**Global Water Pollution of Saltwater, Freshwater, and Groundwater:**

**Sources and Solutions**

Jeremiah Lofthus

Research for the 21st Century

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**TABLE OF CONTENTS**

Introduction………………………………………………………2

Topic Analysis …………………………………………………..3

Reference Sources …………..……………..…………………6

Books …………….………………..……………………….……10

Periodical Articles …………………………………………12

Internet Sources ……………..…………………….………15

Non-Print …………….………………………………….……18

My Research Process ………………….…………………19

**INTRODUCTION**

Across the globe, water is critical to societies for many purposes. People rely on water for everything from drinking and cooking to farming and manufacturing. Without water, no society can survive. Whether it is the person that is drinking freshwater or groundwater, the person that lives off the fish and other animals that must live in the freshwater or saltwater, the person that needs water to process and manufacture the necessities of life, or the animals themselves that need water to live, clean water is crucial for all living things. While most people think that the earth has plenty of water because most of the earth’s surface is covered in water, only 2.5% of all the earth’s water is freshwater that can be used for drinking. Moreover, as more and more pollutants are being dumped in the world’s water supply, this 2.5% is beginning to decrease at an alarming rate.

The issue of water pollution is a global one that has lasted through the centuries and continues to persist. No country throughout the world is free from water pollution. It is a constant problem whether the county’s government decides to address it or not. From the least developed countries of the world to the most developed countries of the world, water pollution is a problem. While the exact source and type of contamination is drastically different when comparing the underdeveloped and developed countries of the world, they all still have the ever-present problem of water pollution. Additionally, the source of most of this water pollution is human activities as documented in case studies like the Exxon Valdez Oil Sill or the Salt Marsh Oil Spill as well as in government reports on water quality in rivers, lakes, and ocean. If humans across the globe do not identify and correct the specific pollutants of saltwater, freshwater, and groundwater, the world’s water supply – whether salt, fresh, or ground – may become endangered.

**TOPIC ANALYSIS**

**Academic Disciplines**

* Environmental Science
* Oceanography
* Biology
* Chemistry
* Sociology

**LC Subject Headings**

* Water
* Pollution
* Environment
* Oil Spill
* Ocean
* Economic Development
* Groundwater
* Lake

**Keywords**

* Exxon Valdez
* Oil Spill
* Salt Marsh Oil Spill
* “water pollution”
* freshwater
* pollutant
* runoff
* fertilizer
* chemical
* groundwater
* lake
* ocean
* stream
* water

**Most Important Databases and Periodical Indexes**

* ProQuest:[proquest.umi.com.libsrv.yvcc.edu:2048/pqdweb?ReqType=301&UserId=PS9VGTMPBM&Passwd=welcome&JSEnabled=1](http://proquest.umi.com.libsrv.yvcc.edu:2048/pqdweb?ReqType=301&UserId=PS9VGTMPBM&Passwd=welcome&JSEnabled=1)
* AcademicOneFile:[www.student.wvc.edu:2158/gtx/start.do?finalAuth=true&prodId=AONE&userGroupName=wena37071](http://www.student.wvc.edu:2158/gtx/start.do?finalAuth=true&prodId=AONE&userGroupName=wena37071)
* Information Bridge: [www.osti.gov/bridge/](http://www.osti.gov/bridge/)
* GreenFile:[web.ebscohost.com.libsrv.yvcc.edu:2048/ehost/search?vid=1&hid=107&sid=8b9a438d-a2ea-4140-8747-b6b5c6d2c34c%40sessionmgr110](http://web.ebscohost.com.libsrv.yvcc.edu:2048/ehost/search?vid=1&hid=107&sid=8b9a438d-a2ea-4140-8747-b6b5c6d2c34c%40sessionmgr110)
* Internet Public Library: www.ipl.org

Description of Experience:

Identifying subject headings and keywords were more difficult than I anticipated. I thought that I knew how to pick good keywords for researching. In doing this project, I realized that I was not selecting the most effective subject headings and keywords. To help with subject headings, I took a trip to the college library. I located the huge red books and a librarian to help me understand how to use them. Working through these books gave me a better understanding of proper subject headings to use. I also found more helpful subject headings once I found a relevant book to my topic by looking at the related subject headings listed for that book. Keywords were more of a trial and error process. I utilized a variety of them in various combinations. Some of them like water pollution were way too broad, so I had to limit my search by using the AND function – water pollution AND another keyword. Other keywords like stream were too narrow, so I had to broaden my search by using the OR function – stream OR river. I have learned a great deal about how to chose the most effective – meaning I get the best and most relevant results – subject headings and keywords.

**REFERENCE SOURCES**

**Organization**

**Water Environment Federation**

601 Wythe St.

Alexandria, VA 22314-1994

Ph: (703) 684-2400

Free: (800) 666-0206

URL: [www.wef.org](http://www.wef.org/)

Email: csc@wef.org

Contact: William Bertera, Exec. Dir.

The WEF is an organization that deals with the exploding problem of pollution including air, water, and noise pollution. WEF is a non-profit organization that is dedicated to showing people the devastating effects that various types of pollution have on the environment. It is the goal of WEF to make sure that the information that disclosed is as up-to-date as possible. The WEF is determined to educate people through its website, conferences, publications, and meetings to give people a better understanding of what pollution is doing to the world that humans must live in. The WEF is one of the leading sources when it comes to information on water pollution. It includes many articles, links, reports, and statistics on the various forms of water pollution as well as possible solutions for correcting the rapidly growing problem. This organization is useful to the topic of water pollution because it includes statistical and data reports on sources of water pollution and solutions for cleaning up the polluted waters as well as measures to eliminate future water pollution.

Hunt, Kimberly N. “Pollution Control.” E*ncyclopedia of Associations*. Detroit: Thomson,

2005. Print.

Kimberly Hunt, who spent years studying various organizations, links various organizations to related topics. Hunt systematically organizes organizations under various topics and subtopics. This guides the reader in quickly finding organizations relevant to any given topic. This book is useful to the topic of water pollution because it gives many organizations associated with water pollution topics. This book is useful because it gives a springboard to find other resources, specifically organizations that deal with water pollution.

**Statistical Information**

• Freshwater is only 2.5% of the entire world water supply

• 68% of water usage is agricultural

• 24%of water supply needed for industry

• 40% projected increase in water usage between 2000 and 2025

Schmitz, Richard J. “Water Pollution.” *Encyclopedia Americana.* Danbury: Scholastic Library

Publishing, 2004. Print.

As an author of various books and collegiate textbooks on the environment, water pollution, and the biological components of water pollution, Richard J. Schmitz, who has a degree in environmental studies with an emphasis in water pollution, is qualified to discuss the topic of water pollution. In this article, Schmitz puts forth a number of statistics valuable to the topic of water pollution as he discusses both the historic and current perspective on water (including specific examples as well as water usage trends) and regulatory laws regulating water and/or water pollution (like dumping of trash or irrigation usage). Schmitz then takes an extensive look at various sources of point and non-point water pollution (including sediments debris, acids, mercury, lead, pesticides, and synthetic organic chemicals) as well as water treatment methods. This statistical article is useful to the topic of water pollution because it gives numerical data that can be used to show how large the problem of water pollution is. It is also useful because it covers several specific contaminants that other sources do not discuss.

**Articles from Encyclopedias/Specialized Reference**

Nelson, Dennis O. “Water Quality.” *Macmillan Encyclopedia of Earth Sciences.* New York:

Macmillan, 1996. Print.

As staff in the Department of Geology at Oregon State University, Dennis O. Nelson, PhD dives into the issues of water quality addressing several key topics. Nelson discusses drinking water standards (including what is poisonous to both plants and animals), the agricultural uses of water (including farming, gardens, orchards, etc and how ground water is polluted), and the industrial applications of water (including industries like plastic, paper goods, computer parts, etc). Nelson then examines water ecosystems (including chemical pollutants that affect lakes and rivers), the treatment of water (including chemical methods of treating polluted water), and surface water versus groundwater (including the relationship of surface water pollution impacting groundwater). This article is useful because it describes how we know when water is contaminated from a chemical standpoint. It also looks at specific pollutants in a variety of situations like farming and industry and proposes some possible solutions.

