MEMO

ARCADIS Design & Consultancy for natural and built assets

To:
Tianna Kilgore, EGLE

Copies:
Grant Trigger, RACER

Arcadis of Michigan, LLC
28550 Cabot Drive
Suite 500
Novi
Michigan 48377
Tel 248 994 2240
Fax 248 994 2241

From:
Buick City Team

Date:
February 10, 2023

Arcadis Project No.:
30121887

Subject:
Monitoring Well Abandonment Procedure
RACER, Buick City, Flint, Michigan

1.0 INTRODUCTION

To facilitate redevelopment activities at the RACER Buick City Site (Site), monitoring wells not planned for future groundwater monitoring activities will be proposed to be abandoned (under separate cover). This memo proposes the process to be used to evaluate the monitoring wells and determine the appropriate well abandonment method.

2.0 MONITORING WELL ABANDONMENT RATIONALE

Approximately 1,300 temporary and permanent monitoring wells have been installed at the Site since the 1980s for various investigative and monitoring purposes (**Figure 1**). Some monitoring wells have been previously abandoned, but most remain in place. In order to ensure that future construction activities to do not cause inadvertent pathways for surface water infiltration or vertical migration, monitoring wells that are no longer needed for investigation or monitoring purposes will be abandoned. Monitoring wells that will remain in place for the duration of construction will be identified and protected prior to the onset of any demolition or construction activities.

Four methods for abandoning monitoring wells will be utilized, as described in the following sections. The appropriate method to use at each well will be determined using the following factors:

- Permanent or temporary well,

- Evidence of impacts above health-based criteria in groundwater,
- Presence of non-aqueous phase liquid (NAPL) greater than 0.1 feet as detected by an interface probe in the well,
- Presence or absence of a confining layer (greater than one foot of silt or clay), and
- Whether the well has an adequate seal between the well screen and the surface (greater than 2 feet of bentonite or grout) to prevent vertical migration.

Note that the procedures described in this memo would not apply to monitoring wells located in areas where soils would be excavated as part of a final remedy.

2.1 Permanent Wells

Permanent monitoring wells will be abandoned by using one of the following methods: 1) modified plug-in-place, 2) plug-in-place, or 3) over-drilling. The methods are described in detail in Section 3. The appropriate abandonment method for each well will be determined by using the evaluation method described below. This is illustrated in a flowchart provided as **Figure 2**.

1. Wells will be abandoned using the modified plug-in-place method if:
    - There is no evidence of impacts above health-based criteria in groundwater and/or NAPL (greater than 0.1 ft), or
    - There is evidence of groundwater impacts and/or NAPL; however, no confining layer is present
2. Wells will be abandoned using the plug-in-place method if:
    - There is evidence of groundwater impacts and/or NAPL and a confining layer; however, the monitoring well was constructed with an adequate seal to prevent vertical migration of impacts.
3. Wells will be abandoned using the over-drill method if:
    - There is evidence of groundwater impacts above health-based criteria and/or NAPL, and
    - There is a confining layer present; however, there is no evidence that the monitoring well was constructed with an adequate seal to prevent vertical migration of impacts.

2.2 Temporary Wells

Temporary wells have been installed at various locations at the Site to facilitate groundwater and LNAPL investigation and monitoring activities. The wells were constructed using 1-inch or 2-inch PVC casings and screens, but typically do not have a surface completion (flush-mount or stickup casing, concrete pad, bollards, etc.). These wells are typically shallow (generally less than 20 feet).

For temporary wells, in addition to the methods above, casing removal will also be evaluated as an abandonment method. Wells will be abandoned using the casing removal method if:

- There is no evidence of impacts above health-based criteria in groundwater and/or NAPL, or

- There is evidence of groundwater impacts and/or NAPL; however, no confining layer is present,
- The casing and screen may be easily removed.

The evaluation of abandonment methods for temporary wells is illustrated in a flowchart provided as **Figure 3**.

3.0 MONITORING WELL ABANDONMENT METHODS

The following process will be used to determine the appropriate abandonment process for each of the monitoring wells.

- Review the existing monitoring well log (if available) to identify construction characteristics including, total depth, casing diameter, initial borehole diameter, and screen intervals,
- Locate the monitoring well in the field.
- Identify if the decommissioning equipment can access the monitoring well and/or if special considerations are necessary to gain access.
- Conduct total depth measurements and water level measurements.
- Calculate the volume of the well that will need to be filled utilizing field measurements; and
- Record all observations and measurements.
- A well abandonment log will be completed for each well. The Arcadis Well Abandonment Log is included as **Attachment A**.

A description of each well abandonment method is summarized below.

