

REPORT

Production Well Capacity and Raw Water Quality Assessment for Stouffville Production Wells

Stouffville Water System Upgrades Class EA, York Region

Submitted to:

Kevin Brown The Municipal Infrastructure Group

Submitted by:

Golder Associates Ltd.

6925 Century Avenue, Suite #100, Mississauga, Ontario, L5N 7K2, Canada

+1 905 567 4444

1668667-5000-R01-Rev1

April 2, 2020

Distribution List

Electronic copy - TMIG

Electronic copy - York Region

Table of Contents

1.0	INTR	ODUCTION	1
2.0	MUNI	CIPAL WELL INFORMATION	2
	2.1	Well Construction Details	2
	2.2	Well Pumping Rates	2
	2.3	Theoretical Yield for Well Screens	3
	2.4	Groundwater Levels and Available Drawdown	4
3.0	WELI	PERFORMANCE AND CAPACITY ASSESSMENT	5
	3.1.1	Stouffville PW1	5
	3.1.2	Stouffville PW2	6
	3.1.3	Stouffville PW3	6
	3.1.4	Stouffville PW5	7
	3.1.5	Stouffville PW6	8
4.0	GRO	UNDWATER QUALITY ASSESSMENT1	0
	4.1	Manganese1	0
	4.2	Iron1	0
	4.3	Sodium1	1
	4.4	Chloride1	1
	4.5	Nitrate1	1
	4.6	Monitoring Well Groundwater Quality1	1
5.0	CON	CLUSIONS AND RECOMMENDATIONS1	3

TABLES

Table 1: Production Well Construction Details	2
Table 2: Well Pumping Rates	3
Table 3: Theoretical Yield for Well Screen	3
Table 4: Available Drawdown	4
Table 5: PW1 Specific Capacity	5

Table 6: PW2 Specific Capacity	6
Table 7: PW3 Specific Capacity	7
Table 8: PW5 Specific Capacity	8
Table 9: PW6 Specific Capacity	9
Table 10: Stouffville Well Capacity and Groundwater Quality Summary	13

FIGURES

- Figure 1: Location Plan
- Figure 2: Annual Average Daily Production, 2002 2018
- Figure 3: Groundwater Elevation Hydrograph, Stouffville Production Well 1
- Figure 4: Groundwater Elevation Hydrograph, Stouffville Production Well 2
- Figure 5A: Groundwater Elevation Hydrograph, Stouffville Production Well 3
- Figure 5B: Projected Groundwater Level to 2041, Stouffville Production Well 3
- Figure 6: Groundwater Elevation Hydrograph, Stouffville Production Well 5
- Figure 7: Groundwater Elevation Hydrograph, Stouffville Production Well 6
- Figure 8: Manganese Concentrations, Projected to 2041
- Figure 9: Iron Concentrations, Projected to 2041
- Figure 10: Sodium Concentrations, Projected to 2041
- Figure 11: Chloride Concentrations, Projected to 2041
- Figure 12: Nitrate Concentrations, Projected to 2041

APPENDICES

- Appendix A: Water Well Records Stouffville Production Wells
- Appendix B: Monitoring Well Groundwater Quality

1.0 INTRODUCTION

Golder was retained by The Municipal Infrastructure Group (TMIG) on behalf of York Region to conduct a production well performance and capacity review and raw water quality assessment for the Stouffville Groundwater System in York Region. This assessment is required as part of the Class Environmental Assessment (EA) for Water System Upgrades for the Community of Stouffville, York Region, Ontario.

The scope of work and objectives of this assessment are as follows:

- Review production well performance and capacity based on historical information and well performance evaluations completed to date;
- Assess raw water quality and model water quality trends out to 2041 (EA planning horizon). Assess water quality distribution trends through water quality concentration mapping for parameters of concern for each source aquifer;
 - The objective of the water quality assessment is to identify water quality parameters with increasing trends expected to cause water treatment process issues and/or issues related to meeting regulatory limits (Ontario Drinking Water Standards) within the EA planning horizon;
 - The water quality assessment will consider the newly proposed MAC/AO for Mn, and will assume that MECP adopts these new limits;
 - Based on the conclusions of this assessment, suitable 'water quality thresholds' for each parameter of concern will be established that will enable the Region to monitor for changes in water quality and determine if corrective action (i.e. well replacement) is required within estimated time frames.
- Assess production well lifespan and confirm whether existing production wells are expected to supply adequate yield to meet future demand of the EA planning horizon.
- Assess if well replacement or significant well modification is expected within the EA planning horizon and propose additional exploration studies to be completed, if warranted.

This report provides a background of relevant municipal well information compiled and used in the assessment (Section 2.0), a review of the well performance and capacity of the wells (Section 3.0), an assessment of raw groundwater quality (Section 4.0), and the study key conclusions and recommendations (Section 5.0).

2.0 MUNICIPAL WELL INFORMATION

2.1 Well Construction Details

The Stouffville water supply system consists of five water supply wells at the locations shown on Figure 1. The production well construction details are shown in Table 1.

Well ID	Date	Driller	Ground Surface Elevation (masl)	Casing / Screen Diameter (mm)	Top of Screen (mbgs)	Bottom of Screen (mbgs)	Aquifer	
STO PW1	1998	IWS	278.7	600 / 300	94.5	99.1	TAC	
STO PW2	1998	IWS	278.4	600 / 300	96.4	100.9	TAC	
STO PW3	1976	IWS	287.2	600 x 300	20.5	23.5		
STO PW5	1960	C.H. Rutledge	308.9	600	7.0	12.5	Lower ORAC	
STO PW6	1966	Faulkner Well Drilling	305.0	600 x 300	13.7	21.4	·	

Table 1: Production Well Construction Details

Notes:

IWS = International Water Supply masl = meters above sea level mm = millimeters mbgs = metres below ground surface

TAC = Thorncliffe Aquifer Complex

ORAC = Oak Ridges Aquifer Complex

The municipal production wells include two deep wells PW1 and PW2 screened in the Thorncliffe Aquifer Complex (TAC) and three shallower wells PW3, PW5 and PW6 screened in the lower Oak Ridges Aquifer Complex (ORAC).

There are a total of 23 monitoring wells in Stouffville and 4 monitoring wells in Lemonville operated by York Region at the locations shown in Figure 1. These include 10 wells screened in the deep aquifer (TAC) and 17 wells screened in the shallow aquifer (ORAC).

2.2 Well Pumping Rates

Annual average daily production rates for each municipal production well from 2002 to 2018 are presented on Figure 2. The average daily production rates for each well from 2002 to 2018, 2014 to 2018 (5-year period), and 2018 are presented in Table 2. Table 2 also presents the maximum day well production since 2002 and the permitted rates for the wells.

Well ID	Average Daily Production (m³/day) 2002-2018	rage Daily oduction m ³ /day) 2014-2018 Average Daily Production (m ³ /day) 2018 Max. Day Production (m ³ /day) 2018 2018 2018 2018		Max. Day Production (m³/day), since 2002	PTTW Rate (m³/day)	PTTW Rate (L/s)
STO PW1	599	483	487	2,831, Jul 2016	2,946	34.1
STO PW2	646	553	558	2,817, Jun 2016	2,946	34.1
STO PW3	1169	1079	1128	2,925, Jul 2016	2,946	34.1
STO PW5	1008	729	537	2,878, Jun 2016	3,110	36.0
STO PW6	917	686	577	2,266, Aug 2002	2,290	26.5

Table 2: Well Pumping Rates

The daily production rates for the wells are presented along with groundwater elevation hydrographs for each well on Figures 3 to 7 for the period of 2002 to 2018.

2.3 Theoretical Yield for Well Screens

The theoretical yield for the production wells was estimated using Johnson Screens – Transmitting Capacity Chart for large diameter 304SS free flow or standard construction at 0.03 meter per second average entrance velocity. All wells were assumed to have pipe size screens, based on the descriptions of casing and well screen in the water well records (Appendix A).

Well ID	Screen Length (m)	Screen Diameter (mm)	Screen Slot	Theoretical Yield for Screen (L/s)	PTTW Rate (L/s)
STO PW1	4.6	300	50	36	34.1
STO PW2	4.6	300	50	36	34.1
STO PW3	6.3	300	50/20	37	34.1
STO PW5	5.8	600	50*	46	36.0
STO PW6	7.6	300	35	34	26.5

Table 3: Theoretical Yield for Well Screen

Note: * Assumed a 50-slot screen as the size was not provided on the well record.

The theoretical yields for the well screens are typically used as a guide in well design and assessment of well performance. The calculated theoretical yields must be used conservatively for design and taking into account well operational monitoring history and assessment of actual well performance testing results.

2.4 Groundwater Levels and Available Drawdown

The groundwater levels monitored at the municipal production wells are shown on Figures 3 to 7.

The height of the groundwater elevation above the pump intake or top of screen (referred to as available drawdown) is shown in Table 4 including the total available drawdown and the available drawdown remaining during pumping at the time of the lowest observed groundwater level.

Table 4: Available Drawdown

				Lowest Observed Pumped Groundwater Level			
Well ID	Pump Intake / Top of Screen (masl)	Average Static Groundwater Elevation (masl)	Total Available Drawdown (m)	Lowest Groundwater Elevation ¹ (masl)	Date(s)	Pumping Rate ¹ (L/s)	Remaining Available Drawdown (m)
STO PW1	203	238	35	221	Jun 2016	31	18
STO PW2	205	236	31	218	Jul 2011, Jun 2016	33	13
STO PW3	269	283	14	270	Jul 2016	34	1
STO PW5	297 / 302	306	4 ²	303	Jun 2016	33	1 ²
STO PW6	287 / 291	304	13²	291	May- Sep 2013, Sep 2016, Jul 2019	24	0 ²

Notes:

1) Based on highest daily pumping rates on the date(s) the lowest groundwater elevation was observed.

2) In cases where the pump intake is set below the top of the well screen the top of the well screen was used to calculate the available drawdown.

3.0 WELL PERFORMANCE AND CAPACITY ASSESSMENT

Golder reviewed production well performance documentation for the Stouffville wells provided by York Region including; well performance evaluation memos, well condition inspection reports and maintenance and rehabilitation reports.

Based on the desktop review, the findings are summarized below.

3.1.1 Stouffville PW1

The following provides a summary of well performance testing and rehabilitation completed at the well:

- An initial pumping test and step test were conducted in 1998 shortly after the well was constructed;
- A well inspection video was conducted in 2011 by IWS; and
- The well was step-tested in 2009 by IWS, in 2013 by York Region and again in 2018 by York Region.

The results of the performance testing and specific capacity values are shown in Table 5.

Table 5: PW1 Specific Capacity

Well ID	Test Date	Pumping Rate (L/s)	Duration (hrs)	Drawdown (m)	Specific Capacity (L/s/m)
	March 1998	34.1	63	23.3	1.5
	March 1998	33.0	_(1)	8.72	3.8
310 PW1	March 2018	36.0	1	9.89	-
		33.0	-	8.27 ⁽²⁾	4.0 ⁽²⁾

Note:

(1) Step test duration not specified in reports provided to Golder.

(2) Interpolated value based on 36.0 L/s step test.

