

Water and Sewage Critical Reading

Purpose

To critically read 3 articles with different points of view on the water and sewage issues in the Florida Keys.

Overview

This section will require students to read 3 articles with different points of view on the water and sanitation issues in the Florida Keys. Then the students are required to identify the “facts” and “opinions” in each article, and then briefly summarize the articles in a short paragraph. Finally, the student must create an essay expressing their own opinion about the water and sewage issue, using citations from these articles and other sources to support their conclusions.

Of note, any of the 3 tasks can be done individually or in the order indicated.

Time

1 two hour session for the first 2 tasks and then assign the essay as a homework assignment.

Key Concepts

Sewage and recreational waters are contentious environmental, scientific, historical, social, and economic issues with data supporting many different points of view. The same facts can be used by proponents to support different points of view.

Skills

This section, in its entirety, can help in critical reading, précis, or synthesis writing, and in the writing of essays with incorporation of facts and citations. It is also useful in developing objectivity in the analysis of scientific and non-scientific writing. Finally, written and verbal communications are stressed.

Materials

The handouts are the only materials needed. The answers can be made into transparencies for instructional purposes. Access to word processing and presentation software and Internet would be useful for production of the writing and essay products.

Background

Sewage and recreational water are contentious environmental, scientific, historical, social, and economic issues with data supporting many different points of view. These 3 articles represent at least 3 aspects of this situation.

Clean water both for use and as a potential discharge into the environment has become a major environmental issue worldwide. The Florida Keys are a subtropical environmentally fragile area with highly endangered coral reefs and island environments, as well as extensive tourism and fishing industry. As an example of one important Florida Key environmental issue, scientists have proposed that one of the most important threats to the fragile island ecology is that of human waste, particularly sewage. The expense of cleaning up the different sources of sewage is immense. Where these monies will ultimately come from is another issue. Determining when the recreational waters are clean enough is yet another scientific, economic and even social issue.

Procedure

The following Critical Reading activities can be done in groups or by individual students. Have the students critically read the enclosed articles on Water and Sanitation issues in the Florida Keys below. The websites of the original articles are available if students wish to explore these articles further.

- Article: **Key West Sewer Repairs to cost \$30 Million City would lay pipes, build 2 Deep Wells**, Nancy Klingener, Miami Herald (April 3, 1997)
<http://www.miami.com/herald/>
- Article: **The Straight Poop**, Don Casey, SailNet Articles,
<http://www.sailnet.com/collections/articles/index.cfm?articleid=caseyd005>
- Article: **From the Ground Up**, June Wiaz, Research in Review: Abstracts (Spring/Summer 1999)
<http://researchback.magnet.fsu.edu/ResearchR/springsummer99/features/FROMTHEGROUNDUP.html>

1. For each Article, review the text and **underline**:

- a) The **facts** about water and sanitation issues as stated in the Article;
- b) The **opinions** of the author and others about water and sanitation issues as stated in the Article.

Share the facts and opinions by reading them out loud to the class.

2. Review what you have underlined and write 3 short paragraphs of 3-4 sentences summarizing the argument each author is making in their Article.

3. Write an **essay** summarizing what you believe (**your opinion**) about the water and sanitation issues, incorporating facts and opinions that you have learned from your Water Research. Use quotes and **citations** to justify your opinion. **Share your opinion** by presenting your essay.

Further Investigation

Students search for other articles representing different or supporting points of view on the diverse issue of recreational waters and sewage. They can adapt their issues as newspaper articles for the School or local Newspaper, incorporating water contamination facts from their own neighborhood. They can write their Congress people to express their opinion on the water issue.

Student Assessment

Give the following critical writing components to each student as a guide to their critical writing products:

- ❖ Decide what are facts and what are opinions in each article on the Water and Sewage issue
- ❖ Briefly summarize these facts and opinions into a paragraph from the point of view of each article
- ❖ Develop an opinion on the Water and Sewage issue and what facts support this opinion
- ❖ Create an essay with fact citations to support this opinion
- ❖ Present this essay in a convincing manner
- ❖ Be prepared to answer questions concerning the essay point of view and supporting facts

Assign points for the following components of the critical writing products:

- ❖ Were the facts and opinions correctly identified and distinguished in each excerpt?
- ❖ Were these facts and opinions correctly and briefly summarized in a short paragraph for each excerpt?
- ❖ Were proper science terms used?
- ❖ Did the essay demonstrate a distinct point of view?
- ❖ Did the facts cited in the essay support this point of view?
- ❖ Did the essay report its sources/citations?
- ❖ Could the student answer questions from the audience about the facts and defend their point of view?

