A SunCam online continuing education course

Ethics Case Study on Lake Peigneur Disappearance

Ethics Case Study on Lake Peigneur Disappearance
A SunCam online continuing education course

Course Outline:

Professional Ethics
NSPE Code of Ethics for Engineers
Lake Peigneur Crisis Overview
Timeline of Events
Engineering Failures
Lessons Learned
Helpful References
Examination

Professional Ethics

Ethics is concerned with moral principles and behaviors. Like doing the right thing and considering others before oneself.

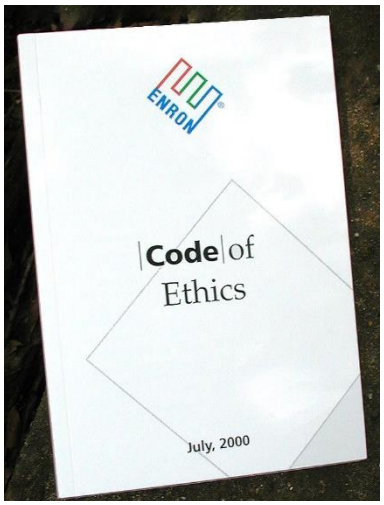
Professional ethics are standards of behavior for working professionals. For example, the Hippocratic Oath has been taken by physicians since the fourth century BCE. The oath established several principles of medical ethics still in use around the world, including medical confidentiality and non-maleficence. Another historic example is the Teacher's Oath, sometimes called the Socratic Oath.

Today, professional behavior standards are set and enforced by:

- Employers, such as corporations,
- Professional organizations, and
- Federal, state, or local regulations.

For example, Costco promotes ethical capitalism and has the following Code of Ethics statement:

> *In order to achieve our mission, we will conduct our business with the following Code of Ethics in mind:*
> - *Obey the law.*
> - *Take care of our members.*
> - *Take care of our employees.*
> - *Respect our suppliers.*



Source: commons.wikimedia.org/wiki/File:Enron_Ethics_Manual.jpg

Federal government employees are subject to the ethical standards in Code of Federal Regulations:

> *5 CFR 2635.101 Basic obligation of public service.*
> *(a) Public service is a public trust. Each employee has a responsibility to the United States Government and its citizens to place loyalty to the Constitution, laws, and ethical principles above private gain. To ensure that every citizen can have complete confidence in the integrity of the Federal Government, each employee must respect and adhere to the principles of ethical conduct set forth in this section, as well as the implementing standards contained in this part and in supplemental agency regulations.*

Ethics Case Study on Lake Peigneur Disappearance
A SunCam online continuing education course

Engineering Ethics

Engineering is a profession. And like every profession, there are several behavioral standards specific to engineers. In the United States, a popular standard is the “Code of Ethics for Engineers” by the National Society of Professional Engineers (NSPE).

The National Council of Examiners for Engineering (NCEES) manages “model law” and “model rules” which include behavioral standards (cover pages below). Each time the model documents are update, the NCEES and NSPE encourage all states to adopt the new standards.

Each state has rules for professional conduct specific to engineers. These rules are usually located in the state administrative code in the chapter/section for engineering. These state rules are enforceable and with disciplinary consequences. An example rule is that a person shall not offer or perform engineering services unless he or she is licensed as a professional engineer.

NSPE Code of Ethics for Engineers

This is the most widely accepted document for engineering ethics in the United States is the “Code of Ethics for Engineers” by the National Society of Professional Engineers (NSPE).

The main statements are copied here:

I. Fundamental Canons

Engineers, in the fulfillment of their professional duties, shall:

1. Hold paramount the safety, health, and welfare of the public.
2. Perform services only in areas of their competence.
3. Issue public statements only in an objective and truthful manner.
4. Act for each employer or client as faithful agents or trustees.
5. Avoid deceptive acts.
6. Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

II. Rules of Practice

1. Engineers shall hold paramount the safety, health, and welfare of the public.
2. Engineers shall perform services only in the areas of their competence.
3. Engineers shall issue public statements only in an objective and truthful manner.
4. Engineers shall act for each employer or client as faithful agents or trustees.
5. Engineers shall avoid deceptive acts.