Specific capacity values have slightly improved at PW1 without the need for any rehabilitation, when comparing recent and past step tests (York Region, 2018).

The long-term groundwater level trends over the last 5 years have been stable, and when pumping near the permitted limit, pumped groundwater levels are approximately 18 m or more above the pump intake (static levels ~35 m above pump intake).

The production rate at PW1 is not limited by the available drawdown; however, it is not recommended to increase water taking above its currently permitted rate of 34.1 L/s since this is already close to the limit of the theoretical yield for the screen (36 L/s).

From a quantity perspective, PW1 is expected to be capable of providing up to the permitted water taking rate of 34.1 L/s (2,946 m³/day) for the EA planning horizon (up to 2041).

3.1.2 Stouffville PW2

The following provides a summary of well performance testing and rehabilitation completed at the well:

- Well PW2 was constructed in 1998 by IWS with an initial pumping test conducted; and
- The well was step-tested in 2011 and 2013 by York Region.

The results of the performance testing and specific capacity values are shown in Table 6.

Table 6: PW2 Specific Capacity

Well ID	Test Date	Pumping Rate (L/s)	Duration (hrs)	Drawdown (m)	Specific Capacity (L/s/m)
	February 1998	34.1	116	22.7	1.5
	September 2011	24.0	_ (1)	9.4	2.6
510 PW2	June 2013	33.0	<1	12.1	-
		24.0	-	8.8(2)	2.7 ⁽²⁾

Note:

(1) Step test duration not specified in reports provided to Golder.

(2) Interpolated value based on 33.0 L/s step test.

Specific capacity values have slightly improved at PW2 without the need for any rehabilitation, when comparing recent and past step tests (York Region, 2018).

The long-term groundwater level trends over the last 5 years have been stable, and when pumping near the permitted limit, pumped groundwater levels are approximately 13 m or more above the pump intake (static levels ~31 m above pump intake).

The production rate at PW2 is not limited by the available drawdown; however, it is not recommended to increase water taking above its currently permitted rate of 34.1 L/s since this is close to the limit of the theoretical yield for the screen (36 L/s).

From a quantity perspective PW2 is expected to be capable of providing up to the permitted water taking rate of 34.1 L/s (2,946 m³/day) for the EA planning horizon (up to 2041).

3.1.3 Stouffville PW3

The following provides a summary of well performance testing and rehabilitation completed at the well:

- Well PW3 was constructed in 1976 by IWS;
- A well inspection video conducted in 2011 and 2016 by IWS;
- The pump was replaced in 2011 by York Region;
- The well was step-tested in 1975, 2009, and 2011 by IWS. The well was again step-tested in 2016 by York Region and in 2017 by IWS; and



Well rehabilitation, including casing and screen brushing, chemical (dispersant and disinfection) treatment, Sonar-Jet treatment, and air-lifting, was conducted in 2011 and 2017 by IWS.

The results of the performance testing and specific capacity values are shown in Table 7.

Well ID	Test Date	Pumping Rate (L/s)	Duration (hrs)	Drawdown (m)	Specific Capacity (L/s/m)
	May 1976	41.7	24	10.1	4.1
	May 1976	33.0	_ (1)	5.59	5.9
	March 2009	34.0	_ (1)	~9.9	3.4
STO PW3	March 2011 (post- rehab)	34.1	1	8.10	4.2
	June 2016	32.9	1	9.88	3.3
	Jan 2017 (post-rehab)	33.0	1	8.79	3.8

Table 7: PW3 Specific Capacity

Note:

(1) Step test duration not specified in reports provided to Golder.

PW3 has a history of iron plugging and deterioration in well performance. Each successive rehabilitation resulted in poorer improvement in performance.

Based on the most recent performance testing (1 hour step test), PW3 can sustain the permitted rate of 34.1 L/s for at least short-durations (with approximately 5 m of available drawdown remaining above the pump intake), following rehabilitation. However, in July 2016 (pre-rehabilitation), a groundwater elevation of 270 masl was observed at PW3 (approximately 1 m above the pump intake) with an average daily production rate of 34 L/s.

Figure 5B shows the groundwater level at PW3 projected to 2041 using a linear regression, based on daily datalogger readings in the production well. This projection shows a water level decline of approximately 1 m every 6 years (a 2 m decline by 2032). This 2 m decline by 2032 could result in the well not being able to achieve its maximum permitted rate of 34.1 L/s. By 2041, the maximum pumping rate may be approximately 28 L/s, assuming the continued deterioration of well performance.

The well therefore is at risk of not meeting its maximum permitted rate of 34.1 L/s, if the well is not frequently rehabilitated and if the observed deterioration of well specific capacity continues.

As recommended by IWS, a well performance test should be conducted every 2-3 years and an intermediate rehabilitation could be conducted between scheduled maintenance (i.e. more frequently than every 5 years) in an attempt to restore the well's performance.

3.1.4 Stouffville PW5

The following provides a summary of well performance testing and rehabilitation completed at the well:

- Well PW5 was constructed in 1960 by C.H. Rutledge;
- The well was step-tested in 2007 by IWS and in 2013 by York Region and GDE; and
- Well rehabilitation, including casing and screen brushing, chemical treatment (acidification and disinfection) and air-lifting, and inspection video was conducted in 2013 by Gerrits Drilling & Engineering (GDE).

The results of the performance testing and specific capacity values are shown in Table 8.

Table 8: PW5 Specific Capacity

Well ID	Test Date	Pumping Rate (L/s)	Duration (hrs)	Drawdown (m)	Specific Capacity (L/s/m)
	March 1960	44.2	48	4.0	11.1
	October 2007	26	_(1)	1.30	20.0
STO PW5	April 2013	25.5	1	1.12	22.8
	August 2013 (post- rehab)	25.5	1	1.11	23.0

Note:

(1) Step test duration not specified in reports provided to Golder.

The specific capacity values at well PW5 continue to improve when comparing recent and past step tests. The well was rehabilitated in 2013 to address buildup of debris in the casing identified from a well inspection video.

At PW5, the theoretical yield for the screen is 46 L/s, which is not a constraint in the well meeting its permitted rate of 36 L/s, however, the well yield is limited due to the shallow depth of the well.

The pump is positioned within the screen at PW5, and it is recommended that the pumped water level not exceed the top of the well screen. The production at PW5 is limited by the available drawdown above the top of the screen (~4 m).

Based on the most recent step testing data (August 2013), approximately 1 m of drawdown was observed after an hour of pumping at the tested rate of 25.5 L/s. In June 2016, a groundwater level of 303 masl was observed (~3 m of drawdown) at an average daily production rate of 33 L/s, leaving only 1 m of available drawdown remaining above the well screen.

Based on the step testing results, the well appears to be capable of supplying 25.5 L/s without dropping the pumping level below the top of the well screen. This capacity of 25.5 L/s for PW5 is assuming that PW6 is pumping at its estimated capacity of 23 L/s (see Section 3.1.5) for a combined total of 48.5 L/s. However, long-term testing at this rate is needed to confirm sustainable rates for both wells PW5 and PW6.

It is recommended that a 72-hour pumping test be conducted at wells PW5 and PW6. The assessment of long-term capacity for well PW5 should take into account the results of the pumping test when available.

3.1.5 Stouffville PW6

The following provides a summary of well performance testing and rehabilitation completed at the well:



- Well PW6 was constructed in 1966 by Faulkner Well Drilling Co. Ltd;
- Step-tested in 2007 by IWS, in 2011, 2012 and 2016 by York Region and again in 2017 by IWS; and
- Well rehabilitation including casing and screen swabbing. Sonar-Jet and surfactant treatment and air-lifting and inspection video conducted in 2012 and 2017 by IWS.

The results of the performance testing and specific capacity values are shown in Table 9.

Table 9: PW6 Specific Capacity

Well ID	Test Date	Pumping Rate (L/s)	Duration (hrs)	Drawdown (m)	Specific Capacity (L/s/m)
	1966	22.2	48	15.5	1.4
	May 2007	21.0	-	8.95 ⁽¹⁾	2.4 ⁽¹⁾
	October 2011	21.0	-	21.0 ⁽¹⁾	1.0 ⁽¹⁾
STO PW6	March 2012 (post- rehab)	22.7	1	8.98	2.5
		21.0	-	8.25 ⁽¹⁾	2.6 ⁽¹⁾
	October 2016	21.0	1	10.16	2.1
	November 2017 (post-rehab)	22.7	1	9.89	2.3

Note:

(1) Interpolated value based on step tests at different rates.

PW6 has a history of bio/mineral deposition, and the well has been rehabilitated on two occasion to improve well performance.

The theoretical yield for the screen at PW6 is 34 L/s, which is not a constraint in the well meeting its permitted rate of 26.5 L/s, however the yield is limited due to the shallow depth of the well. Groundwater level trends have been fairly stable at PW6 and nearby monitoring well MW6, with static levels consistently close to 304 masl (13 m of available drawdown) for the last 5 years.

The pump is positioned within the screen at PW6 and it is recommended that the pumped water level not exceed the top of screen (291 masl). The production at PW6 is limited by the available drawdown (~13 m).

Based on the recent step testing data, approximately 10 m of drawdown was observed after an hour of pumping at the tested rate of 22.7 L/s in November 2017 (post-rehabilitation) and 21.0 L/s in October 2016 (prerehabilitation). Groundwater elevations of 291 masl (0 m of remaining drawdown) have been observed at an average daily production rate of approximately 24 L/s.

Based on the step testing results, the well appears to be capable of supplying 23 L/s without dropping the pumping level below the top of the well screen. This capacity of 23 L/s for PW6 is assuming that PW5 is pumping at its estimated capacity of 25.5 L/s (see Section 3.1.4) for a combined total of 48.5 L/s. However, long-term testing at this rate is needed to confirm sustainable rates for both wells PW5 and PW6.



It is recommended that a 72-hour pumping test be conducted at wells PW5 and PW6. The assessment of long-term capacity for well PW6 should take into account the results of the pumping test when available.

4.0 GROUNDWATER QUALITY ASSESSMENT

Raw groundwater quality results for production wells and monitoring wells from 2008 to 2019 were provided by York Region. The results were compared to the Ontario Drinking Water Quality Standards, Objectives and Guidelines (ODWS), Ontario Regulation 169/03 under the Safe Drinking Water Act, 2002.

Parameters of concern were identified based on the 2019 Municipal Drinking Water Licence Renewal (MDWL), Raw Water Assessment (York Region, 2019a), which analyzed water quality data for 2014 to 2018. Parameters, including manganese, iron, sodium and chloride had elevated concentrations or increasing trends at well PW3. Nitrate concentrations show increasing trends at PW5. For the current assessment, the above noted parameters were plotted for all five production wells using the entire dataset (2008 to 2019) and trends were projected out to the EA planning horizon (2041). Manganese, iron, sodium, chloride and nitrate concentrations were also plotted for the monitoring wells (2008 to 2019, where reported). With the exception of nitrate (sampled quarterly), the parameters of concern were sampled once per calendar year. All groundwater quality projections were estimated using a linear regression that took into account the entire dataset. Concentrations below the laboratory method detection limit (MDL) were plotted as their respective MDL. The groundwater quality assessment was based on a limited data set and continued long-term groundwater quality monitoring is recommended to improve reliability of projections and reduce the effect of outlier data.