Key West Sewer Repairs to Cost \$30 Million City Would Lay Pipes, Build 2 Deep Wells

April 3, 1997

NANCY KLINGENER

Miami Herald

<http://www.miami.com/herald/>

The city of Key West will spend \$30 million over the next five years to replace old sewer pipes that now allow rainwater and high tides to flow to, and occasionally inundate, the city's sewage plant.

The plan was finalized this week when the City Commission approved a consent order, the latest amendment in the state's longtime oversight of the city's efforts to deal with sewage treatment.

The city also plans to build two deep wells to inject treated sewage half a mile into the ground. Those wells, along with more intense treatment to remove nutrients, could cost another \$20 million.

The latest consent agreement does not commit the city to the deep wells, but the city did agree to replace old collection pipes -- some of them 50 years old -- to reduce the rainwater and tide water invading the pipes by 40 percent within five years.

David Fernandez, the city's utility director, said some of the old pipes are in terrible shape, but they are not leaking substantial amounts of raw sewage.

``They leak in more than they leak out because you're in essence sucking the water out - - you're pumping it," he said. ``But there's always that possibility."

The work crews never know exactly what they will find when they dig up the old channels, he said.

``In some cases, the pipe doesn't even exist. Lime compacts to form rock and the pipe breaks away, disintegrates and you wind up with a cavity the shape of the pipe," he said.

The most severe problems the city has experienced lately result from the water leaking into the sewer pipes then causing an overflow at the Richard Heyman, Environmental Protection Facility -- the sewage treatment plant -- on Fleming Key.

Generally, the water that should not be there accounts for about 40 percent of the volume coming into the treatment plant, Fernandez said.

The city has also had several spills of raw sewage when pipes broke or pumps malfunctioned.

Another concern of the state regulators and environmental groups is the quality of water coming out of the outfall pipe. For years, Reef Relief has lobbied for better treatment.

``The outfall meets state standards, but it doesn't address the special requirements of coral reefs, which require a nutrient-free environment," said DeeVon Quirolo, Reef Relief's project director.

“They need clear, clean nutrient-free water to thrive, and they're not getting it because of these discharges,” Quirolo said. “Anything that can be done to improve that situation has to be done.”

Quirolo is concerned about the prospect of deep injection wells, especially if the effluent is not completely stripped of nutrients first.

But the state is encouraging the city to look toward the injection of sewage effluent.

“If there's a malfunction, it's preferable for the wastewater to go into an injection well than to go directly into surface waters,” said Gus Rios, an environmental specialist with the state Department of Environmental Protection.

Fernandez said the city is trying to find the money to apply nutrient stripping, as well as applying for permits for the deep well. The first well could be in use by the end of 1998, he said.

“This is not a substitute for nutrient removal in our eyes. We've committed to both concepts,” he said. “It's simply common sense to give immediate relief to the environment. It's something that we would have to do anyway. Our outfall is past its useful life.”

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The Straight Poop

Don Casey

SailNet Articles

<http://www.sailnet.com/collections/articles/index.cfm?articleid=caseyd005>

Let's Put Aside Political Correctness and Face the Truth

I just returned from a visit to the Conch Republic. The big news in Key West is closure of the beaches--all of the beaches--due to fecal contamination. Many of the island's sewer pipes have disintegrated, so raw sewage is flowing through what is essentially a covered trench. That might be okay in granite, but it's not so good in coral. To make matters worse, parallel storm drains provide the sewage an even more direct route to the sea.

"And," as my Key West friend spontaneously pointed out, "you just know that all those boats in the anchorage are pumping directly overboard."

Conch Republicans, including my friend, have known for decades that sewage treatment systems in the Florida Keys are inadequate, outdated and in disrepair. Efforts to ward off the inevitable included a moratorium on building, quickly abandoned when financial interests trumped ecological concerns. There is no mystery here. This is not a whodunit. Pollution surrounds the island, and its source is the toilets ashore.

Still, my friend is correct. Even though federal law has for nearly 25 years forbidden overboard discharge in coastal waters, many, perhaps most, recreational boats still pump raw sewage overboard. It is our dirty little secret.

Given the vested interest sailors have in clean water, what could precipitate such bad-boy behavior? How can we publicly support clean water while secretly pumping our heads overboard?

