

# Department of Environmental Protection

Jeb Bush  
Governor

Twin Towers Office Building  
2600 Blair Stone Road  
Tallahassee, Florida 32399-2400

Colleen M. Castille  
Secretary

March 23, 2006

Drew Baird  
Regenesis  
38 Blackburn Street  
Greenville, South Carolina 29607

Re: **HRC Advanced™**

Dear Mr. Baird:

The Florida Department of Environmental Protection hereby accepts Hydrogen Release Compound Advanced (HRC Advanced) as an innovative product for in situ, anaerobic, reductive dechlorination of contaminated groundwater in Florida. As indicated by Regenesis, HRC Advanced is similar to the original HRC formulation in that it contains a non-toxic, food-grade polylactate ester, which upon introduction into an aquifer quickly undergoes a fermentation that produces hydrogen. In turn, the hydrogen serves as an electron donor in a reductive dechlorination process. However, it differs from the original formulation in that it also contains fatty acids, which ferment more slowly than the polylactate ester, thereby providing a controlled-release supply of hydrogen over a longer period of time. Enclosure 1 contains a list of ingredients for HRC Advanced.

This acceptance applies only to the regulatory jurisdiction of the Division of Waste Management within the Florida Department of Environmental Protection. Other divisions, government agencies and local governments may choose to recognize this acceptance if their needs and regulations are similar. The Division of Waste Management, however, is not responsible for applications beyond its jurisdiction.

There are no objections to the use of HRC Advanced provided: (a) the considerations of this letter are taken into account; (b) a site-specific Remedial Action Plan is approved by the Department; and (c) each Remedial Action Plan submitted seeks permission for a temporary injection zone of discharge pursuant to rule 62-522.300(2)(c), Florida Administrative Code (F.A.C.), for pH, total dissolved solids and color (and chloride if an appreciable amount will be liberated as a contaminant degradation by-product). Rule 62-522.300(2)(c), F.A.C., became effective August 27, 2001, and in most cases provides permission for a temporary zone of discharge by rule rather than by variance. The chemical ingredients of both original HRC and HRC Advanced are such that they qualify for zone of discharge permission by rule. Additional information is provided in Enclosure 2.

While the Department of Environmental Protection does not provide endorsement of specific or brand name remediation products or processes, it does recognize the need to determine their acceptability from an environmental standpoint with respect to applicable rules and regulations, and the interests of public health and safety. Vendors must then market the products and processes on their own merits regarding performance, cost, and safety in comparison to competing alternatives in the marketplace. In no way, however, shall this regulatory acceptance letter be construed as Department certification of product performance. Additionally, the Department emphasizes a distinction

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Mr. Drew Baird  
March 23, 2006  
Page Two

between its regulatory acceptance and an approval. Products and processes are accepted but they are not approved.

Also, it is not a requirement that a particular remediation product or process have an official acceptance letter in order for it to be proposed in a site-specific Remedial Action Plan. The plan, however, must contain sufficient information about the product or process to show that it meets all applicable and appropriate rules and regulations.

Those who prepare Remedial Action Plans are advised to include a copy of this letter in the appendix of the plans they submit, and call attention to it in the text of their document. In this way, technical reviewers throughout the state will be informed that you have contacted the Department of Environmental Protection to inquire about the environmental acceptability of HRC Advanced. To aid those reviewers, supplemental information as Enclosure 3 is provided.

The Department reserves the right to revoke its acceptance of a product or process if it has been falsely represented. Also, Department acceptance of any product or process does not imply it has been deemed applicable for all cleanup situations, or that it is preferred over other treatment or cleanup techniques in any particular case. A site-specific evaluation of applicability and cost-effectiveness must be considered for any product or process, whether conventional or innovative, and adequate site-specific design details must be provided in a Remedial Action Plan. You may contact me at (850) 877-1133, extension 29 if there are any questions.

