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August 11, 2016

New Jersey Department of Environmental Protection
Bureau of Case Management
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Attn: Donna Gaffigan, Case Manager

Re: *Addendum to the December 2015 Site-Wide Groundwater Progress Report*
Hoffmann-La Roche Inc.
340 Kingsland Street
Nutley, New Jersey
SRP PI #s 009949, 614465, and 625447
TRC Project No. 105009/198233

Dear Ms. Gaffigan:

On behalf of Hoffmann-La Roche Inc. (Roche), TRC Environmental Corp. (TRC) is submitting the attached Addendum to the December 2015 Site-Wide Groundwater Progress Report, dated August 11, 2016. This report presents the results of IA-specific investigations conducted in IA-1, IA-10, IA-15, and at selected off-Site locations (Windsor Place and Building 716).

The reported field programs were performed in accordance with the NJDEP's Technical Requirements for Site Remediation (N.J.A.C. 7:26E) and applicable NJDEP Guidance, the approved Quarterly PDB Ground Water Sampling Plan Rev. 3 (June 2014) and Request for Approval-Modification of the Site-Wide Groundwater Sampling Plan – IRM Implementation Period – July 2015 (May 2016), Roche Remediation Road Map (September 2012), and associated correspondence (NJDEP comments, Roche Response letters).

If you have any questions or need additional information, please feel free to contact Art Goeller at 908-988-1621 or agoeller@trcsolutions.com, or Dan Nachman at 908-988-1637 or dnachman@trcsolutions.com.

Very truly yours,

Arthur F. Goeller, LSRP (No. 591661)
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Cc: Chandra Patel, Roche

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1.0 INTRODUCTION

On behalf of Hoffmann-La Roche Inc. (Roche), TRC Environmental Corporation (TRC) has prepared this Addendum to the December 2015 Site-Wide Groundwater Progress Report (GWPR) to summarize supplemental characterization activities that were conducted at the 120-acre Roche facility (Site – Figure 1) between April 2015 and March 2016. These groundwater activities are associated with recently-discovered impacts within and/or in close proximity to off-Site Building 716 [B716][1], the southern portion of Investigative Area (IA)-10 (former Building 112 [B112]) and an adjacent section of Windsor Place, and the deep bedrock delineation of 1,4-dioxane exceedances in IA-1.

1.1 Document Organization

This document is organized into the following five sections (excluding the Introduction):

- Section 2.0 provides references to deliverables that summarize the most recent Site background information;
- Section 3.0 provides a technical overview (scope/methods) of the supplemental soil and groundwater characterization activities performed during the reporting period;
- Section 4.0 provides the findings for the supplemental investigations;
- Section 5.0 provides a schedule of future activities and upcoming deliverables; and
- Section 6.0 provides a list of references.

[1] B716 is a residential property building located at 800 Bloomfield Avenue in Nutley, New Jersey, immediately south of the main Roche property (approximately 75 feet south-southwest of IA-15).

2.0 SITE BACKGROUND

A comprehensive Site background (including Site description and history, physical setting, and historic regulatory compliance and deliverables) has been provided with the April 2014 Site-Wide Groundwater Remedial Investigation Report (GWRIR) and subsequent GWPRs dated January 2015 and December 2015. Refer to the December 2015 GWPR for the most updated Site background information.

3.0 TECHNICAL OVERVIEW

This section provides a technical overview of the supplemental groundwater investigation and source characterization activities conducted at selected Site areas between April 2015 and March 2016. The field activities were conducted in accordance with the TRSR (N.J.A.C. 7:26E), the Field Sampling Procedures Manual (2005) and applicable guidance documents, the approved Site-Wide GWSP – Interim Remedial Measures (IRM) Implementation Period Rev. 2 and subsequent modifications, and the Site-specific Quality Assurance Project Plan (QAPP). Tables 1-1 through 1-4 provide a sample collection summary for the recently-completed IA-specific programs. QA samples (field blanks and trip blanks) collected during each sampling phase/event are listed in Table 1-5. The findings of these activities are presented in Section 4.0.

3.1 Remediation Standards and Criteria

Any chemical compound detected in groundwater with a concentration that exceeds the New Jersey Groundwater Quality Standards for Class IIA Aquifers [GWQS] (N.J.A.C. 7:9C) is defined as a groundwater constituent of concern (COC, or contaminant). For 1,4-dioxane, the prior NJDEP Interim Groundwater Quality Criterion (IGWQC) of 10 micrograms per liter (µg/L) was considered for screening and assessment. Sampling events completed after this reporting period will consider the recently promulgated IGWQC of 0.4 µg/L. Delineation of groundwater contaminants for the remedial investigation (RI) and subsequent characterization activities were based on a comparison of the groundwater analytical results with the applicable GWQS.

3.2 Supplemental Investigation and Remediation Program Objectives

Supplemental investigations have been conducted at the Site to refine the horizontal and vertical extent of impacted groundwater documented in the Site-wide GWRIR, identify sources of groundwater contamination on- and off-Site, characterize background water quality conditions, and collect additional data that will be useful for the development and implementation of effective and practicable remedial strategies.

Additional wells will be installed under planned supplemental investigative and Remedial Action (RA) programs. The ongoing and future groundwater activities will be documented in subsequent GWPRs.

3.3 Supplemental Groundwater Characterization Program

3.3.1 *Supplemental Well Program*

Between August 2015 and January 2016, supplemental monitoring wells were installed at selected on-Site (IAs 1, 10, 11, 13, and 15) and off-Site (B716, Windsor Place) locations to further investigate potential or known source areas and delineate the extent of groundwater constituents. Figure 2 provides the location of these new wells. Appendix A provides the well construction documentation for the supplemental wells installed during the reporting period. Consistent with previous reports and for convenience of reference during investigations (rather than to imply groundwater flow zones), the groundwater was divided into 7 depth zones with S1 through S3 from ground surface to 0 feet above mean sea level (msl), and D1 through D4 from 0 above msl to > 450 feet below msl.

The table below lists the supplemental wells completed at the Site between August 2015 and January 2016 under the various supplemental groundwater characterization programs. Table 2 provides a summary of well construction details. Table 3 provides a summary of the depth zones and the total number of on- and off-Site monitoring wells associated with them.

