

**Executive Summary
Gelman Sciences, Inc. Unit E Aquifer
Groundwater Contamination
Decision Document**

Site Name and Location:

Gelman Sciences, Inc.
Scio Township
Washtenaw County
Site ID #: 81000018

Purpose:

This document is prepared in accordance with Section 20120d of Part 201 (Environmental Remediation) of the Natural Resources and Environmental Protection Act (NREPA) to provide a summary of the decision regarding cleanup of the Unit E aquifer groundwater contamination plume (Unit E Plume) plume, along with the reasons for the Department of Environmental Quality (DEQ) selecting a remedial action for the Unit E Plume at the Gelman Sciences, Incorporated site of environmental contamination (Gelman site.) This document is also prepared in response to the status conference in Washtenaw County Circuit Court on February 25, 2004, wherein the court ordered Pall Life Sciences, Inc. (PLS) to submit their comprehensive feasibility study (FS) by June 1, 2004, and the DEQ to respond to the FS by September 1, 2004. This document supplements previous remedial decisions for other contaminated groundwater units that are embodied in the October 1992 Consent Judgment (File No. 88-34734-CE), and subsequent Remediation and Enforcement Order dated July 17, 2000.

Basis:

The decision outlined in this document is based upon the Administrative Record developed by the DEQ.

Summary:

The Gelman site is comprised of the PLS plant property located on Wagner Road just south of Jackson Road in Scio Township, and extends eastward and north-eastward into the City of Ann Arbor, and westward and north-westward in Scio Township. From 1966, to 1986, PLS used 1,4-dioxane in the manufacture of medical filters. Various methods of disposal and waste handling during this period resulted in widespread groundwater contamination. Three major aquifers were identified and designated as the Unit C₃ (includes the Core Area), Unit D₀ (includes the Western System), and Unit D₂ (includes the Evergreen System) aquifers. PLS began groundwater remediation efforts to address these aquifers in 1997. In May of 2001 the deeper, Unit E Aquifer, was also discovered to be contaminated. Since the contamination in the Unit E aquifer was discovered, 30 monitoring wells have been installed to determine the nature and extent of contamination. In May 2003, PLS and DEQ agreed that PLS should develop a FS to systematically evaluate remedial alternatives for the Unit E Plume.

The June 2004, FS examined remedial alternatives for addressing the entire Unit E Plume, and proposed PLS's remedial alternative. The DEQ reviewed PLS's FS and

preliminarily concluded that PLS's proposed alternative could not be approved as presented. On July 7, 2004, the DEQ preliminarily identified a remedial alternative consistent with Part 201, and solicited public comment.

Upon considering public comments received during the public comment period, the DEQ makes the following decision regarding the Unit E plume:

In order to address the elements required for remedial actions under Part 201, the DEQ has determined that extracting and treating contaminated groundwater in the vicinity of Wagner Road and Maple Road, coupled with capture of the "leading edge" of contamination is necessary to comply with Part 201, and the Consent Judgment. The performance objectives for the groundwater extraction in the vicinity of Maple Road, the vicinity of Wagner Road, and for the leading edge are that, once initiated, a hydraulic barrier should be created to halt the further migration of concentrations of 1,4-dioxane above 85 ppb in the downgradient or easterly direction.

The DEQ believes there may an opportunity for PLS to satisfy the conditions set forth on pages 15 and 16 of the attached detailed Decision Document, and that, if those conditions can be satisfied, capturing the leading edge of the plume would not be necessary to satisfy Part 201 criteria. PLS has indicated to the DEQ that it may be able to satisfy those conditions within one year. Thus the DEQ has outlined in this Decision Document parallel pathways PLS can take to explore their ability to satisfy the necessary conditions that would allow the leading edge of the Unit E Plume to lawfully migrate untreated, while concurrently moving forward with the necessary steps to expeditiously perform interim response actions and enable timely treatment at the leading edge, if that is necessary.

Statutory Determinations:

This DEQ Decision is protective of public health, safety, and welfare, and the environment. The Decision provides for removal of hazardous substances from the Unit E Plume until Generic Residential Cleanup Criteria protective for drinking water are met. Alternatively, this Decision provides for complying with other provisions of Part 201 and the Consent Judgment.

Andrew W. Hogarth, Chief
Remediation and Redevelopment Division

Date

Attachment

Decision Document
Gelman Sciences, Inc. Unit E Aquifer
Washtenaw County, Scio Township
Groundwater Contamination
September 1, 2004

Introduction

This document is prepared in accordance with Section 20120d of Part 201 (Environmental Remediation) of the Natural Resources and Environmental Protection Act (NREPA) to provide a summary of the decision regarding cleanup of the Unit E aquifer groundwater contamination plume (Unit E Plume), along with the reasons for the Department of Environmental Quality's (DEQ) selection of a remedial alternative for the Unit E Plume at the Gelman Sciences, Incorporated (GSI) site of environmental contamination (Gelman site.) This document is also prepared pursuant to a Washtenaw County Circuit Court order that required Pall Life Sciences (PLS) to submit a final feasibility study (FS) for the Unit E Plume to the DEQ by June 1, 2004, and required the DEQ to make a decision regarding cleanup of the Unit E Plume by September 1, 2004. In February 1997, the Pall Corporation acquired GSI, and the company was known as Pall/Gelman Sciences, Inc. until 2001, when the company changed its name to PLS. For simplicity, this document will refer to PLS regarding all past and current actions of the company. This document will refer to all areas that have been impacted by the contamination as the "Gelman site".

Gelman Site Location and General History

The Gelman site is comprised of the PLS plant property located on Wagner Road just south of Jackson Road in Scio Township, and extends eastward and north-eastward into the City of Ann Arbor, and westward and north-westward in Scio Township. From 1966, to 1986, PLS used 1,4-dioxane in the manufacture of medical filters. Various methods of disposal and waste handling during this period resulted in widespread groundwater contamination. In the fall of 1985, the first contaminated private water supply wells were discovered in the vicinity of the PLS property, and additional well sampling was done. Bottled water was provided to affected residences and businesses until the municipal water supply was extended into these areas. To date, approximately 124 private water supply wells have been connected to the municipal water supply system as a result of groundwater contamination.

