVE	ZEELAND	MI	49464	RESIDENTIAL, IMPROVED-401	ZEELAND TWP
21	ELZINGA DANIEL G-SHARON	ADAMS ST		ZEELAND	MI	49464	4304 PERRY ST	HUDSONVILLE	MI	49426	AGRICULTURAL, VACANT-102	ZEELAND TWP
22	SEINEN MICHAEL	56TH AVE	894 56TH AVE	ZEELAND	MI	49464	894 56TH AVE	ZEELAND	MI	49464	RESIDENTIAL, IMPROVED-401	ZEELAND TWP
23	BROUWER FARMS LLC	56TH AVE	142 56TH AVE	ZEELAND	MI	49464	5857 ADAMS ST	ZEELAND	MI	49464	RESIDENTIAL, IMPROVED-401	ZEELAND TWP
24	VANKOEVERING BRETT-SUSAN	48TH AVE	95 48TH AVE	ZEELAND	MI	49464	95 48TH AVE	ZEELAND	MI	49464	RESIDENTIAL, VACANT-402	ZEELAND TWP
25	CONSUMERS ENERGY	ADAMS ST		ZEELAND	MI	49464	ONE ENERGY PLAZA	JACKSON	MI	49201	INDUSTRIAL, VACANT-302	ZEELAND TWP
26	ELZINGA DANIEL G	ADAMS ST	4861 ADAMS ST	ZEELAND	MI	49464	4304 PERRY ST	HUDSONVILLE	MI	49426	AGRICULTURAL, IMPRVD -101	ZEELAND TWP
27	VERMEER MATTHEW-KRISTI	48TH AVE	355 48TH AVE	ZEELAND	MI	49464	355 48TH AVE	ZEELAND	MI	49464	RESIDENTIAL, IMPROVED-401	ZEELAND TWP
28	JACOBSEN BENJAMIN-NANCY TRUST	ADAMS ST	4783 ADAMS ST	ZEELAND	MI	49464	4783 ADAMS ST	ZEELAND	MI	49464	RESIDENTIAL, IMPROVED-401	JAMESTOWN TWP
29	SULT DONALD A-HARRIET F TRUST	48TH AVE	200 48TH AVE	ZEELAND	MI	49464	200 48TH AVE	ZEELAND	MI	49464	RESIDENTIAL, IMPROVED-401	JAMESTOWN TWP
30	DAYBREAK DAIRY LLC	ADAMS ST	5117 ADAMS ST	ZEELAND	MI	49464	4861 ADAMS ST	ZEELAND	MI	49464	RESIDENTIAL, IMPROVED-401	ZEELAND TWP
31	BROUWER FARMS LLC	ADAMS ST	5740 ADAMS ST	ZEELAND	MI	49464	5857 ADAMS ST	ZEELAND	MI	49464	AGRICULTURAL, VACANT-102	ZEELAND TWP
32	T DYKSTRA INC	56TH AVE		ZEELAND	MI	49464	4747 35TH ST	ZEELAND	MI	49464	AGRICULTURAL, VACANT-102	ZEELAND TWP
33	BROUWER FARMS LLC	56TH AVE	120 56TH AVE	ZEELAND	MI	49464	5857 ADAMS ST	ZEELAND	MI	49464	AGRICULTURAL, VACANT-102	ZEELAND TWP
34	BRODNICKI STEVEN-BETH	48TH AVE	299 48TH AVE	ZEELAND	MI	49464	299 48TH AVE	ZEELAND	MI	49464	RESIDENTIAL, IMPROVED-401	ZEELAND TWP
35	BROWER BRUCE A-LUANN LVG TRUST	48TH AVE	380 48TH AVE	ZEELAND	MI	49464	380 48TH AVE	ZEELAND	MI	49464	RESIDENTIAL, IMPROVED-401	JAMESTOWN TWP
36	SMALLEGAN JAMES-PATRICIA	ADAMS ST	4763 ADAMS ST	HUDSONVILLE	MI	49426	1663 48TH AVE	HUDSONVILLE	MI	49426	AGRICULTURAL, IMPRVD -101	JAMESTOWN TWP
37	BROWER BRUCE A-LUANN LVG TRUST	48TH AVE	380 48TH AVE	ZEELAND	MI	49464	380 48TH AVE	ZEELAND	MI	49464	RESIDENTIAL, IMPROVED-401	JAMESTOWN TWP
38	BROUWER ALVIN	56TH AVE	231 56TH AVE	ZEELAND	MI	49464	133 56TH AVE	ZEELAND	MI	49464	AGRICULTURAL, VACANT-102	ZEELAND TWP
39	CONSUMERS ENERGY	OTTOGAN ST		ZEELAND	MI	49464	ONE ENERGY PLAZA	JACKSON	MI	49201	INDUSTRIAL, VACANT-302	ZEELAND TWP
40	ELZINGA PAUL A	ADAMS ST	4870 ADAMS ST	ZEELAND	MI	49464	4870 ADAMS ST	ZEELAND	MI	49464	RESIDENTIAL, IMPROVED-401	ZEELAND TWP
41	VANDERLUGT GERALD-JOAN	48TH AVE	275 48TH AVE	ZEELAND	MI	49464	275 48TH AVE	ZEELAND	MI	49464	RESIDENTIAL, IMPROVED-401	ZEELAND TWP
42	XIONG YER	56TH AVE	130 56TH AVE	ZEELAND	MI	49464	130 56TH AVE	ZEELAND	MI	49464	RESIDENTIAL, IMPROVED-401	ZEELAND TWP
43	BROUWER DALE-KENNETH	ADAMS ST	5785 ADAMS ST	ZEELAND	MI	49464	5857 ADAMS ST	ZEELAND	MI	49464	AGRICULTURAL, IMPRVD -101	ZEELAND TWP
44	DEKLEINE WAYNE TRUST-DEKLEINE BETTY	ADAMS ST	4730 ADAMS ST	ZEELAND	MI	49464	4730 ADAMS ST	ZEELAND	MI	49464	AGRICULTURAL, IMPRVD -101	JAMESTOWN TWP
45	VANKOEVERING BRETT-SUSAN	48TH AVE	95 48TH AVE	ZEELAND	MI	49464	95 48TH AVE	ZEELAND	MI	49464	RESIDENTIAL, IMPROVED-401	ZEELAND TWP
46	SMALLEGAN JIM-PATRICIA	48TH AVE		ZEELAND	MI	49464	1663 48TH AVE	HUDSONVILLE	MI	49426	AGRICULTURAL, IMPRVD -101	JAMESTOWN TWP
47	BROUWER ALVIN	56TH AVE	133 56TH AVE	ZEELAND	MI	49464	133 56TH AVE	ZEELAND	MI	49464	AGRICULTURAL, IMPRVD -101	ZEELAND TWP
48	CONSUMERS ENERGY	48TH AVE	33 48TH AVE	ZEELAND	MI	49464	ONE ENERGY PLAZA	JACKSON	MI	49201	INDUSTRIAL, VACANT-302	ZEELAND TWP
49	FRYE DAVID-SHARON	ADAMS ST	5791 ADAMS ST	ZEELAND	MI	49464	5791 ADAMS ST	ZEELAND	MI	49464	RESIDENTIAL, IMPROVED-401	ZEELAND TWP
50	GOTCHER JASON E-ANDREA C	48TH AVE	69 48TH AVE	ZEELAND	MI	49464	69 48TH AVE	ZEELAND	MI	49464	RESIDENTIAL, IMPROVED-401	ZEELAND TWP
51	KLEIS RICHARD A	56TH AVE	174 56TH AVE	ZEELAND	MI	49464	5894 OLD ALLEGAN RD	HAMILTON	MI	49419	RESIDENTIAL, VACANT-402	ZEELAND TWP
52	HESLINGA MATT-REBECCA	48TH AVE								49464		
53	WASTE MANAGEMENT	ADAMS ST		ZEELAND	MI	49464	P.O. BOX 1450	CHICAGO	IL	60690	RESIDENTIAL, VACANT-402	ZEELAND TWP
54	WASTE MANAGEMENT	ADAMS ST	5245 ADAMS ST	ZEELAND	MI	49464	PO BOX 1450	CHICAGO	IL	60690	RESIDENTIAL, IMPROVED-401	ZEELAND TWP

