Ecosystem recovery of Tampa bay following the 2021 release of phosphate mine wastewater from the Piney Point facility

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## Abstract (150-250 words)

Mining activities can support local and global economies, yet also impose significant consequences for the natural environment. Phosphate mining in central Florida has been ongoing for decades and many facilities present risks to freshwater and coastal aquatic environments in the state. In 2021, a breach in the liner of a wastewater holding pond at Piney Point, a legacy phosphate processing facility, resulted in the emergency discharge of ~815 million liters of highly acidic and nutrient-laden (nitrogen, phosphorus) process water into Tampa Bay. A multi-agency, event-response monitoring program resulted, which documented ecosystem impacts within several months. Short-term declines in water quality were observed, with a notable harmful algal bloom and substantial fish kills occurring three months after the initial wastewater release. The long-term recovery of Tampa Bay over the last 30 years has demonstrated that coordination among public and private entities can lead to improved environmental health. Acute spills like the 2021 event threaten past successes, while efforts to mitigate and prevent these negative outcomes in the future are ongoing. This chapter will present the historical context and management of Piney Point as a precursor to the events of 2021, while providing quantitative examples of the bay’s response for interpretation relative to the long-term recovery of the bay. The role of the Tampa Bay Estuary Program as a non-regulatory institution that works to build public and private partnerships for bay management will also be explored, with emphasis on its role coordinating monitoring efforts and disseminating open science communication products.

## 1 Introduction (500-1500 words)

Provide background for the instructor that helps integrate the case study into disciplinary material and, if possible, relate the case study to ABET General Criteria (Student Outcomes 1-7), Program Criteria for Civil Engineering and Environmental Engineering, and general definitions and statements (e.g., ABET’s Statement on Implementing DEI Concepts into Program Criteria). The references in this section should focus on pedagogical aspects of the case study. As Section Editor, I can assist with the latter.

ABET General Criteria Student Outcomes:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

1. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

1. an ability to communicate effectively with a range of audiences.

1. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

1. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

1. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

1. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Regarding DEI. The ABET information can be found here <https://www.abet.org/about-abet/idea-inclusion-diversity-equity-accessibility/> Social justice issues relevant to the spill could be addressed.

This case study provides an example of the roles and responsibilities of public institutions and private organizations and how they can work together to address environmental problems (Environmental Engineering Program Criterion e)

## 2 Background (1000-2000 words)

Provide background information for the study that relates to the events, design process, etc. Make sure to include sufficient information (including pictures, figures, graphs, etc.) so that a novice (i.e., student) can understand the case study. Include references to the events that allow for the reader to investigate further.

## 3 Student Activities (500-1000 words)

### 3.1 Classroom discussion questions

Include at least 3 discussion questions based on the case study that can be used in a classroom situation.

### 3.2 Individual student responses

Include at least 3 questions/prompts based on the case study that can be used in a homework assignment or on an exam. These could include further reading (be sure to provide references to readily available materials) or personal reflections.

## 4 Conclusion (500-1000 words)

Include a discussion of key take-aways.

## References