III. Professional Obligations

1. Engineers shall be guided in all their relations by the highest standards of honesty and integrity.
2. Engineers shall at all times strive to serve the public interest.
3. Engineers shall avoid all conduct or practice that deceives the public.
4. Engineers shall not disclose, without consent, confidential information concerning the business affairs or technical processes of any present or former client or employer, or public body on which they serve.
5. Engineers shall not be influenced in their professional duties by conflicting interests.
6. Engineers shall not attempt to obtain employment or advancement or professional engagements by untruthfully criticizing other engineers, or by other improper or questionable methods.
7. Engineers shall not attempt to injure, maliciously or falsely, directly or indirectly, the professional reputation, prospects, practice, or employment of other engineers. Engineers who believe others are guilty of unethical or illegal practice shall present such information to the proper authority for action.
8. Engineers shall accept personal responsibility for their professional activities, provided, however, that engineers may seek indemnification for services arising out of their practice for other than gross negligence, where the engineer's interests cannot otherwise be protected.
9. Engineers shall give credit for engineering work to those to whom credit is due, and will recognize the proprietary interests of others.

Lake Peigneur Crisis Overview

The Lake Peigneur disappearance was one of the most unusual and dramatic engineering disasters in history. The incident occurred on November 20, 1980, in southern Louisiana, at the location shown in Figure 1.

Figure 1: Location of the Lake Peigneur Disaster.
Source: https://en.wikipedia.org/wiki/Lake_Peigneur

The disaster started during a seemingly routine drilling operation by Wilson Brothers Corporation (Wilson Brothers), a subcontractor to the Texaco Oil Company (Texaco). Texaco was looking to explore oil present under Lake Peigneur, a shallow freshwater body. There is a salt dome (buried salt formation) under the area of Lake Peigneur which has been mined for over a century, as shown in Figure 2. It is well known that salt domes have oil and gas pockets around the edges, and Texaco looked to capitalize on these resources, as depicted in Figure 3.

Figure 2: Picture from inside the salt mine below Lake Peigneur prior to the disaster. The salt pillars were left to help hold up the ceiling of the mine.
Source: State Library of Louisiana, p.d.

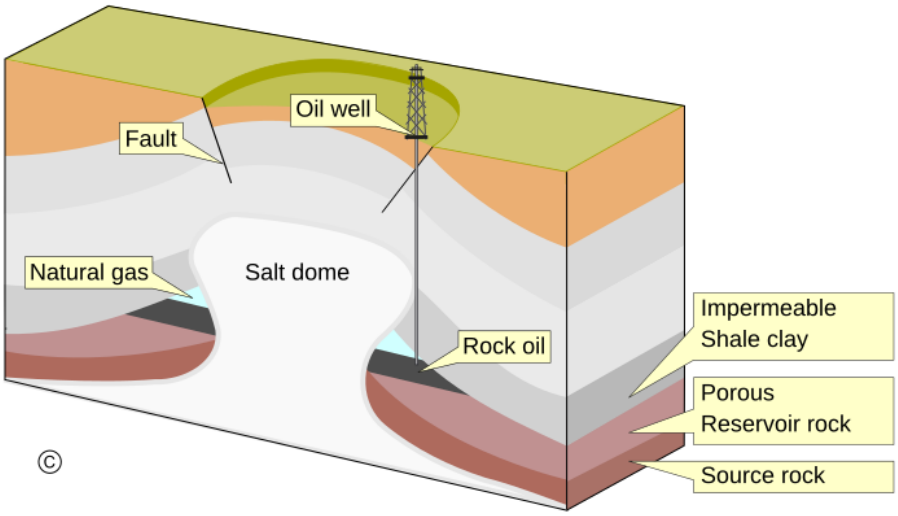


Figure 3: Diagram showing common practice of oil drilling at the edges of a salt dome.
Source: commons.wikimedia.org/wiki/File:Salt_dome_trap.svg, MagentaGreen, CC-BY-SA-3.0

Ethics Case Study on Lake Peigneur Disappearance
A SunCam online continuing education course

Texaco obtained an oil drilling state lease, performed a geological evaluation, and hired Wilson Brothers to perform the exploratory drilling at a location at the south end of the lake. Coordinates were given to Wilson Brothers. The drill team setup a drilling platform on the lake at what they thought were the correct coordinates. However, the drill location was over a portion of an old salt mine with active mining operations by the Diamond Crystal Salt Company, as depicted in Figure 4.