Beginning in 1986, investigations by PLS identified soil contamination on the PLS property, and four areas of groundwater contamination extending off the property. Three major aquifers were identified and designated as the Unit C₃ (includes the Core Area), Unit D₀ (includes the Western System), and Unit D₂ (includes the Evergreen System) aquifers. In May of 2001, the deeper, Unit E aquifer, was also discovered to be contaminated. The complex geology in the vicinity of the PLS property contributed to the widespread nature of the contamination.

The compound of concern at the Gelman site is 1,4-dioxane (C₄H₈O₂). It is an organic solvent that is most often used as a stabilizer in chlorinated solvents. In the case of PLS, pure 1,4-dioxane was used as a solvent for cellulose in the filter manufacturing process. The compound 1,4-dioxane is completely soluble in water, and is held together by strong bonds that prevent it from breaking down readily in groundwater. Toxicity testing has

determined that high doses of 1,4-dioxane cause cancer in mice. It is presumed to be a human carcinogen through long-term exposure to low doses.

When the contamination was first discovered in late 1985, the generic residential cleanup criteria were 3 parts per billion (ppb) for groundwater, and 60 ppb for soils. In June 1995, the state legislature amended Part 201 of the NREPA, resulting in an increase of the generic residential cleanup criteria to 77 ppb for groundwater, and 1,500 ppb for soils. In June 2000, the DEQ updated its risk based cleanup criteria, which resulted in the current generic residential cleanup criteria of 85 ppb for groundwater, and 1,700 ppb for soils. The concentration in surface water considered safe for public health and the environment is 2,800 ppb if the surface water is not used as a source of drinking water. However, if that surface water is used as a source of drinking water, the concentration considered safe is 34 ppb.

Common treatment systems are ineffective in removing 1,4-dioxane from water. Ultraviolet oxidation, which is currently being used at the Gelman site, uses a combination of hydrogen peroxide (H₂O₂), and ultraviolet light to convert 1,4-dioxane to carbon dioxide and water.

PLS has tested a new treatment technology, using ozone and hydrogen peroxide, for use at current and future treatment locations. The DEQ has not yet approved the use of this new technology. One advantage of this treatment method would be that it eliminates the use of three hazardous chemicals required by the current treatment system.

The maximum concentration of 1,4-dioxane found in different areas of the Gelman site has changed over time, as shown in Table 1.

**Table 1 - Concentrations of 1,4-Dioxane
Past and Recent**

System	1,4-dioxane (ppb)	Year	1,4-dioxane (ppb)	Year	Applicable Standard
Core	212,000	1988	11,390	2003	85 ppb
Evergreen	43	1990	3,031	2003	85 ppb
Western	132	1986	175	2003	85 ppb
Marshy	49,800	1994	14,300	2003	85 ppb
Unit E	3,250	2001	7,800	2004	85 ppb
Soils	2,400,000	1988	944,000	1998	1,700 ppb

Summary of Gelman Site Risks

Part 201 of the NREPA requires liable parties to implement response activities at sites of environmental contamination. Parties are allowed to consider current and future land use as a basis for determining the degree of cleanup required at a specific site. As part of deciding whether a cleanup is appropriate, liable parties and the DEQ are required to evaluate many potential pathways of exposure and determine which, if any, pathways are or may be complete. Pathways that are complete, or realistically may become complete, must be addressed in some fashion. The types of pathways considered include, among

other things, use of groundwater for drinking water, groundwater discharging to surface water, volatilization from soil or groundwater to indoor air.

The DEQ has established generic cleanup criteria for soils and groundwater which are protective of public health and the environment in various exposure pathways. As mentioned in the "Gelman Site Location and General History" section of this document, the DEQ has promulgated a generic residential cleanup criterion (GRCC) for 1,4-dioxane in groundwater of 85 ppb, based on consumption of groundwater for drinking water. This is a risk based criterion calculated by the DEQ, and is not a drinking water standard as could be, but has not been, established by a state or federal agency. The use of groundwater for drinking water from the Unit E Plume is a completed pathway. Residents in Scio and Ann Arbor townships rely on groundwater for their drinking water, and the City of Ann Arbor uses a combination of groundwater and surface water to provide drinking water to their residents and citizens.

Gelman Site Enforcement Activities

Legal actions by the state against PLS began in 1988, and ultimately resulted in two separate Consent Judgments (CJ) in October 1992: one for cleanup actions, and another for recovery of state response costs of \$1.1 million. In September 1996, the CJ for cleanup actions was amended to incorporate the cleanup criteria changes brought about by the June 1995 amendments to Part 201 of the NREPA, and to establish new schedules where needed. Because of the complexity of the Gelman site, the original CJ for cleanup actions divided the site into six separate systems (Core, Evergreen, Western, Marshy, Soils, and Spray Irrigation Field) with specific requirements for each.

In February 2000, the Department of Attorney General (DAG) filed a motion in Washtenaw County Circuit Court (court) to enforce several provisions of the CJ with which PLS had not complied. A hearing on the motion was held in July 2000, regarding stipulated penalties and injunctive relief for additional response actions. During the hearing, staff of PLS testified that they would have an additional treatment system added to their central treatment facility within ten weeks, after which accelerated extraction of contaminated groundwater would be initiated from the existing Evergreen extraction wells, and the horizontal wells in the aquifer leading to the Evergreen subdivision area. PLS staff estimated that their plan for additional extraction would result in achieving the cleanup criteria within five years. On July 17, 2000, the court issued an Opinion and Remediation Enforcement Order (REO). The DEQ's request for penalties was taken under advisement. The court ordered PLS to perform most of the additional investigation requested by the DEQ. The court also ordered PLS to install the additional treatment equipment within 75 days, and to submit a plan to the DEQ within 45 days to outline steps for achieving the cleanup criteria in all affected water supplies within five years.