Supplemental Well Programs = 44 Monitoring Wells			
IA-1 Deep Bedrock 1,4-Dioxane Delineation	IA-1	(2) Zone D1	DW-67A, DW-68A
		(2) Zone D2	DW-67B, DW-68B
IA-10 / Windsor Place Investigation	IA-10/Off-Site	(13) Zone S1	MW-472A, MW-472S, MW-476A, MW-477A, MW-480A, MW-485A, MW-486A, MW-487A, MW-487S, MW-488A, MW-489A, MW-496A, and MW-496S
		(4) Zone S2	MW-479B, MW-481B, MW-482B, and MW-483B
		(4) Zone S3	MW-479C, MW-481C, MW-482C, and MW-483C
B716 Investigation	IA-15/ IA-11/ IA-13 Off-Site	(4) Zone S1	MW-304A, MW-338A, MW-339A, and MW-340A
		(7) Zone S2	MW-304B, MW-338B, MW-339B, MW-340B, MW-451B, MW-478B, and IW-152B
		(6) Zone S3	MW-145C, MW-304C, MW-338C, MW-339C, MW-340C, and MW-478C
		(2) Zone D1	DW-47A, DW-49A

3.4 Investigative Area (IA)-Specific Programs

Three supplemental investigative programs were completed in the subject time frame to collect relevant Site data to better understand groundwater contaminant distribution. The following sections provide the technical overview and scope of the investigations completed in each IA during the reporting period.

3.4.1 *IA-1 1,4-Dioxane Deep Bedrock Investigation*

The source of a shallow zone 1,4-dioxane groundwater plume beneath IA-1/IA-4 was identified in the eastern boundary of IA-1, in the vicinity of former Buildings 44, 45, and 56 (see Figure 3 for the location of the former buildings). Prior to this supplemental groundwater investigation, groundwater contamination with 1,4-dioxane concentrations exceeding 100 µg/L was detected in Zones S1, S2 and S3 under IAs 1 and 4, and a more dispersed 10 to 100 µg/L plume (with isolated exceedances of 100 µg/L impacts in IA-1 and IA-10) was observed in Zone S3 proximal to the railroad tracks (extending from IA-12 to southeastern IA-10 and the northwestern portion of IA-11). Much of this dispersed plume may have an off-Site origin to the north or northwest. Roche will address the impact of regional plumes on their Site in the Conceptual Site Model (CSM) Report.

While the IA-1/IA-4 Pre-Design Investigation (PDI) focused on delineating the 1,4-dioxane plume to 500 µg/L (for an IRM treatment of Zones S1 through S3), additional refinement of the horizontal and vertical extent of the 1,4-dioxane plume (for zones below S3) was warranted.[2] Between October 2015 and March 2016, Roche implemented a 1,4-dioxane deep bedrock delineation program to determine groundwater quality in Zones D1 and D2 in IA-1.

3.4.1.1 Monitoring Well Installation and Sampling

Between October 23 and October 27, 2015, four groundwater monitoring wells were installed in IA-1 to delineate the vertical extent of 1,4-dioxane in the deep bedrock zones. The two monitoring well clusters (DW-67 and DW-68) were installed in Zones D1 and D2 at locations displaying the highest 1,4-dioxane concentrations in Zone S3. As shown on Figure 3, wells DW-67A and DW-67B were installed in close proximity to Zone S3 well MW-391C (350 µg/L of 1,4-dioxane). DW-68A and DW-68B were installed in close proximity to Zone S3 well MW-136C (237 µg/L of 1,4-dioxane).

After a stabilization period, one round of groundwater samples was collected from the newly-

[2] At the time of the IA-1/IA-4 PDI, sufficient areal delineation of 1,4-dioxane was established to the 10 µg/L IGWQC in Zones S1, S2, and S3. In November 2015, the NJDEP promulgated a 0.4 µg/L GWQS for 1,4-dioxane. Roche is currently in the process of evaluating contaminant levels in existing wells via laboratory analytical methods that lower the method detection limits below the 0.4 µg/L GWQS.

installed wells using the low-flow sampling method. The groundwater samples were collected every 5 feet of saturated open borehole. All groundwater samples were submitted to Accutest Laboratories (Accutest) in Dayton, New Jersey for Volatile Organic Compound analyses via USEPA Method 8260C (VOC) and 1,4-dioxane analyses via USEPA Method 8260C with selective ion monitoring (SIM). On March 17 and 18, 2016, a confirmatory groundwater sampling round was conducted at DW-67A/B and DW-68A/B. The collected samples were analyzed for VOC via USEPA Method 8260C and 1,4-dioxane via USEPA Method 8270D with SIM.

A sample summary list and well construction details are provided in Tables 1-1 and 2-1, respectively. Monitoring well logs and other documentation are included in Appendix A. Appendix B contains the low-flow groundwater measurements associated with the November 2015 and March 2016 sampling events. Refer to Section 4.1.1 for a discussion of groundwater analytical results.

3.4.2 *IA-10/Windsor Place Investigation*

Shallow groundwater exceedances in the southeastern portion of IA-10 have exhibited a suite of groundwater contaminants that is different from surrounding portions of IA-10 and the rest of the Roche Site. This shallow groundwater plume is composed predominantly of trichloroethene (TCE) (> 90%), with very minor exceedances of tetrachloroethene (PCE) and breakdown products. Historical reports prepared for the Deluxe site (immediately west of IA-10) documented the installation of shallow temporary wells in public streets east of Deluxe in 1999, including two (TP-35 and TP-36) in Windsor Place. A sample collected from one of these temporary wells showed a TCE concentration in excess of 1,000 µg/L. The source of this elevated concentration was unknown.

To determine the source of this TCE plume, between April 2015 and January 2016, Roche implemented a soil and groundwater investigation program in the southern portion of IA-10 and an adjacent section of Windsor Place to locate the source of TCE contamination in shallow groundwater. Soil and groundwater characterization samples were collected in IA-10 within the footprint and immediate vicinity of B110 and B112 (west and east of Windsor Place, respectively), and subsequently in an off-Site public road (Windsor Place).

3.4.2.1 Temporary Well Installation

Temporary wells were installed in two phases in the Roche property on the east and west sides of Windsor Place. The first phase consisted of the installation of 13 temporary wells (TW-171

through TW-183)[3] in the footprint of former B112 (east of Windsor Place) and on the Roche property immediately west of Windsor Place that includes former B110. These temporary wells were installed in April 2015 and between June and August 2015. The second phase consisted of the installation of 17 soil borings/temporary wells (TW-177-1 through TW-177-17) in a closely-spaced grid around temporary well TW-177 (former B112 footprint), where high TCE was detected in a groundwater sample collected in the first phase. The second phase of temporary wells were screened in the 2 to 4 feet of saturated overburden, and were installed from July 14 to July 16, 2015. The locations of the Phase I and Phase II temporary wells are shown on Figures 4 and 5, respectively. Table 1-2 provides a summary of groundwater samples collected in the IA-10/Windsor Place area.