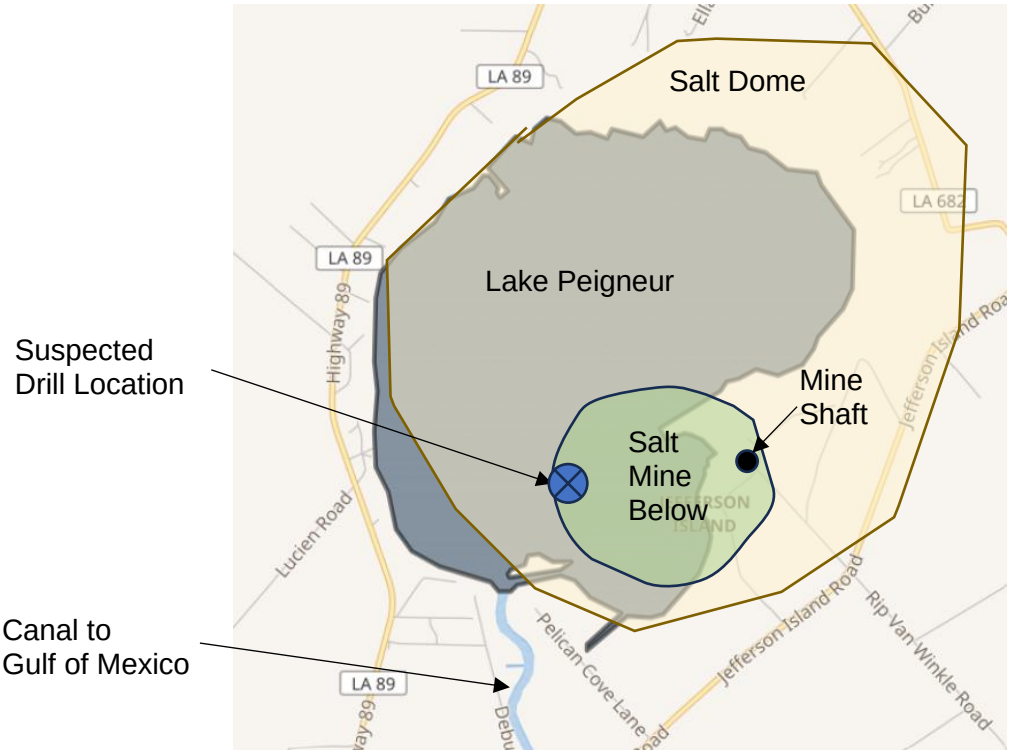


Figure 4: Lake Peigneur with approximate drill location.
Source: https://en.wikipedia.org/wiki/Lake_Peigneur, OpenStreetMap, CC BY-SA 2.0, modified

As the drilling operation progressed to around 1,300 feet, the 14-inch drill bit punctured the ceiling of an inactive level of the salt mine, as shown in Figure 5. This puncture created a direct connection between the mine and the lake which caused water from the lake to flood into the mine. The salty earth around the mine began to dissolve and break apart which enlarged the opening and caused flow to increase at an alarming rate. The situation was very dangerous for those on boats around the lake and for the workers in the mine.

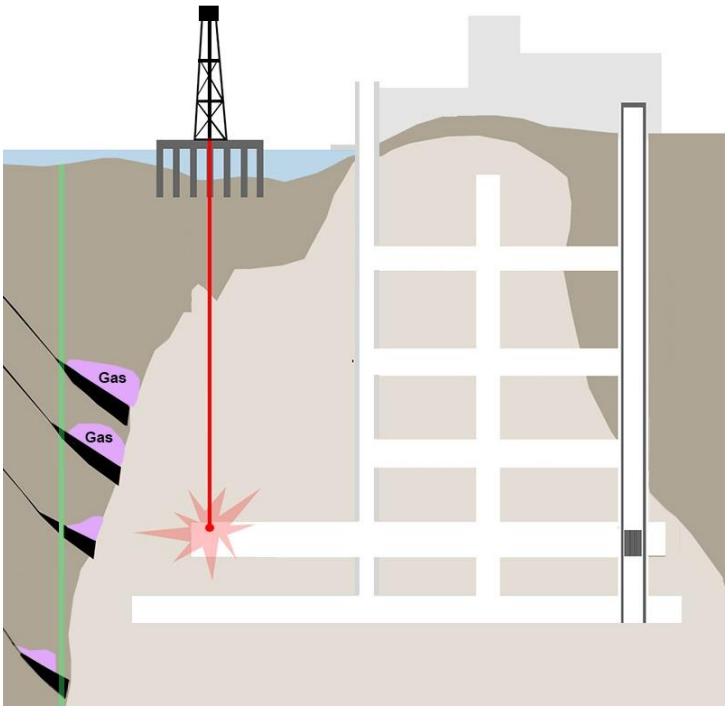


Figure 5: Depiction of the drill penetrating the salt dome and striking a mine level. The green line is the targeted drill location while the red is the actual location. Workers used the elevator shown on the right to escape.
Source: commons.wikimedia.org/wiki/File:MAPPA_PEIGNEUR.jpeg, Enrico Cabianca, CC-BY-4.0, modified

The original lake was only 11 feet deep before it was transformed into a massive whirlpool. Water was drawn with such power that it caused the oil rig, barges, and even a tugboat to be pulled into the expanding sinkhole. The oil rig was completely swallowed by the whirlpool of draining water and deposited deep in the earth such that it was never recovered. For a short period, the lake was essentially gone with just the mud bottom visible except a small pool around the drill area.