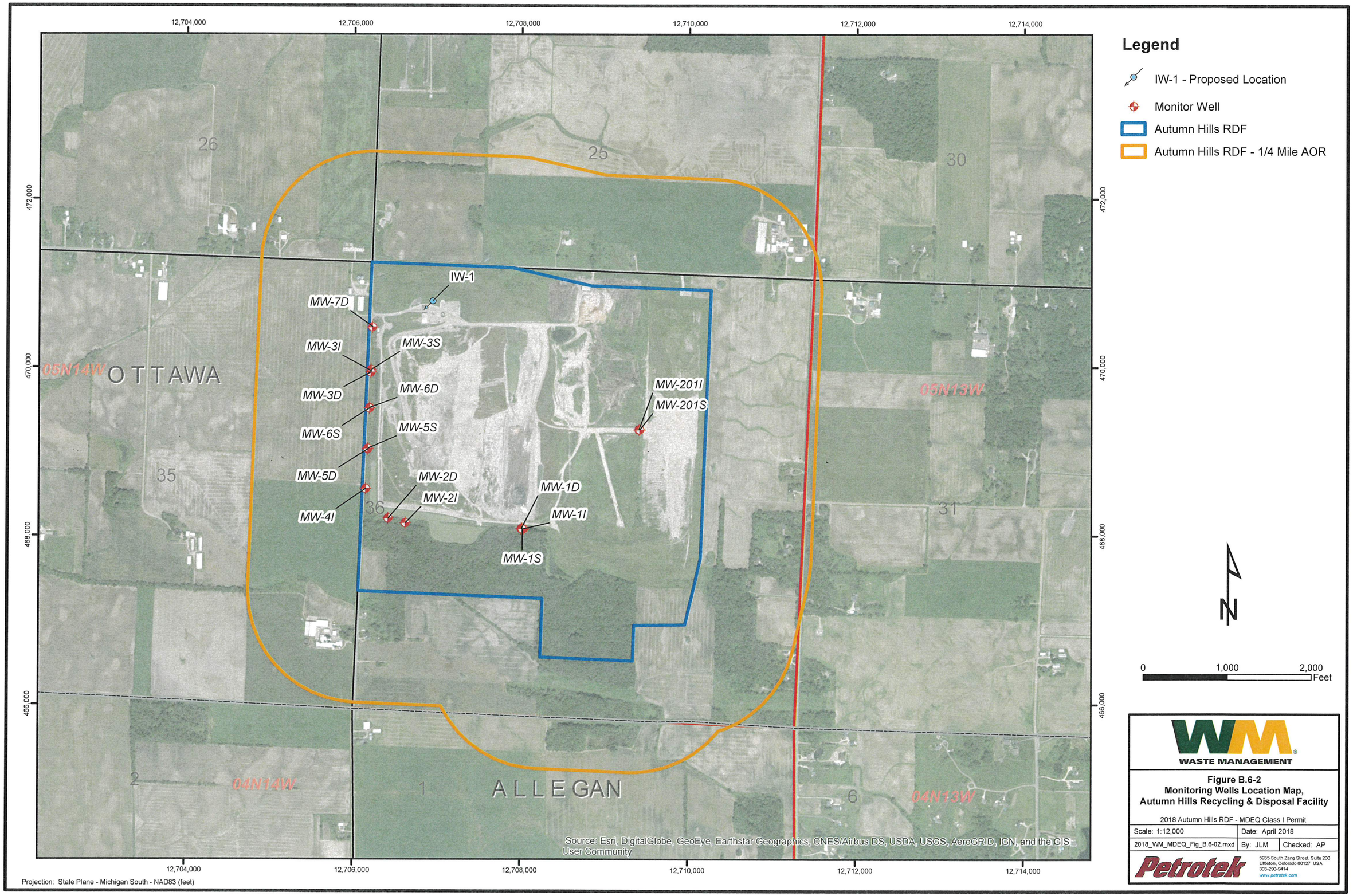
* Figure label number presented on Figure B.6-1

