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Standard Guide for Remediation of Ground Water by Natural Attenuation at Petroleum Release Sites¹

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1. Scope

1.1 This is a guide for determining the appropriateness of remediation by natural attenuation and implementing remediation by natural attenuation at a given petroleum release site, either as a stand alone remedial action or in combination with other remedial actions.

1.2 Natural attenuation is a potential remediation alternative for containment and reduction of the mass and concentration of petroleum hydrocarbons in the environment to protect human health and the environment. Remediation by natural attenuation depends upon natural processes such as biodegradation, dispersion, dilution, volatilization, hydrolysis, and sorption to attenuate petroleum constituents of concern to achieve remedial goals.

Note 1—Remedial goals must be established through another process as determined by the appropriate regulatory agency.

1.3 In general, remediation by natural attenuation should not be considered a presumptive remedy. A determination of whether remediation by natural attenuation is appropriate for an individual petroleum release site, relative to site-specific remedial goals, requires site characterization, assessment of potential risks, evaluation of the need for source area control, and evaluation of potential effectiveness similar to other remedial action technologies. Application and implementation of remediation by natural attenuation requires demonstration of remedial progress and attainment of remedial goals by use of converging lines of evidence obtained through monitoring and evaluation of resulting data. When properly applied to a site, remediation by natural attenuation is a process for risk management and achieving remedial goals. Monitoring should be conducted until it has been demonstrated that natural attenuation will continue and eventually meet remedial goals.

1.3.1 The primary line of evidence for remediation by natural attenuation is provided by observed reductions in

plume geometry and observed reductions in concentrations of the constituents of concern at the site.

1.3.2 Secondary lines of evidence for remediation by natural attenuation are provided by geochemical indicators of naturally occurring degradation and estimates of attenuation rates.

1.3.3 Additional optional lines of evidence can be provided by microbiological information and further analysis of primary and secondary lines of evidence such as through solute transport modeling or estimates of assimilative capacity.

1.4 The emphasis in this guide is on the use of remediation by natural attenuation for petroleum hydrocarbon constituents where ground water is impacted. Though soil and ground water impacts are often linked, this guide does not address natural attenuation in soils separate from ground water or in situations where soils containing constituents of concern exist without an associated ground water impact. Even if natural attenuation is selected as the remedial action for ground water, additional remedial action may be necessary to address other completed exposure pathways at the site.

1.5 This guide does not address enhanced bioremediation or enhanced attenuation.

1.6 Also, while much of what is discussed is relevant to other organic chemicals or constituents of concern, these situations will involve additional considerations not addressed in this guide.

1.7 The guide is organized as follows:

1.7.1 Section 2 lists referenced documents.

1.7.2 Section 3 defines terminology used in this guide.

1.7.3 Section 4 describes the significance and use of this guide.

1.7.4 Section 5 provides an overview of the use of natural attenuation as a remedial action alternative, including:

1.7.4.1 Advantages of remediation by natural attenuation as a remedial alternative;

1.7.4.2 Limitations of remediation by natural attenuation as a remedial alternative; and

1.7.4.3 Using multiple lines of evidence to demonstrate the appropriateness of remediation by natural remediation.

¹ This guide is under the jurisdiction of ASTM Committee E50 on Environmental Assessment, Risk Management and Corrective Action and is the direct responsibility of Subcommittee E50.04 on Corrective Action.