As a result of the additional investigation of the Western System requested by the DEQ, a connection between the upper contaminated units and Unit E aquifer was discovered.

The court continues to hold all penalties under advisement. Status conferences are being held periodically, with the next one scheduled for 3:00 p.m. on September 8, 2004, at the Washtenaw County Circuit Court.

FIVE YEAR PLAN

The Five Year Plan (Plan), as revised to incorporate concerns raised by the DEQ, was adopted by the court in January 2001. The Plan covers the entire Gelman site except the Unit E aquifer, and generally replaces previously approved work plans for separate systems. The Plan allows PLS flexibility to adjust some components of the remediation systems, but requires minimum extraction rates at key locations until changes are approved by the DEQ. Monthly benchmarks, as required by the REO, have been incorporated into the Plan. These benchmarks require the removal of a specified number of pounds of 1,4-dioxane each month, and are revised annually. The rate of mass removal decreases gradually over the life of the Plan as the concentration of 1,4-dioxane in the aquifers is reduced by cleanup actions. PLS is submitting quarterly reports on the progress of the remedial actions. The DEQ and PLS also meet regularly to discuss progress and determine what adjustments are needed.

Unit E Plume

The Unit E aquifer is contaminated with 1,4-dioxane above the residential criterion (based on drinking water) in an area extending from Parkland Plaza to Worden Street, east of Veterans Park. The Unit E aquifer is the deepest of the glacial aquifers, and lies just above the bedrock, over 200 feet below the ground surface in some areas.

In the spring of 2001, as a result of the DEQ requested investigation of the Western System, it was discovered that there is no confining layer of clay separating the Unit D₂ aquifer from the Unit E aquifer in an area west of the PLS property. The exact location(s) of the connection(s) that has allowed 1,4-dioxane contamination to migrate into the Unit E aquifer has not been determined. Investigation to-date has focused on defining the extent of contamination. In reviewing historic data, it was discovered that earlier data indicated that the Unit E was contaminated, however, this fact escaped the attention of the DEQ at that time, and was not brought to the attention of the DEQ by PLS or other parties.

Following the discovery of contamination in the Unit E aquifer in May 2001, 30 monitoring wells have been installed to determine the nature and extent of contamination. Recent investigation has focused on the area in and around Veterans Park, and the Maple Village Shopping Center (MVSC). In March 2003, PLS proposed an interim response at the MVSC. Monitoring wells installed since that time show that the width of the plume at that location is over 1,000 feet. After reviewing the data, PLS determined that their March 2003, proposal was not feasible due to the volume of water that would need to be extracted, treated, and discharged.

In May 2003, PLS and DEQ agreed that PLS should develop a feasibility study to systematically evaluate remedial alternatives for the Unit E Plume.

In July 2003, PLS drilled a test boring on the west side of the MVSC as part of an effort to drill a test well for use as a potential extraction well. Sampling results obtained from the test boring determined that the highest concentration of 1,4-dioxane at that location was 282 ppb. Because this was much lower than the maximum concentration known to be present in the MVSC area, it was decided that the location of the test boring was not optimal for groundwater extraction. A new location for a test well was selected and

installed (TW-16), near the intersection of Jackson and Maple Roads. PLS completed an aquifer performance test of TW-16 in August 2003, and the results are being considered by the DEQ in its review of remedial alternatives proposed by PLS.

In November 2003, PLS performed a series of tests to determine if *in situ* (in place) oxidation of groundwater with ozone and/or hydrogen peroxide is a feasible remedial alternative and determined the need to do additional testing. This delayed the planned submittal date of a comprehensive feasibility study to examine alternatives for addressing the entire Unit E aquifer contamination. In January 2004, at the request of the DEQ, PLS submitted an interim FS to summarize remedial alternatives considered to-date. The DEQ provided comments on the interim feasibility study on April 13, 2004.

The DEQ also provided conditional approval of PLS's *In Situ* Work Plan dated February 17, 2004. PLS implemented the work plan in March through May 2004, and planned to evaluate the results for inclusion in the comprehensive feasibility study, if applicable. Because the technology proved to be infeasible, it was not considered further.

From May 2002, through June 2004, PLS operated two extraction wells (TW-11 and TW-12), in upgradient portions of the Unit E aquifer on their property, removing about 150 gallons per minute (gpm) during that time period. In July 2004, PLS began operating a new extraction well, TW-17, and ceased operation of TW-12, in which concentrations had decreased to 68 ppb. As of the end of July 2004, TW-11 and TW-17 were collectively removing 228 gpm, and the concentration of 1,4-dioxane in those two wells were 600 ppb and 670 ppb, respectively.

At a status conference in Washtenaw County Circuit Court on February 25, 2004, the court ordered PLS to submit their comprehensive FS by June 1, 2004, and the DEQ to respond to the FS by September 1, 2004. The FS examined remedial alternatives for addressing the entire Unit E Plume, and proposed PLS's remedial alternative.

As discussed below, the DEQ reviewed PLS's FS, and preliminarily concluded that PLS's proposed alternative could not be approved as presented. The DEQ preliminarily identified a remedial alternative consistent with Part 201, and solicited public comment. The following sections document the DEQ's decision process and identify the DEQ's remedial alternative and the rationale for its selection.

Evaluation of the Feasibility Study

On June 2, 2004, PLS submitted its Final FS, and Proposed Interim Response Plan to the DEQ. The DEQ thoroughly evaluated the FS, and has prepared this document in response to the major items addressed in the FS. PLS did not address all of the DEQ's comments on the interim FS for the Unit E Plume in the current FS. The absence of comments on any item in the FS should not be interpreted as DEQ's agreement with such items.