Tchobanoglous, George. “Water Pollution.” *McGraw-Hill Encyclopedia of Science and*

*Technology*. New York: McGraw-Hill, 1997. Print.

As a professor of civil and environmental engineering at the University of California at Davis as well as a McGraw-Hill professional, George Tchobanoglous, who has a Ph.D. in environmental engineering explains the various aspects of water pollution. He discusses the different several broad categories of contaminants including suspended solids, biodegradable organics, and pathogenic organisms. Tchobanoglous also discusses the transport and transformation processes and operations of contaminated water to make it useable once again. He also discusses water pollution issue like dissolved oxygen in streams and effluent discharge - wastewater that needs to be disposed of. This article is useful to the water pollution topic because it gives the broad categories that contaminants can be classified under and the practical methods and procedures for purifying polluted water.

**BOOKS**

The following two books are the best books for quality information. I determined that these two were the best books to use for the topic of water pollution based on the information found in them as well as the credentials of the author. In comparing the information from all the books – and at the same time taking into account credentials – these were the best, most quality sources of information.

Murck, Barbara W. *Environmental Science: A Self-Teaching Guide*. Hoboken: John Wiley,

2005. Print.

As University of Toronto Mississuaga’s director of environment programs, Barbara Murck is well qualified to write on this topic with a degree from Princeton and a PhD from the University of Toronto. Murck discusses many key issues related to environmental science. She begins with background including characteristics of Earth, interactions among Earth’s cycles, and the major spheres of Earth. She then continues with looking at life (including ecosystems, habitat, biodiversity, people, and populations), resources (including forests, wildlife, fisheries, soils, minerals, energy, and water). Murck concludes with looking at pollution (water, soil, air, and cities in regards to waste management) and global change that is occurring because of this pollution. This book is useful to water pollution because it gives some specific background information into environmental science (which gives the foundation to understanding the effects of water pollution) and discusses drinking water quality, contaminates of water and their health effects, main sources and types of water pollution, and the most effective ways of fixing the contamination.

Gerdes, Louise I. *Endangered Oceans*. Detroit: Greenhaven Press, 2009. Print.

With a degree in Environmental Science, Louise Gerdes discusses the earth’s oceans that are becoming endangered. Gerdes discusses various things that threaten the world’s oceans like human activities including ships, oil operations and spills, debris and garbage, and farming runoff. Other sources of endangering the world’s ocean include the destruction of natural habitats like coral reefs and acidification – the increasing acidity of the world’s oceans. Gerdes discusses the seriousness of the current situation on each of these topics including recent events illustrating the points. In concluding, Gerdes discusses the ramifications if nothing is done to prevent these threatening activities but also offers solutions to the problems. This book is useful to the topic of water pollution because it deals with specific water pollution issues in regards to oceans like human activities impact the oceans. It gives specific examples that can be used in a research paper in discussing the problem of ocean pollution as well as gives some specific future ramifications if the ocean pollution is not stopped.

**PERIODICAL ARTICLES**

The following three periodicals are the best periodicals for quality information dealing with the topic of water pollution. The first two were accessed using ProQuest while the last one was accessed using GreenFile through EBSCO.

Peterson, Charles H., et al. “Long-Term Ecosystem Response to the Exxon Valdez Oil Spill.”

*Science* 302.5653 (2003): 2082. Platnium Periodicals, ProQuest. Web. 30 Oct. 2010.