Table B.6-2. Freshwater Wells within 1/4-Mile of the Autumn Hills RDF Boundary

Well ID	County	Twp	Rge	Sec	Owner Name	Well Address	Well Depth	Const Date	Case Depth	Screen From	Screen To	SWL	Flowing	Aq Type	Elev DEM	Landsys
00253	Ottawa	05N	14W	25	POEL, TOM	893 56th	206	1/24/1984	201	201	206	30	N	DRIFT	692	ICE-MARGINAL TILL
00254	Ottawa	05N	14W	25	ELZINGA, DANIEL	4861 Adams	180	10/11/1979	150	0	0	62	N	ROCK	732	ICE-MARGINAL TILL
00273	Ottawa	05N	14W	35	LOMAN, DEL	284 64TH ST	120	11/4/1977	115	115	120	8	N	DRIFT	669	LODGE TILL OR FINE SUPRAGLACIAL DRIFT
00274	Ottawa	05N	14W	36	DOZEMAN, RANDY	S OF ADAMS	122	7/20/1981	83	0	0	6	Y	ROCK	712	ICE-MARGINAL TILL
00275	Ottawa	05N	14W	36	CALKINS, WM	125 48th	203	2/29/1984	201	196	203	36	N	DRIFT	699	ICE-MARGINAL TILL
02764	Ottawa	05N	14W	36	MATT LEPARD	275 48TH AVE	38	6/16/2000	29	29	38	15	N	DRIFT	719	ICE-MARGINAL TILL
04342	Ottawa	05N	14W	36	DAVID ROSE	69 48TH	200	8/6/2002	190	190	200	25	N	DRIFT	679	ICE-MARGINAL TILL
03624	Ottawa	05N	14W	36	Matt LePard	275 48th Avenue	210	12/5/2000	0	0	0	0	N	ROCK	709	ICE-MARGINAL TILL
03726	Ottawa	05N	14W	25	Elzinga, Daniel	5117 Adams	180	3/14/2001	145	0	0	80	N	ROCK	719	ICE-MARGINAL TILL
06119	Ottawa	05N	14W	26	N American Natural Resources	56th & Adams NW corner	238	12/8/2004	198	198	238	37	N	DRIFT	682	ICE-MARGINAL TILL
06142	Ottawa	05N	14W	36	MIKE MORREN	130 56TH AVE.	150	6/30/2004	125	0	0	30	N	ROCK	673	LODGE TILL OR FINE SUPRAGLACIAL DRIFT
08040	Ottawa	05N	14W	36	KEN PORTERFIELD	142 56TH AVE	150	9/19/2007	129	0	0	35	N	ROCK	676	LODGE TILL OR FINE SUPRAGLACIAL DRIFT
08440	Ottawa	05N	14W	36	Nancy Elzinga	201 48th Ave.	220	8/3/2009	190	190	220	73	N		722	ICE-MARGINAL TILL
12093	Ottawa	05N	14W	36	Rob KlienJans	166 56th ave	134	3/8/2010	124	124	134	25	N			ICE-MARGINAL TILL
Type IIB	Ottawa	05N	14W	36	Autumn Hills RDF	700 56th Ave.	238	6/25/1992	238	220	238	36	N	DRIFT	TBD	NO DATA

Note: Water wells labeled Well A, B, and C on Figure A.4-6 were surveyed by Holland Engineering; an additional well was identified by WM in north-central portion of Section 36.
No water well records were available for these wells.