PLS considered an array of process options that were combined into thirteen separate remedial alternatives, and are summarized below. These alternatives were screened and the eight surviving alternatives were evaluated in more detail. PLS asserted that each of these eight alternatives would adequately protect public health due to the depth of the

groundwater and the existence of a municipal water supply. Alternatives that did not survive the screening process are noted below as having been eliminated. The DEQ's outline of the alternatives PLS considered is listed below. The DEQ has revised the title of some of the alternatives to more accurately reflect the proposed response action.

Alternative 1 – No Action

This alternative is considered for comparison purposes, and was eliminated due to not meeting the requirements of Part 201.

Alternative 2 – Monitored Natural Attenuation and Institutional Controls

This alternative includes:

- a hydrogeological investigation to determine where the groundwater contamination (plume) would flow if no remedial action is taken
- a network of monitoring wells to track the migration of the plume
- long-term monitoring
- institutional controls (deed restrictions or a local ordinance) to restrict use of the groundwater

This alternative was eliminated due to the uncertainty of public support.

Alternatives 3a-e – Groundwater Pumping at Leading Edge, Pipeline to PLS Wagner Road Facility, Treatment and Discharge by Various Methods

These alternatives share:

- extraction from three wells of approximately 500 gpm to prevent further migration of contamination in excess of the GRCC
- pipeline to PLS property on Wagner Road for treatment
- treatment with ultra-violet light and hydrogen peroxide (current method), or ozone and hydrogen peroxide

The five discharge methods/locations considered are:

- a. pipeline to the Huron River
- b. reinjection into plume at multiple locations on PLS property where 1,4-dioxane exceeds 85 ppb
- c. reinjection into plume at multiple locations where 1,4-dioxane is 1-85 ppb
- d. reinjection into plume at multiple locations where 1,4-dioxane is less than 1 ppb
- e. Discharge to Honey Creek at existing outfall

Alternative 3b was eliminated due to the unknown effects of reinjection within the plume.

Alternative 3d was eliminated due to the inability to reliably treat groundwater to non-detect.

Alternatives 4a-d – Groundwater Pumping at Leading Edge, Treatment with Ozone and Hydrogen Peroxide near Maple Road, Discharge by Various Methods

These alternatives share:

- extraction from three wells of approximately 500 gpm to prevent further migration of contamination in excess of the GRCC
- pipeline to the Maple Road area for treatment
- treatment with ozone and hydrogen peroxide

The four discharge methods/locations considered are:

- a. pipeline to the Huron River

- b. reinjection into plume at multiple locations on PLS property where 1,4-dioxane exceeds 85 ppb
- c. reinjection into plume at multiple locations where 1,4-dioxane is 1-85 ppb
- d. reinjection into plume at multiple locations where 1,4-dioxane is less than 1 ppb

Alternative 4b was eliminated due to the unknown effects of reinjection within the plume. Alternative 4d was eliminated due to the inability to reliably treat groundwater to non-detect.

Alternative 5 – Groundwater Pumping at Leading Edge, Pipeline to PLS Wagner Road Facility, Injection into Deep Formation Without Treatment

This alternative includes:

- extraction from three wells of approximately 500 gpm to prevent further migration of contamination in excess of the GRCC
- pipeline to PLS property on Wagner Road
- injection into the deep formation (about one mile deep, below bedrock) without treatment

Alternative 6 – Migration of Plume toward the Huron River, Groundwater Pumping near Huron River (if necessary to meet criteria), Treatment and Discharge to the Huron River

This alternative is similar to Alternative 2, with the addition of:

- a contingency to extract, treat and discharge groundwater to the Huron River if concentrations of 1,4-dioxane exceed relevant criteria
- relying on the Washtenaw County Rules and Regulations for Protection of Groundwater and court orders as institutional controls to restrict use of the groundwater

PLS's Proposed Remedial Alternative

PLS conducted a detailed review of the eight alternatives that survived the screening process and chose Alternative 6, with the addition of interim response actions for an undetermined length of time, to reduce the mass of 1,4-dioxane, in order to minimize the possibility that downgradient groundwater extraction and treatment will be necessary. The components of PLS's Proposed Remedial Alternative (PRA) are:

- a hydrogeological investigation to determine where the Unit E Plume would flow if no remedial action is taken
- a network of monitoring wells to track the migration of the plume
- long-term monitoring
- installation of one or two more extraction wells near Wagner Road and an increase in the extraction rate to 250 gpm (currently 228 gpm from two extraction wells), with treatment and discharge to the Honey Creek Tributary under their existing discharge permit;
- extraction of 200 gpm from one well at Maple Road, nearby treatment with ozone and hydrogen peroxide and reinjection into two wells at Maple Road, north and south of the extraction point.
- a contingency to extract, treat and discharge groundwater to the Huron River if concentrations of 1,4-dioxane exceed relevant criteria at compliance points protective of the Huron River

- relying on the Washtenaw County Rules and Regulations for Protection of Groundwater (WCRRPG) and court orders as institutional controls to restrict use of the groundwater

Criteria for Selecting Remedial Actions

Under the CJ, actions taken by PLS must capture groundwater contamination in excess of applicable cleanup standards emanating from its facility, and properly dispose of the treated groundwater. Part 201 and the Part 201 Rules identify a number of criteria the DEQ must use in selecting Remedial Actions. Section 20118(2) specifies that, at a minimum, remedial actions must:

- a. assure the protection of the public health, safety, and welfare, and the environment;
- b. except as otherwise provided, attain a degree of cleanup and control of hazardous substances that complies with all relevant and appropriate requirements, rules, criteria, limitations and standards of state and federal environmental law. [NOTE: Section 20118(5) and (6) allows the Department to “waive” the requirements of Rule 299.5705(5) and 299.5705(6) under certain conditions. These rules specify that remedial actions not allow contaminated groundwater plumes to expand once a remedial action is initiated, and provide for active removal of hazardous substances from contaminated groundwater. Exceptions to these rules will be referred to as a “waiver”.]