As a professor at the University of North Carolina at Chapel Hill Institute of Marine Sciences, Charles Peterson is well qualified to lead this group of authors in exploring the effects of the Exxon Valdez Oil Spill. Peterson’s intent is to inform the reader of the long-term effects of the Exxon Valdez Oil Spill – not just the immediate deaths but also the effects that continue into the 21st century. Using numerical data, graphs, charts, tables, and referencing other research, Peterson discusses the commonly known immediate effects of the spill as well as the long-term more obscure effects that have lingered into the 21st century including growth rates, fertility rates, toxicity levels, and muscle disintegration. Peterson’s intention to inform the reader of these problems coincides with this water pollution research – specifically oil spill impacts on the ocean. As compared to other articles, Peterson’s work is at the top as it covers the immediate and long-term, which other sources did not touch, and has the benefit of considering and tracking this issue over a long period of time. In this article, Peterson’s work has value to the topic of water pollution because it considers the long-term effects of oil spills and not just the immediate effects.

Mei, H. and Y. Yin. “Studies on Marine Oil Spills and Their Ecological Damage.” *Journal of*

*Ocean University of China* *JOUC* 8.3 (2009): 312. ProQuest Science Journals, ProQuest.

Web. 30 Oct. 2010.

As professors at the Ocean University of China, H. Mei and Y. Yin have the credentials to discuss the reasons and impacts of marine oil spills. Mei and Yin discuss sources and causes of marine oil spills (accidents, drilling platforms, etc) as well as the impacts on the environment (fisheries, shallow water and coastal resources, ecosystems, etc) to inform the readers of the dangers and lasting effects of these oil spills. While the authors site other works as well as using numerical data and case studies to support their thesis, there seems to be a bias or agenda that comes through in this work. In comparison to other articles, this one is toward the top because it gives specific examples of what oil spills do to the environment and include some aspects not found in other resources. Mei’s work is valuable to the topic of water pollution because it gives some of the specific sources of oil spills including the tankers and pipeline breaks as well as the impact on the environment including death of sea life, sea vegetation, and effects on people, and the authors’ intent is in line with the water pollution research topic.

Abrantes, Nelson, Ruth Pereira, and Fernando Goncalves. “Occurrence of Pesticides in

Water Sediments, and Fish Tissues in a Lake Surrounded by Agricultural Lands:

Concerning Risks to Humans and Ecological Receptors.” *Water, Air, and Soil* *Pollution*

212.1-4 (2010): 77-88. *GreenFILE*. EBSCO. Web. 30 Oct. 2010.

As the lead author, Nelson Abrantes, who works at the Center for Environmental and Marine Studies as a post doctorate researcher, along with fellow experienced researchers Pereira and Goncalves, who also had emphases in environmental studies, are well qualified in writing an article informing the reader of the consequences of pesticides on water sources, ecosystems, and human health. Nelson and his companions explore pollution through pesticides utilizing a case study involving Lake Vela and evaluating the occurrence of pesticides which looked at levels of pesticides in surface water, groundwater, sediments, and fish tissues and compared these levels to regulatory and toxicological benchmarks as well as discussed the effects of these high concentrations including harm to the fish as well as people through contaminated the drinking water. Nelson uses numerical data as evidence in supporting his thesis as well as charts and graphs to further illustrate. Of the articles for this research topic, Nelson’s is a top one or two as it is a pinpointed specific case study that would accentuate a point in the research paper. Nelson’s work is useful to the topic of water pollution because it tackles a specific source of freshwater and groundwater pollution utilizing a case study, and Nelson’s intent to inform the reader of the problem and source of the contamination is consistent with the research question as well.

**INTERNET SOURCES**

Rosen, C. J. and B. P. Horgan. *Preventing Pollution Problems from Lawn and Garden*

*Fertilizers.* University of Minnesota, 2010. Web. 4 Nov. 2010.

< http://www.extension.umn.edu/distribution/horticulture/dg2923.html>.