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Natural Attenuation For Ground Water Remediation

**John H. Cushman, Daniel M.
Tartakovsky**



Natural Attenuation For Ground Water Remediation:

Natural Attenuation for Groundwater Remediation Commission on Geosciences, Environment, and Resources, Board on Radioactive Waste Management, Water Science and Technology Board, Committee on Intrinsic Remediation, 2000-07-31 In the past decade officials responsible for clean up of contaminated groundwater have increasingly turned to natural attenuation essentially allowing naturally occurring processes to reduce the toxic potential of contaminants versus engineered solutions This saves both money and headaches To the people in surrounding communities though it can appear that clean up officials are simply walking away from contaminated sites When is natural attenuation the appropriate approach to a clean up This book presents the consensus of a diverse committee informed by the views of researchers regulators and community activists The committee reviews the likely effectiveness of natural attenuation with different classes of contaminants and describes how to evaluate the footprints of natural attenuation at a site to determine whether natural processes will provide adequate clean up Included are recommendations for regulatory change The committee emphasizes the importance of the public's belief and attitudes toward remediation and provides guidance on involving community stakeholders throughout the clean up process The book explores how contamination occurs explaining concepts and terms and includes case studies from the Hanford nuclear site military bases as well as other sites It provides historical background and important data on clean up processes and goes on to offer critical reviews of 14 published protocols for evaluating natural attenuation Use of Monitored Natural Attenuation for Groundwater Remediation Western Australia. Department of Environmental Protection, 2002

Soil and Groundwater Remediation Technologies Yong Sik Ok, Jörg Rinklebe, Deyi Hou, Daniel C.W. Tsang, Filip M.G. Tack, 2020-03-23 This book offers various soil and water treatment technologies due to increasing global soil and water pollution In many countries the management of contaminated land has matured and it is developing in many others Topics covered include chemical and ecological risk assessment of contaminated sites phytomanagement of contaminants arsenic removal selection and technology diffusion technologies and socio environmental management post remediation long term management soil and groundwater laws and regulations and trace element regulation limits in soil Future prospects of soil and groundwater remediation are critically discussed in this book Hence readers will learn to understand the future prospects of soil and groundwater contaminants and remediation measures Key Features Discusses conventional and novel aspects of soil and groundwater remediation technologies Includes new monitoring sensing technologies for soil and groundwater pollution Features a case study of remediation of contaminated sites in the old industrial Ruhr area in Germany Highlights soil washing soil flushing and stabilization solidification Presents information on emerging contaminants that exhibit new challenges This book is designed for undergraduate and graduate courses and can be used as a handbook for researchers policy makers and local governmental institutes **Soil and Groundwater Remediation Technologies A Practical Guide** is written by a team of leading global experts in the field **Groundwater Remediation**

Nicholas P. Cheremisinoff, 2017-06-13 Written by one of the world's foremost authorities on the subject this is the most comprehensive and in depth treatment available to environmental engineers and scientists for the remediation of groundwater one of the earth's most precious resources Groundwater is one of the Earth's most precious resources We use it for drinking bathing and many other purposes Without clean water humans would cease to exist Unfortunately because of ignorance or lack of caring groundwater is often contaminated through industrialization construction or any number of other ways It is the job of the environmental engineer to remediate the contaminated groundwater and make what has been tainted safe again Selecting the proper remediation strategy and process is the key to moving forward and once this process has been selected it must be executed properly taking into consideration the costs the type of contaminants that are involved time frames and many other factors This volume provides a broad overview of the current and most widely applied remedial strategies Instead of discussing these strategies in a generic way the volume is organized by focusing on major contaminants that are of prime focus to industry and municipal water suppliers The specific technologies that are applicable to the chemical contaminants discussed in different chapters are presented but then cross referenced to other chemical classes or contaminants that are also candidates for the technologies The reader will also find extensive cost guidance in this volume to assist in developing preliminary cost estimates for capital equipment and operations maintenance costs which should be useful in screening strategies The eight chapters cover all of the major various types of contaminants and their industrial applications providing a valuable context to each scenario of contamination This is the most thorough and up to date volume available on this important subject and it is a must have for any environmental engineer or scientist working in groundwater remediation