4.1 Manganese

The current aesthetic objective (AO) for manganese (Mn) in drinking water is 0.05 mg/L due to staining and taste, and there is currently no maximum acceptable concentration (MAC) prescribed under the ODWS. An AO of 0.02 mg/L is proposed for total manganese in drinking water, and a health-based MAC of 0.12 mg/L is also proposed for total manganese in drinking water by Health Canada.

Figure 8 shows the reported concentrations of manganese in raw groundwater sampled from each Stouffville Production Well from 2008 to 2019 and projected to 2041. With the exception of exceedances in 2008, PW3 is the only production well that exceeds the current AO for manganese. Manganese concentrations at PW1 and PW2 were typically found to be between 0.02 and less than 0.05 mg/L, and concentrations at PW5 and PW6 were consistently below 0.02 mg/L. The following are noteworthy based on the trend analysis:

- PW1 and PW2 will continue to exceed the proposed AO and PW1 is projected to exceed the current AO in 2032. PW1 and PW2 are not projected to exceed the proposed MAC by 2041.
- PW3 will continue to exceed the proposed AO and is projected to exceed the proposed MAC by 2040.
- PW5 and PW6 are not projected to exceed the proposed AO before 2041.

4.2 Iron

The current AO for iron (Fe) is 0.3 mg/L due to staining and taste, and there is currently no maximum acceptable concentration (MAC) prescribed under the ODWS.

Figure 9 shows the reported concentrations of iron in raw groundwater sampled from each Stouffville Production Well from 2008 to 2019 and projected to 2041

PW3 consistently exceeds the current AO for iron, and all other production wells have exceeded the AO on one or more occasions. Iron concentrations at PW1 and PW2 fluctuate above and below the current AO. With the exception of 2017 data, all reported iron concentrations for PW5 and PW6 were at or below 0.1 mg/L. Although, Figure 9 indicates PW5 is projected to exceed the AO for iron by 2035, this trendline is influenced by the 2017 data. Subsequent iron concentrations were lower and comparable to typical levels measured since 2008, which have been below the AO.

4.3 Sodium

The current AO for sodium (Na) is 200 mg/L, and there is currently no maximum acceptable concentration (MAC) prescribed under the ODWS. However, the local Medical Officer of Health should be notified when the sodium concentrations exceed 20 mg/L, so that this information may be passed on to local physicians.

As shown on Figure 10, the reported concentrations of sodium in raw groundwater from 2008 to 2019 have not exceeded the AO for sodium at any of the Stouffville Production Wells. By 2041, none of the production wells are projected to exceed the current AO for sodium.

4.4 Chloride

The current AO for chloride (CI) is 250 mg/L at which it produces a detectable salty taste, and there is currently no maximum acceptable concentration (MAC) prescribed under the ODWS.

As shown on Figure 11, the reported concentrations of chloride in raw groundwater from 2008 to 2019 have not exceeded the AO for chloride at any of the Stouffville production wells. Only PW3 is projected to exceed the current AO for chloride in 2035.

4.5 Nitrate

The current health-based MAC for nitrate is 10 mg/L.

As shown on Figure 12, the reported concentrations of nitrate in raw groundwater from 2008 to 2019 have not exceeded the MAC for nitrate at any of the Stouffville Production Wells. By 2041, none of the production wells are projected to exceed the current MAC for nitrate. Between 2017 and 2019, several results at PW3 were below an elevated MDL of 2.5 or 5 mg/L. In 2017 and 2018, two results at PW5 were below an elevated MDL of 5 mg/L. For the purposes of projecting concentrations, anomalous non-detect data points that were above historical reportable concentrations were removed from Figure 12.

4.6 Monitoring Well Groundwater Quality

Figure B-1 to B-10, in Appendix B, shows the reported concentrations of manganese, iron, sodium, chloride and nitrate in raw groundwater sampled from ORAC and TAC monitoring wells in 2008 to 2019 (where reported).

- MW1, MW2 (no data), MW8D, and MW15 are proximal to PW1 and PW2, screened within the TAC:
 - Concentrations of manganese were generally above the proposed AO and below the current AO. It should be noted that MW15 (ID "MW15-NP") had a reported manganese concentration near the proposed MAC in 2015 (0.11 mg/L);

- Concentrations of iron at all three monitoring wells were generally near or above the current AO, with the highest concentration observed at MW8D in 2009 (1.99 mg/L);
- Concentrations of sodium and chloride at all three monitoring wells were below the current AO;
- Concentrations of nitrate at all three monitoring wells were below the current MAC;
- The concentration trends for parameters of concern at these monitoring wells are generally consistent with trends observed at PW1 and PW2. The groundwater quality at these monitoring wells appears representative of the source aquifer. Specifically, the TAC has naturally occurring manganese and iron.
- MW3, MW7, MW9, and MW22 are proximal to **PW3**, screened within the **ORAC**:
 - At MW3 concentrations of manganese were consistently above the current AO. Concentrations of manganese at MW7 and MW9 were near or above the proposed AO. MW22 exceeded the proposed MAC for manganese on multiple occasions (maximum reported concentration of 0.72 mg/L);
 - Concentrations of iron at all four monitoring wells were generally above the current AO, with the highest concentration observed at MW9 in 2008 (2.32 mg/L);
 - The concentration trends for parameters of concern at these monitoring wells (except MW22) are generally consistent with trends observed at PW3. The groundwater quality at MW3, MW7 and MW9 appears representative of the source aquifer (elevated manganese and iron).
 - MW22 shows anomalously high sodium and chloride concentrations;
 - Concentrations of sodium at MW22 ranged from 597 to 950 mg/L (current AO of 200 mg/L);
 - Concentrations of chloride at MW22 ranged from 914 to 1930 mg/L (current AO of 250 mg/L);
 - MW3, MW7 and MW9 had reported sodium and chloride concentrations below the current AO;
 - Concentrations of nitrate at all four monitoring wells were below the current MAC.
- MW4, MW5, MW6, and MW11S are proximal to **PW5 and PW6**, screened within the **ORAC**:
 - Concentrations of manganese at all four monitoring wells were generally below the proposed AO;
 - Concentrations of iron at all four monitoring wells were generally below the current AO, except for 2017 values (MW4 and MW5);
 - Concentrations of sodium and chloride at all four monitoring wells were below the current AO;
 - Concentrations of nitrate at MW4 were above the current MAC in 2008 and 2010 (10.9 and 10.4 mg/L, respectively), and the other three monitoring wells were below the current MAC;
 - The concentration trends for parameters of concern at these monitoring wells are generally consistent with trends observed at PW5 and PW6. The groundwater quality at these monitoring wells appears representative of the source aquifer, with the exception of nitrate concentrations at MW4.
- Stouffville monitoring wells further away from the municipal production wells:



- Other than MW22, the highest reported concentrations of manganese occurred at MW21 (TAC, maximum concentration of 0.17 mg/L in 2017) and MW28S (ORAC, 0.19 mg/L in 2017), versus the proposed MAC of 0.12 mg/L. Manganese exceedances above the proposed AO were reported at ORAC wells MW13 and MW36S, and TAC wells MW18, MW23 and MW36D.
- The highest reported concentrations of iron occurred at MW21 (TAC, 3.46 mg/L reported in 2014), and MW36S (ORAC, 5.54 mg/L in 2013), versus the current AO of 0.3 mg/L. Iron exceedances were also reported at MW16 (ORAC) and TAC wells MW11D, MW18, MW23 and MW36D.
- Other than MW22, the highest reported concentrations of sodium and chloride occurred at MW11D (TAC, 716 mg/L for sodium and 1700 mg/L for chloride, reported in 2011 which was the last reported date). The current AO for sodium and chloride are 200 and 250 mg/L, respectively. Sodium exceedances were also reported at MW28S (ORAC), and chloride exceedances were reported at ORAC wells MW28S, MW36S and MW39S.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The following table provides a summary of the results of the assessment of well capacity and groundwater quality at the five Stouffville municipal wells.

Well ID	PTTW Rate (L/s)	Well Capacity Constraints	Groundwater Quality Constraints
STO PW1	34.1	 Capable of producing the permitted rate of 34.1 L/s for the EA planning horizon (2041) 	 Exceeds proposed AO for Mn Projected to exceed current AO for Mn in 2032 Previously exceeded the AO for Fe, with increasing trend
STO PW2	34.1	 Capable of producing the permitted rate of 34.1 L/s for the EA planning horizon 	 Exceeds proposed AO for Mn Previously exceeded the AO for Fe, with increasing trend
STO PW3	34.1	 Currently capable of producing 34.1 L/s At risk of not being able to sustain 34.1 L/s due to declining well yield and need for frequent rehab over EA horizon 	 Exceeds current and proposed AO for Mn, and current AO for Fe Projected to exceed proposed MAC for Mn by 2040 Projected to exceed the AO for CI in 2035
STO PW5	36.0	 Constrained by shallow well depth Appears capable of producing 25.5 L/s for the EA horizon Long-term testing is needed to confirm capacity 	 Fe concentrations above AO noted in 2017; however, subsequent concentrations were lower, comparable to typical levels measured since 2008
STO PW6	26.5	Constrained by shallow well depth	 Fe concentrations above AO noted in 2017; however, subsequent concentrations were lower,

Table 10: Stouffville Well Capacity and Groundwater Quality Summary

Well ID	PTTW Rate (L/s)	Well Capacity Constraints	Groundwater Quality Constraints
		 Appears capable of producing 23 L/s for EA horizon with frequent rehabilitation Long-term testing is needed to confirm capacity 	comparable to typical levels measured since 2008

A 72-hour pumping test is recommended at wells PW5 and PW6 to better define the long-term well capacity of these supply wells.

The program of well performance testing and rehabilitation should continue to monitor and correct potential well yield declines particularly at wells PW3, PW5 and PW6.

Given the well capacity constraints identified above (PW3, PW5 and PW6) and the water quality constraints, a groundwater exploration program is recommended to investigate additional sources of supply in order to maintain the currently permitted total capacity of the Stouffville well system through the EA planning horizon to 2041.

The groundwater quality assessment was based on a limited data set and continued long-term groundwater quality monitoring is recommended to improve reliability of projections and reduce the effect of outlier data.



Signature Page

Golder Associates Ltd.