3.4.2.2 Soil Boring Investigation and Sampling

In July 2015 and October 2015, a total of 102 soil samples were collected between 1.0 and 8.0 feet below ground surface (bgs) prior to the installation of the 17 temporary wells (TW-177-1 through TW-177-17) and eight monitoring wells (MW-473A, MW-474A, MW-475A, MW-485A, MW-486A, MW-487A, MW-488A, and MW-489A). The locations of the soil borings completed during this investigation and are provided on Figure 6.[4]

The temporary well borings were advanced via direct-push Geoprobe® by Environmental Management Associates Inc. (EMA) drillers (Farmingdale, NJ) under TRC supervision. The soil samples were collected in Encore™ samplers from the saturated zone (biased toward high photoionization detector [PID] readings and/or staining, if present) and analyzed by Accutest for Target Compound List (TCL) VOCs. Soil boring logs and a discussion of soil analytical results are presented in Appendix C and Section 4.1.2, respectively. Table 1-3 provides the list of soil samples collected during this investigation.

3.4.2.3 Monitoring Well Installation and Sampling

Between July 2015 and January 2016, 21 monitoring wells were installed in the southeastern portion of IA-10 and the northernmost portion of Windsor Place in Zones S1, S2, and S3, to investigate the extent of dissolved TCE contamination in the area. Three Zone S1 wells (MW-472S, MW-487S, and MW-496S) were installed in the shallow overburden (to a maximum depth of 10 feet bgs) to evaluate potential shallow sources on Windsor Place (adjacent to the Nutley Municipal Sewer), in close proximity to former B112, and in between. The remaining 10 Zone S1 wells (MW-472A, MW-476A, MW-477A, MW-480A, MW-485A, MW-486A, MW-487A, MW-488A, MW-489A, and MW-496A) were installed within the shallow zone between 5 and

[3] Grab samples were not collected at TW-174 and TW-183.

[4] Soil boring locations completed during previous investigations in the area are also provided on Figure 6. Refer to the IA-10 RIR (December 2013) and other IA-specific reports to review analytical data at these previously-sampled soil boring locations.

22 feet bgs. Zone S2 (MW-479B, MW-481B, MW-482B, and MW-483B) and Zone S3 (MW-479C, MW-481C, MW-482C, and MW-483C) wells were installed on-Site, east-southeast of the source area, to delineate the downgradient extent of the plume in these deeper zones. Additional well construction details are provided in Table 2. Monitoring well documentation, including well logs, permits, records, NJDEP Forms A & B, etc., is included in Appendix A. Refer to Table 1-2 for a summary of groundwater samples collected in the IA-10/Windsor Place area.

In January 2016, 92 groundwater samples were collected using the low-flow sampling method from 64 wells (Zones S1, S2, and S3) in southern IA-10 and off-Site along Windsor Place. The samples were submitted to Accutest for analysis of VOCs and 1,4-dioxane. A sample summary list is provided in Table 1. Refer to Section 4.1.2 for a brief discussion of groundwater analytical results.

3.4.3 *IA-15/B716 Investigation*

IA-15 is located on Kingsland Street across from the main campus of the Roche facility, at the southeastern corner of the Site. An area of elevated chlorinated VOC (CVOC) groundwater contamination (> 100 µg/L) has been detected in the northwestern portion of IA-15, adjacent to Building 116 (B116). The groundwater plume in this portion of IA-15 is present in Zones S1, S2, S3, and D1, and is comprised primarily of PCE with significantly lower concentrations (2 to 3 orders of magnitude lower) of TCE, and no or very low (< 5 µg/L) concentrations of cis-1,2-dichloroethene (cis-1,2-DCE). IA-15 PDI activities reported in previous GWPRs were unable to identify any source of groundwater contamination in this IA, specifically in the vicinity of B116.

B716 is an off-Site residential property building (not owned by Roche) that is located approximately 75 feet south-southwest of B116 (IA-15). Previous quarterly sampling results of well cluster MW-171, adjacent to the west side of B716, indicated that elevated concentrations (in the range of 200 to 500 µg/L) of PCE and its breakdown products were present in Zones S1, S2, and S3 in close proximity to B716. Between August and October 2015, additional monitoring wells were installed and sampled to evaluate potential sources of PCE contamination near B716 (including possible local surficial or shallow subsurface releases, and upgradient areas [IA-15, IA-11, and/or IA-13]).

3.4.3.1 Monitoring Well Installation and Sampling

In August and September 2015, 18 monitoring wells (MW-304A, MW-338A, MW-339A, MW-340A, MW-304B, MW-338B, MW-339B, MW-340B, MW-451B, MW-478B, MW-145C, MW-304C, MW-338C, MW-339C, MW-340C, MW-478C, DW-47A, and DW-49A) and one injection well (IW-152B) were installed in off-Site areas parallel to the railroad tracks (separating B716 from Site IAs 15 and 13) in Zones S1, S2, S3, and D1 to evaluate the source of

PCE at B716 and delineate the extent of VOCs near B116 (IA-15) and downgradient of IA-11.

Between August and October 2015, groundwater samples were collected from the 18 new B716 monitoring wells and 24 additional wells (previously-installed in IA-15, IA-13, IA-11, and off-Site locations) via the low-flow sampling method and analyzed for VOCs (including 1,4-dioxane). The monitoring wells installed at the Site to-date are shown on Figure 2. Appendix A contains the well logs and other documentation; a sample summary list and well construction details are provided in Tables 1-4 and 2, respectively. Refer to Section 4.1.3 for a discussion of groundwater analytical results.

3.4.3.2 Fluid Level Measurements

On October 7, 2015, a groundwater gauging event of limited scope was conducted in Zones S1, S2, S3 and D1 wells located in IA-15, IA-13, the southeastern portion of IA-11, areas surrounding B716, as well as other downgradient, off-Site areas (Table 4).

Prior to initial water-level measurements, the integrity of each well was inspected, and a PID was used to screen the well opening for the presence of volatile gases. A Solinst® oil-water interface probe was used to record depth-to-water measurements from established surveyed points and to assess the potential for the presence of light/dense non-aqueous phase liquids (LNAPL/DNAPL) in each well. All pertinent observations and data were recorded on field sampling forms and in a field logbook.

The water-level measurements used to generate groundwater contour maps and vertical flow gradients are provided in Table 4. The NJDEP contour map reporting forms are included in Appendix D. Results of the groundwater gauging events are provided in Section 4.1.3.

3.5 Site-Wide/Surface Geophysics Survey

In 2013, as part of the Site-wide groundwater RI (GWRI), a surface geophysical investigation was completed at the Site along the alignment of the Norfolk Southern railroad track and along an area between Main Gate 49 and Route 3 (parallel to St. Paul's Brook and the Valley Drain, respectively). These areas were initially targeted for geophysical investigation because they were suspected areas of higher permeability, based on projections of NJGS mapped faults (approximately 1 mile north of the Site) and other features, and the distribution of groundwater contamination within the Site boundary. The 2013 investigation identified nine fracture tracers as potential extensions of the regional fault system associated with the Newark Rift Basin. In 2014 and 2015, additional surface geophysical studies were completed on a Site-wide scale (spanning portions of the majority of the Site IAs [IA-13 being the exception], as well as some off-Site areas) to further correlate the Site's contamination distribution and groundwater flow

regime with near-surface bedrock fractures and/or faults.