The Economics of Groundwater Remediation and Protection Paul E. Hardisty, Ece Ozdemiroglu, 2004-12-20 Economic literature is often too theoretical for engineers and policymakers to put into practical use while scientific literature on the remediation of contaminated aquifers rarely considers costs and benefits Written by a hydrogeologist and an economist The Economics of Groundwater Remediation and Protection integrates economics and cost benefit analysis tools with optimal protection and remediation strategies for groundwater resources The book provides a thorough introduction of the concepts of groundwater flow and contaminant transport and the basics of economic decision making techniques It illustrates the types of risks and impacts caused by groundwater contamination and the economic benefits of its remediation The volume reviews a wide range of issues such as cost implementation and expectations of success for the latest remediation trends and techniques The book shows how economic analysis can be used to determine how much we should pay for groundwater clean up and when spending too much or too little actually makes us all worse off The authors step by step methodology for decision making focuses on determining optimal remedial objectives from containment to extensive cleanup and the selection of least cost alternatives They use examples from their personal experience to illustrate the methodologies in action and put the issues into perspective Combining the theoretical and practical aspects of science policy

and economics this book places the importance of groundwater remediation in the context of environmental economics protection and preservation The Economics of Groundwater Remediation and Protection is also an excellent introduction to innovative solutions for funding remediation projects education and incentive programs such as mitigation banking land pollution credit schemes and conservation credit alternatives

Engineering Tools for Environmental Risk Management Katalin Gruiz, Tamás Meggyes, Éva Fenyvesi, 2019-01-08 The four volumes of the book series Engineering Tools for Environmental Risk Management deal with environmental management assessment monitoring tools environmental toxicology and risk reduction technologies This last volume focuses on engineering solutions usually needed for industrial contaminated sites where nature's self remediation is inefficient or too slow The success of remediation depends on the selection of an increasing number of conventional and innovative methods This volume classifies the remedial technologies and describes the reactor approach to understand and manage in situ technologies similarly to reactor based technologies Technology types include physicochemical biological or ecological solutions where near natural sustainable remediation has priority A special chapter is devoted to natural attenuation where natural changes can help achieve clean up objectives Natural attenuation and biological and ecological remediation establish a serial range of technologies from monitoring only to fully controlled interventions using just the natural ecosystem or sophisticated artificial living systems Passive artificial ecosystems and biodegradation based remediation in addition to natural attenuation demonstrate the use of these green technologies and how engineering intervention should be kept at a minimum to limit damage to the environment and create a harmonious ecosystem Remediation of sites contaminated with organic substances is analyzed in detail including biological and physicochemical methods Comprehensive management of pollution by inorganic contaminants from the mining industry leaching and bioleaching and acid mine drainage is studied in general and specifically in the case of an abandoned mine in Hungary where the innovative technology of combined chemical and phytostabilization has been applied The series of technologies is completed by electrochemical remediation and nanotechnologies Monitoring verification and sustainability analysis of remediation provide a comprehensive overview of the management aspect of environmental risk reduction by remediation This book series focuses on the state of knowledge about the environment and its conscious and structured application in environmental engineering management and decision making

In Situ Treatment of Soil and Groundwater Contaminated with Chromium National Risk Management Research Laboratory (U.S.), 2000

The Handbook of Groundwater Engineering John H. Cushman, Daniel M. Tartakovsky, 2016-11-25 This new edition adds several new chapters and is thoroughly updated to include data on new topics such as hydraulic fracturing CO₂ sequestration sustainable groundwater management and more Providing a complete treatment of the theory and practice of groundwater engineering this new handbook also presents a current and detailed review of how to model the flow of water and the transport of contaminants both in the unsaturated and saturated zones covers the protection of groundwater and the remediation of

contaminated groundwater **Groundwater and Soil Remediation** Evan K. Nyer, 1998-05-01 This bestselling author presents his latest compilation of time and cost saving techniques methods and strategies for soil and groundwater remediation This book outlines advanced technologies including phytoremediation air sparging reactive zones vacuum enhanced recovery and more **Handbook of Groundwater Protection and Cleanup Policies for RCRA Corrective Action** , 2002

Unveiling the Magic of Words: A Review of "**Natural Attenuation For Ground Water Remediation**"

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