Joslan

John ha

John Easton, M.Sc., P.Geo Senior Hydrogeologist, Associate

John Piersol, M.Sc., P.Geo Senior Hydrogeologist, Associate

AS/JS/JP/ng/ly

Golder and the G logo are trademarks of Golder Associates Corporation

https://golderassociates.sharepoint.com/sites/13234g/5000 hydrogeology/report/rev1/1668667-5000-rev1-2april2020-stouffville hydrogeological report.docx



REFERENCES

- Gerrits Drilling & Engineering Ltd, 2013. Stouffville Well 5 2013 Well Rehabilitation and Testing, submitted September 16, 2013.
- International Water Supply Ltd (IWS), 2011. Stouffville Well No. 3 Well and Pump Maintenance, submitted April 11, 2011.
- International Water Supply Ltd (IWS), 2012. Rehabilitation of Stouffville Well No. 6, submitted May 30, 2012.
- International Water Supply Ltd (IWS), 2017. Stouffville Well No. 3 Well and Pump Maintenance, submitted June 20, 2017.
- International Water Supply Ltd (IWS), 2018. Stouffville Well No. 6 Well and Pump Maintenance, submitted May 4, 2018.
- York Region, 2013a. Stouffville PW5 Step Test Conducted on April 18, 2013. Internal memorandum submitted April 26, 2013.
- York Region, 2013b. Stouffville PW2 Step Test Conducted on June 25, 2013. Internal memorandum submitted July 11, 2013.
- York Region, 2016a. Stouffville PW 3 Well Performance Test (June 7, 2016). Internal memorandum submitted July 11, 2016.
- York Region, 2016b. Stouffville PW6 Step Test Conducted on October 19, 2016. Internal memorandum submitted October 28, 2016.
- York Region, 2017. Stouffville Local Groundwater Flow Model Presentation Report, dated March 20, 2017.
- York Region, 2018. Stouffville PW1 Step Test Conducted on March 2, 2018. Internal memorandum submitted April 10, 2018.
- York Region, 2019a. 2019 Municipal Drinking Water Licence Renewal Raw Water Assessment, submitted July 2019.
- York Region, 2019b. Stouffville Production Well Raw Water Quality Data, 2008 2018, received July 31, 2019.
- York Region, 2019c. Stouffville Monitoring Well Raw Water Quality Data, 2008 2018, received July 31, 2019.
- York Region, 2019d. Stouffville Hydrographs and Production Volumes, 2019, received August 15, 2019.
- York Region, 2019e. Stouffville Production Well Raw Water Quality Data, 2019, received August 15, 2019.
- York Region, 2019f. Stouffville Monitoring Well Raw Water Quality Data, 2019, received August 15, 2019.



FIGURES



AREA IN THE SHEET SIZE HAS BEEN MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN M

























APPENDIX A

Water Well Records – Stouffville Production Wells

Ministry of Environment and Energy	۵۵۰۰۰۰۰۰۰۰۰۰۰۰۰۰۰۰۰۰۰۰۰۰۰۰۰۰۰۰۰۰۰۰۰۰۰	· · · · · · · · · · · · · · · · · · ·	The Ontaric WATE	Water Resourc	es Act ;ORD
Print only in spaces provided. Mark correct box with a checkmark, where applicable	2. <u>11</u> 1 2	6924458	Municipa 690		22 13 24
Coupty or District	Township/Borough/City/	Town Millage	ham & block	k tract survey, etc. Lot	5
Owner's surname	Address	St Nama	bol.	Date completed (7	3 9°8
21 c Zone East	Ing Northing	RC Elevation	RC Basin Code		
	OVERBURDEN AND BED	ROCK MATERIALS (se	e instructions)		4/
General colour Most common material	Other materials		General description	From	To
brown day		0 1 0 1		0	6
trown day	ome sandage	and boulde	rs	6	24
a ravent	ome clay a po	and bach	nd a	37	45
avand a sando	once survey -	mache	d.	45	65
day a grave	L	hard		65	148
clay	andy, grave	labldhs p	ached	148	236
quy day	some gravel	shd	sy hard	236	279
guy day	1	hand	6.0	279	293
greiz daig	some gravel	hard	straky	295	306
31 Jana C	me day a gra	ver. pach			
41 WATER RECORD 51 Water found	CASING & OPEN HOL	E RECORD Depth - feet	Sizes of opening (Slot No.)	31-33 Diameter 54-38 Leng	th 39 4
at - feet Vind of Water diam inches	Steel 12	From To 13-16	Material and type	Depth at top	of screen 3
2 Satty 4 Gas Gas 15-18 ; Fresh 3 Sulphur 19 24	2 Galvanized 3 Concrete 4 Open hole 3 Open hole	+2 200	" st. st. wire	wrap 310) _{feet}
2 □ Salty 6 □ Minerals 2 □ Salty 6 □ Gas 20-21 c □ Freeb 3 □ Sulphur 24 17-18	5 Plastic	20-23	61 PLUGGIN	e C Abandonn	l D 1ent
2 Salty 6 Gas 1/2	2 Galvanized 3 Concrete 4 Open hole 9 Blactic	260 30	Depth set at – feet From To Mat	erial and type (Cement grout, b	entonite, etc.
25-28 1 Fresh 3 Support 25 2 Salty 4 Minerals 6 Gas 24-25	1 Steel 26 2 Galvanized	27-30	325 278 Mo	irc #3 silica	grave
30-33 1 □ Fresh 3 □ Sulphur ³⁴ ⁶⁰ 2 □ Salty 4 □ Minerals 6 □ Gas	 Concrete Open hole Plastic 		26-29 30-33 80	ment grow	•
Pumping test method 10 Pumping rate 11-14	Duration of pumping				/
1 Pump Bailer 450 GPM Static level Water level Water levels Water levels Water levels	Pumping 2 Recovery	In diagram be	elow show distances of	of well from road and lot	ine.
19-21 22-24 15 minutes 30 minutes	45 minutes 60 minutes 32-34 60 minutes 35-37		-, -, 1	1	
feet feet feet feet feet feet	feet 122 feet				
GPM feet Recommended pump type Recommended 43-45	Clear Cloudy Recommended 46-49				
Deep pump setting feet	pump rate GPM	Ju stou	ffulle s/k (Mo	unst.)	
FINAL STATUS OF WELL		Ne Ve	L 17=1	32.1	
Abandoned, insumcients s Deservation well Generation and the second secon	10 Continished 10 Replacement well	↓			
4 L Recharge well s L Dewatering				N	
WATER USE 55-56 ₁ □ Domestic 5 □ Commercial ₂ □ Stock 6 @ Municipal	9 □ Not used			10, 30	
a Irrigation / Public supply 4 Industrial 8 Cooling & air conditioning	9			A.	
				s S	
Rotary (conventional) Generational Generational Generational Generation	10 Digging 11 Other			15659	1
]		T0000	
Name of Well Contractor	Well Contractor's Licence No.	Data 58 source	2801	JUL 0 7 1	998 63-68
PO, Box 310 Barrie Out		Date of inspection	Inspector		
Name of Well Technician	Well Technician's Licence No.	Remarks	I	000 Å	
Signature of Technician/Contractor	Submission date	NIN WINI		USS. (59	
	I				A

0506 (07/94) Font

Form 9

Z - MINISTRI OF ENVIRONMENT & ENERGI COFT	2 - MINISTRY	OF	ENVIRONMENT	&	ENERGY	COPY
---	--------------	----	-------------	---	--------	------