As documented in the January 2015 GWPR, a Site-wide surface geophysical investigation was conducted at the Site between August 2014 and October 2014 by Quantum Geophysics of Phoenixville, PA (Quantum), under the direction of TRC. In April 2015, an off-Site transect (deferred due to access issues) was completed along the north side of Route 3. The surface geophysics programs were conducted using microgravity and multi-channel analysis of surface waves (MASW) technologies. A total of 24 transect lines were selected for the evaluation (1-1' through 24-24'). When Site conditions interfered with the completion of a contiguous line, the transect lines were segmented and the original transect ID was qualified with A, B, C nomenclature, as appropriate (e.g., 1A-1A', 1B-1B' and 4A-4A', 4B-4B', 4C-4C', etc.), resulting in a total of 36 surveyed transects. The Quantum report of the surface geophysical surveys (not presented in either of the two previous GWPRs) is included in Appendix E. Refer to Section 4.2 for a discussion of the results.

3.6 Data Reliability

The analytical methods used for the IA-specific groundwater sampling events are provided in the QAPP and the laboratory analytical reports. The laboratory data reports and Electronic Data Deliverables/Electronic Data Submission (EDD/EDS) for the recent data are included on compact disc in Appendix F. Table 1 presents a summary of groundwater samples collected between April 2015 and March 2016 and soil samples collected in July and October 2015.

Sample collection activities and laboratory analyses of soil and groundwater samples obtained as part of the sampling programs were performed in accordance with the TRSR and the revised QAPP (2013). Sample analysis was completed by Accutest. Sample summary tables associated with these programs are included in Table 1.

A quality assurance review was performed on the laboratory analytical reports for all the collected VOC and 1,4-dioxane samples. The method-specific calibrations and quality control performance criteria were met for the data generated during this investigation, except as indicated in the conformance/non-conformance summaries provided in the laboratory reports.

Based on a review of the laboratory reports, the groundwater and soil data appear valid as reported and may be used for decision-making purposes. As a result, TRC did not further qualify any data. Overall, the groundwater and soil sample data collected in association with this report are considered to be valid and useful for the intended data quality objectives and their intended purpose. There are no requirements for additional sampling or re-sampling.

3.7 Factors Influencing Data

No significant events or seasonal variations are known to have influenced the sampling procedures or the results of the sampling programs presented in this report. Discrepancies in analytical groundwater sample results associated with the 1,4-dioxane investigation may be attributable to laboratory method (8260SIM vs. 8270SIM). In addition, implemented remediation programs (soil excavations, groundwater IRMs, etc.) conducted at Site (i.e., IA-2, IA-6, IA-7, IA-9, IA-12, etc.) could have resulted in improved groundwater quality conditions at the Site, including the IAs relevant to this report.

Some of the data summary figures included with this report depict data collected during multiple sampling events and/or using different sampling methods (e.g., grab, low-flow, etc.). While the multiple data sets may have resulted in slight variations in the contaminant concentration ranges (for selected constituents), the quality of the data is not considered compromised and support conclusions made regarding supplemental Site characterization.

3.8 Deviation from the Technical Requirements and Guidance

All field activities were conducted in compliance with the approved RI workplans, QAPP, and the TRSR and applicable guidance documents. As such, there were no sampling methods or procedures that deviated from the TRSR and applicable guidance.

4.0 SUPPLEMENTAL INVESTIGATIVE FINDINGS

This section presents the findings of the supplemental groundwater and soil sampling activities conducted between April 2015 and March 2016. The methods and procedures employed during the various field activities are presented in Section 3.0 (Technical Overview). The laboratory data packages and the electronic data deliverables associated with these investigative activities are included on compact disc(s) in Appendix F. Tables 5-1 through 5-4 summarize sample analytical data collected during the IA-specific programs. A summary of analytical results associated with corresponding field and trip blanks is included in Table 5-5.

4.1 IA-Specific Programs

4.1.1 *IA-1 1,4-Dioxane Deep Bedrock Delineation*

Analytical results from the Zone D1 (DW-67A and DW-68A) and Zone D2 wells (DW-67B and DW-68B) are included in Table 5-1. A cross-section (A-A') profiling the vertical distribution of 1,4-dioxane in IA-1 is provided on Figure 3. Table 5-1 and Figure 3 have been supplemented with analytical data collected from adjacent wells (MW-391A, MW-391-C, MW-391-S3, MW-136, MW-136B, and MW-136C) during the September 2015 IA-1/IA-4 IRM and/or the Monitored Natural Attenuation sampling event (September - October 2015). As shown on Figure 3, vertical delineation of 1,4-dioxane to the former criterion of 10 µg/L has not been attained.[5] The highest 1,4-dioxane concentrations detected were in wells DW-67A and DW-67B at 193 µg/L and 114 µg/L, respectively, during initial sampling (less than 30 days from well installation). Significantly lower concentrations of 1,4-dioxane were observed in DW-68A (64 µg/L) and DW-68B (63.5 µg/L) during the initial sampling round (November 2015). A confirmatory sampling event was completed for the newly-installed DW-67 and DW-68 clusters in March 2016 via analytical method 8270SIM.[6] Analytical results were lower in all wells during this subsequent round of sampling, particularly in the DW-68 cluster (DW-68A = 14.8 µg/L; DW-68B = 32.1 µg/L, DW-67A = 82.1 µg/L, and DW-67B = 26.2 µg/L).

Overall, 1,4-dioxane concentrations are higher in the central portion of IA-1 in Zones D1 (DW-67A) and D2 (DW-67B) where concentrations were recorded one order of magnitude higher than those observed in the southeastern portion of IA-1 (DW-68A and DW-68B) in November 2015. Groundwater sampling results during the March 2016 sampling round (completed more than 4 months after well installation) were significantly lower than concentrations observed in the November 2015 event, which could be a result of true aquifer conditions or attributable to the different analytical method (8260CSIM vs. 8270DSIM).

[5] The 1,4-dioxane impacts have been laterally delineated to the former IGQWC (10 µg/L). Delineation to the current IGWQC of 0.4 µg/L will be addressed in sampling events after the time period of this report.

[6] The analysis of samples for 1,4-dioxane from the Site-wide sampling (September 2013 through May 2015) and the November 2015 IA-1 sampling were completed via analytical method 8260SIM.

4.1.2 *IA-10/Windsor Place – Soil and Shallow Groundwater Investigation*

Between July 2015 and January 2016, Roche implemented a soil and groundwater investigation program in the southern portion of IA-10 and an adjacent section of Windsor Place to locate the source of TCE contamination in shallow groundwater. Soil and groundwater characterization samples were collected in IA-10 within the footprint and immediate vicinity of B110 and B112 (west and east of Windsor Place, respectively).