The DEQ considers the above requirements to be “threshold criteria” that a remedial action must satisfy. In addition, the following are considered by DEQ to be “balancing criteria” in weighing alternatives that meet the threshold criteria. Section 20118(3) and (4) state that “the cost-effectiveness of alternative means of complying with Section 20118 shall be considered by the Department only in selecting among alternatives that meet all of the criteria in Section 20118(2); and that remedial actions that permanently and significantly reduce the volume, toxicity, or mobility of hazardous substances are to be preferred.”

Part 6 of the Part 201 Rules provides additional criteria regarding remedy selection. While Rule 601 reiterates the Section 20118 requirements, Rule 603 provides additional criteria the DEQ must use in selecting remedies, including:

- The effectiveness of protecting the public health, safety, and welfare, and the environment;
- The long-term uncertainties associated with the proposed remedial action;
- The toxicity, mobility, and propensity to bio-accumulate of the hazardous substances;
- The short and long-term potential for adverse health effects from human exposure;
- The costs of the remedial action, including long-term maintenance;
- The reliability of the alternatives;
- The potential for future remedial action costs if an alternative fails;
- The potential threat to public health, safety, and welfare, and the environment associated with excavation, transportation and re-disposal or containment;
- The ability to monitor remedial performance;
- The public’s perspective about the extent to which the proposed remedial action effectively addresses Part 201 and the Part 201 Rules.

DEQ Analysis of PLS's PRA Using the Above Criteria

The DEQ has carefully reviewed PLS's FS in relation to the criteria described above. The DEQ has determined that PLS's PRA is not acceptable for the reasons described below. PLS's estimated cost for their PRA is based on 20 years of monitoring followed by 30 years of operation and maintenance of the contingency treatment system, implying that the cleanup criteria will be achieved in 50 years. However, there is no documentation to support that the cleanup criteria will be achieved in 50 years. In addition, the DEQ has reviewed the WCRRPG and has determined it does not meet the requirements for an acceptable Part 201 institutional control in its current form, nor has any court order been imposed to reliably restrict groundwater use. An example of the deficiencies in the WCRRPG is that there is no provision to abandon existing drinking water wells in the area threatened or impacted by the groundwater contamination and there is no restriction on installation and operation of industrial wells, which could change the configuration of the plume.

PLS's PRA also relies on the City's anticipated decision not to resume operation of the Northwest Supply well (a.k.a. Montgomery well). PLS indicates that the available information shows that this well will not be impacted by the contamination. However, the Unit E Plume is in the western portion of the wellhead protection area for the Northwest Supply well, the City has not abandoned this well, and low levels of 1,4-dioxane have been detected in the well. In addition, the DEQ has a policy against granting waivers of its rules to allow for plume expansion in wellhead protection areas. Further, PLS's PRA presumes that the Unit E Plume will not underflow the Huron River and there is no provision to monitor or protect existing private water supply wells east of the Huron River if the plume does underflow the Huron River. PLS's PRA would impermissibly allow the extent of environmental contamination to expand. As proposed, and under present circumstances, this alternative does not meet the threshold criteria of assuring the protection of the public health, safety, and welfare, and the environment. This alternative is based on the assumption that the Unit E Plume will migrate along a predicted path toward, and discharge entirely to, the Huron River at concentrations below the groundwater-surface water interface criterion, as shown in Figure 11 from the PLS Feasibility Study. PLS assumes that no additional residential or community wells will become contaminated as a result of this migration. There is a substantial degree of long-term uncertainty associated with these assumptions and, consequently, PLS's remedial alternative. There is not currently enough information available to predict the exact route the plume will follow, including whether it will ultimately contaminate additional residential wells. Nor is there sufficient information about how long the plume will take to get to the river and/or other receptors, and what concentrations the plume will be when it arrives at receptors. The potential difficulty of securing adequate institutional controls from the City or County adds uncertainty to the feasibility of this remedial alternative and combines with the other uncertainties to make this alternative relatively unreliable in protecting public health, safety, welfare, and the environment.

PLS states that their PRA will be less disruptive and more compatible with existing land uses than the leading edge alternatives; however, it is premature to make such a statement since the ultimate path of the plume cannot be determined until a hydrogeological study is performed. The study required by such an approach would also

require numerous monitoring wells, which would also be likely to create some disruption of residential neighborhoods.

For the above reasons, the DEQ has determined that, under the present circumstances, PLS's PRA does not satisfy the requirements established by Part 201 and the Part 201 Rules.

The DEQ's preliminary identification of additional conditions that would have to be met in order for the DEQ to approve a modified version of PLS's PRA, including a waiver of Rule 705(5), are restated below. The DEQ initially identified these conditions only to allow for comparison to the other alternatives, not necessarily as a recommendation that these steps be taken.

1. Abandonment of the Montgomery well (Northwest Water Supply well) and elimination of the associated wellhead protection area designation by the City.
2. Prevention of any further migration of 1,4-dioxane contamination beyond Maple Road in excess of 2,800 ppb (the criterion protective of surface water).
3. A plan for monitoring any water supply wells that are found to be threatened with contamination by subsequent investigations to determine the fate of the plume, and a contingency plan to prevent unacceptable exposure if water supply wells are affected.
4. Enactment of an acceptable institutional control, in a specified period of time, to prevent any groundwater withdrawal that would exacerbate the contamination, in addition to preventing the use of contaminated groundwater for drinking water.
5. Groundwater monitoring to ensure that contamination above the GRCC does not underflow the Huron River, with a contingency plan to intercept any such contamination.
6. Provide for acceptable disposal of the treated groundwater from the Maple Road interim response, by providing sufficient hydrogeological information to resolve concerns about reinjection, and/or by shifting to an alternate means of disposal.

Public Involvement

The DEQ has developed an in-depth Citizen Involvement Plan (CIP) for the Gelman site. The plan is attached in Appendix A, and is summarized below.