Legend
IW-1 - Proposed Location
Autumn Hills RDF
Autumn Hills RDF - 1/4 Mile AOR
Adjacent Land Owners within 1/4 mile
Note: See Table B.6-1 for Property Owner Information
IW-1
OTTAWA
ALLEGAN
05N14W
05N13W
04N14W
04N13W
0
1,000
2,000
Feet
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Projection: State Plane - Michigan South - NAD83 (feet)
WASTE MANAGEMENT
Figure B.6-1
Surface Property Owners within 1/4 Mile, Autumn Hills RDF
2018 Autumn Hills RDF - MDEQ Class I Permit
Scale: 1:12,000
Date: May 2018
2018_WM_MDEQ_Fig_B.6-01.mxd
By: JLM
Checked: AP
Petrotek
5935 South Zang Street, Suite 200
Littleton, Colorado 80127 USA
303-290-9414
www.petrotek.com


Legend
IW-1 - Proposed Location
Monitor Well
Autumn Hills RDF
Autumn Hills RDF - 1/4 Mile AOR
IW-1
MW-7D
MW-3I
MW-3S
MW-3D
MW-6D
MW-6S
MW-5S
MW-5D
MW-2D
MW-2I
MW-4I
MW-1D
MW-1I
MW-1S
MW-201I
MW-201S
OTTAWA
ALLEGAN
05N14W
05N13W
04N14W
04N13W
26
25
30
35
36
31
2
1
6
12,704,000
12,706,000
12,708,000
12,710,000
12,712,000
12,714,000
472,000
470,000
468,000
466,000
0
1,000
2,000
Feet
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Projection: State Plane - Michigan South - NAD83 (feet)
WASTE MANAGEMENT
Figure B.6-2
Monitoring Wells Location Map,
Autumn Hills Recycling & Disposal Facility
2018 Autumn Hills RDF - MDEQ Class I Permit
Scale: 1:12,000
Date: April 2018
2018_WM_MDEQ_Fig_B.6-02.mxd
By: JLM
Checked: AP
Petrotek
5935 South Zang Street, Suite 200
Littleton, Colorado 80127 USA
303-290-9414
www.petrotek.com