4.1.2.1 IA-10/Windsor Place Soil Sampling Results

In July and October 2015, soil sampling was conducted in the southern portion of IA-10 to locate the source of a predominantly TCE plume observed during historic and recent groundwater sampling events in the vicinity of former B112. A total of 74 soil samples were collected from 17 borings completed in the footprint of former B112. In addition, 28 soil samples were collected from eight borings completed on Windsor Place, in close proximity to the Nutley Municipal Sewer or the boundary with IA-10 (B110 area). PID readings of soil cuttings ranged from non-detect to 3.4 parts per million (ppm). All soil samples were submitted to Accutest for TCL VOC analysis. Soil analytical results are summarized in Table 5-2 and on Figure 6.

As shown on these tables and figure, of the 74 soil samples collected, only one sample collected between 7.0 and 7.5 feet bgs, at borehole TW-177-4, showed detectable TCE, at a concentration of 0.03 mg/kg. Since this sample was collected slightly below the water table, the NJDEP Default Impact to Ground Water Soil Screening Level (DIGWSSL) for TCE (DIGWSSL = 0.01 mg/kg) does not apply, and this detection is not an exceedance of a NJDEP soil standard. As shown on Figure 6, TW-177-4 was completed adjacent to monitoring well MW-472S, close to the boundary of former B112 and Windsor Place. Soil boring logs for each location and the electronic data deliverables are provided in Appendices C and F, respectively.

4.1.2.2 Temporary Well Results

The sampling results for the first phase (April to August 2015) of temporary wells installed from 10 to 20 feet bgs in bedrock are provided in Table 5-3A and summarized on Figure 4. These results indicate that the TCE in shallow groundwater does not emanate from the property currently owned by Roche on the west side of Windsor Place (B110). The samples collected on the property currently owned by Roche on the east side of the Windsor Place plume indicated an area within the footprint of B112 with TCE at 382 µg/L in groundwater (TW-177). There were no groundwater data in Windsor Place in the vicinity of the sewer during the first phase (April to August 2015). A minor sheen of petroleum NAPL was detected in the shallow bedrock during the installation of temporary well TW-180. Free product was not detected in the temporary well

(or subsequently installed monitoring well MW-479C).

The sampling results from the second phase of temporary wells (June to July 2015), installed within saturated overburden in former B112 are shown on Figure 5. These results indicate a small area of TCE > 100 µg/L in groundwater in the saturated overburden, with one temporary well showing 315 µg/L of TCE (TW-177-7).

4.1.2.3 IA-10/Windsor Place Monitoring Well Sampling Results

Results from the January 2016 groundwater sampling event indicate that the COCs identified above their respective GWQS in the IA-10/Windsor Place area include: TCE, PCE, carbon tetrachloride (CT), 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethene (1,1-DCE), vinyl chloride (VC), and benzene. TCE is the primary groundwater contaminant. Tables 5-3A and 5-3B and Figures 7 through 10 summarize the groundwater analytical results in the IA-10/Windsor Place area in Zones S1 through S3. A summary of maximum TCE and total VOC levels in the IA-10/Windsor Place source area is presented below.

Summary of Maximum TCE and Total VOC Concentrations in IA-10/Windsor Place Source Area

Hydrostratigraphic Zone	**IA-10 B110** ***(upgradient)***		**Windsor Place** ***(off-Site)***		**IA-10 B112** ***(downgradient)***	
	TCE	VOCs	TCE	VOCs	TCE	VOCs
Zone S1 - OB	*No wells*	*No wells*	747	757	503	515
Zone S1	NE	4	**7,920**	**7,959**	**1,410**	**1,435**
Zone S2	NE	2	*No wells*	*No wells*	**1,030**	**1,043**
Zone S3	NE	2	*No wells*	*No wells*	166	237

Note:
B110 wells = MW-44, -45, -480A, -44B, -44C.
Windsor Place wells = MW-487S, -496S, -473A, -474A, -475A, -485A, -486A, -487A, -488A, -489A, -496A.
B112 wells = MW-472S, -27, -28, -446A, -472A, -476A, -477A, -27B, -479B, -27C, -479C.
Zone S1 – OB wells installed in shallow overburden to maximum depth of 10 feet bgs.
NE = no exceedances of GWQS.
All concentrations are in µg/L. The listed contaminant concentrations are the highest levels for each respective area. Concentrations above 1,000 µg/L are highlighted in yellow/bold. Refer to Table 5-3B for a comprehensive summary of IA-10/Windsor Place monitoring well analytical results.

As shown on these tables and figures, the highest TCE concentrations (up to 7,920 µg/L in MW-487S) detected were in Zone S1 wells screened to a maximum depth of 22 feet bgs on Windsor Place immediately adjacent to the eastern edge of the Nutley Sanitary Sewer (Figure 8). Elevated TCE levels were also observed downgradient of the Nutley Sanitary Sewer in Zone S2 (MW-479B = 1,030 µg/L) and Zone S3 (MW-479C= 166 µg/L) (Figures 9 and 10). The three shallow overburden wells (screened from 5 to 10 or 15 feet bgs) in Windsor Place and B112

show lower TCE concentrations, ranging between 248 and 747 µg/L.

The very high TCE concentrations in Zone S1 appear to be localized to the Nutley Sanitary Sewer on Windsor Place (and adjacent IA-10 B112), and display a decreasing concentration gradient with increasing depth, as evidenced by the lower TCE concentrations detected in deeper nearby wells (MW-479B and MW-479C). The elevated TCE concentration (1,670 µg/L) detected in shallow overburden well MW-472S in September 2015 may be indicative of a second, minor source in the footprint of former B112, or may have resulted from migration of higher-concentration TCE releases from the Nutley Sewer in the past. As shown on Figure 9, the >10 µg/L TCE plume extends to the southeast in Zone S2, covering a large portion of southeastern IA-10. Figure 10 shows that in Zone S3, total VOC levels are significantly lower (approximately 100 µg/L) at the source area, with a more expansive > 10 µg/L plume that extends to the south-southeast of IA-10.

As shown on Figures 7 through 10, the VOC contamination in the shallow zones is substantially delineated in Zones S1 and S2. Additional delineation in Zone S3 may be warranted. Presently there are no monitoring wells installed in Zones S2 and S3 on Windsor Place.

4.1.3 *B716 Groundwater Investigation*

Due to detections of PCE and other CVOCs in wells MW-171A, MW-171B and MW-171C (Zones S1, S2, and S3) located adjacent to B716, Roche installed additional wells at this off-Site property, which was never owned by Roche, nor was it ever the site of Roche operations. The additional investigation was designed to assess potential contributions from IA-15 and IA-11 (upgradient of B716), and the potential for a separate source at the B716 property. Monitoring well installation and sampling and a focused groundwater gauging event were completed in the B716 area.