The DEQ meets quarterly with local officials from Scio Township, Washtenaw County, the City of Ann Arbor, Ann Arbor Township, and representatives of Scio Residents for Safe Water to discuss the quarterly reports submitted by PLS and other relevant issues. The DEQ has established four information repositories that are sent updates on a regular basis, about every six weeks. A DEQ internet site devoted to the Gelman project went on-line in April 2004. The DEQ has developed an e-mail list to which updates are sent frequently.

As it relates to the FS and public involvement, the DEQ discussed with the attendees of the quarterly meeting on May 3, 2004, the plan to disseminate copies of the draft FS to the information repositories upon receipt. We also explained that there would be opportunity for public comment.

On June 3, 2004, the DEQ sent copies of the FS to the information repositories and an e-mail was sent to the distribution list regarding the availability of the FS, and the DEQ's proposed public comment period and intention to hold a public meeting during the last week of July. By mid-June the FS was made available on the DEQ's Gelman website and the public comment period was announced.

The DEQ calendars published on June 28, 2004, and July 12, 2004, announced the DEQ's public meeting to take oral and written comment on July 28, 2004 in Ann Arbor, and the public comment period from July 7, 2004, to August 6, 2004. The DEQ produced a fact sheet summarizing the FS, the DEQ's analysis of the FS, and DEQ's PRA on July 7, 2004. A legal notice announcing the date of the public meeting and brief summary of the FS, along with the DEQ alternative was published in the Ann Arbor News on page G30, on July 25, 2004.

A public meeting was held on July 28, 2004, in the Slausen Middle School Auditorium, during which time presentations were made, questions were asked and answered, and public comments were taken.

The DEQ attended two additional public meetings sponsored by the City of Ann Arbor on August 4, and 12, 2004, to further answer questions from the public. DEQ extended the public comment period first to August 9, 2004, then to August 16, 2004, in response to the public comment that more time was needed.

The DEQ's Public Comment Responsiveness Summary is attached as Appendix B.

DEQ's Preliminary (July 2004) Proposed Remedial Alternative and Evaluation

The DEQ reviewed each of the alternatives considered in the Feasibility Study individually and in combination with interim responses. The DEQ determined that extraction from the leading edge alone is not as protective of public health, safety and welfare, and the environment as it would be in combination with interim responses. Interim responses would significantly reduce the overall cleanup time and decrease the uncertainty associated with PLS's PRA, thereby limiting the potential for human exposure and unexpected impacts on the plume due to any groundwater withdrawals. The following factors were considered by the DEQ in making its recommendation for the PRA in its Fact Sheet released on July 7, 2004.

Interim Responses

The DEQ identified two interim responses that can, and should be implemented prior to efforts to begin extracting groundwater contamination at the leading edge of the Unit E Plume. Due to the size of the plume, the interim responses discussed below are intended to continue in operation as part of the final remedy.

Wagner Road: The DEQ has recently directed PLS to perform an interim response near Wagner Road to prevent further eastward migration of groundwater contamination. This can be accomplished in the near-term with limited additional infrastructure, independent of any decision on a final remedy. This can also likely be accomplished using the existing treatment system and available discharge capacity without compromising the ongoing cleanup of the shallower aquifers. Attaining capture any farther east using the existing

system would be significantly more difficult due to the wetlands immediately east of Wagner Road.

Maple Road: Additional interim response at Maple Road is also warranted, as there is a significant change in the geology east of Maple Road that has an unexplained impact on the migration of contamination. The known concentrations of 1,4-dioxane east of Maple Road (except MW-79 on the east side of Maple Road) are significantly lower than what is found west of Maple Road. For this reason, capture of the contamination at Maple Road will significantly reduce the uncertainty involved in extracting only at the leading edge. However, extraction to capture the Unit E Plume at this location cannot begin until a discharge method that has the capacity to accommodate the necessary volume of water is secured. Because of the importance of decreasing the migration of contamination to the east of Maple Road as soon as possible, the DEQ recommended that consideration be given to determining if the storm or sanitary sewer could be used on a temporary basis for discharge of treated groundwater using PLS's mobile ozone/hydrogen peroxide treatment system. This treatment system can treat up to 200 gpm of extracted groundwater.

Discharge Methods

Securing a reliable method for discharge of treated groundwater has been difficult throughout the history of the Gelman site, and the difficulty in doing so has often delayed implementation of response actions. For this reason, it is essential to identify a lawful, safe and reliable discharge method that is reasonably implementable.

In Situ Option: As discussed in the FS, *in situ* (in place) treatment of groundwater would reduce or eliminate the need to extract groundwater, as treatment would take place underground. Unfortunately, no *in situ* technology has been adequately developed to reliably treat such a large volume of water for this contaminant.

Reinjection Options: The FS examined several groundwater reinjection options, two of which survived the initial screening process. As indicated under the DEQ's analysis of those alternatives, the DEQ does not consider groundwater reinjection to be a feasible discharge method for technical reasons. These technical reasons include: 1) the unknown capacity of the aquifer to accept the amount of water that would need to be extracted and reinjected; 2) the unknown effects on the plume due to the complex geology; and 3) the probability that previous problems with fouling of the injection wells will reoccur, thereby resulting in interruptions in extraction that could allow the plume to move beyond the extraction wells. In addition, it appears the public may not support reinjection that could increase the area of groundwater impacted by low levels of contamination (1-85 ppb), as may be the case with Alternatives 3c and 4c. Reinjection would only be feasible if further investigation, coupled with intensive performance monitoring of reinjection, could alleviate the DEQ's concerns.

Surface Water Options: Several surface water discharge options have also been considered. There are several factors that raise questions about the feasibility of an increased discharge to the Honey Creek Tributary, including the capacity of the tributary to handle a doubling of the discharge volume. The use of the Allen Drain and the sanitary sewer were considered in the FS, and were eliminated for various reasons. Neither the Allen Drain, nor the sanitary sewer, which eventually flow to the Huron River, have the

capacity to allow for a continuous discharge of the volume of water necessary for remediation of the Unit E Plume.