Being sponsored by the University of Minnesota, C. J. Rosen, an Extension Soil Scientist in the Department of Soil, Water, and Climate, and B. P. Horgan, an Extension Turfgrass Specialist, discuss the dangers associated with the use of lawn and garden fertilizers. They discuss the use of phosphorus and the runoff concerns related to it including soil tests from using different levels of phosphorus fertilizer applications. They also discuss the use of nitrogen and the leaching concerns related to it including sources like animal manure, septic tank sources, and fertilizer spills. In concluding, Rosen and Horgan discuss the guidelines for selecting a fertilizer and guidelines for application and landscape maintenance to reduce water pollution. This website is useful to the topic of water pollution because it describes some specific types of runoff pollution including phosphorus and nitrogen. It also gives specific guidelines on how to prevent this type of water pollution by selecting the right fertilizer, using the right amount, and using the prescribed reapplication time frames.

*Pesticides and Water Quality*. University of California Integrated Pest Management, 7 Nov.

2007. Web. 4 Nov. 2010. <http://www.ipm.ucdavis.edu/WATER/U>.

Sponsored and developed by the staff of the University of California Department of Integrated Pest Management, the anonymous authors of the material and articles are qualified to discuss water pollution issues related to the use of pesticides and chemicals. An entire section of the website was devoted to pesticides and water quality in which numerous topics were discussed such as point and nonpoint pollution, things that people can do to help prevent it, and consequences of continued use. Authors also discussed contamination of water sources including creeks, rivers, and oceans due to pesticides, toxicity of common pesticides to living organisms including animals and humans, as well as the toxicity of insecticides on animals and humans. Further, they discuss the chemicals to use if a person really needs a pesticide or insecticide, the amount of the specific pesticide or insecticide that should be used, and proper usage to avoid runoff contamination. This website is useful to the water pollution topic because if gives some specific examples of chemical s that are commonly used and are a source of pollution in rivers and groundwater. It also includes the practical steps that people can use to help minimize this water pollution.

United States. Environmental Protection Agency Water Office. *Office of Water*. EPA, 2010.

Web. 4 Nov. 2010. < http://water.epa.gov/>.

Sponsored the Environmental Protection Agency Department of the Water Office, the website has authority found in the credentials of the EPA to discuss water pollution issues. The EPA discusses a wide variety of water pollution related issues including drinking water, laws and regulations, types of water, and pollution prevention and control. They analyze drinking water including source water protection, current drinking water rules, and regulations on wells. They also discuss types of water sources that the EPA recognizes including ground water, lakes, oceans, coasts, estuaries, and beaches, rivers and streams, and wastewater. Further, they discuss all the rules and regulations that pertain to keeping each of these areas clean and pollution free. This website is useful for the topic of water pollution because has many of the laws and legislation that have been enacted to protect the world’s water supply in each of the specific types of water. It also included the specific numerical data on drinking water standards. It gave the maximum levels of many common chemicals used by society.

**NON-PRINT**

*Salt Marsh Oil Spill*. Narr. Christopher M. Reddy, Ph.D. History Channel, 2009. DVD.

As a marine chemist with an emphasis in oil spills working in affiliation with Woods Hole Oceanographic Institutions, Christopher M. Reddy, Ph. D. discusses the present effects of the Salt Marsh Oil Spill. Reddy discusses the long term effects of oil spills that people thought time would fix but have not. He uses the 1969 Salt Marsh Oil Spill to illustrate his point. First, he discusses why the oil levels have not diminished over the years – a quiet location, no tides, no moving water, etc. Second, Reddy discuss the effects on both the plants and animals in the area. He uses several examples including crabs not borrowing deep because of the oil and being eaten by predators, grass not being as thick or strong as in other areas, and mussels not being as productive as in other areas. This video is useful to the topic of water pollution because it describes a specific oil spill and the long lasting effects of oil particularly in “quiet” locations.

Through this video, the producer hoped to inform the audience of the long-lasting effects of oil spills using a case study of the Salt Marsh. This video was very successful in informing the viewers of the long-lasting effects of oil spills on the plants, animals, and soil in the area as well as the humans that would use those resources. Using statistical and numerical data, Reddy made is case very clear. In terms of visual qualities, the video was fair. It was well laid out in design and flowed nicely; however, transitions flowing from various scenes as well as the camera angle at certain points could have made the video better.