Print only in spa Wark correct bo	aces provided. x with a checkmark, where appli	icable.	692445	8 Municipality		
County or Distant	•	Townshin/Borough/Ci	SHEET 2 C	DF 2	survey, etc. Lot	
Tothe	L Eiset name	former	sonshipd Nb	usham X	3	5_
Region	21 York - Sta	sffville 17250 9	longe St. No	what let. Date comp	bleted 1 3	nth
21 21	ی Zone ۲ ــــــــــــــــــــــــــــــــــــ	Basting Northing	RC Eleva 24 25 26		#2	
	LOG	OF OVERBURDEN AND B	EDROCK MATERIALS (see instructions)	Dep	oth – fe
General colour	Most common material				306	™ 32
<u>A</u>	graved for	Sand Son	c cray		327	33
quy	Charg	Surving				
31						
32				54 Sizes of opening 31-33	65 Diameter 34-38 Lengt	<u>ц</u> ħ
41 WA Water found at - feet	Kind of water diam	de Wall n Material thicknes	Depth - feet	(Slot No.)	inches	
10-13	Eresh 3 Sulphur 14		110111 10	Material and type	Depth at top of	of scre
2	☐ Salty 4 ☐ Minerals		13-16	No.		
15-18 1	□ Salty 4 □ Minerals □ Salty 6 □ Gas □ Fresh 3 □ Sulphur 19 □ Salty 4 □ Minerals	2 Galvanized 3 Concrete 4 Open hole 5 Plastic				fee D
15-18 1 2 20-23 1	3 Satty 6 Gas □ Fresh 3 Sulphur 19 □ Satty 6 Gas Gas □ Satty 6 Gas Gas □ Fresh 3 Sulphur 19 4 Minerals 6 Gas □ Fresh 3 Sulphur 24 □ Fresh 3 Sulphur 24	1 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 17-18 1 2 Galvanized 2 Galvanized	20-23	61 PLUGGING & S Annular space Depth set at - feet	SEALING RECOR	fee D ent
2 15 18 1 2 20-23 1 2 25-28 1	3 Salty 6 Gas Fresh 3 Sulphur 19 Salty 6 Gas Fresh 3 Sulphur 19 Fresh 3 Sulphur 19 Fresh 3 Sulphur 24 Salty 6 Gas 6 Fresh 3 Sulphur 24 Salty 6 Gas 6 Fresh 3 Sulphur 29	1 Ocalivanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 17-18 1 2 Galvanized 3 Concrete 4 Open hole 5 Plastic	20-23	61 PLUGGING & S Annular space Depth set at - feet From To 10-13 14-17	SEALING RECOR	fee D ent entonite
2 15 18 1 20-23 1 20-23 1 2 25-28 1 2 30-33 1	i Salty 6 Gas i Fresh 3 Sulphur 19 i Salty 6 Gas intereals i Salty 6 Gas intereals i Fresh 3 Sulphur 19 i Salty 6 Gas intereals i Fresh 3 Sulphur 29 i Salty 4 Minereals 6 i Fresh 3 Sulphur 29 i Salty 4 Minereals 2 i Gas 2 2 2 i Fresh 3 Sulphur 34 i Gas 2 2	1 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 10 Steel 2 Galvanized 3 Concrete 4 Open hole 5 Plastic	20-23	61 PLUGGING & S	SEALING RECOR	fee D ent entonite
2 15 18 1 2 20-23 1 2 25-28 1 2 30-33 1 2	i Salty 6 Gas i Salty 6 Gas i Fresh 3 Sulphur 19 i Salty 6 Gas interals i Fresh 3 Sulphur 19 i Salty 6 Gas interals i Fresh 3 Sulphur 24 i Minerals 6 Gas interals i Fresh 3 Sulphur 29 i Salty 6 Gas 2 i Fresh 3 Sulphur 29 i Salty 6 Gas 2 i Fresh 3 Sulphur 4 i Minerals 6 Gas 2	1 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 17-18 1 Steel 19 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 Steel 26 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 Steel 26 3 Concrete 4 Open hole 5 Plastic 2 Plastic	20-23	61 PLUGGING & S	SEALING RECOR	fee D ent entonite
2 15 18 1 2 20-23 1 2 25-28 1 2 30-33 1 2 71 Pumping test 71 □ Pump 2	a Minerals a Salty Gas Fresh 3 Sulphur 19 Salty Gas Gas Fresh 3 Sulphur 19 Fresh 3 Sulphur 19 Fresh 3 Sulphur 24 Salty Gas Gas 1 Fresh 3 Sulphur 29 Salty Gas Gas 2 Fresh 3 Sulphur 29 Salty Gas 6 Gas 2 Fresh 3 Sulphur 34 6 Salty Gas 2 2 3 3 Salty Gas 6 Gas 2 Presh 3 Sulphur 34 60 60 Salty 6 Gas 60 60 60 Salty 6 Gas 60 60 60 a Interals 6 Gas 60 60 a Bailer	1 Ocalivanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 17.18 1 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 24.25 1 24.25 1 3 Concrete 4 Open hole 5 Plastic	20-23 27-30	61 PLUGGING & S Depth set at - feet Material and From To 10-13 14-17 18-21 22-25 26-29 30-33 B0 Depth Set	SEALING RECOR Abandonm d type (Cement grout, be	fee D entonite
2 15 18 1 2 20-23 1 2 25-28 1 2 30-33 1 2 71 Pumping test 71 Pumping test 5 tatic level	i Salty i Minerals 6 Gas 7 Fresh 3 Sulphur 19 3 Sulphur 19 i Minerals 6 Gas Gas i iiinerals 6 Gas Gas iiinerals iiiinerals 6 Gas Gas iiiinerals iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii	1 Ocalvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 17-18 1 Steel 19 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 Steel 26 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 21-25 1 Steel 26 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 10 Pure hole 5 Plastic 11-14 Duration of pumping Junited GPM	20-23 27-30 27-30 In diagram Indicate no	61 PLUGGING & S Depth set at - feet Material and From To 10-13 14-17 18-21 22-25 26-29 30-33 BOD Depth set at - feet Depth set at - feet Material and 10-13 14-17 18-21 22-25 26-29 30-33 BOD DOCATION OF WEL below show distances of well orth by arrow.	SEALING RECOR Abandonm d type (Cement grout, be L 生 I from road and lot li	fee D ent entonite
2 15 18 1 2 20-23 1 2 25-28 1 2 30-33 1 2 71 Pumping test 71 Pumping test 1 □ Pumping Static level 19-21	a Minerals a Salty Gas Fresh 3 Sulphur 19 Salty Gas Gas Fresh 3 Sulphur 19 Salty Gas Gas Fresh 3 Sulphur 24 Salty Gas Gas Fresh 3 Sulphur 29 Salty Gas Gas 2 Fresh 3 Sulphur 29 Salty Gas Gas 2 Fresh 3 Sulphur 24 Minerals Gas Gas 2 Salty Gas Gas 2 Salty Gas Gas 2 Salty Gas Gas 2 Salty Gas Gas 2 Minerals Gas Gas 2 Salty Gas Sulphur 34 Water level Pumping rate 2 30 minu 22-24 15 minutes 30 minu 26-28 </td <td>1 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 17.18 1 Steel 19 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 Steel 26 2 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 2 Galvanized 2 Galvanized 2 Plastic 10 Puration of pumping Units Min 11-14 Duration of pumping Min Min 1 Pumping 2 Recover 11-14 Steel 26 60 minutes 29-31 45 minutes 32-34 60 minutes</td> <td>20-23 27-30 27-30 In diagram Indicate no</td> <td>61 PLUGGING & S Depth set at - feet Material and From To 10-13 14-17 18-21 22-25 26-29 30-33 Below show distances of well orth by arrow.</td> <td>SEALING RECOR Abandonm d type (Cement grout, be LL ± 1 from road and lot li</td> <td>fee D ent entonite</td>	1 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 17.18 1 Steel 19 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 Steel 26 2 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 2 Galvanized 2 Galvanized 2 Plastic 10 Puration of pumping Units Min 11-14 Duration of pumping Min Min 1 Pumping 2 Recover 11-14 Steel 26 60 minutes 29-31 45 minutes 32-34 60 minutes	20-23 27-30 27-30 In diagram Indicate no	61 PLUGGING & S Depth set at - feet Material and From To 10-13 14-17 18-21 22-25 26-29 30-33 Below show distances of well orth by arrow.	SEALING RECOR Abandonm d type (Cement grout, be LL ± 1 from road and lot li	fee D ent entonite
2 15 18 1 2 20-23 1 2 25-28 1 2 25-28 1 2 30-33 1 1 2 30-33 1 2 30-33 1 1 2 30-33 1 1 1 2 30-33 1 1 1 2 30-33 1 1 1 2 30-33 1 1 1 2 30-33 1 1 1 2 30-33 1 1 1 2 30-33 1 1 1 2 30-33 1 1 1 2 31 1 2 1 1 1 2 1 1 1 2 1 1 1 1 1 1 2 1 1 1 2 1 1 1 2 1 1 1 2 1 1 1 2 1 1 1 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1	a Minerals a Minerals a Salty b Gas c Salty a Sulphur b Gas c Gas c Gas c Gas c Gas c Salty c Gas c <t< td=""><td>1 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 17.18 1 Steel 19 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 Steel 26 2 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 5 Plastic 11-14 Duration of pumping 116 Mill GPM </td><td>20-23 27-30</td><td>61 PLUGGING & S Depth set at - feet Material and From To 10-13 14-17 18-21 22-25 26-29 30-33 Below show distances of well orth by arrow.</td><td>SEALING RECOR Abandonm d type (Cement grout, be</td><td>fee D ent entonite</td></t<>	1 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 17.18 1 Steel 19 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 Steel 26 2 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 5 Plastic 11-14 Duration of pumping 116 Mill GPM	20-23 27-30	61 PLUGGING & S Depth set at - feet Material and From To 10-13 14-17 18-21 22-25 26-29 30-33 Below show distances of well orth by arrow.	SEALING RECOR Abandonm d type (Cement grout, be	fee D ent entonite
2 15 18 1 2 20-23 1 2 25-28 1 2 30-33 1 2 30-33 1 2 30-33 1 2 Static level 19-21 19-	i A Minerals 6 Gas 7 Fresh 3 Sulphur 19 3 Sulphur 19 A Minerals 6 Gas Gas Interals A Minerals 1 Fresh 3 Sulphur 19 A Minerals 1 Fresh 3 Sulphur 24 Minerals B Cas Ca	1 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 17-18 1 Steel 19 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 Steel 26 2 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 2 Galvanized 10 Concrete 4 Open hole 5 Plastic 5 11-14 Duration of pumping 1-16 GPM Hours 5 11-14 Duration of pumping 1-16 GPM Hours 60 minutes 29-31 32-34 60 minutes 29-31 10 10 10 Pumping 2 11 Pumping 2 12 Recover 10 14 10 10 <t< td=""><td>20-23 20-23 27-30 27-30 27-30 27-30 1n diagram Indicate no 5-37 et 42 49</td><td>61 PLUGGING & S Depth set at - feet Material and From To 10-13 14-17 18-21 22-25 26-29 30-33 Below show distances of well orth by arrow.</td><td>SEALING RECOR Abandonm d type (Cement grout, be</td><td>fee D ent entonite</td></t<>	20-23 20-23 27-30 27-30 27-30 27-30 1n diagram Indicate no 5-37 et 42 49	61 PLUGGING & S Depth set at - feet Material and From To 10-13 14-17 18-21 22-25 26-29 30-33 Below show distances of well orth by arrow.	SEALING RECOR Abandonm d type (Cement grout, be	fee D ent entonite
2 15 18 1 2 20-23 1 2 25-28 1 2 25-28 1 2 30-33 1 2 30-33 1 1 2 30-33 1 1 1 2 30-33 1 1 1 2 30-33 1 1 2 30-31 1 1 2 30-31 1 1 2 30-31 1 1 2 30-31 1 1 2 30-31 1 1 2 30-31 1 1 2 30-31 1 1 2 30-31 1 1 1 2 30-31 1 1 1 2 30-31 1 1 1 2 30-31 1 1 1 1 1 1 1 1 1 1 1 1 1 1	i A Minerals i Gas i Fresh 3 Sulphur 19 i Salty Gas i Minerals i Salty Gas i inerals i Salty Gas i inerals i Salty Gas i inerals i Fresh 3 Sulphur 19 i Salty Gas i inerals i Salty Gas i inerals i Salty Gas i i i Salty Gas i i i Salty Gas i i i Salty Gas i i i i Salty Gas i i i i i Salty Gas i i i i i i Salty Gas i i i i i i i <td< td=""><td>1 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 17-18 1 Steel 19 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 Steel 26 2 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 5 Plastic 11-14 Duration of pumping 10 10 12 Pumping 2 Recover 11-14 Duration of pumping 10 10 11 Pumping 2 Recover 10 11 Pumping 2 Recover 10 12-31 feet feet feet feet 19 Clear Cloudy 10 10 43-45</td><td>20-23 27-30</td><td>61 PLUGGING & S 0 Annular space Depth set at - feet Material and From To 10-13 14-17 18-21 22-25 26-29 30-33 Below show distances of well orth by arrow.</td><td>SEALING RECOR Abandonm d type (Cement grout, be</td><td>fee D ent entonite</td></td<>	1 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 17-18 1 Steel 19 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 Steel 26 2 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 5 Plastic 11-14 Duration of pumping 10 10 12 Pumping 2 Recover 11-14 Duration of pumping 10 10 11 Pumping 2 Recover 10 11 Pumping 2 Recover 10 12-31 feet feet feet feet 19 Clear Cloudy 10 10 43-45	20-23 27-30	61 PLUGGING & S 0 Annular space Depth set at - feet Material and From To 10-13 14-17 18-21 22-25 26-29 30-33 Below show distances of well orth by arrow.	SEALING RECOR Abandonm d type (Cement grout, be	fee D ent entonite
2 15 18 1 2 20-23 1 2 25-28 1 2 25-28 1 2 30-33 1 2 30-33 1 2 30-33 1 2 30-33 1 2 30-33 1 1 1 2 30-33 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii	1 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 11 Steel 19 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 1 Steel 26 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 21-25 1 Steel 26 Galvanized 3 Concrete 4 Open hole 5 9 Plastic 11-14 Duration of pumping 11 Duration of pumping 18 Plastic 19 Pumping 2 10 Pumping 2 11 Pumping 60 minutes 29-31 32-34 60 minutes 19 19 19 19 Recommended 4	20-23 20-23 27-30 27-30 27-30 5-37 et 42 42 42 449 2M	61 PLUGGING & S 61 Annular space Depth set at - feet Material and 10-13 14-17 18-21 22-25 26-29 30-33 Below show distances of well onth by arrow.	SEALING RECOR Abandonm d type (Cement grout, be	fee D ent entonite
2 2 15 18 1 2 20-23 1 2 25-28 1 2 25-28 1 2 30-33 1 2 30-33 1 2 30-33 1 2 30-33 1 2 30-33 1 1 2 30-33 1 1 2 30-33 1 1 2 30-33 1 1 2 30-33 1 1 2 30-33 1 1 2 30-33 1 1 2 30-33 1 1 2 30-33 1 1 2 30-33 1 1 2 30-33 1 1 2 30-33 1 1 2 30-33 1 1 1 2 30-33 1 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	a Minerals a Satty a a Minerals a Satty a b Fresh a Sulphur 19 a Satty a Gas a a Satty a Sulphur 19 b Satty a Gas a b Fresh a Sulphur 20 c Gas a Minerals a a c Fresh a Sulphur 20 a a b Satty a Baller Minerals a a a c Fresh a Sulphur 34 b0 a a a c Satty 6 Gas a <	1 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 11 Steel 19 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 1 Steel 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 11-14 Duration of pumping 15 Plastic 11-14 Duration of pumping 16 Pumping 2 Recover 11 Pumping 11 Pumping 19 Galvanized 19 Gover 10 Pumping 11 Pumping 12 Recover 14 Get 15 Feet 16 Clear 19 Clear 19 10	20-23 20-23 27-30 27-30 5-37 et 42 -49 2M	61 PLUGGING & S Depth set at - feet From To Material and 10-13 14-17 18-21 22-25 28-29 30-33 80 LOCATION OF WEL to below show distances of well both by arrow.	SEALING RECOR Abandonm d type (Cement grout, be	fee D ent entonite
2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	a Minerals a Minerals a Salty b Fresh a Sulphur b Salty a Sulphur b Gas c Gas c Gas c Gas c Salty c Gas c Fresh s Sulphur c Gas c Fresh s Sulphur c Gas c Gas c Salty c Gas	1 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 12 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 1 Steel 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 21 Steel 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 11-14 Duration of pumping 2-31 Steel 60 minutes 29-31 Steel 10 Pumping 29-31 Steel 10 Feet 10 Recowrended 44 pump rate 10 Replacement well 11 Plastic 12 Recommended 14 Get 15<	20-23 20-23 27-30 27-30 27-30 5-37 et 42 -49 2M	61 PLUGGING & S Depth set at - feet From To Material and 10-13 14-17 18-21 22-25 26-29 30-33 80 LOCATION OF WEL to below show distances of well both by arrow.	SEALING RECOR △ Abandonm d type (Cement grout, be L 生 1 from road and lot li	fee p ent ent ntonite ine.