As a result, the only remaining feasible discharge option is a surface water discharge to the Huron River. Due to the distance to the Huron River, extensive lengths of pipeline would be required to transport extracted groundwater (from the leading edge and Maple Road), first to a treatment location via a double-walled pipeline, then to the Huron River for discharge at a location downstream from the City of Ann Arbor's water supply intake. Although the installation of pipelines can be disruptive to the community, this is a relatively short-term inconvenience and could be accomplished using standard engineering and construction techniques, including horizontal boring in appropriate locations to minimize disturbance. The location of the treatment system and the route of the pipeline depicted in the DEQ's Fact Sheet was for discussion purposes, and was not a determination that these are the most suitable pipeline routes.

In summary, based on the DEQ's analysis through July 7, 2004, of the relevant criteria and available information, the DEQ proposed a remedial alternative that combined PLS's Alternative 4a with additional interim responses at Wagner Road and Maple Road. The location of the new treatment system was proposed to be in the vicinity of the Maple Village Shopping Center.

DEQ's September 1, 2004 Selected Remedial Alternative for the Unit E Plume

The DEQ has reviewed the public comments received, performed additional analysis, and has concluded that, under the present circumstances, the final remedy for the Unit E Plume should be slightly modified from that proposed in the DEQ's Fact Sheet released on July 7, 2004. In order to provide the best balance of criteria outlined in Part 201, the DEQ has determined that interim responses (extraction and treatment of contaminated groundwater in the vicinity of Wagner Road and Maple Road), coupled with capture of the "leading edge" of contamination, is necessary to comply with Part 201 and the CJ. The performance objective for the groundwater extraction in the vicinity of Maple Road and Wagner Road is that, a hydraulic barrier be created to halt the further migration at each location of concentrations of 1,4-dioxane above 85 ppb in the downgradient or easterly direction.

PLS should immediately conduct additional investigation of the Unit E Plume in the vicinity of Wagner Road to determine the necessary volume and flow rate to achieve the above performance objective. The DEQ's June 29, 2004, letter to PLS on this subject is currently under the dispute resolution process outlined in the CJ. The parties have agreed to extend the period of informal negotiations while PLS performs additional investigation to determine what response actions would be needed to create a hydraulic barrier at Wagner Road. Disposal of treated groundwater from the Wagner Road area should take place at the PLS groundwater treatment facility. If the volume of water necessary to be extracted to meet the performance objective outlined above is greater than the existing unutilized capacity of the groundwater treatment facility, the DEQ recommends that a reduced pumping rate from shallower groundwater units be allowed by the Court to free up necessary capacity to achieve the performance standard. This would require modification of the Court's order approving the Five-year plan, the objectives of which the DEQ believes will not be met by the July 2005 deadline, regardless of any reduction in extraction from

the shallower aquifers, to accommodate increased extraction from the Unit E Plume. The DEQ- approved groundwater modeling may be necessary to predict the minimum pumping rate necessary to maintain hydraulic capture of shallower unit contamination.

Treatment of contaminated groundwater in the Maple Road vicinity should take place at a newly constructed groundwater treatment facility. The DEQ has considered comments from the public and PLS regarding the location of this new treatment system at or near the MVSC and has obtained additional information about the operation of such a system. The DEQ recognizes that the MVSC may not be an ideal location; however, it is not clear that an ideal location exists. The DEQ believes it is feasible to construct and operate a treatment system at the MVSC, but recommends that alternate locations be explored. The treatment technology type for the Maple Road area action should be the ozone/hydrogen peroxide method, if subsequent remedial design work determines this method will be likely to achieve anticipated National Pollutant Discharge Elimination System (NPDES) permit requirements. If the ozone/hydrogen peroxide technology is unable to achieve the necessary treatment standards, then the treatment method should be the currently employed ultra-violet/hydrogen peroxide method. Disposal of treated groundwater from the Maple Road area treatment system should be to the Huron River, via transmission pipeline, with the outfall located downstream from the City of Ann Arbor's drinking water intake.

The additional interim responses described above are similar to those proposed by PLS, with the additional objective of cutting off the migration of groundwater contamination east of Wagner Road and east of Maple Road. This would effectively cut the plume into three sections, and significantly reduce the amount of time needed to clean up the contaminated aquifer, reducing the threat to public health, safety and welfare, and the environment, and addressing the uncertainties that make PLS's PRA unacceptable. In addition, the reduction of time to remedy the contamination, in comparison to PLS's remedial alternative, would offset, to some degree, the additional capital costs required for the DEQ's PRA. Because PLS's PRA is not protective, the relative costs cannot be used as a basis for the choice between the two remedies.

The DEQ also recommends that temporary use of the sanitary and/or storm sewer for disposal of treated groundwater from the Maple Road area should be pursued, as there is some limited capacity in the sewers that are available during dry weather. This would serve to reduce the migration of higher concentrations to the east while the infrastructure necessary for the final remedy is put in place. This option should be pursued concurrently with determining the best location, and securing access for, a treatment system and discharge pipeline, and investigation to better characterize the geology at the leading edge of the plume.

PLS must also perform a hydrogeological investigation at the leading edge of the contamination to determine the location and number of extraction wells necessary to capture the leading edge of the Unit E Plume in excess of 85 ppb. The investigation must be performed on a schedule that will ensure that extraction, treatment and discharge of groundwater from the leading edge can be implemented once a DEQ-approved work plan for the Maple Road extraction system is implemented.

The DEQ has considered public comments regarding the need for a stochastic groundwater model and agrees that such a model could be an important tool for designing and evaluating response activities. An expert consulting firm is needed to evaluate the dataset to determine if it is adequate to conduct a stochastic modeling analysis. If the DEQ determines that stochastic modeling can be done, this model must be completed and submitted to the DEQ. This model would serve three functions: 1) provide information to monitor and assess the effectiveness of the Unit E Plume response activities; 2) serve as an important tool for the evaluation and optimization of the Unit E Plume response activities; 3) provide useful information for the design and implementation for PLS's proposed alternative, if that's the eventual decision, in which case additional data would need to be collected east of Maple Road.