3.1 Modified Plug in Place Well Abandonment Procedure

The well abandonment process will generally consist of the following steps:

1. Perforate the base of the well screen utilizing a length of drilling rod or other equipment, to allow the grout seal to penetrate the surrounding filter pack.
2. Prepare a neat cement grout.
3. Place the neat cement grout in the perforated well casing via the tremie method (i.e., the grout will be pumped from the bottom of the well upward). The grout will be added until the well is filled to above the top of the well casing at grade. Verify that the amount of grout added equals or exceeds the calculated volume of the void to be filled.
4. Check for settlement of the grout after 24 hours and top off the grout, as necessary.

3.2 Plug in Place Well Abandonment Procedure

The well abandonment process will generally consist of the following steps:

1. Remove the protective casing and well casing to a depth of approximately 3 to 4 feet below ground surface (bgs), if possible.

2. Perforate the base of the well screen utilizing a length of drilling rod or other equipment, to allow the grout seal to penetrate the surrounding filter pack.
3. Prepare a neat cement grout.
4. Place the neat cement grout in the perforated well casing via the tremie method. The grout will be added until the well is filled to above the top of the well casing remaining in place (i.e., typically approximately 3 to 4 feet bgs). Verify that the amount of grout added equals or exceeds the calculated volume of the void to be filled.
5. Check for settlement of the grout after 24 hours and top off the grout, as necessary.

3.3 Over-drilling Well Abandonment Procedure

The well abandonment process will generally consist of the following steps:

1. Remove the protective casing, if possible.
2. After the protective casing has been removed, advance drill casing (with an outside diameter larger than the well diameter) over the well casing to the bottom of the original borehole.
3. Prepare a neat cement grout or a bentonite grout that is compatible with the soil and groundwater conditions present at the monitoring well. Alternatively, hydrated bentonite pellets may be used to plug the borehole, using procedures similar to those for abandoning boreholes.
4. Place the cement grout in the borehole via tremie method (i.e., the grout will be pumped from the bottom of the borehole upward) at the same time the drill casing are removed from the borehole. Grout will be added until the borehole is filled to approximately 3 to 4 feet bgs. Verify that the amount of grout added equals or exceeds the calculated volume of the void to be filled. If hydrated bentonite pellets are utilized, measure deposition depth with a weighted tape as the drill casing are removed from the borehole to ensure that bridging does not occur. At certain shallow well locations installed in competent formations, it may be possible to remove the drill casing prior to installing the sealant. If this is attempted, confirmatory measurements must be taken to verify that borehole integrity was maintained prior to plugging the hole.
5. Check for settlement of the grout after 24 hours and top off the grout, as necessary.

3.4 Temporary Well Casing Removal Abandonment Procedure

The well abandonment process will generally consist of the following steps:

1. Remove the well materials
2. Prepare a neat cement grout.
3. Place the neat cement grout in the borehole via a tremie pipe. The grout will be added until the well is filled to above the top of the well casing at grade. Verify that the amount of grout added equals or exceeds the calculated volume of the void to be filled.
4. Check for settlement of the grout after 24 hours and top off the grout, as necessary.

If the casing cannot be removed, the Modified Plug in Place method will be used.

Attachments:
Figure 1 – Site Plan showing Monitoring Well Locations
Figure 2 – Permanent Monitoring Well Abandonment Flow Chart
Figure 3 - Temporary Monitoring Well Abandonment Flow Chart

Attachment A – Arcadis Well Abandonment Form

NORTH END
SOUTH END

FLINT RIVER

UNIT FLOW THRU TERMINAL LOCATION

CONSOLIDATED FREIGHTWAYS

LEONHART CHEMICAL

UNIVERSAL SYSTEMS

FLINT COATINGS

VACANT INDUSTRIAL PARK

KASLE STEEL AUTO BLANKERS LOCATION

P.P.G. INDUSTRIES

FORMER ASHTON LAGOON (FILLED)

FORMER POWERHOUSE BLDG 07

BLDG 94

BLDG 02

BLDG 84

FORMER DUPONT PLANT LOCATION

BLDG 09

BLDG 42

BLDG 08

BLDG 44

BLDG 12

BLDG 11

BLDG 70

BLDG 71

BLDG 20

BLDG 30

BLDG 21

BLDG 32

BLDG 43

BLDG 23

BLDG 25

BLDG 18

ADMIN. BLDG 01

OAK PARK

OAK TECHNOLOGY PARK

UNION BLDG LOCAL 599

LEGEND:

- SOIL BORING
- ABANDONED MONITORING WELL
- MONITORING WELL (ACTIVE)
- PIEZOMETER
- RECOVERY WELL
- OBSERVATION WELL
- SOIL GAS POINT
- SUB-SLAB MONITORING POINT
- TRANSECT POINT
- SURFACE WATER
- RIVER GAUGE
- TEST PIT
- UNABLE TO LOCATE