As surrounding water began filling the empty lake, sections of the shoreline collapsed and moved vehicles, trees, Jefferson Island, and even parts of the surrounding landscape. The drop of water level was so great that it temporarily reversed the flow of the nearby Delcambre Canal which now flowed backward into the lake and even created a temporary waterfall as shown in Figure 6.

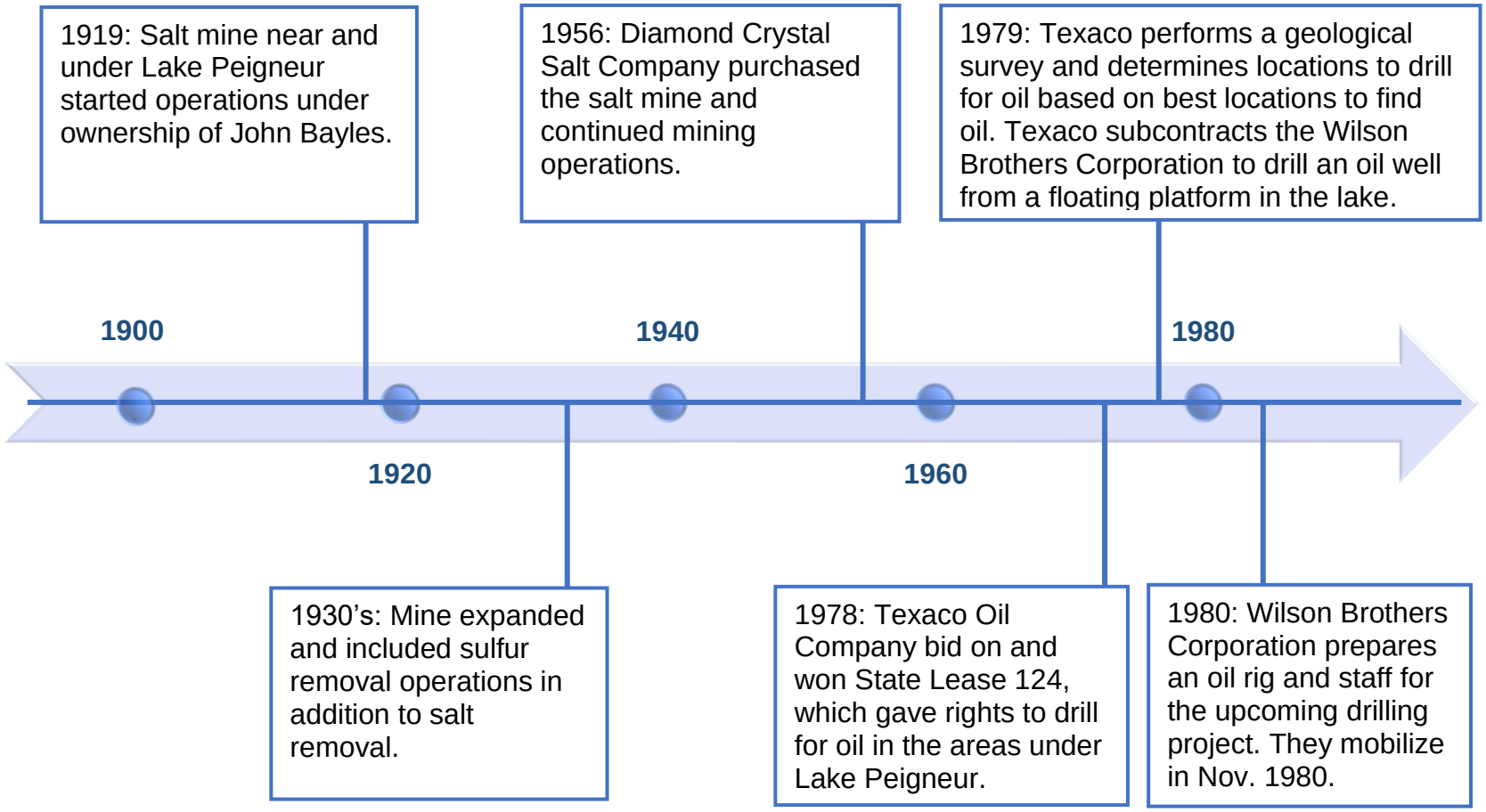
Figure 6: Delcambre Canal flowing backwards with a waterfall after the disaster.
Source: https://en.wikipedia.org/wiki/File:Lake_Peigneur_Waterfall.png, Unlicensed