Sincerely,

*Rick Ruscito*

Rick Ruscito, P.E.  
Ecology and Environment, Inc.  
Bureau of Petroleum Storage Systems  
Petroleum Cleanup Section 6

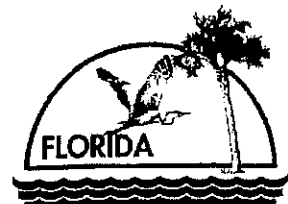
*Rebecca S. Lockenbach*

Rebecca S. Lockenbach  
FDEP Section Leader  
Bureau of Petroleum Storage Systems  
Petroleum Cleanup Section 6

Enclosures: (1) Voucher for Proprietary Concentrations of Ingredients  
(2) Regulatory Information  
(3) Supplemental Information  
(4) UIC Notification Memorandum

c: Tom Conrardy - FDEP, MS 4530, Tallahassee

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# Department of Environmental Protection

Jeb Bush  
GovernorTwin Towers Office Building  
2600 Blair Stone Road  
Tallahassee, Florida 32399-2400Colleen M. Castille  
Secretary

March 23, 2006

Drew Baird  
Regenesis  
38 Blackburn Street  
Greenville, South Carolina 29607Re: **Proprietary Concentrations Voucher for HRC Advanced™ Ingredients**

Dear Mr. Baird:

On February 22, 2006, the Florida Department of Environmental Protection received a letter from you, listing the ingredients of a remediation product called HRC Advanced, along with their proprietary concentrations. The information in the disclosure has been reviewed by the Department in order to identify groundwater and underground injection control rules and regulations that apply when HRC Advanced is used for the cleanup of groundwater contaminated by chlorinated organic compounds. In exchange for the confidential submittal, we hereby vouch for the proprietary concentrations of the ingredients listed in the table below.

Having compared these ingredients and their proprietary concentrations to applicable groundwater standards, we hereby indicate that permission for a temporary injection zone of discharge for the following must be obtained pursuant to rule 62-522.300(2)(c), Florida Administrative Code (F.A.C.), each time a site-specific Remedial Action Plan proposing HRC Advanced is submitted: pH, total dissolved solids, color, and chloride (if appreciable concentrations will be liberated as a by-product of chlorinated contaminant degradation).

| Chemical Abstract Service<br>(CAS) Number | Ingredient<br>Name       | Percent<br>% |
|-------------------------------------------|--------------------------|--------------|
| 823190-10-9                               | HRC-PED*                 | Proprietary  |
| 61790-12-3                                | Fatty Acid (neutralized) | Proprietary  |
| 201167-72-8                               | Glycerol tripolylactate  | Proprietary  |
| 56-81-5                                   | Glycerol                 | Proprietary  |
| 1310-58-3                                 | Potassium hydroxide      | Proprietary  |
| 21041-95-2                                | Calcium hydroxide        | Proprietary  |

\* Common name: Hydrogen Release Compound - Partitioning Electron Donor

\* Chemical names: Glycerides, di-, mono [2-[2-[2-(2-hydroxy-1-oxopropoxy)-1-oxopropoxyl]-1-oxopropoxy]propanoates]

or

Propanoic acid, 2-[2-[2-(2-hydroxy-1-oxopropoxy)-1-oxopropoxy]-1,2,3-propanetriyl ester]

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For underground injection control purposes, remediation plans proposing in situ, injection-type aquifer remediation must provide the volume and composition of the fluid that will be introduced to the aquifer. Since the concentrations of the individual ingredients in HRC Advanced are proprietary, it will suffice to indicate only the overall concentration of the HRC Advanced mixture to be injected, and provide a footnote indicating that a one-time confidential disclosure regarding the proprietary concentrations of the individual ingredients was provided to the Department on February 22, 2006. We recommend including a copy of this voucher in the appendix of the plan.

Reviewers of remediation plans that propose the use of HRC Advanced for the cleanup of a contaminated aquifer may direct questions to Rick Ruscito at (850) 877-1133, extension 29.

Sincerely,



Rick Ruscito, P.E.  
Ecology and Environment, Inc.  
Bureau of Petroleum Storage Systems  
Petroleum Cleanup Section 6



Rebecca S. Lockenbach  
FDEP Section Leader  
Bureau of Petroleum Storage Systems  
Petroleum Cleanup Section 6