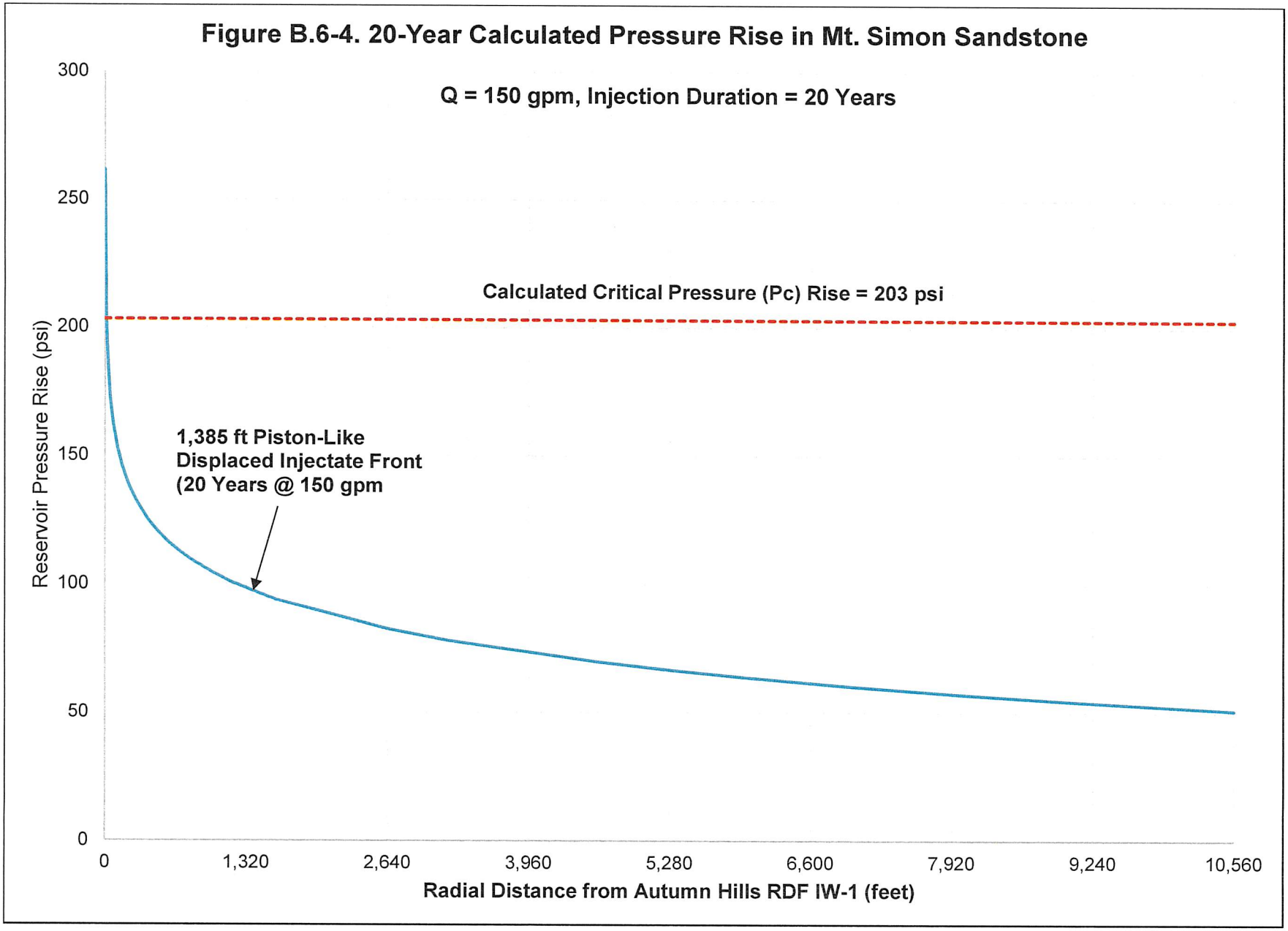


Figure B.6-4. 20-Year Calculated Pressure Rise in Mt. Simon Sandstone
Q = 150 gpm, Injection Duration = 20 Years
Calculated Critical Pressure (Pc) Rise = 203 psi
1,385 ft Piston-Like
Displaced Injectate Front
(20 Years @ 150 gpm
Reservoir Pressure Rise (psi)
300
250
200
150
100
50
0
0
1,320
2,640
3,960
5,280
6,600
7,920
9,240
10,560
Radial Distance from Autumn Hills RDF IW-1 (feet)

Petrotek

21759

APPLICATION FOR PERMIT TO DRILL A WELL FOR OIL, GAS, GEOLOGICAL TEST, BRINE DISPOSAL, OR KEY WELL FOR SECONDARY RECOVERY

UNDER AUTHORITY OF ACT 61, P.A. OF 1939, AS AMENDED, AND ACT 326, P.A. 1937 AS AMENDED.

MAIL TO:
SUPERVISOR OF WELLS
GEOLOGICAL SURVEY DIVISION
MICHIGAN DEPARTMENT OF CONSERVATION
LANSING 26, MICHIGAN

See Reverse Side Before Filling Out This Application

1. DATE: August 3, 1959

2. APPLICATION IS MADE TO DRILL A WELL FOR: (GAS, OIL, BRINE DISPOSAL, SECONDARY RECOVERY, ETC.) Oil or gas

3. ENCLOSED HEREWITH FIND AMOUNT OF: $ 25.00

4. LESSEE (OWNER OF LEASE RIGHTS): G. W. STRAKE

5. ADDRESS: 3300 Gulf Building - Houston 2, Texas

6. PHONE: CA 7-6294

7. LESSOR (FULL NAME OF OWNER OF MINERAL RIGHTS): Winnie Van Koevering

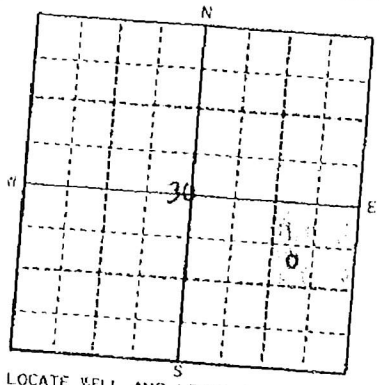
8. WELL NO.: 1

9. SURFACE OWNER (IF OTHER THAN MINERAL OWNER): Same as above

10. DRILLING CONTRACTOR: McClure Drilling Company

11. ADDRESS: Alma, Michigan

12. PHONE: 1001



LOCATE WELL AND LEASE ACCURATELY ON THIS SECTION PLAT · 640 ACRES

13. SW ¼ OF NE ¼ OF SE ¼, SECTION 30 T 5N N.S., R 13W E.M.

14. ACRES IN LEASE: 40 acres

15. TOWNSHIP: Jamestown

16. COUNTY: Ottawa

17. *Locate well in two directions from nearest lines of quarter section and property ownership lines:*

990 FT. FROM north (north-south) LINE OF QUARTER SECTION

330 FT. FROM south (north-south) PROPERTY LINE

890 FT. FROM east (east-west) LINE OF QUARTER SECTION

430 FT. FROM west (east-west) PROPERTY LINE

18. NUMBER OF FEET FROM NEAREST PRODUCING WELL: Wildcat

19. KIND OF TOOLS TO BE USED (Cable, rotary, combination): Rotary

20. WELL IS TO BE COMPLETED IN Trenton (or St. Peter) FORMATION

21. INTENDED DEPTH OF WELL: approximately 4300'

22. PROGRAM OF CASING, SEALING, AND COMPLETING WELL

Set and cement 10-3/4" surface pipe approximately 30' below base of Marshall Sandstone (approx. 300') and if potential producer, set and cement 7" or 5-1/2" O.D. production casing on bottom. All oil, gas and/or water encountered to be confined to the formation in which it occurs.