4.1.3.1 <u>B716 Groundwater Flow Regime – Southeastern Portion of Site</u>

At the Roche Site, shallow groundwater generally flows toward the center of the Site, and then flows southeast, parallel to the Valley Drain, and exits the Roche property in the southeast, toward IA-15. B716 is hydraulically downgradient of the Site, receiving groundwater flow from both the northwest (IA-10, Nichols Park, etc.), the northeast (IA 11) and the east/southeast (IAs 14 and 15). St. Paul's Brook and the Valley Drain (culverted) run in close proximity to the south-southwest edge of the B716 property (see Figure 2). A dam across St. Paul's Brook located within Nichols Park, approximately 85 feet southeast of B716, can also be observed on this figure. As shown on Figure 11, a groundwater mound can be observed in Zone S1 in an area south of B716 (upgradient of the dam). The depicted groundwater contours for Zone S1 indicate the potential for groundwater flow toward B716 from the northwest (Nichols Park), northeast

(IA-11) and east/southeast (IA-14, IA-15). This is an area of upward hydraulic gradients, with flow upward from Zone S3 through Zones S2 and S1 to the Valley Drain and St. Paul's Brook.

As shown on Figures 11 through 14, the area of elevated potentiometric head and a strong convergence of flow observed in Zone S1 does not extend into Zones S2, S3, and D1. In Zones S2, S3, and D1, groundwater generally flows from the northwest and northeast to the southeast (Figures 12, 13, 14).

Vertical Gradient Evaluation

Water-level measurements from 44 well clusters (screening Zones S1, S2, S3, D1, and D2 at on-Site and/or off-Site locations) were used to calculate vertical hydraulic gradients. The difference in hydraulic head between selected pairs of wells, screened at different depths, was determined from the measurement of water levels conducted on October 7, 2015 for selected wells surrounding B716. The vertical gradient was derived by using the difference in hydraulic head divided by the vertical distance between the middle of the well screens in each pair of wells. Appendix G provides a table summary of the calculated vertical hydraulic gradients for the selected well pairs (indicating the potential vertical flow direction between Zones S1 and S2, S2 and S3, S3 and D1, and D1 and D2) and a map depicting the location of the evaluated well clusters.

As shown on the table in Appendix G, the majority of well clusters evaluated displayed slight upward vertical hydraulic gradients (particularly from Zone D1 to Zone S1).[7] Figure 1 of Appendix G shows that the well clusters with an upward groundwater flow component are located in the northwestern corners of IA-15 and IA-13, the southeastern portion of IA-11 and off-Site areas east of Nichols Park, including B716 (from areas across IA-11 to the southeast, across the St. Paul's Brook dam). Areas of downward hydraulic head are apparent in well clusters located southeast of B77 (IA-13), B116 (IA-15), B716 (off-Site), as well as locations west of St. Paul's Brook, with the more significant downward gradients observed between Zones S3 and D1 wells MW-112C and DW-25-D1 (-1.090 foot/foot) and Zones S2 and S3 wells MW-340B and MW-340C (-0.861 foot/foot). Overall, the vertical hydraulic gradients for the well pairs ranged between -1.090 to +0.546 foot/foot (downward and upward, respectively).

[7] The September 2013 groundwater monitoring quarter established the baseline conditions of vertical groundwater gradient at the Site (documented in the April 2014 GWRIR), where the majority of Site wells are reported to display a downgradient vertical gradient.

4.1.3.2 B716 Groundwater Analytical Results

Elevated VOC concentrations (with total CVOCs > GWQS in the range of generally 200 to 600 µg/L) have been observed at the MW-171 well cluster during the quarterly sampling program (September 2013 through June 2015). Monitoring wells MW-171A, MW-171B, and MW-171C screen Zones S1 through S3 and are located immediately adjacent to the west-southwest side of B716. The objective of the recently-installed B716 wells was to assess the source(s) of contamination detected at B716 and determine if the VOC exceedances are associated with on-Site impacts observed in IA-15, IA-11, or a source on the B716 property. Table 5-4 provides the analytical data from the B716 sampling program. Figures 15 through 18 depict a summary of recent VOC exceedances in the area in Zones S1, S2, S3, and D1. The B716 wells were also sampled for 1,4-dioxane. The 1,4-dioxane results are included on Figure 19, which presents 1,4-dioxane data (Zones S1 through S3 and D1 through D4) collected throughout the Site between September 2013 and March 2016.

As shown on Figure 15, there are three areas of elevated VOC levels (>100 µg/L) – in IA-15 (southwest of B116), immediately upgradient of and under B716, and at an off-Site location across IA-11 (adjacent to the Nutley Municipal Sewer). The distribution of the >100 µg/L plume is more extensive in deeper zones, particularly in Zone S3 (Figures 16 through 18). As shown on Figures 16 and 17, monitoring wells displaying slightly higher PCE concentrations in Zones S2 and S3 are located northeast and southwest of B716 (MW-338B/C and MW-171B/C, respectively), and in an off-Site area downgradient of IA-11 (MW-304B/C).

The plumes in IA-11 and IA-15 show distinct signatures. The CVOC plume in western IA-11 (and upgradient plumes along the CAMS in Zone S3) show significant percentages of PCE breakdown products (mostly cis-1,2-DCE), while the IA-15 plume is >90% PCE. The CVOC contamination delineated in the new wells on the B716 property shows higher concentrations of cis-1,2-DCE and other CVOCs, and is therefore similar to the CVOC contamination detected in western IA-11. The plumes identified on the B716 property in all zones appear to be the southern extension of the IA-11 plume and the other plumes migrating through IA-11 along the alignment of the CAMS. However, the possibility of some contribution from the IA-15 plume cannot be ruled out.

4.2 Site-Wide/Surface Geophysics Survey

Between August 2014 and April 2015, a surface geophysical survey program (microgravity and MASW) was conducted at the Site by Quantum under the direction of TRC. This program was undertaken to identify any potential near-surface bedrock fractures associated with the regional fault zone that may be influencing groundwater flow and to further understand contaminant distribution in the bedrock aquifer system. Appendix E provides the Quantum Report for this

investigation.

A total of 36 survey transects (including segmented transect lines) were conducted throughout the Site and at selected off-Site locations (i.e., north of Route 3, Nichols Park, and Spruce Street [Nutley, NJ]). Appendix E includes a map depicting the location of the survey transects.

Of the two surface geophysical methods conducted at the Site, the microgravity technology proved to be more effective, identifying 129 fracture-like anomalies in the bedrock. The performance of MASW proved less reliable due to possible interference with existing subsurface structures (e.g., buried utilities and piping). The combined analysis of the two surface geophysical methods resulted in the location of 137 fracture-like anomalies and 12 potential fractures (designated as SW-PF#1 through SW-PF#12). The potential fractures identified trend north-south, comparable to findings reported in the 2013 investigation (GWRIR).[8] The majority of the 137 fracture-like anomalies identified in the Site-wide surface geophysics survey are spatially small. Approximately 40 of these fracture-like anomalies are fairly large, ranging from 40 feet to 150 feet wide.