ENCLOSURE 2

REGULATORY INFORMATION

- a. Groundwater cleanup standards: The onus shall be on users of HRC Advanced to ensure that all applicable groundwater contaminant standards will be met at the time of project completion. This includes the contaminants of concern, any residuals associated with the injected HRC Advanced, and any by-products produced as a result of chemical reactions. The following chapters of the Florida Administrative Code are cited: Chapter 62-550, F.A.C., for primary and secondary water quality standards; Chapter 62-520, F.A.C. for groundwater classes and standards; Chapter 62-522, F.A.C., for groundwater permitting and monitoring requirements; Chapter 62-528, F.A.C., for underground injection control, particularly Part V, for Class V, Group 4 aquifer remediation projects; and Chapter 62-777, F.A.C., for contaminant cleanup target levels.
- b. Groundwater injection standards: For in situ aquifer remediation, the composition of the injected fluid must meet the drinking water standards set forth in Chapter 62-550, F.A.C., pursuant to underground injection control Rule 62-528.600(2)(d), F.A.C., and the minimum criteria for groundwater as defined in Rule 62-520.400(1), F.A.C. Additional information about minimum groundwater criteria for specific chemicals can be found in Chapter 62-777, F.A.C. If the fluid does not meet these injection requirements, then it will be necessary to obtain permission for a temporary injection zone of discharge. Depending on the chemical composition of the fluid to be injected, the temporary zone of discharge may be permitted by rule or by variance.
- c. Injection zone of discharge: In order to obtain permission for a temporary injection zone of discharge pursuant to rule 62-522.300(2)(c), Florida Administrative Code (F.A.C.), each site-specific Remedial Action Plan proposing the use of HRC Advanced submitted for Department approval shall:  
(a) indicate that groundwater standards for pH, total dissolved solids, color, and chloride (if a sufficient amount will be liberated as a contaminant degradation by-product) could be temporarily exceeded;  
(b) indicate the size of the temporary discharge zone for which permission is sought (i.e. radius of influence for each injection point);  
(c) indicate the period of time for which a temporary zone of discharge is necessary; and (d) propose groundwater monitoring of pH, total dissolved solids, color, and chloride (if applicable).

By the end of the requested time period, pH, total dissolved solids, color, and chloride (if applicable) must meet their respective groundwater standards, or their natural-occurring background values for at a given remediation site, whichever is less stringent. The current secondary standards for these parameters are as follows: pH, range 6.5 to 8.5; total dissolved solids, 500 milligrams per liter (mg/L), maximum; color, 15 color units, maximum; and chloride, 250 mg/L, maximum.

- d. Utilization of wells: If a remediation site happens to have an abundance of monitoring wells, then the Department has no objection to the use of some wells for the injection of HRC Advanced. However, no "designated" monitoring well, dedicated to the tracking of remediation progress (by sampling) shall be used for injection. This will avoid premature conclusions that the entire site meets cleanup goals. By making sure that designated tracking wells are not also used for treatment, there

will be more assurance that the treatment process has permeated the entire site and that it did not remain localized to the area immediately surrounding each designated tracking well.

- e. Groundwater monitoring: Several aspects of monitoring are discussed below.
1. Active remediation monitoring: During the period of active remediation, a cleanup site's groundwater shall be monitored for contaminants of concern in accordance with the provisions of an approved Remedial Action Plan.
  2. Post active remediation monitoring: During the period of post active remediation, a cleanup site's groundwater shall be monitored for contaminants of concern in accordance with the provisions of an approved Remedial Action Plan.
  3. Underground injection control monitoring: As indicated in paragraph c above, in regard to permission for a temporary injection zone of discharge, rule 62-522.300(2)(c), F.A.C., requires that Remedial Action Plans proposing the use of HRC Advanced include groundwater monitoring of pH, total dissolved solids, color, and chloride (if applicable). It is suggested that the groundwater monitoring include the sampling of these parameters before injection of the HRC Advanced, and after on a quarterly basis, for the length of time that a temporary injection zone of discharge is sought. For example, if a one (1)-year time period for the temporary zone of discharge is sought, then sample the groundwater for pH, total dissolved solids, color, and chloride (if applicable) on a quarterly basis for one (1) year. Compare the sample result for each parameter to its respective secondary drinking water standard that is set forth in Chapter 62-550, F.A.C., or the cleanup site's natural-occurring background value, whichever is less stringent. As parameters meet their respective standards or background values, the frequency of their sampling can be decreased or discontinued. The quarterly sampling is a suggestion, not a requirement, and this frequency should be adjusted on a site-specific basis.
- f. Operation:
1. Avoidance of migration: Injection of HRC Advanced shall be performed in such a way, and at such a rate and volume, that no undesirable migration of either the HRC Advanced or the contaminants already in the aquifer occurs, pursuant to Rule 62-528.630(3), F.A.C.
  2. Underground injection control operating permit: Per rule 62-528.640(1)(c), F.A.C., the issuance of an enforceable, site-specific Remedial Action Plan Approval Order constitutes the granting of the operating permit for a Class V injection well. Although an operating permit is not required for aquifer remediation wells pursuant to Rule 62-528.640(1)(b), and 62-528.640(1)(c), F.A.C., since no movement of the contamination plume is expected to accompany HRC Advanced injection, the Department requests that the information items listed in Rule 62-528.640(1)(b), F.A.C., be considered and included in Remedial Action Plan proposals as a matter of good and thorough design practice. Briefly summarized, they are: quality of water in the aquifer; quality of the injected fluid; existing and potential uses of the affected aquifer; and well construction

details. Additionally, each Remedial Action Plan should clearly indicate the total amount of HRC Advanced that will be injected.