2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	a Minerals a Minerals a Salty b Fresh a Sulphur b Salty a Sulphur b Gas c Gas c Gas c Gas c Fresh s Sulphur c Gas c Fresh s Sulphur c Gas c Gas <t< td=""><td>1 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 11 Steel 12 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 1 Steel 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 21-23 1 Steel 26 Galvanized 3 Concrete 4 4 Open hole 5 Plastic 11-14 Duration of pumping 12 Plastic 19 Pumping 2 19 Pumping 2 19 Pumping 32-34 60 minutes 32-34 19 Geet feet 19 Geet Clear 19 Clear Cloudy 43-45 Recom</td><td>20-23 20-23 27-30 27-30 27-30 27-30 5-37 et 42 2-49 2M S</td><td>61 PLUGGING & S 61 Annular space Depth set at - feet From To Material and 10-13 14-17 18-21 22-25 26-29 30-33 80 LOCATION OF WEL to below show distances of well both by arrow.</td><td>SEALING RECOR △ Abandonm d type (Cement grout, be L 生 1 from road and lot li</td><td>fee p ent ent ntonite</td></t<>	1 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 11 Steel 12 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 1 Steel 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 21-23 1 Steel 26 Galvanized 3 Concrete 4 4 Open hole 5 Plastic 11-14 Duration of pumping 12 Plastic 19 Pumping 2 19 Pumping 2 19 Pumping 32-34 60 minutes 32-34 19 Geet feet 19 Geet Clear 19 Clear Cloudy 43-45 Recom	20-23 20-23 27-30 27-30 27-30 27-30 5-37 et 42 2-49 2M S	61 PLUGGING & S 61 Annular space Depth set at - feet From To Material and 10-13 14-17 18-21 22-25 26-29 30-33 80 LOCATION OF WEL to below show distances of well both by arrow.	SEALING RECOR △ Abandonm d type (Cement grout, be L 生 1 from road and lot li	fee p ent ent ntonite
2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	a Minerals a Minerals a Salty b Fresh a Sulphur a Sulphur b Salty a Sulphur b Gas c Gas c Gas c Fresh a Sulphur c Gas c Fresh a Sulphur b Gas c Gas	1 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 12 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 1 Steel 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 26 Galvanized 3 Concrete 4 Open hole 5 Plastic 11-14 Duration of pumping 2 Recover 11-14 Duration of pumping 11 Pumping 2 12 Pumping 2 13 Gold minutes 29-31 32-34 60 minutes 16eet feet 17 Plastic 18 Galvanized 19 10 10 Replace	20-23 20-23 27-30 27-30 27-30 27-30 5-37 et 42 -49 2M	61 PLUGGING & S 61 Annular space Depth set at - feet Material and 10-13 14-17 10-13 14-17 10-22-25 20-29 20-29 30-33 Bold CATION OF WELL abelow show distances of well borth by arrow.	SEALING RECOR Abandonm d type (Cement grout, be L 生 1 from road and lot li	fee D ent entonite
2 15 18 1 2 20-23 1 2 25-28 1 2 25-28 1 2 30-33 1 2 30-33 1 2 30-33 1 2 30-33 1 2 30-33 1 2 30-33 1 2 30-33 1 2 30-33 1 2 30-33 1 2 30-33 1 2 30-33 1 2 30-33 1 2 30-33 1 2 30-33 1 2 30-33 1 1 2 30-33 1 1 2 30-33 1 1 2 30-33 1 1 2 30-33 1 1 2 30-33 1 1 2 30-33 1 1 2 30-33 1 1 2 30-33 1 1 2 30-3 1 1 1 2 30-3 1 1 2 30-3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	a Minerals a Salty a Balty a Minerals Balty a Minerals Balty a Minerals Balty a Sulphur a Balty a Sulphur a Fresh a Sulphur a Balty a Minerals a Balty a Sulphur a Balty a Minerals a a Gas a a a Sulphur a a a Balty a a a <td>1 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 1 Steel 19 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 Steel 26 2 Galvanized 2 24-25 1 Steel 26 2 Galvanized 2 2 24-25 1 Steel 26 2 Galvanized 2 2 24-25 Galvanized 26 3 Concrete 4 9 GPM Unation of pumping 10 10 11-14 Duration of pumping 11 11 12 Pumping 2 Recover 13 29-31 32-34 60 minutes 29-31 16et feet feet 16 14 Gear Cloudy 4 4 16</td> <td>20-23 20-23 27-30 27-30 27-30 27-30 5-37 et 42 -49 2M</td> <td>61 PLUGGING & S 0 Annular space Depth set at - feet Material and 10-13 14-17 10-13 14-17 10-13 14-17 10-22-25 26-29 26-29 30-33 Bold CATION OF WEL The below show distances of well borth by arrow. Secc</td> <td>SEALING RECOR Abandonm d type (Cement grout, be L 生 1 from road and lot li</td> <td>fee p ent ent onite state ine.</td>	1 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 1 Steel 19 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 Steel 26 2 Galvanized 2 24-25 1 Steel 26 2 Galvanized 2 2 24-25 1 Steel 26 2 Galvanized 2 2 24-25 Galvanized 26 3 Concrete 4 9 GPM Unation of pumping 10 10 11-14 Duration of pumping 11 11 12 Pumping 2 Recover 13 29-31 32-34 60 minutes 29-31 16et feet feet 16 14 Gear Cloudy 4 4 16	20-23 20-23 27-30 27-30 27-30 27-30 5-37 et 42 -49 2M	61 PLUGGING & S 0 Annular space Depth set at - feet Material and 10-13 14-17 10-13 14-17 10-13 14-17 10-22-25 26-29 26-29 30-33 Bold CATION OF WEL The below show distances of well borth by arrow. Secc	SEALING RECOR Abandonm d type (Cement grout, be L 生 1 from road and lot li	fee p ent ent onite state ine.
2 15 18 1 20-23 1 2 25-28 1 2 30-33 1 2 30-33 1 Pumping test 1 19-21 feet If flowing give Recommende 3 FINAL STATL 1 Water si 2 Observ 3 Test hol 4 Recharge Water Nopersi 2 2 3 1 0 4 Industri 1 1 1 1 1 1 2 1 2 2 3 1 1 1 1	a Minerals a Salty a a Salty a b Fresh 3 Sulphur 19 a Minerals a Minerals a a Salty a Minerals a a a Salty a Sulphur 19 a b Fresh 3 Sulphur 29 a a b Salty a Biller a a a a a c Fresh 3 Sulphur 30 a <td< td=""><td>1 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 1 Steel 19 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 Steel 26 3 Concrete 2 Galvanized 3 Concrete 3 Concrete 4 Open hole 5 Plastic 24-25 1 Steel 26 3 Concrete 4 Open hole 5 Plastic Min 11-14 Duration of pumping Min 12 Pumping 2 Recover 14 Pumping 2 Recover 12-5 Hecmmended 4 14 Pumping 2 Recover 15 Recommended 4 16 Recommended 4 19 Infinished 10 <t< td=""><td>20-23 20-23 27-30 27-30 5-37 et 42 -49 2M</td><td>61 PLUGGING & S Annular space Depth set at - feet From To Material and 10-13 14-17 18-21 22-25 26-29 30-33 80 LOCATION OF WELL a below show distances of well both by arrow.</td><td>L ± 1 from road and lot li</td><td>fee p ent entonité ine.</td></t<></td></td<>	1 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 1 Steel 19 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 Steel 26 3 Concrete 2 Galvanized 3 Concrete 3 Concrete 4 Open hole 5 Plastic 24-25 1 Steel 26 3 Concrete 4 Open hole 5 Plastic Min 11-14 Duration of pumping Min 12 Pumping 2 Recover 14 Pumping 2 Recover 12-5 Hecmmended 4 14 Pumping 2 Recover 15 Recommended 4 16 Recommended 4 19 Infinished 10 <t< td=""><td>20-23 20-23 27-30 27-30 5-37 et 42 -49 2M</td><td>61 PLUGGING & S Annular space Depth set at - feet From To Material and 10-13 14-17 18-21 22-25 26-29 30-33 80 LOCATION OF WELL a below show distances of well both by arrow.</td><td>L ± 1 from road and lot li</td><td>fee p ent entonité ine.</td></t<>	20-23 20-23 27-30 27-30 5-37 et 42 -49 2M	61 PLUGGING & S Annular space Depth set at - feet From To Material and 10-13 14-17 18-21 22-25 26-29 30-33 80 LOCATION OF WELL a below show distances of well both by arrow.	L ± 1 from road and lot li	fee p ent entonité ine.
2 15 18 1 2 20-23 1 2 25-28 1 2 30-33 1 2 30-33 1 2 30-33 1 2 30-33 1 2 30-33 1 2 Static level 19-21 <td>□ Salty 6 Gas □ Fresh 3 □ Sulphur 19 □ Salty 6 Gas 1 □ Salty 6 Gas 1 □ Salty 6 Gas 1 □ Fresh 3 □ Sulphur 29 □ Salty 6 Gas 2 □ Fresh 3 □ Sulphur 29 □ Salty 6 Gas 2 □ Fresh 3 □ Sulphur 29 □ Salty 6 Gas 2 □ Fresh 3 □ Sulphur 30 □ Salty 6 Gas 2 □ Salty 6 Gas 2 □ Fresh 3 □ Sulphur 30 0 2 Bailer 2 Water level 30 minu 2 □ Feet Pump intake set at GPM 2 30 minu etat GPM</td> <td>1 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 21 Steel 26 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 Steel 26 20-24-25 1 Steel 26 20-24-25 1 Steel 26 24-25 1 Steel 26 24-25 Plastic 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 60 minutes 28-31 32-34 60 minutes 29-31 32-34 60 minutes 1eet Clear Cloudy 43-45 Recommended 4 pump rate GP Gitioning 9 Not used</td> <td>13-16 20-23 27-30 S Y 5-37 et 42 49 PM S</td> <td>61 PLUGGING & S Depth set at - feet Material and From To 10-13 14-17 18-21 22-25 26-29 30-33 Below show distances of well below show distances of well both by arrow.</td> <td>SEALING RECOR △ Abandonm d type (Cement grout, be L ± 1 from road and lot li 15658</td> <td>fee P ent entonité ine.</td>	□ Salty 6 Gas □ Fresh 3 □ Sulphur 19 □ Salty 6 Gas 1 □ Salty 6 Gas 1 □ Salty 6 Gas 1 □ Fresh 3 □ Sulphur 29 □ Salty 6 Gas 2 □ Fresh 3 □ Sulphur 29 □ Salty 6 Gas 2 □ Fresh 3 □ Sulphur 29 □ Salty 6 Gas 2 □ Fresh 3 □ Sulphur 30 □ Salty 6 Gas 2 □ Salty 6 Gas 2 □ Fresh 3 □ Sulphur 30 0 2 Bailer 2 Water level 30 minu 2 □ Feet Pump intake set at GPM 2 30 minu etat GPM	1 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 21 Steel 26 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 Steel 26 20-24-25 1 Steel 26 20-24-25 1 Steel 26 24-25 1 Steel 26 24-25 Plastic 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 60 minutes 28-31 32-34 60 minutes 29-31 32-34 60 minutes 1eet Clear Cloudy 43-45 Recommended 4 pump rate GP Gitioning 9 Not used	13-16 20-23 27-30 S Y 5-37 et 42 49 PM S	61 PLUGGING & S Depth set at - feet Material and From To 10-13 14-17 18-21 22-25 26-29 30-33 Below show distances of well below show distances of well both by arrow.	SEALING RECOR △ Abandonm d type (Cement grout, be L ± 1 from road and lot li 15658	fee P ent entonité ine.
2 15 18 1 2 2 20-23 1 2 2 25-28 1 30-33 1 2 2 30-33 1 2 2 30-33 1 2 2 30-33 1 2 2 30-33 1 2 Static level Isga 19-21 feet 19-21 feet 14 flowing give Recommende 3 3 Test hol 4 Recharge WATER USE 1 2 Observe 3 Test hol 4 Industri METHOD OF 1 2 Rotary Name of Well Con Name of Well Con	a Minerals a Salty a Balty a Minerals Balty a Sulphur 19 Balty a Sulphur 19 Balty a Sulphur 24 Fresh a Sulphur 24 Balty a Gas 22 Balty a Sulphur 24 Salty a Sulphur 29 Balty a Sulphur 24 Fresh a Sulphur 34 Balty a Balty a a Minerals a a a Gas a a a Minerals a a a Gas a a a Gas a a a Gas a a a Gas a a a Bailer b Water levels during a Bailer b Abandoned, insuff	1 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 1 Steel 19 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 Steel 26 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 11 Duration of pumping 1 Galvanized 3 Concrete 4 Open hole 5 Plastic 1 Steel 26 11-14 Duration of pumping 1 Min 1 Pumping 2 Recover 1tes 45 minutes 60 minutes 28-31 32-34 60 minutes 1eet Clear Cloudy 43-45 Recommended 4 pump rate Gitioning 9 Not used 10 Other 0 11 Other	No. Data source	61 PLUGGING & S Annular space Depth set at - feet Material and 10-13 14-17 18-21 22-25 26-29 30-33 BOCCATION OF WELL below show distances of well both by arrow. Secc Page #	EALING RECOR Abandonm d type (Cement grout, be L ± 1 from road and lot li 15658 Date received JUL 0 7 1	fee D ent entonite ine.
2 15 18 1 2 2 20-23 1 2 2 25-28 1 30-33 1 2 30-33 1 2 30-33 1 2 25-28 1 2 30-33 1 2 25-28 1 Pumping test 1 1 Recommender 2 Observe 3 Test hol 4 Recharge VATER USE 1 1 Domesi 2 2 Stock 3 1 Industri	a Minerals Balty a Minerals Balty a Sulphur 19 Satty a Sulphur 19 Satty a Sulphur 19 Fresh a Sulphur 24 Fresh a Sulphur 24 Satty a Gas 22 Satty a Sulphur 24 Satty a Bailer Water levels during Water level cas 30 minu 22 Bailer Pump intake set at GPM Recommended pump setting Deep a Abandoned, insuff Boandoned, insuff	1 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 1 Steel 19 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 Steel 26 2 Galvanized 2 Galvanized 3 Concrete 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 1 Steel 26 24-25 1 Steel 26 1 GPM Concrete 4 Open hole 5 11-14 Duration of pumping 1 1 Pumping 2 Recover 1tes 45 minutes 32-34 60 minutes 2 1 1tes 45 minutes 160 minutes 2 1 1 1 Clear Cloudy 4 4 4 1 1 Mater at end o	No. No. Data source Date of inspection	61 PLUGGING & S Annular space Depth set at - feet Material and 10-13 14-17 18-21 22-25 26-29 30-33 BO LOCATION OF WELL below show distances of well on the by arrow. Secc Page #	SEALING RECOR Abandonm d type (Cement grout, be L ± 1 from road and lot li 15658 Date received JUL 0 7 1	9
2 15 18 1 2 20-23 1 2 22-23 1 2 25-28 1 30-33 1 2 30-33 1 2 30-33 1 2 Static level 19-21 19-21 feet 20-25-28 feet 20-25-28 feet 20-25-29 feet 20-25-29 feet 20-20-20 feet 20-20-20 feet 20-20-20 feet 20-20-20<	a Minerals a Salty a Balty a Minerals a Sulphur 19 a Sulphur 19 a Sulphur 14 Balty a Gas a Fresh a Sulphur 24 b Fresh a Sulphur 24 b Salty a Balter 22 a Sulphur 24 a Minerals b Gas a a a a c Gas a a a a a c Gas a a a a a c Gas a a a a a a c Gas a	1 Galvanized 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 11 Steel 19 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 24-25 1 Steel 26 2 Galvanized 3 Concrete 4 Open hole 5 Plastic 11 Duration of pumping 11 12 Pumping 2 Recover 14 Duration of pumping 11 15 Plastic 60 minutes 28-31 32-34 60 minutes 28-31 45 minutes 60 minutes 28-31 45 minutes 60 minutes 29-31 45 minutes 60 minutes 29-31 10 Replacement well 11 0 Replacement well 10 Other 10 11 Other 11 11 Other <	No. No. No. No. No. No. No. Remarks	61 PLUGGING & S Annular space Depth set at - feet Material and 10-13 14-17 18-21 22-25 26-29 30-33 80 LOCATION OF WELL below show distances of well both by arrow.	EALING RECOR Abandonm d type (Cement grout, be L ± 1 from road and lot li 15658 Date received JUL 0 7 1	9