Transect line 21-21' (located in the southeastern portion of the Site) and transect line 24-24' (located on Route 3, along the shoulder of the westbound lanes) displayed similar fracturing profiles, indicating that the projected fault entering the Site on the north bends to the southeast.

[8] A smaller-scale surface geophysics investigation (targeting areas along St. Paul's Brook and the Valley Drain) was conducted at the Site in 2013. Findings from the 2013 program identified north-south trending fractures (PF#6, PF#7, PF#8, and PF#9) that correlate with the projected fault lines mapped by the USGS in an area north of the Site.

5.0 SCHEDULE OF FUTURE GROUNDWATER INVESTIGATION AND REMEDIAL ACTION ACTIVITIES

The sections below present various schedules of RI and RA field activities that are planned for completion in the near future, including summaries of IRM performance monitoring plans for selected IAs. The schedule for project deliverables anticipated for submittal to the NJDEP within the next 12 months is also provided.

5.1 RI/RA Field Programs

The table below lists the IRM programs selected for implementation in Site IAs where contaminant mass reduction and/or control was warranted, as well as supplemental groundwater sampling programs designed to monitor groundwater quality during the IRM implementation period and/or gather supplemental data for potential natural attenuation applicability.

RI/RA Field Programs							
IA & RI/RA Program	**Targeted COCs**	**Status**	**Treatment Zone**	**Anticipated Technology**	**NJDEP Permit**	**Anticipated Start Date**	**Duration**
Site-Wide GWSP - IRM Implementation Period	VOCs, 1,4-dioxane	Ongoing	N/A	MNA	N/A	Ongoing (as of 3Q 2015)	1 year[1]
Site-Wide MNA Parameters	VOCs	Ongoing	N/A	MNA	N/A	Ongoing	TBD
IA-1/IA-4 IRM	toluene, benzene, 1,4-dioxane	Design & installation completed; operation ongoing	Groundwater in overburden and bedrock	IWAS/ART, ISCO	Air discharge for off-gas; PBR for injections	Ongoing (as of 2Q 2016)	2 - 3 years
IA-2 IRM	benzene, chloroform, methylene chloride	Design & installation completed; operation ongoing	Groundwater in overburden and bedrock	Thermal Treatment (ERH)	Air discharge for off-gas; PBR for electrode drip	Completed (1Q 2016)	6 – 8 months *Completed*
				IWAS	Air discharge for off-gas	Ongoing (as of 2Q 2015)	2 - 3 years
IA-3/IA-7 /CAMS IRM	PCE and breakdown products	PDI & Pilot Test completed; Design ongoing	Groundwater in overburden and bedrock	IWAS, EISB	Air discharge for off-gas; PBR for Injected Amendment	3Q 2016	1 - 2 years
IA-6 IRM	chlorobenzene	Design & installation completed; operation ongoing	Groundwater in overburden and bedrock	IWAS/ART	Air discharge for off-gas; PBR	Ongoing (as of 2Q 2016)	2 – 3 years

RI/RA Field Programs							
IA & RI/RA Program	**Targeted COCs**	**Status**	**Treatment Zone**	**Anticipated Technology**	**NJDEP Permit**	**Anticipated Start Date**	**Duration**
IA-9 IRM	toluene & PCE and breakdown products	PDI and IRM completed	Unsaturated and Saturated Overburden	Excavation and EISB	PBR for Backfilled Amendment	Excavation completed. Amendment placed July 2015	1 year *Completed*
IA-10 IRM (B70)	benzene	Ongoing	Groundwater in overburden	EISB (with no recirculation)	PBR for Injected Amendment (submitted 8/1/2014)	Monitoring ongoing (injections completed 1Q 2015)	1 - 2 years
IA-10 IRM (B104)	PCE, TCE and breakdown products	Ongoing	Groundwater in overburden	EISB (with no recirculation)	PBR for Injected Amendment	Monitoring ongoing (injections completed 2Q 2015)	2 years
IA-11 IRM Bedrock	PCE and breakdown products	PDI & Pilot test completed; Pumping test 4Q 2015; Design ongoing	Groundwater in bedrock (Zones S1, S2, and S3)	Excavation of source residuals in weathered bedrock; EISB (with recirculation)	PBR for Injected Amendment; Air discharge for off-gas	Excavation in 3Q 2016, if implemented; further remedies TBD	2 - 4 years
IA-12 IRM Bedrock	PCE and breakdown products	PDI & Pilot test completed; Phase I ERH completed; Pumping test completed 1Q 2016; IWAS in construction	Groundwater in bedrock	Thermal Treatment (ERH)	Air discharge for off-gas; PBR for electrode drip	Completed (as of 3Q 2015)	6 - 9 months *Completed*
				IWAS with chemical oxidation	Air discharge for off-gas; PBR for Injected Amendment	2Q 2016	2 years

Notes:

1. A minimum of 1 year of monitoring was proposed in the Site-Wide GWRP – IRM Implementation Period (September 2015). This sampling plan provided flexibility to adjust the frequency, number of wells and parameters after 4 sampling quarters. A proposal to modify the plan will be submitted to the NJDEP after the June 2016 sampling event.
2. Completed IRM programs are shown in gray.
3. ERH = Electrical Resistance Heating.
4. MNA = Monitored Natural Attenuation.
5. N/A = Not Applicable.
6. PBR = Permit-by-Rule.
7. TBD = To Be Determined.
8. IWAS = In-Well Air Stripping.
9. ART = Accelerated Remediation Technologies.
10. ISCO = *in situ* chemical oxidation.
11. EISB = Enhanced *in situ* bioremediation.

5.2 IRM Performance Monitoring

IA-specific performance monitoring plans have been developed for most of the proposed IRM areas. Currently, the IA-11 IRM system is undergoing design.

As requested by the NJDEP in an information request letter dated October 27, 2015, a summary of the IRM monitoring programs is provided in the table below. Please note that these plans are subject to amendment to address field observations and changing conditions. The figures included in Appendix H identify the locations of monitoring wells selected for long-term monitoring during the IRM implementation period. A comprehensive IRM Progress Report will be submitted to the NJDEP in the fall or winter of 2016.