**REVIEW OF MY RESEARCH PROCESS**

As this was my first major research project that required a number of different types of sources, this research experience was very new to me. I definitely needed a plan to keep me going. Throughout the process, I learned a number of new things including resources I could access, how to be more efficient in my searching, and how to use advanced features. One of the most useful things that I learned and have already used in some of my other classes is the specific forms of Google like Google Book and Google Scholar. I have also had the opportunity to share these findings with others. After completing this research, I feel prepared to tackle any research project that a professor might give in my educational career.

The first thing that I needed to do was decide on my research topic. Once I settled on water pollution, I had to figure out what kind of information I wanted – what was I going to focus on or discuss, what was I going to omit, etc. This helped me to stay focused on my specific topic as well as made my future searches more efficient. Next, I created a rough outline of all the information I would need and how each part related to another. Once I had all the information organized into their specific sections, I thought about the keywords or subjects associated with each and compiled a list. My trip to my local college library was helpful in this. The big red books of subject heading, which I had never used before, and looking at other subjects listed under potential books helped me shape and reshape this list of keywords and subject headings.

Then, I began my search. I started typing in keywords and terms that were related to my topic into the search engines and then combinations of these until I found pinpointed results. After I had looked around and gathered all the information that I wanted, I organized it into groups. I definitely think that using the right keywords and advanced searches were the greatest help to me. Once I started to learn about the different places I could search for information, I took the information I had learned about searching on the web and used it to search databases and card catalogs though I had to change it just slightly. Overall, I think the right keywords are what make or break a search.

With my outline of information and keywords and subject headings, I was ready to start searching. While searching, I came across an abundance of all kinds of information – legal documents, reports, statistical information, graphs, viewpoints, scholarly journals, research studies, books, magazines, agency documents, and many other types of information. At times, I was definitely in information overload. There was so much information that I did not know where to go or where to start. I think that out of all the different types, reports and statistical information were the greatest help to me. I really like them because they are not someone’s opinion; they are actual fact. Today, everyone has his or her own opinion about everything, but it is very nice when I can do a search and find information that is backed by statistical or numerical data. This was a huge help to me in my searching and would also be helpful in writing an accurate research paper. The scholarly journals, which were new to me, were also helpful. It was good to know that I could trust the information given because of the credentials of the journal it came from. I never realized that there were so many journals or that some were so subject specific. This is yet another resource for me for other classes.

I have a couple conclusions about the nature of my topic of water pollution. First, water pollution is a very in-depth subject. I did not know when I started this research project that I would have so much information to sift through. I know now that if I am going to do a good job on this topic, I am going to need to cover the abundance of information that I am presented with. It is not a topic that can be skimmed over. It requires a good amount of time and energy. Another conclusion as to the nature of my topic is that it was broad originally. Looking back at my original research plan, I know that I was way too broad and was trying to cover too much. To do justice to the parts that I was going to include, I needed to eliminate some of the more minor aspects of water pollution.

In regards to comparing the internet with other sources of information, I think that there are arguments on both sides. When I compare the internet with my other information sources (like an encyclopedias or scholarly journals), I would say that there are pro’s and con’s to it. On the good side, there is an abundance of information that is obtainable at the push of a button. I used the internet quite frequently with my searches, and I found it to be a very quick way to get information. I found that using the internet as an information source really helped my in my searching for information. On the other hand, the internet also made things a little difficult for me. When I typed a keyword into the search engine, it always came up with way too many results. One of the bad things about internet as a source is that there is an over-abundance of information that one could look through. I found that using a book or encyclopedia helped me to narrow my search results to a number that I could handle. Additionally, anyone can put something on the internet, so I must be extra diligent to make sure that I am looking at credible websites. When I choose other sources like encyclopedias or scholarly journals, I do not have to be on such a high guard. Finally, internet information seemed to be more general. To find my good statistics and case studies, I really needed to rely on scholarly journals, government documents, and other sources besides the internet.