Environm and Ener	nent gy			and a second sec				WATE	RWEL	LREC	0
Printronly in spa Mark correct box	ces provided. x with a checkmark, whe	re applicable.	4		6924	459	- 2	Municipal 690		DN	1
County or District			Township/Bo	rough/City/T	own/Village	+ Harl	ch and	Con block	tract surve	ey, etc. Lo	1
Owner's surname	28.4/ Firs	st name	Address	101013	in the	<u>, , , , , , , , , , , , , , , , , , , </u>		-L	Date	26 2	
Kigion	of Your - Sto	2 forthe	e 17250	D Yong	<u>re St.</u>	AC Eleval	arkel.	Basin Code	i completed	day m	onth
21 U			ا نینید	18.	24	25 26		لينيا الأسلي	<u> </u>	. <u>.</u>	
0	Need common moto		ERBURDEN	AND BED	ROCK MA	TERIALS (General	ions)		De	pth -
General colour	n Nost common mate	त्र्य		materials						From	F
mon	- day			0					·	m	
moun	craij	sor	negro	wel	1		. 1 1			ر <u>ب</u> ۱ (۲	2
	gravel	son	re glar	1, 49	avel	Cem	ented			22	2
	sandagas	rel sa	ndy	ciay)	pach	h 1			20	
	clay.	sa	nay s	onc q'	land	+ par	Li			X 	5-
	growd	a pan	d vyan	ay a	ay h	di	na.	4		57	1
	da	n an	a son	wo w	Jala A		al. J	4		11.	2
A	dai	June A	Min ge	mude	NUV V >	λ. Γ.	The	hand		738	
yny	any .		mi	undre .	da.	- Jun	hid			302	a
	Surviv F	A	me que		ing	100					
31	· · · · · · · · · · · · · · · · · · ·										.
32							54				, İ
41 WA	TER RECORD	51 Inside	CASING & O	Wall	E RECOR Depth	D - feet	Sizes of (Slot No.)	opening) ([³¹⁻³³ Diameter	34-38 Len	gth
at - feet	Kind of water	diam inches	Material	thickness inches	From	To	Material	AO T and type	12	Depth at top	o of sci
10-13 1 L 2 [Salty 6 ☐ Gas		Galvanized Concrete	201		2-2	st. s	st.	·	316	f
15-18 1 [2 [☐ Fresh 3 ∐ Sulphur 19 ☐ Salty 4 ☐ Minerals 5 Gas		Open hole Plastic	274	+ 4	202	61	PLUGGIN	G & SEALI	NG RECO	RD
20-23 1 [☐ Fresh 3 ☐ Sulphur 24 ☐ Salty 4 ☐ Minerals	17-18 1 💭 2 🗌 3 🗌	Galvanized Concrete			a .	Depth set at	Annular space	rial and type //	Abandonr	nent
25-28 1 [Fresh 3 🛛 Sulphur 29	1Z :	Open hole Plastic	375	\$259	216	From	10 288" N.	xrz # 3	silin	ah
30-33	☐ Saity 6 Gas	24-25 1 2 3 3	Steel 26 Galvanized Concrete			27-30	28 8 1	286° b	entonit	te seo	(
2	□ Salty ₆ □ Gas		Open hole Plastic				286	4 ³⁰⁻³³ 80	imente	nout	
Pumping test r	nethod 10 Pumping rate	450	ration of pumping	17118	À		LO		WELL	2	
Static level	Water level 25 Water leve		mping 2	Recovery	Pn.	In diagram	below show orth by arrow	distances o	f well from r	oad and lot	line.
5 11212	22-24 15 minutes	30 minutes 45	5 minutes 60 32-34	0 minutes						ξž	
	100 feet 141	142 feet	feet	147 _{feet}						30	
	GPM	feet	Clear	Cloudy		L.) 	727'	1 mar 111496 999	10)	
Recommender	a pump type Recommende pump setting Deep	a 43-45 Re pu	ecommended Imp rate	46-49 CP14			المثنية ا			12	
50-53				GPM		5	touffully Interim	= S/K street		town	
FINAL STATU	IS OF WELL 54 apply 5 Abandone	ed, insufficient suppl	ly 🤋 🗌 Unfinishe	ed ment well	-	5	1-am		Lot	27 12	
3 Coserva 3 Test hole 4 Recharg	e well 8 Dewaterin	ed (Other) ng	,			R				8	
WATER USE	. 55-56					¥ +	WELL N	12		107	
2 Domesti 2 Stock	ic 5 GC Commerce 6 Municipa 9 D Diblio and	cial I poly	9 ☐ Not used 10 ☐ Other							6	
₄ □ Industria		air conditioning								R	
METHOD OF		ssion			11						
2 Cable to 2 Rotary (3 Rotary (conventional) ₆ D Boring (reverse) ₇ Diamond	551UN	9 Driving 10 Digging 11 DOther						1	FCFC	20
₄ □ Rotary ((air) ₈ [] Jetting						· · ·-		L	0005	2
Name of Well Con	tractor	۲ ۲	Well Contractor	's Licence No.	Dat.	a rce	58 Contraction	201	59 62 Date re	eceived	100
Address	tronal bate	r Jupply	1082		NO Dat	e of inspection	4	Inspector	JU		177
KO. Po	× 310 Bar	ric On	H . Well Technician'	's Licence No.	SN A Rer	narks	•.		-		
Wind	res		T-0115	5	E E				000	6	