Let's put aside political correctness and face the truth. Who honestly believes that storing excrement under your bunk is a good idea? Holding tanks stink, leak, and sometimes burst. Handling a pump-out hose is not just unpleasant; it is a clear and present health hazard. From the perspective of boat and crew, disposing of excrement immediately is simply the most sanitary way of dealing with it.

The fundamental question is, it seems to me, is pooping in the ocean a villainous act? To answer that, we need to understand the impact of human waste on water quality. I believe it is possible to draw a valid parallel with another natural bodily function--breathing. Every time you exhale, you are "polluting" the air with carbon dioxide. Scientists believe that rising temperatures worldwide--this summer being a perfect example--are due to excessive amounts of carbon dioxide in the atmosphere. It is called global warming, and doomsayers warn that the long-term effects will be catastrophic.

Here is the point: When you exhale, you are contributing to global warming. Of course, your car puts a million times more carbon dioxide into the air than you do. But it is

undeniably true that your breathing contributes to air pollution. Or does it? If we stopped driving internal-combustion cars, stopped burning fossil fuels, stopped slash-and-burn deforestation, would the carbon dioxide we each exhale individually be pollution or merely a part of the natural equation of life on earth?

W. C. Fields decried drinking water because "Fish [procreate] in it." They also [defecate] in it. Pooping in the water may be aesthetically offensive, but it isn't polluting unless it is harmful. There has never been any evidence linking fecal water contamination to overboard discharge except when the boats are densely packed in enclosed waters. The same dynamic is at play with air quality in a crowded room, but step outside and you can breathe in the same spot for 100 years without degrading the air around you.

Am I advocating overboard discharge? Most of the time it is the only reasonable way for the small boat to deal with excrement, and most of the time direct discharge represents the least risk to both crew and environment. If your boat has sufficient electrical power, an onboard treatment system might be better for the environment, but not one that uses formaldehyde or chlorine. The residue of these sanitizing agents is, according to scientific study, more harmful to marine life than the raw sewage.

The real sources of fecal pollution are municipal sewage systems and agricultural runoff. Sewage spills are reported regularly in the newspapers, including today:

U.S. Virgin Islands -- A St. Croix pumping station has malfunctioned a second time in a week, pumping thousands of gallons of chlorine-treated sewage into the Caribbean Sea since Friday, officials confirmed Monday.

In a seemingly endless repetition of "accidents," municipalities pump hundreds of millions of gallons of raw sewage into the waters every year. The impact of agricultural runoff--including the fertilizer you use on your lawn--is greater still. Agreeing that flushing your head contributes to the problem is no different to saying that breathing contributes to bad air. We should quit making that concession.

Allowing boat toilets to be painted as contributors to water pollution only deflects attention from the real problems. Rhode Island recently petitioned the EPA to allow the designation of the entire state as a No Discharge Zone (NDZ), an overwhelmingly popular measure that was granted with hardly a whimper from boaters. It may help the fortunes of public officials lacking the courage to take on the state's real pollution issues, but it will not improve the water quality in Rhode Island.

Overboard discharge may be a crime against the state, but it is not a crime against nature. I don't think there is any question that conscientious direct discharge--one flush at a time--is better for the planet than disposing of 30-gallons of concentrate. Conscientious discharge means you never discharge your head in an enclosed basin, into sluggish waters, or when another boat is close enough to hear you flush.

It takes organization and money to fight discharge laws. It only takes enlightenment and will to ignore them.

It is your water, too. If you think I'm wrong, show me the evidence.

From the Ground Up

June Wiaz

Research in Review: Abstracts

Spring/Summer 1999

<http://researchback.magnet.fsu.edu/ResearchR/springsummer99/features/FROMTHEG ROUNDUP.html>

Tucked between Florida's Evergladed chin and the arc of ancient coral islands known as the Florida Keys, lies majestic Florida Bay. In the best of times, this estuary is roughly 500 square miles of placid and productive, clear blue-green water. From an airplane window, the bay's unusual clarity gives it the look of a rarified fish tank, playing tricks with viewers' depth perception.

The bay is home to more than 250 species of fish, numerous bottom-dwelling organisms such as sponges, corals, shrimp and lobster, as well as alligators, crocodiles, green sea turtles, West Indian manatees, fish-loving birds and wind-surfing humans. Therein, as ever, lies the rub.

For most of this century, Florida Bay's history has been tied to human manipulation of the environment of the Florida Keys. Beginning in 1906 with the construction of causeways for the Overseas Railway linking Miami to Key West, the bay has been subject to relentless pressure from development. The railway beds effectively reduced the exchange of water between the Atlantic Ocean and the bay, and coral growth rates in the bay's southwestern corner began to decline.