23. WELL LOCATION IS IN: (Cleared Farm Land, Open Grass Land, Brush Land, Timbered Land.) Brush Land

24. ARE THERE ANY LAKES, STREAMS, DRAINAGE WAYS, SWAMPS, OR MARSHES NEARER THAN 300 FEET FROM WELL LOCATION? Yes [X] No [ ]

25. ARE THERE ANY BUILDINGS OR OTHER STRUCTURES WITHIN 75 FEET OF THE PROPOSED LOCATION? Yes [ ] No [X]

26. IF ANSWER TO NO. 24 ABOVE IS YES, DESCRIBE AND GIVE DISTANCE FROM LOCATION AND SPECIFY PRE-CAUTIONS TO BE TAKEN TO PROTECT FRESH WATER FROM WELL WASTES. It will be necessary to move the location 100 feet east of a standard location to gain distance from a dry-run located approx. 135 feet west of the proposed location. There is also a drain ditch located approx. 210 feet east of the proposed location.

APPLICANT AGREES TO COMPLY WITH THE PROVISIONS OF ACT 61, PUBLIC ACTS OF 1939, AS AMENDED, AND ACT 326, PUBLIC ACTS OF 1937, AS AMENDED, AND RULES AND REGULATIONS PERTAINING TO THE LOCATING, DRILLING, CASING, SEALING, COMPLETING, PRODUCING, AND PLUGGING OF WELLS. BEFORE COMMENCING DRILLING OPERATIONS, CONTACT THE NEAREST OIL HAZARD REDUCTION FIELD OFFICE. (See reverse side)

27. ADDRESS CORRESPONDENCE AND PERMIT TO: John McDonald - General Delivery - Martin, Michigan

28. PHONE:

29. OWNER OF LEASE RIGHTS: G. W. STRAKE

30. AUTHORIZED REPRESENTATIVE: John McDonald

LEAVE BLANK

DATE ISSUED 8-4-59 GROUP NO.

PERMIT NO. 21,759 ACCOUNT NO.

FOR CASHIER'S USE ONLY · DO NOT WRITE IN THIS SPACE

DISTRIBUTION

1. WHITE · GEOL. SURVEY DIV. · LANSING.
2. CANARY · CASHIER.
3. BLUE · F.ADM.DIV. · FIELD.
4. GOLDENROD · GEOL. SUR. DIV. · FIELD.
5. PINK · F.A.DIV. · GR. RAPIDS.
6. GREEN · APPLICANT.

GS-1 Rev. 1/56

Winnie Van Koevering #1

FORM GS-2 500 SETS 2-59

STATE OF MICHIGAN

DEPARTMENT OF CONSERVATION

SUPERVISOR OF WELLS

№ 3308

PERMIT TO DRILL A WELL FOR OIL OR GAS

(POST CLOTH PERMIT AT WELL LOCATION)

Permit No. 21,759 Date Issued August 4, 1959

Permission is hereby granted to G. W. Strake
Owner

3300 Gulf Building, Houston 2, Texas
Address

Lease Name Minnie Van Koevering Well Number 1

To drill a well for Oil or Gas

in the [illegible] Section 30, T.5N., R.13W., Jamestown Twp., Ottawa Co.

and located 990' from north and 890' from east line of quarter section

and located 330' from south and 430' from west property line

This permit is issued subject to the provisions and requirements of Act 61, P. A. 1939 and Act No. 326, P. A. 1937, as amended, and rules, regulations, requirements, or orders issued by the Supervisor of Wells and Department of Conservation.

GERALD E. EDDY, SUPERVISOR OF WELLS

By Robert M. Acker

CAUTION

DRILLING OPERATIONS NOT TO BE COMMENCED until all the well location requirements have been completed and the permit has been posted in a conspicuous place at the well site.

WASTE IS PROHIBITED in the drilling, producing, and plugging of this well. This includes underground, surface, and market waste.

DAMAGE TO FRESH WATERS, both underground and surface, is prohibited in the drilling, producing, and plugging of this well.

UNNECESSARY DAMAGE TO LIFE AND PROPERTY is prohibited in the drilling, producing, and plugging of this well.

Department offices at: Lansing, Phone IVanhoe 5-8144, Ext. 2686
Mount Pleasant, Phone SP 3-8691
Cadillac, Phone PRospect 5-3181
Allegan, Phone 89
Grand Rapids, Phone GLendale 8-3007
Escanaba, Phone 1397

PERMITS MAY BE TRANSFERRED ONLY WITH PERMISSION OF THE SUPERVISOR OF WELLS

11

Allegan, Michigan
August 4, 1959
11:15 A.M.

TO: W. N. Hale, Allegan Office

FROM: Betty Barton, Allegan Office

SUBJECT: Commencement of the G. W. Strake - Van Koevering # 1, SW NE SE, Sec. 30, T. 5N., R. 13W., Jamestown Twp., Ottawa Co.

Joe Moore came in to report that they will be ready to commence drilling operations on the above named well on Thursday - August 6, 1959.