0 400' 800'
APPROXIMATE SCALE IN FEET

RACER TRUST
BUICK CITY
FLINT, MICHIGAN

SITE PLAN

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1

FIGURE 2
PERMANENT MONITORING WELL ABANDONMENT FLOW CHART
RACER BUICK CITY

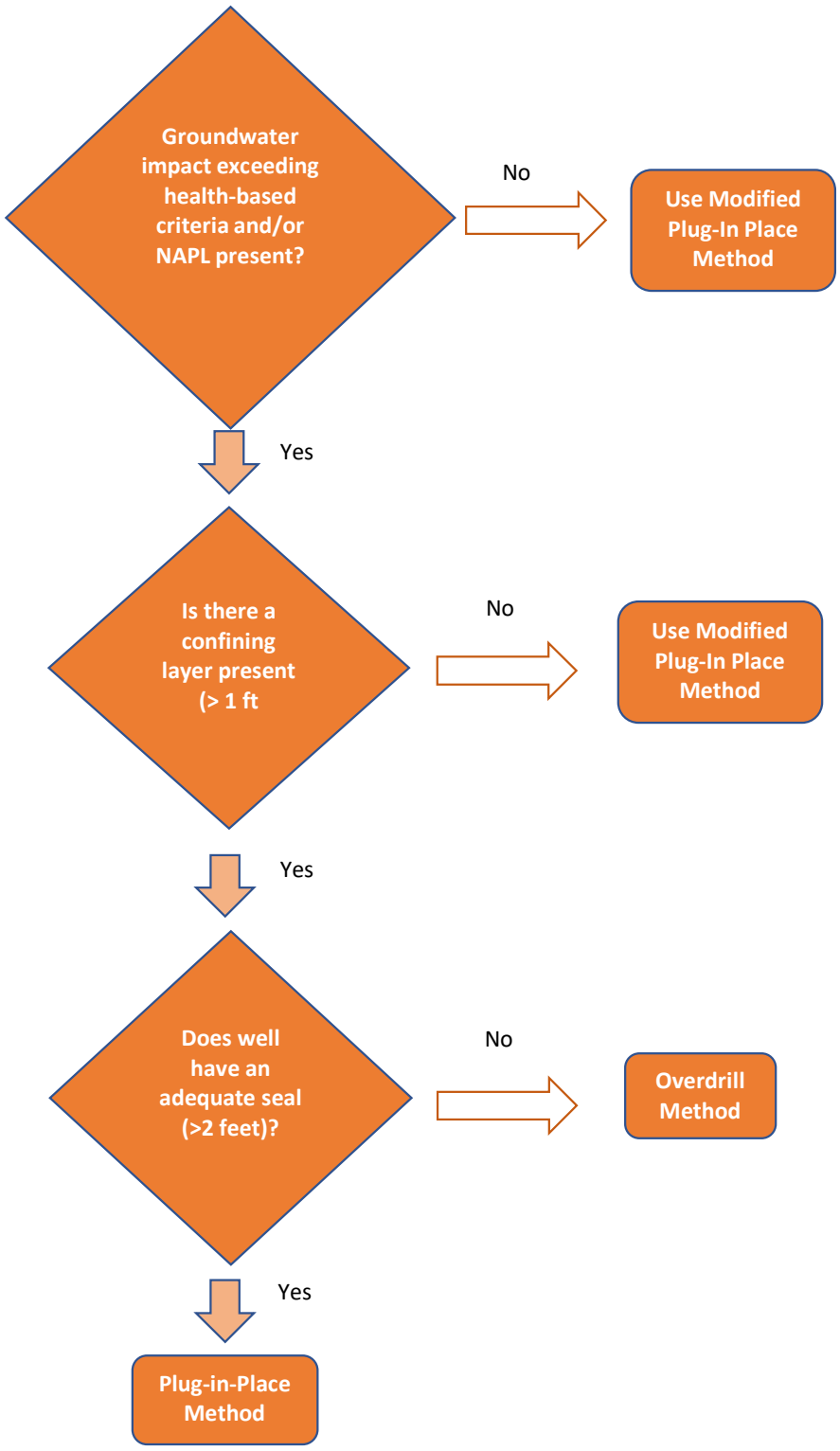
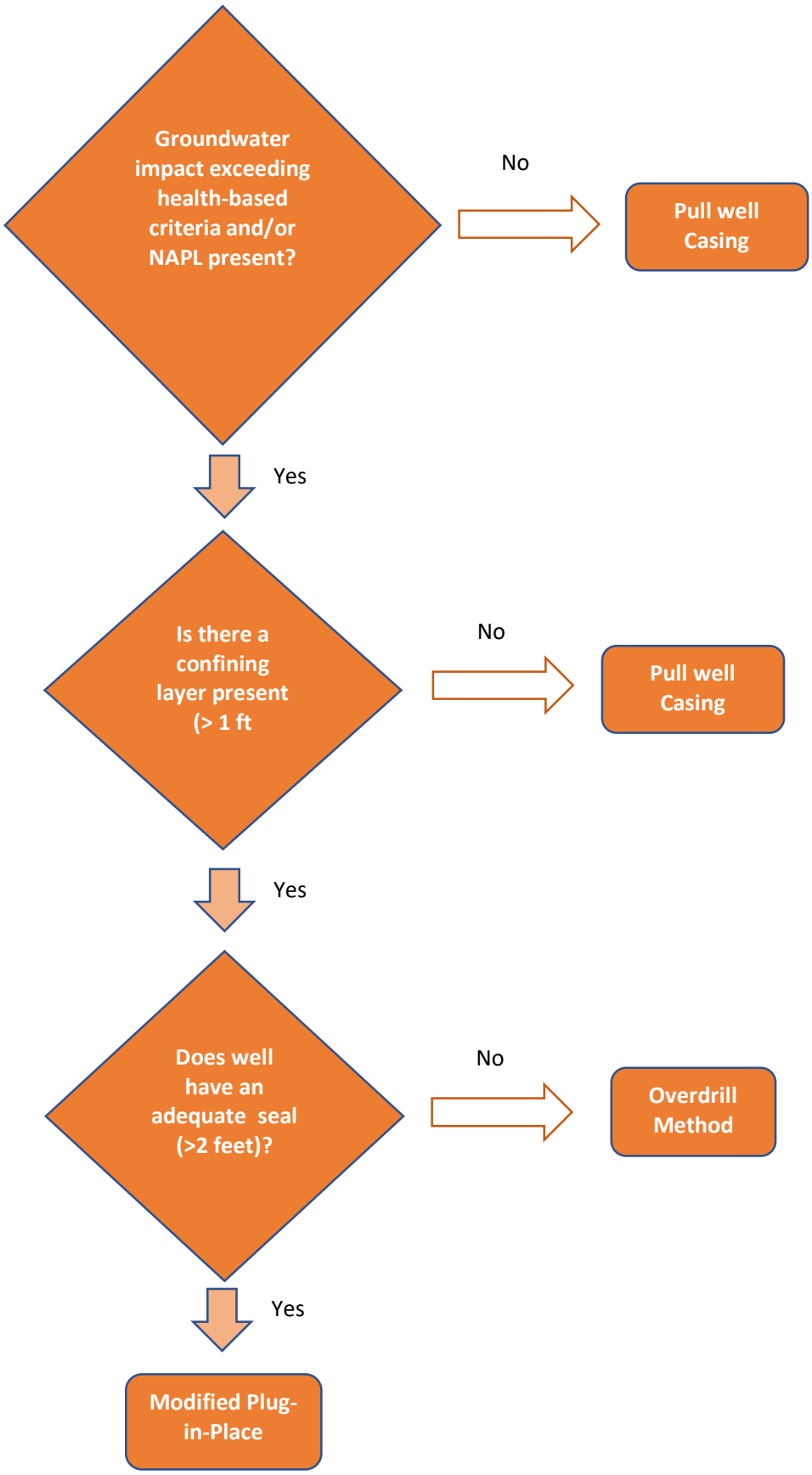