- g. Abandonment of wells: Upon issuance of a Site Rehabilitation Completion Order, or a declaration of "No Further Action", injection wells shall be abandoned pursuant to Section 62-528.645, F.A.C. The Underground Injection Control Section of the Department shall be notified so that the injection wells can be removed from its inventory list.

ENCLOSURE 3

SUPPLEMENTAL INFORMATION

- a. UIC Notification: Department of Environmental Protection reviewers of injection-type, in situ aquifer remediation plans, regardless of whether in Tallahassee or district offices, must fill in the blanks on the Enclosure 4 memorandum, whose subject is "Proposed Injection Well(s) for In Situ Aquifer Remediation at a Contaminated Site". The completed form must be submitted to the Underground Injection Control Section at 2600 Blair Stone Road, Tallahassee, Florida 32399-2400.
- b. Injection points: HRC Advanced can be pressure-injected into direct-push borings or dedicated injection points. While the spacing and depths of such points are site-specific, it is indicated, for illustrative purposes, that typical spacing ranges from 10 to 25 feet.
- c. Two modes of application: Regenesis indicates that HRC Advanced can be applied in either a concentrated or dilute form. The concentrated application is a pressure injection with no water added, and is suitable for fine-grained, low permeability formations where injections of large fluid volumes may be problematic. The dilute application is the injection of emulsified HRC Advanced, which is first prepared by mixing hot water with it in a ratio range of 20:1 to 40:1 (hot water:HRC). The dilution helps to increase the distribution of the HRC Advanced in the aquifer, thereby providing better contact of the product with the contaminant(s) being treated. Regenesis indicates that the maximum application rate of HRC Advanced in very permeable sands is generally not more than 40 pounds per vertical foot.
- d. Dosage: Regenesis, the manufacturer, indicates that the major factors taken into account when estimating the amount of HRC Advanced to be used are the mass of dissolved and sorbed contaminant(s) to be treated, the stoichiometric hydrogen demand of the specific contaminant(s), and the demand exerted by natural-occurring, competing electron acceptors. A multiplying safety factor is also used.

As an example of the stoichiometric hydrogen demand alone, Regenesis uses perchloroethylene (PCE), and cites 4 moles of hydrogen as the theoretical amount needed to completely dechlorinate the 4 moles of chlorine atoms present in 1 mole of PCE. On an overall weight basis, this translates to 4.34 pounds of HRC Advanced per pound of PCE to be treated.

- e. Competing electron acceptors: If natural-occurring, competing electron acceptors such as oxygen, nitrate, manganese, iron, and sulfate are present at a site to be remediated by HRC Advanced, then it will first be necessary to supply enough HRC Advanced to drive the site to anaerobic conditions. The manufacturer, Regenesis, indicates that the total amount of HRC Advanced to be applied is estimated by first adding the demand of these competitors to the demand of the contaminant(s) to be treated, and the sum then multiplied by a safety factor based on site conditions.
- f. Density and viscosity: HRC Advanced is reported to have a density of 1.1 to 1.3 grams per cubic centimeter, which is equivalent to approximately 9.2 to 10.8 pounds per gallon. Its viscosity is approximately 400 centipoise.
- g. Additional information: Regenesis' Internet address is [www.regenesis.com](http://www.regenesis.com).

## Florida Department of

MemorandumEnvironmental Protection

TO: Richard Deuerling, Mail Station 3530  
Division of Water Resource Management  
Underground Injection Control Section  
Florida Department of Environmental Protection  
2600 Blair Stone Road, Tallahassee, FL 32399-2400

FROM: \_\_\_\_\_ [see Note 1.]  
\_\_\_\_\_  
\_\_\_\_\_

DATE: \_\_\_\_\_

SUBJ: **Proposed Injection Well(s) for In Situ Aquifer  
Remediation at a Contaminated Site**

Pursuant to paragraph 62-528.630(2)(c), F.A.C., inventory information is hereby provided regarding the proposed construction of temporary injection well(s) for the purpose of in situ aquifer remediation at a contaminated site.