File

Post Office Box 123
Allegan, Michigan
August 4, 1959

TO: Mr. R. H. Acker, Geologist, Geological Survey

FROM: W. Neal Hale, Conservation Officer Oil Hazard Reduction

SUBJECT: G. W. Strake - Winnie Van Kovering #1
SW NE SE, section 30, T5N R13W, Jamestown Twp.,
Ottawa County

We have inspected and approve the subject location and approve same for nearness to surface water and drainage ways

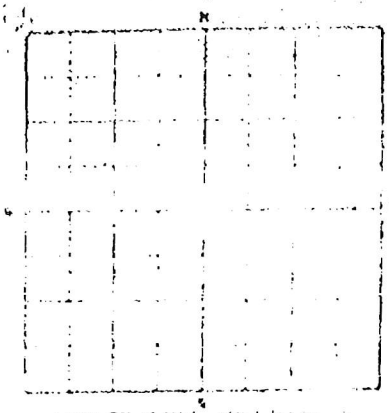
W. Neal Hale

cc: H. A. Young
B. C. Ackerman

STATE OF MICHIGAN
DEPARTMENT OF CONSERVATION

LOG OF OIL, GAS OR TEST WELL

TO BE FILED WITH SUPERVISOR OF WELLS WITHIN 30 DAYS AFTER COMPLETION OF WELL. ACT 61 P. A. 1939 AND ACT 326 P. A. 1937



LOCATE WELL ACCURATELY

Permit No. 21759

Owner or Operator G. W. Strake

Address 3300 Gulf Building Houston, Texas

Well No. 1 Farm Winnie Van Koevering

County Ottawa Township Jamestown

Location SW¼-NE¼-SE¼ Sec. 30 Twp. 5N Range 14W Elevation 676.7 Ground

Footage 990 ft. from N line and 890 ft. from line of quarter section

Type of well Dry Hole Total depth 4308 Completed in Trenton Black River

Name of producing formation None Top of formation

Date drilling begun 8/6/59 Date drilling completed 8/29/59

Drilling contractor McClure Drlg. Corp. Address Mt. Pleasant, Michigan

WATER ZONES

NAME	FROM	TO	AMOUNT

OIL OR GAS ZONES

NAME	FROM	TO	AMOUNT

CASING AND CEMENTING

SIZE	WHERE SET	CEMENT	AMT. PULLED
10 3/4"	294'	200 Reg	None

STEEL LINES RUN

RUN AT	CORRECTED TO	RUN BY
1505'	1505'	L. P. Shaner
2835'	2835'	
3013'	None	L. Kuelen

PERFORATIONS

DATE	FROM	TO	NO. HOLES

ACID OR SHOOTING RECORD

DATE	FROM	TO	GALS. ACID OR QTS. NITRO

Rotary tools from 0 feet to 4308 feet. Cable tools from feet to feet.

Natural initial production first 24 hours Bbls. After acid or shot Bbls.

If gas well, cu ft. per 24 hours Rock pressure, lbs. per sq. in.

The above information is complete and correct. Signed John McDonald

Date 9/1/59 Title Chief Geologist

GS-10 Rev. 4 55

GIVE COMPLETE FORMATION RECORD ON REVERSE SIDE

SEP 10 1959

FORMATION RECORD

FROM	TO	FORMATION
[illegible]	146	Drift
[illegible]	170	Marshall Sand
[illegible]	540	Shale, [illegible]
540	575	Dolomite & Shale
575	910	Shale
910	920	Red Rock
920	1310	Shale
1310	1550	Antrim
1550	1620	Traverse Formation
1620	1750	Traverse Lime & Chert
1750	1950	Lime, [illegible]
1950	1984	Lime & Anhydrite
1984	2025	Detroit River Dolomite
2025	2352	Dolomite & Anhydrite
2352	2360	Bass Island
2360	2375	Chert & Dolomite
2375	2444	Dolomite
2444	2770	Dolomite & Shale
2770	2821	" & Anhydrite
2821	2864	A-2 Dolomite
2864	2931	Lime
2931	2938	Lime & Anhydrite
2938	2972	Lime, Anhydrite, & Shale
2972	3045	Dolomite & Anhydrite
3045	3250	Salt
3250	3256	Anhydrite
3256	3301	Niagara
3301	3311	Dolomite & Anhydrite
3311	3362	Lime, gray, & Anhydrite
3362	3364	Shale, red, & Lime
3364	3435	Shale, red
3435	3475	Shale, green, & Lime
3475	3519	Lime & Anhydrite
3519	3524	Shale, green
3524	3683	Shale & Dolomite
3683	3885	Shale
3885	3908	Trenton Lime
3908	3962	Dolomite & Anhydrite
3962	3993	Lime & Anhydrite
3993	4149	Dolomite & Lime
4149	4186	Lime & Shale
4186	4199	Lime & Chert
4199	4308	Lime
		Syfo 4000' - 1 degree
4308		Total Depth

Cons. 7019
4/50

c/L

MICHIGAN DEPARTMENT OF CONSERVATION

WELL PLUGGING RECORD

TO BE FILED WITHIN THIRTY DAYS AFTER PLUGGING IS COMPLETED

59

Permit No. 21739 Date September 2, 1959

Owner or Operator G. W. Strake Address 3300 Gulf Building, Houston 2, Texas

Well Name Winnie Van Koevering No. 1 Location SW ¼ NE ¼ SE ¼ Section 30

Town Jamestown County Ottawa T. 5N N.S., R. 13W E.W.