The DEQ's PRA would require monitoring of the Northwest Supply well to ensure that the GRCC protective for drinking water is not exceeded. Of the six conditions that would have to be met for PLS's alternative to be approved, the potential impact to the Northwest Supply well is the only one that remains relevant to the DEQ's PRA. The DEQ's PRA is preferable because it reduces technical uncertainties associated with other remedial alternatives, achieves cleanup objectives more quickly, and is more readily implementable than PLS's PRA. Although the DEQ has not done a detailed analysis of the length of time to achieve cleanup using its PRA, the DEQ believes the cleanup can be achieved within 20 years. PLS's leading edge alternatives were also estimated to take 20 years to achieve cleanup. If a detailed analysis were done of the DEQ's PRA, compared to any of PLS's leading edge alternatives, there is no question that the DEQ's alternative would be completed in a significantly shorter length of time.

The DEQ has determined that, absent PLS satisfying the minimum conditions set forth below (as modified from DEQ's July 2004 conditions), implementation of the DEQ's PRA is necessary to satisfy the threshold criteria of protection of the public health, safety, welfare and the environment; and compliance with applicable or relevant and appropriate, rules, criteria, limitations and standards of applicable environmental law. However, the DEQ is sensitive to the numerous public comments received that do not support the "leading edge" portion of the DEQ's preliminary PRA. The DEQ is also aware that the City of Ann Arbor has initiated a claim against PLS to replace the Northwest Supply well. In light of the number of currently unresolved issues, the DEQ believes there may an opportunity for PLS to satisfy the conditions set forth below, and, as a result, is willing to allow a limited amount of additional time for PLS to meet these conditions.

1. Abandonment of the Northwest Supply well and elimination of the associated wellhead protection area designation by the City.
2. Prevention of any further migration of 1,4-dioxane contamination beyond Maple Road in excess of 2,800 ppb (the criterion protective of surface water).
3. Having an acceptable institutional control for relevant portions of the Gelman site, by September 1, 2005. The institutional control must address the deficiencies in the WCRRPG identified in the DEQ Interoffice Communication dated August 18, 2004 (Appendix C), including abandonment of any existing water supply wells that are within the area to be restricted by the institutional control and provision of a permanent alternate water supply.

4. A DEQ-approved plan for monitoring any water supply wells that are outside the area covered by an institutional control that are later found to be threatened with contamination by subsequent investigations to determine the fate of the plume, and a contingency plan to prevent unacceptable exposure if water supply wells are affected.
5. A DEQ-approved groundwater monitoring plan to ensure that contamination above the GRCC protective for drinking water does not underflow the Huron River, with a contingency plan to address any such contamination.
6. Provide for acceptable disposal of the treated groundwater from the Maple Road interim response, by providing sufficient hydrogeological information to resolve concerns about reinjection, and/or by shifting to an alternate means of disposal.

If these conditions can be satisfied, capturing the leading edge of the plume would not be necessary to satisfy Part 201 criteria. PLS has indicated to the DEQ that it may be able to satisfy the conditions within one year. However, efforts by PLS to satisfy the conditions should not result in a delay of implementing the DEQ's selected remedial alternative, in the event that PLS's efforts to satisfy the conditions fail. Therefore, PLS must take the following steps, concurrently with any efforts to satisfy the specified conditions:

1. Submit a schedule by October 1, 2004, that specifies implementation of interim response measures that will result in achieving capture of 1,4-dioxane in excess of 85 ppb at Wagner Road by March 1, 2005;
2. Determine whether temporary use of the storm and/or sanitary sewer during dry weather is feasible for discharge of some quantity of groundwater extracted at MVSC. If discharge to the sewer(s) is feasible then PLS should treat on location using an approved treatment technology. The PLS mobile ozone/hydrogen peroxide treatment system, if approved, and additional unit or units, should be used if sewer capacity is greater than 200 gpm, provided that any public safety issues associated with these treatment units can be addressed.
3. Identify a feasible location for a treatment system adequately sized to treat groundwater extracted from the vicinity of Maple Road and the leading edge by September 1, 2005.
4. Identify feasible routes for a pipeline from the Maple Road area to the treatment system and then to the Huron River downgradient of the City's water supply intake by September 1, 2005.
5. Submit a plan to the DEQ, by September 1, 2005, for securing access for the treatment systems and pipelines, that will result in PLS securing access for that infrastructure by March 1, 2006.
6. Hire a DEQ-approved expert consulting firm to provide an assessment, by December 1, 2004, of the Unit E Plume dataset to determine if it is adequate to conduct the stochastic modeling analysis. If the DEQ determines, based upon the firm's recommendation, that stochastic modeling can be done, this model must be completed and submitted to the DEQ by April 1, 2005. If the modeling firm determines the dataset is not adequate, the firm shall identify the deficiencies of the dataset to the DEQ.

If, by September 1, 2005, the conditions outlined on pages **15 and 16** have not been satisfied, PLS must then take the remaining steps necessary to implement the DEQ's selected remedial alternative. The exact timing and sequence of events cannot be

determined at this time; however, extraction at the leading edge should not begin until the extraction in the Maple Road area is operating according to a DEQ-approved work plan. These steps include, but are not limited to, the following, subject to DEQ approval:

1. Complete the plan and design for achieving capture at Maple Road;
2. Complete the plan and design for achieving capture at the leading edge;
3. Enact a monitoring plan at each location to verify capture;
4. Develop a contingency plan to be implemented if the objectives of any of the three Unit E capture systems are not being met. This plan must include identification of “trigger criteria” that initiate utilization of the plan and a schedule for implementation of the contingency plans;
5. Work with the DEQ and the City of Ann Arbor to revise the existing Citizen Involvement Plan (CIP). This revised CIP must inform residents and other stakeholders in the area to be affected by remedial actions about planning and remedy implementation.

This concludes the DEQ’s analysis and selected remedial alternative.