Over the years, dredge and fill operations have taken their toll. Much of the dredging handiwork was to create "fast land" to support a population boom beginning in the early 1950s. In the process, dozens of canals pierced ancient coral heads, inelegantly exposing their porous nature, and creating a faster highway for underground wastewater to reach Florida Bay and Atlantic waters. These manmade conduits cut into natural subsurface water routes, allowing oxygen-poor and hydrogen sulfide-rich waters to invade them. Many artificial canals became incapable of flushing themselves of pollutants as readily as natural cuts in the islands' bedrock. As a consequence, even today some of the more than 200 canals in the Keys are downright putrid.

But the list of insults to America's only subtropical environment is a long one that begins and ends with the Keys' increasing popularity. Just from 1980 to 1998, the population of Monroe County (which incorporates most of the Keys) increased by roughly 35 percent, reaching more than 85,000. On top of the year-round residents is a healthy tourism industry that accounts for an additional 25,000 inhabitants on any given day during the winter tourist season.

Sewage Woes

With people come the after effects of so many consumed conch fritters and piña coladas. Of all the problems posed by the influx of humans on the fragile Keys' environment, adequate treatment of human waste has been the most vexing. Primarily because of the enormous difficulty and expense of digging holes and trenches in solid rock, and stringing a sewerage system through 120 island-hopping miles of prime real estate, centralized municipal treatment facilities so common to most urban areas is as rare to the Keys as a snowstorm.

Surprisingly, only within the last 10 years have population centers in the Keys begun to employ a system of centralized sewage treatment. Before 1989, raw, untreated waste from Key West was pumped directly into the Atlantic. Ernest Hemingway's storied and picturesque old haunt, in fact, was one of the last places in the continental U.S. to discontinue the practice of dumping untreated sewage into the environment.

Residents have been using septic tanks routinely in the Keys since the 1950s. But in that decade, local and city governments--with no funds for centralized sewerage plants--opted for another method endorsed by federal engineers: shallow-well injection.

Today, roughly 750 sewage disposal wells that range in depth from 30 to 90 feet are operating in the Florida Keys. In the Upper Keys, most of the injected wastewater receives what is called secondary treatment--the norm throughout Florida--by what are called "package plants." Roughly 350 are now in operation, treating wastewater before pumping it into the ground.

In the mid-1980's, a notable downturn in Florida Bay's water quality got the attention of the public, the media and scientists. A slime mold infection, which corresponded to an increase in salinity, killed large swaths of seagrass--some even visible by satellite--algal blooms proliferated, and shrimp and lobster fisheries began to suffer. The bay's increased saltiness was thought to be caused by a combination of drought and a reduction in the amount of freshwater reaching Florida Bay from the Everglades--a drop of up to 40 percent from development and diversion of 'Glades water to the east.

In the past decade, the bay's levels of nitrogen and chlorophyll have generally increased, along with its turbidity--the cloudiness of the water. Nearshore waters clearly are most in jeopardy, and long-time residents of the Keys when surveyed three years ago uniformly agreed that there have been notable changes in flora and fauna -- all for the worse.

Early this year, a research study by scientists from Florida International University reported that "there is good evidence that domestic wastewater is a significant source of nutrients for the groundwater and confined embayments and canals of the Florida Keys..."

Groundwater Spill-Over

When coastal groundwater gets contaminated by human and animal waste, it can dump large quantities of nutrients--predominantly nitrates and phosphates--into marine ecosystems--Jamaica's Discovery Bay, the Great South Bay of New York, and salt marshes in Massachusetts are three examples that have suffered as a result. However, as the FIU reports suggests, only recently have scientists begun to study possible groundwater contributions of wastewater nutrients into Florida Bay.

"You read in the papers that EPA has determined that so many pounds of nitrogen and phosphorus are going into the ground in the Keys," says Dr. Jeff Chanton, chemical oceanographer at FSU. Chanton (Ph.D.) has been conducting research since 1994 on nutrient-rich groundwater flows into Florida Bay, along with his colleague Dr. William Burnett, with support from the state Department of Environmental Protection as well as from federal agencies.

The question, says Chanton, is whether current methods of disposal--primarily the shallow injection wells--are satisfactory.

"Do they need to go to centralized sewerage (throughout the Keys)? That's what we're trying to determine," Chanton says.