Type of Well Dry Hole (OIL, GAS, BRINE DISP., SAL OR DRY HOLE) Total Depth 4108' Formation Trenton Black River

Date Plugging Started 8/21/59 Date Plugging Completed 8/21/59

Was permission of Department of Conservation obtained before plugging began? Yes

Name of Department Representative who authorized or supervised plugging Robert Breed

CASING SIZE	WERE SET	AMOUNT RECOVERED	SHOT OR RIPPED	BRIDGES OR PLUGS (BRUSH, STONE, CEMENT, ETC.)	DEPTH PLACED	NUMBER SACKS
10 3/4"	294'	None				

Describe in detail how well was plugged Fill hole with heavy rotary mud from total depth to 1680', spot 50 sx cement to base of surface pipe, spot 5 sx cement @ 300'. Fill hole with heavy rotary mud to 20' from surface & spot 5 sx of cement. Cut surface pipe off below plow depth & weld on steel cap. (10-13-59 Checked for final plugging approval, well surface O.K. but mush pit not covered. Referred to F. A. Div.) B.B.

(USE REVERSE SIDE IF NEEDED)

Were tools, tubing, casing, etc., lost or left in the hole before or during plugging? No If so, give details

Did a Service Company pump mud, spot cement, or set bridge plugs? Yes If so, give name and address Allied Services, Mt. Pleasant, Michigan

Was the well plugged by a Company or Contractor other than Owner or Operator? Yes If so, give name and address McClure Drilling Corporation, Mt. Pleasant, Michigan

Representatives of Owner, Operator, Company, or Contractor who witnessed plugging Joe Moore

CERTIFICATE:

"I, _____ of _____ (Company), state that I am authorized by said Owner or Operator to make this report; and that this report was prepared under my supervision and direction, and that the facts stated herein are true, correct and complete to the best of my knowledge."

(SIGNATURE) (ADDRESS) (TITLE)

FINAL INSPECTIONS:

By Department Representative	Date
Robert Breed	OCT 15 1960
R. L. Dietz F.A.	9-13-60

BCK 9-14-60

SEP 10 1959

G. W. Strake
Winnie Van Koevering #1

Date of Completion 8-29-59
Date Last Produced DRY HOLE
Last Production
oil-gas-water
Date work is to start 8-29-59

STATE OF MICHIGAN
DEPARTMENT OF CONSERVATION
SUPERVISOR OF WELLS

Leave Blank
Permit No. 21759
Date Issued
D.P. No.
Date Issued

APPLICATION FOR PERMISSION TO:
(Submit in Quadruplicate)

~~DEEPEN~~ - ~~REWORK~~ - ABANDON
(Cross out those which do not apply)

Supervisor of Wells
Department of Conservation
Lansing 13, Michigan

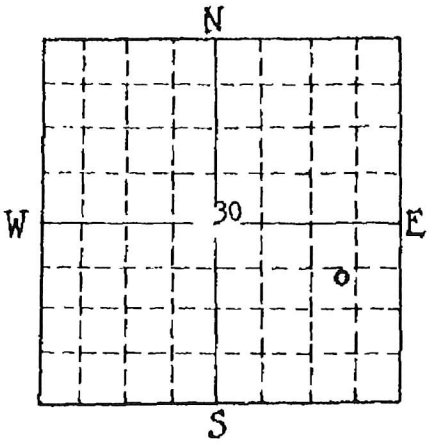
Allegan Michigan August 29 19 59

In compliance with the provisions of Act 61, Public Acts of 1939, and Act 326, Public Acts 1937 and the rules and regulations issued and adopted thereunder permission is requested to ~~Deepen~~ - ~~Rework~~ - Abandon the

G. W. STRAKE — Well Owner
Winnie Van Koevering # 1 — Well Name and Number
SW ¼, NE ¼, SE ¼, Sec. 30 T. 5N N.S., R. 13W E.W.

Jamestown — Township
Ottawa — County

The work to be done by: McClure Drilling Co.
Operator or Contractor



Outline the present condition of the well giving casing, cementing, formation, and production data.

10" 294' (205 cem.)

Drift to 146
Mar. 146-170
Ant. 1310
Tr. Fm. 1561
Tr. Ls. 1620
Det.Riv. Anhy. 1950
Poros. 1968-2020

Bass Is. 2552
Salina 2674
A-2 Dol. 2821
A-1 2986
Wh. Niag. 2356
Trenton 3885
T. D. 4308' 4302'

Describe the proposed work in detail.

Circulate the hole with mud from the total depth to approximately 1700'.

Spot 50 sacks of cement through the Traverse pay zone and fill solidly with mud to just below the surface pipe.

Place 5 sacks of cement on top of the mud in the hole and fill with mud from the cement to approximately 20' from the surface.

Place 5 sacks of cement on top of the mud in the hole.

Cut surface pipe off below plow depth and weld a heavy steel plate on top of pipe in hole.
(Be sure all oil, gas and/or water is confined to the formation in which it occured.)
CALL THE DEPARTMENT OF CONSERVATION AT ALLEGAN (PHONE 89) BEFORE 9:30 A.M. WHEN READY TO START PLUGGING OPERATIONS.

Field Office ALLEGAN
Approved
Date

(Cellars and slush pits are to be filled and levelled and all material and debris removed from the location. All rat holes must be filled with mud also.)

G. W. STRAKE
Name of Company or Operator
By
Authorized Representative

bjb Record of proposed work to be filed within 30 days after its completion.

G.S. 37 6-6-44