Site-Wide IRM Performance Monitoring Plan					
IRM Information			**IRM Groundwater Monitoring Plan**		
IA	**Technology**	**Start Date**	**Well IDs**	**Analytical Parameters**	**Sampling Schedule**
IA-1 (B55)	EISB	January 2016	**Zone S1:** MW-254B, MW-255B, MW-389A, MW-390A, MW-391A, MW-392A, MW-1	• VOCs • Field parameters (pH, temperature, ORP, DO, specific conductivity)	Quarterly January 2016 - End of 2017 (expected)
IA-1 /IA-4	Injections +IWAS	April 2016	**Zone S1:** MW-2, MW-136, MW-256A, MW-256B, MW-357A, MW-357-SBR, MW-369A, MW-370A, MW-371A, MW-372A, MW-384A, MW-387A, MW-388A, MW-390A, MW-391A, MW-392A, MW-393A, MW-416A, MW-426A **Zone S2:** MW-2B, MW-136B, MW-357-S2, MW-371B, MW-387B, MW-388B, MW-390B, MW-392B, MW-393B, MW-394B, MW-416B, MW-426B **Zone S3:** MW-2C, MW-136C, MW-357-S3, MW-371C, MW-387C, MW-391C, MW-391-S3, MW-392C, MW-393C, MW-394C, MW-416C	• VOCs • 1,4-Dioxane • Field parameters (pH, temperature, ORP, DO, specific conductivity)[3]	Baseline: April 2016; Startup: May 2016; Quarterly July 2016 – October 2018

Site-Wide IRM Performance Monitoring Plan					
IRM Information			**IRM Groundwater Monitoring Plan**		
IA	**Technology**	**Start Date**	**Well IDs**	**Analytical Parameters**	**Sampling Schedule**
IA-2	Injections +IWAS	September 2015	**Zone S1:** MW-14A, MW-155R, MW-156R, MW-158, MW-17, MW-322A, MW-398A, MW-423A **Zone S2:** MW-158B, MW-264B, MW-418B, MW-419B, MW-420B, MW-421B, MW-422B, MW-423B, MW-424B **Zone S3:** MW-264C, MW-320C, MW-420C, MW-421C, MW-422C, MW-424C	• VOCs • Field parameters (pH, temperature, ORP, DO, specific conductivity)	Monthly September - November 2015; Quarterly thereafter.
IA-3/ IA-7/ CAMS	Injections +IWAS	June 2016	**Zone S1:** MW-15A, MW-139, MW-192, MW-193, MW-194, MW-253A, MW-293A, MW-491A, MW-492A, MW-494A, IW-132A1 **Zone S2:** TBD **Zone S3:** TBD **Zone D1:** TBD	• VOCs • Field parameters (pH, temperature, ORP, DO, specific conductivity)	TBD
IA-6	Injections, IWAS, Biosparge	April 2016	**Zone S1:** ART-75, ART-76, ART-78, ART-89, MW-52, MW-160, MW-161, MW-163, MW-317A, MW-318A, MW-346A, MW-350A, MW-395A, MW-396A, MW-397A, MW-447A **Zone S2:** ART-77, ART-79, ART-80, ART-81, ART-82, ART-83, ART-84, ART-85, ART-87, BIOS-1B, BIOS-2B, BIOS-3B, BIOS-4B, BIOS-5B, BIOS-6B, BIOS-7B, BIOS-8B, BIOS-9B, BIOS-10B, BIOS-11B, BIOS-12B, BIOS-13B, BIOS-14B, BIOS-15B, MW-53, MW-157B, MW-317B, MW-318B, MW-321B, MW-346B, MW-350B, MW-447B **Zone S3:** ART-86, ART-88, MW-54, MW-317C, MW-321C, MW-346C, MW-350C	• VOCs • 1,4-Dioxane • Field parameters (pH, temperature, ORP, DO, specific conductivity)	Baseline: April 2016 (70 samples); Monthly (22 samples); Quarterly (3 samples).
IA-10 (B104)	Injections	March 2015	**Zone S1:** 186RI-MW1, 186RI-MW2, MW-32, MW-259A, MW-281A, MW-283A, MW-284A, MW-285A, MW-286A, MW-287A, MW-23W	• VOCs • Dissolved iron & manganese, sulfate, nitrate • Field parameters (pH, temperature, ORP, DO, specific conductivity)	Quarterly

Site-Wide IRM Performance Monitoring Plan					
IRM Information			**IRM Groundwater Monitoring Plan**		
IA	**Technology**	**Start Date**	**Well IDs**	**Analytical Parameters**	**Sampling Schedule**
IA-12	Injections, IWAS	April 2016	**Zone S1:** MW-60F, MW-60G, MW-60M, MW-60R, MW-80C, MW-225A, MW-239, MW-294A, MW-295A, MW-359A, MW-360A, MW-362A, MW-365A, MW-435A, MW-436A, MW-437A, MW-438A, MW-439A, MW-440A, MW-442A, MW-443A, MW-444A, MW-445A **Zone S2:** MW-24C, MW-60-Z2R, MW-80-Z2R, MW-225B, MW-295B, MW-359B, MW-360B, MW-362B, MW-365B, MW-435B, MW-436B, MW-437B, MW-438B, MW-439B, MW-442B, MW-443B, MW-444B, MW-445B **Zone S3:** MW-60G-S3, MW-225C, MW-239C, MW-294C, MW-364C	• VOCs • Dissolved iron & manganese • Field parameters (pH, temperature, ORP, DO, specific conductivity)	Baseline May 2016; Monthly June – August 2016; Quarterly following persulfate injections.

Notes:
1. Detailed IRM performance monitoring plans were submitted to the NJDEP with the PBR applications of selected IAs.
2. The IRM Performance Monitoring schedule for IA-11 is not provided as design is still pending or is being re-evaluated.
3. The IA-1/IA-4 IRM performance monitoring plan also includes analysis of 1,4-dioxane biodegradation DNA Census (Microbial Insights) for monitoring wells MW-370A, MW-371A, MW-392A, MW-392B, and MW-392C.
4. DO = Dissolved Oxygen.
5. ORP = Oxidation Reduction Potential.
6. TBD = To Be Determined.

5.3 Schedule of Upcoming Groundwater Deliverables

The table lists the Site groundwater deliverables anticipated for submittal to the NJDEP within this calendar year.

Future Groundwater Deliverables	
Document Title	**Anticipated Submittal to NJDEP**
GWPR # 3	Fall 2016
CSM Report	Fall or Winter 2016
Site-Wide GWSP *(post-June 2016)*	Fall or Winter 2016
IRM Progress Reports Compilation	Fall or Winter 2016

6.0 REFERENCES

TRC, Hoffmann-La Roche Inc., Nutley Facility, Site-Wide Ground Water Remedial Investigation Report, April 2014.

TRC, Hoffmann-La Roche Inc., Nutley Facility, Investigative Area IA-15 Groundwater Pre-Design Investigation (PDI) Report for Development of Interim Remedial Measures (IRM), December 2014.

TRC, Hoffmann-La Roche Inc., Nutley Facility, Revised Site-Wide Groundwater Sampling Plan – IRM Implementation Period (Rev. 2), September 2015.

TRC, Hoffmann-La Roche Inc., Nutley Facility, Site-Wide Groundwater Progress Report, January 2015.

TRC, Hoffmann-La Roche Inc., Nutley Facility, Site-Wide Groundwater Progress Report, December 2015.