FIGURE 3
TEMPORARY MONITORING WELL ABANDONMENT FLOW CHART
RACER BUICK CITY



Attachment A

Arcadis Well Abandonment Form

Well Abandonment Record

Site Name: _____ County: _____

Well ID: _____ Project Number: _____

Date Installed _____ Date Abandoned: _____

Subcontractor: _____ Total Well Depth from TOC: _____ (ft)

Screen Depth from TOC: _____ (ft) Water Table Depth from TOC: _____ (ft)

Casing Diameter: 2-inch ☐ 4-inch ☐ Screen Diameter: 2-inch ☐ 4-inch ☐

Casing Type: Galvanized ☐ PVC ☐ Stainless Steel ☐ Length: _____

Screen Type: Galvanized ☐ PVC ☐ Stainless Steel ☐ Length: _____

Casing/Screen: Pulled ☐ Cut ☐ Depth BGS: _____ (ft)

Borehole Grouted: Yes ☐ No ☐ From _____ (ft) to _____ (ft)

Grout Type: Bentonite ☐ Cement ☐

Grouting Method: Through Casing ☐ Tremie ☐ Other ☐ (explain)

Grout Type/Comments: _____

_____

_____

Area Resurfaced: Yes ☐ No ☐

Resurfacing Details: _____

_____

_____

Crew: Location Sketch:

Comments:

_____

Signature of Consultant

_____ _____

Company/Position Date