·····

2 - MINISTRY OF ENVIRONMENT & ENERGY COPY

Print or Mark co	nly in spaces provided. orrect box with a checkmark, where applicat	le. 11	69244	459	Municipality Cc	n. Øi N i	
County	or District	Townshin/Boroudh	SHEE //City/Town/Village	T 2 OF 2	TO 14 15	ev, etc. Lot	22 23
15	2h	former to	anship	of Markham	×	'n	55
Owners Ree	von a Jonh - Stouttville	. 17250 Jon	ge St. K	lewmarket.	Date completed	<u>26</u> 2 m	inth ye
21		Isting /Northin		RC Elevation RC	Basin Code II	#	2
<u> </u>		F OVERBURDEN AND	BEDROCK MAT	TERIALS (see instructi	ons)	Der	oth – feel
Genera	al colour Most common material	Other mate	rials	General	description	From	То
	Shavel f-m	sand son	re clay	- 1 1		200	33
	Sandp	some day a	grave	pacria		320	225
	- day	saray goi	t-m	Joanna			
31							
32							
41 Water f	WATER RECORD 51 found inside	CASING & OPEN Wall	HOLE RECORD Depth -	- feet Sizes of o (Slot No.)	pening ³¹⁻³³ Diamete	r ^{34–38} Leng	th f
at - fee	tet Kind of water diam 10-13 1 Fresh 3 Sulphur 14 10-11 10-13 1 Fresh 3 User 14 10-11	Material thickr inche	s From	To H 13-16 G Material a	nd type	Depth at top	of screen
	2 Galty 6 Gas	2 Galvanized 3 Concrete 4 Open hole		S			feet
	2 Gas	5 □ Plastic 1 □ Steel ¹⁹		20-23	PLUGGING & SEAL Annular space	Abandonm	D Ient
	2 Salty 6 Gas	2 Galvanized 3 Concrete 4 Open hole		Depth set at - From	To Material and type (Cement grout, b	entonite, e
	23-28 1 □ Fresh 3 □ Sulphur 29 2 □ Salty 4 □ Minerals 6 □ Gas 24-25	1 Steel 26 2 Galvanized		27-30 18-21	22-25		
	30-33 (☐ Fresh 3 ☐ Sulphur ³⁴ 60 4 ☐ Minerals 2 ☐ Salty 6 ☐ Gas	3 Concrete 4 Copen hole		26-29	30-33 80		
Pu	Imping test method 10 Pumping rate 11-1	Duration of pumping	7-18				
71. 👌 🗆 Sta	Pump 2 Bailer GPN atic level 2 ²⁹ Water levels during	Pumping 2 Reco	/lins very	In diagram below show Indicate north by arrow.	distances of well from	road and lot l	ine.
LS.	Index of pumping 19-21 22-24 15 minutes 30 minutes 26-28 29- 29-	-31 45 minutes 60 minut	es 35-37				
	feet feet feet feet feet feet	et feet	feet				
	GPM fee	et Clear Clou	idy 46-49				
	Shallow Deep fee	pump rate	GPM	0			
FINA	L STATUS OF WELL 54		=1	Secla	ge#1		
1 2 3	Water supply s Abandoned, insufficien Observation well s Abandoned, poor quali Test hole 7 Abandoned (Other)	ty 10 🗌 Replacement w	ell	e e e j)		
4	Recharge well s Dewatering						
WATE	ERUSE 55-56 Domestic 5 Commercial Stock 6 Municipal	9 ☐ Not used 10 ☐ Other					
3 4	Irrigation 7 Public supply Industrial 8 Cooling & air condition	ing					
METH	HOD OF CONSTRUCTION 57						
1 2 3	Cable tool 5 C Air percussion Cable tool 6 C Boring Rotary (reverse) 7 C Diamond	10 Driving 10 Digging 11 D Other			1	5659	3
4	, ∟ ⊣otery (air) ₈ ⊔ Jetting				ـلـ 	5505	<u> </u>
Name	of Well Contractor	Well Contractor's Licer	Data sour	a 58 Contracctor rce 2	301 ⁵⁹⁻⁶² JI	IL 0 7	998
Addres	PO. Bar 310 Bandin	Ont	Date	e of inspection	Inspector	\	
Name	of Well Technician	Well Technician's Lice	nce No.	narks			
V) Signal	ture of Technician/Contractor	Submission date			CSS	. <i>a</i> a	
A A	/ XI PTIN/	day mo v	- 11 -				

- And the second secon second sec

GRECORDING CHARTS

stouffville Public Util:	Lties Comm	Date compl	leted	Ont, month	1960 year)
(print in block letters)		Address			
Casing and Screen Record	a grann dae		Finite Pur	mping Test	(2)。第二日 第二日 第二日 第二日 第二日 第二日 第二日 第二日
Inside diameter of casing $23 \ 1/3^{n}x \ 2$	4" O.D.	Static leve	91 6"	iters (walks) fillers	
Total length of crising 304 Stainless Stee 19'1" with 3'6" Length of screen Don't to top of screen	700 Test-pumping rate				
Diameter of finished hole	81	. Recommo with 1	ended pumping pumping level o	rate	G.P.M.
Well Log	No. C. Fadde A	esta (alla fatta ha	Wa	iter Record	arran ar anna
Overburden and Bedrock Record	· From ft.	To ft.	Depth(s) at which water(s) found	No. of feet water rises	Kind of water (fresh, salty, sulphur)
Tomenil		The second second	181	81 611	Fresh
Brown clay	4	-18	-0	and a second sec	
Sand and gravel	18	-44*6*	S. S. all an		CONTRACTOR OF THE OWNER
natupan			E INTERNE		11.000
	-	Shertilak -	1.000		
Je	Since .	and the second			
cannis (Francisco - Constantino - Constantino - Constantino - Constantino - Constantino - Constantino - Consta					
			1941 - H.	-	
For what purpose(s) is the water to be used Municipal Is well on upland, in valley, or on hillside upland	? ?	. In ro	Loca diagram below ad and lot line	tion of Well show distances o e. Indicate north	f well from by arrow.
C.H.Butledge		18 C			(
		8	N.	1 -1-	() ⁽⁾
Drilling Firm			11	0100	r' A
Drilling Firm. Nobleton,Ont. Address			167	11 1250	
Drilling Firm Nobleton, Ont. Address 612		o.	10T "	1210	
Drilling Firm Nobleton, Ont. Address 612 Licence Number		a. 	10 ⁷	· HAN	
Drilling Firm Nobleton, Ont. Address 612 Licence Number C.H.Rutledge Name of Driller		•• •• ••	107 " Lot 10	- HAN 500	e MC
Drilling Firm Nobleton, Ont. Address Licence Number C.H.Rutledge Name of Driller Nobleton, Ont.			107 " Lot 10 Lot 10 Jisso	- HAN 500	5 **C
Drilling Firm Nobleton, Ont. Address 612 Licence Number C.H.Rutledge Name of Driller Nobleton, Ont. ddress May 30th, 1960.			10" Lot 10 27 Juso.	- HALL EUG AL. Y EUG 3.00	5 A1C"
Drilling Firm Nobleton, Ont. Address 612 Licence Number C.H.Rutledge Name of Driller Nobleton, Ont. Adress May 30th, 1960. Date		···	107 " Lot 10 Lot 10 Jisso.	· HAN EUC Al. V EUC J. C. M.	EAIC ant
Drilling Firm Nobleton, Ont. Address 612 Licence Number C.H.Rutledge Name of Driller Nobleton, Ont. Address May 30th, 1960. Jate (Signature of Licensed Drilling Contract	tor)		167 " Lot 10 Lot 10 Jusso	· HAN EUC Al. X EUC 2.000 3.00	E MC

$\begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} $	Urces	Commission		CNIARIO W	NURCES 13 821
Elev	ownsh Date co	ip, Village <u>, To</u> mpleted Stou	WHITC own or City. (13th Ja (day ffville,	Whitchuro month Ontario	year)
Casing and Screen Record		0.**	Pumping	g Test /	
Inside diameter of casing 24" Outer Inside diameter of casing 12" Inner Total length of casing 45" Type of screen Johnston 35 slot 25' long Length of screen 25' plus 10' Stainless Steel Pipe Pipe	Stat Tes Pun Dun Wa	ic level t-pumping ra nping level ration of test p ter clear or clo	te 2591 591 oumping 48 oudy at end of	351 hours 24 test clear	G.P.M.
Diameter of finished hole 21 th	Red	commended p	umping rate	351	G.P.M.
	wit	h pump settin	g of 65	feet belo	w ground surface
Gravel Packed.				Wate	r Record
Overburden and Bedrock Record		From ft.	To ft.	Depth(s) at which water(s) found	Kind of water (fresh, salty, sulphur)
Top soil		0	1		
Grey clay and stones		1	7		
Sand	-		70	45-701	Fresh
For what purpose(s) is the water to be used? Town supply	-	In diagra road and	Location m below show lot line. In	of Well v distances of we dicate north by	ell from Arrow.
Drilling or Boring Firm Faulkner Well Drilling Co.Ltd.			SIDE	190,	
Address 687 Water St. Peterborough, Ont.			لې •	F	e e S ^{arti}
Licence Number 1689			WEL		
Name of Driller or Borer George Babcock	(3)	<			
Address 608 Orpington Rd. Peterborough	I.I.I.		1973 H		
Date January 13th, 1966 J. J. J	87 #		CON 8		
Form 7 15M-60-4138				~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	

.....

APPENDIX B

Monitoring Well Groundwater Quality

golder.com