Chanton and Burnett, along with graduate students Kevin Dillon and Reide Corbett, are using tracers--compounds that can be introduced at the source and easily detected elsewhere downstream--to measure how quickly sewage from injection wells in the Keys makes its way to surface water.

Their methodology builds on work done by Burnett in the 1980's. When Burnett and FSU colleagues were working in Central Florida to analyze the environmental effects of the phosphate mining industry there they consistently found elevated levels of radioactivity in the groundwater underlying the mined sites, as well as the unmined areas. As it turns out, the element radium and its gaseous decay product, radon, commonly are associated with phosphate deposits. Burnett says radon's special characteristics, a key one being that it doesn't react with other materials, make it an excellent tracer.

"We're using radon and methane as prospecting tools to locate the areas where groundwater comes out. But now we're also figuring out how fast it travels," Chanton explains. His team is mainly concerned with how much nitrogen and phosphorus is reaching Florida Bay from shallow well injection of partially treated wastewater.

The FSU team also is collaborating with Dr. Lee Kump of the Department of Geosciences at Pennsylvania State University. The Penn State work involves drilling out columns of rock and running nutrients through them to see if nitrates and phosphates attach to the surface of the underground carbonate rock, or if they pass through. Kump is measuring nutrient distributions around these sites, and has experience with analogous conditions--much of Pennsylvania rests atop a similar type of karst, or porous limestone geology.

Besides geology, other natural phenomena conspire to prevent scientists from getting quick-and-easy answers. For example, researchers must factor in tidal influence on groundwater flow. On average, the height of water in Florida Bay actually is somewhat greater than it is in the Atlantic, likely caused by wind out of the western Gulf "piling up" water in the eastern Gulf. That means that net groundwater flow is slightly toward the Atlantic.

In reality, the groundwater of the Keys "sloshes" back and forth, says Chanton, complicating already difficult-to-gauge groundwater flow patterns through the underlying cracks and fissures of partially-dissolved limestone. The slight overall flow toward the Atlantic is good news for the bay, and not such good news for the offshore Atlantic reefs which have suffered greatly in recent years. The small gradient toward the Atlantic is not as important in the wider and less porous lower Keys, Chanton said.

A Happy Environmental Accident?

In their work on septic tank fluids on Big Pine Key and shallow-well injection of wastewaters on Key Largo, the FSU researchers have reached at least one indisputable conclusion--wastewater in the ground fairly rapidly wends its way to surface waters. The

Swiss cheese-like rock that underlies much of Florida is especially porous in the Keys, particularly the upper reaches from Key Largo to Long Key.

In some places, injected wastewater can reach the surface water in a matter of just several hours, although in one injection well study on Long Key, the FSU team found that some of the wastewater can remain in the immediate vicinity of the well for several months. The high flow rates are more typical of the upper Keys which are underlain by the more porous Key Largo limestone.

The question for all locations is whether the wastewater that emerges is "polished," says Chanton--whether the phosphate and nitrates stick to the limestone matrix through which it travels. Phosphate is the real demon in the mix--the shallow bay and the nearby Atlantic coral reefs are extremely sensitive to the stuff.

"We can show that the water does move from the injection wells into the surface waters of the bay. But now we're trying to determine the extent to which the nutrients are scrubbed as they move through the system. It looks like there's good evidence that the phosphate is removed," Chanton says.

Preliminary information suggests upwards of 90 percent of the phosphate adheres to the underground limestone, he said. The finding, if subsequent tests support it, amounts to a "happy accident" by sanitation engineers who came up with the shallow-well injection idea in the 1950s. In all likelihood, Chanton said, designers of the system had no clue about the natural affinity for Keys limestone for the phosphates in human waste when they installed their first injection pump.

But they also had little or no appreciation for the long-term capacity of the islands' limestone foundation to keep stripping those pollutants out of wastewater constantly pumped from above. Chanton cautions that although there is heavy dilution of this dirty water at depth, nearly all of it eventually percolates to the surface.

"If you take a cup of sewage and pour it into the canal, you dilute it by many, many factors," Chanton says. But those 'cups' are flowing in there all the time."

Still, the absolute amount reaching surface waters is not known, nor are the effects of nitrates which apparently aren't altered very much in their journey through the limestone's nooks and crannies. Just how much more of this injected pollution the Keys and their surrounding waters can withstand is anyone's guess, he said.

"Without doubt, water injected into disposal wells eventually reaches the surface. The question now is just how well these underground processes clean up the water before it comes back up."