Site name: \_\_\_\_\_  
Site address: \_\_\_\_\_  
City/County: \_\_\_\_\_  
Latitude/Longitude: \_\_\_\_\_  
FDEP Facility Number: \_\_\_\_\_

Site owner's name: \_\_\_\_\_  
Site owner's address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Well contractor's name: \_\_\_\_\_ [see Note 2.]  
Well contractor's address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Brief description of the in situ injection-type aquifer remediation project:

\_\_\_\_\_  
\_\_\_\_\_

Richard Deuerling

Page 2 of 3

Date: \_\_\_\_\_

Site name: \_\_\_\_\_

FDEP Facility No.: \_\_\_\_\_

Summary of major design considerations and features of the project:

Areal extent of contamination (square feet): \_\_\_\_\_

Number of injection wells: \_\_\_\_\_

Composition of injected fluid [see Note 3.]  
(ingredient, wt. %): \_\_\_\_\_

Injection volume per well (gallons): \_\_\_\_\_

Single or multiple injection events: \_\_\_\_\_

Injection volume total (all wells, all  
events): \_\_\_\_\_

A site map showing the areal extent of the groundwater contamination plume, and the location and spacing of injection wells and associated monitoring wells is attached.

The following is a summary description of the affected aquifer:

Name of aquifer: \_\_\_\_\_

Depth to groundwater (feet): \_\_\_\_\_

Aquifer thickness (feet): \_\_\_\_\_

The injection well(s) features are summarized below, and/or a schematic of the injection well(s) is attached.

Direct-push or HSA/Mud rotary (*circle the appropriate well type*)

Diameter of well(s) (i.e., riser pipe & screen) (inches): \_\_\_\_\_

Total depth of well(s) (feet): \_\_\_\_\_

Screened interval: \_\_\_\_\_ to \_\_\_\_\_ feet below land surface

Grouted interval: \_\_\_\_\_ to \_\_\_\_\_ feet below land surface

Casing diameter, if applicable (inches): \_\_\_\_\_

Cased depth, if applicable: \_\_\_\_\_ to \_\_\_\_\_ feet below land surface

Casing material, if applicable: \_\_\_\_\_

The in situ injection-type aquifer remediation plan for this contaminated site is intended to meet the groundwater petroleum cleanup criteria set forth in Chapter 62-777, F.A.C. Additionally, all other groundwater standards will be met at the time of project completion for any residuals associated with the ingredients of the injected remediation products, and any by-products or intermediates produced as a result of the chemical or biochemical transformation of those

Richard Deuerling

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Date: \_\_\_\_\_

Site name: \_\_\_\_\_

FDEP Facility No.: \_\_\_\_\_

those ingredients or the site's contaminants during their use. Applicable primary and secondary drinking water standards are set forth in Chapter 62-550, F.A.C., and additional groundwater quality criteria are set forth in Chapters 62-520 and 62-777, F.A.C.

The remediation plan estimates that site remediation will take \_\_\_\_\_ months. We will notify you if there are any modifications to the remediation strategy which will affect the injection well design or the chemical composition and volume of the injected remediation product(s).

The proposed remediation plan was approved on \_\_\_\_\_ by an enforceable approval order. A copy is attached. The remediation system installation is expected to commence within 60 days. Please call me at \_\_\_\_\_ if you require additional information.

Note 1. Local programs are not authorized to approve underground injections into aquifers. Reason: Per agreement with the USEPA, the FDEP cannot delegate this authority. Local programs, after reviewing a Remedial Action Plan or an injection proposal document, should prepare the Approval Order and route it to Tallahassee for Bureau Chief's signature, and then complete this form. This form is primarily for use by state and local program technical reviewers, but petroleum remediation contractors may fill in all blanks except those labeled "FROM" and "DATE" on page 1, and the approval date and telephone number blanks in the last paragraph. Those blanks should be completed only by a state or local program reviewer.

Note 2. If an injection well installation contractor has not yet been selected, then indicate the name and address of the project's general remediation contractor/consultant.

Note 3. Complete chemical analysis of injected fluid is required by Chapter 62-528, F.A.C. Proprietary formulations shall make confidential disclosure. Injected fluids must meet drinking water standards of Chapter 62-550, F.A.C., unless an exemption or variance has been granted.