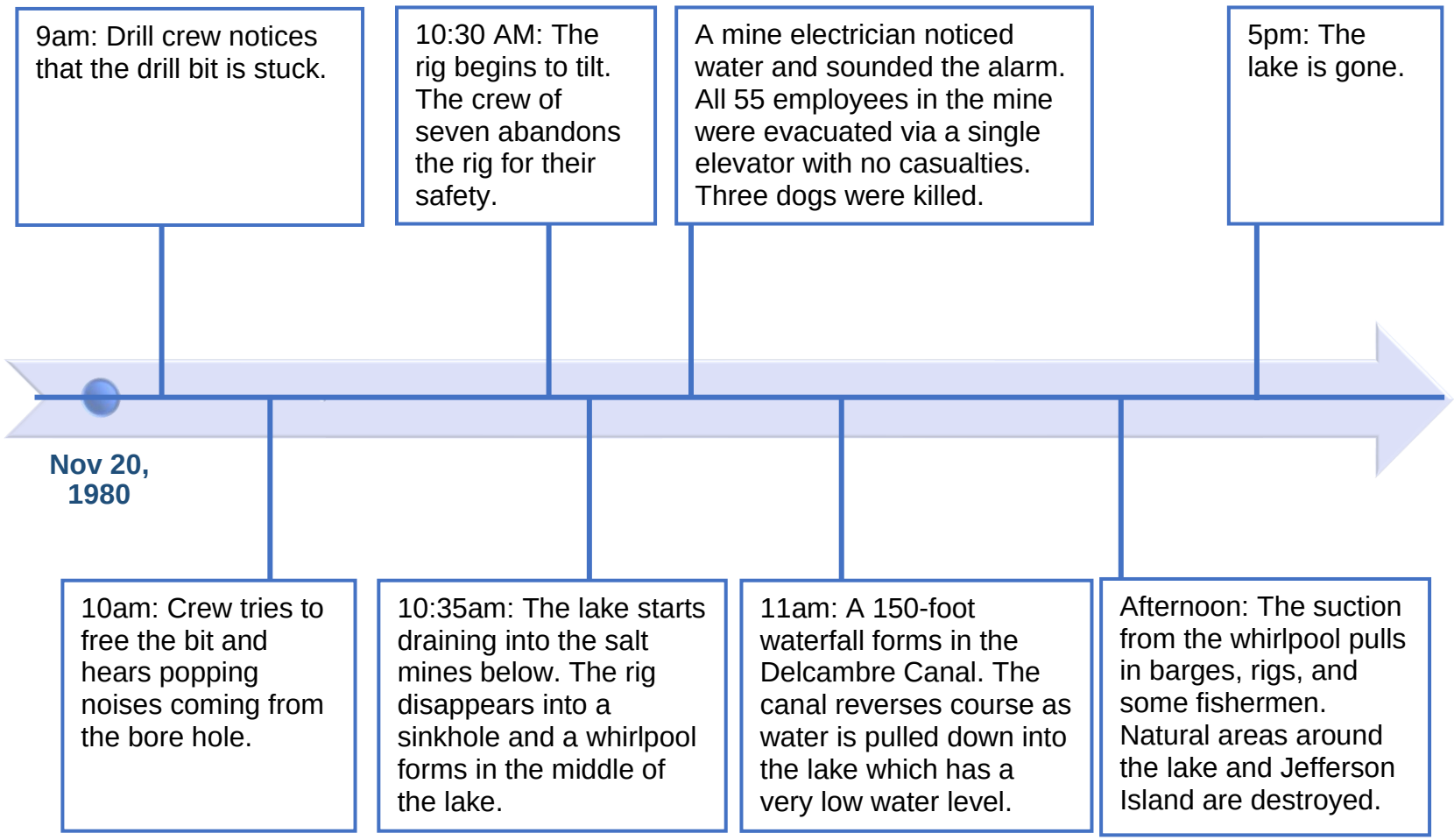
It seems miraculous that no human lives were lost. There were 55 employees working in the salt mine at the time with only a single small elevator. Yet all managed to escape to safety. An electrician heard unusually noised and witnessed the first signs of water intrusion and sounded an alarm very quickly. Workers had to wait patiently in line as the elevator went up and down hundreds of feet to bring each group to the surface. Safety protocols were in place and followed by all involved.

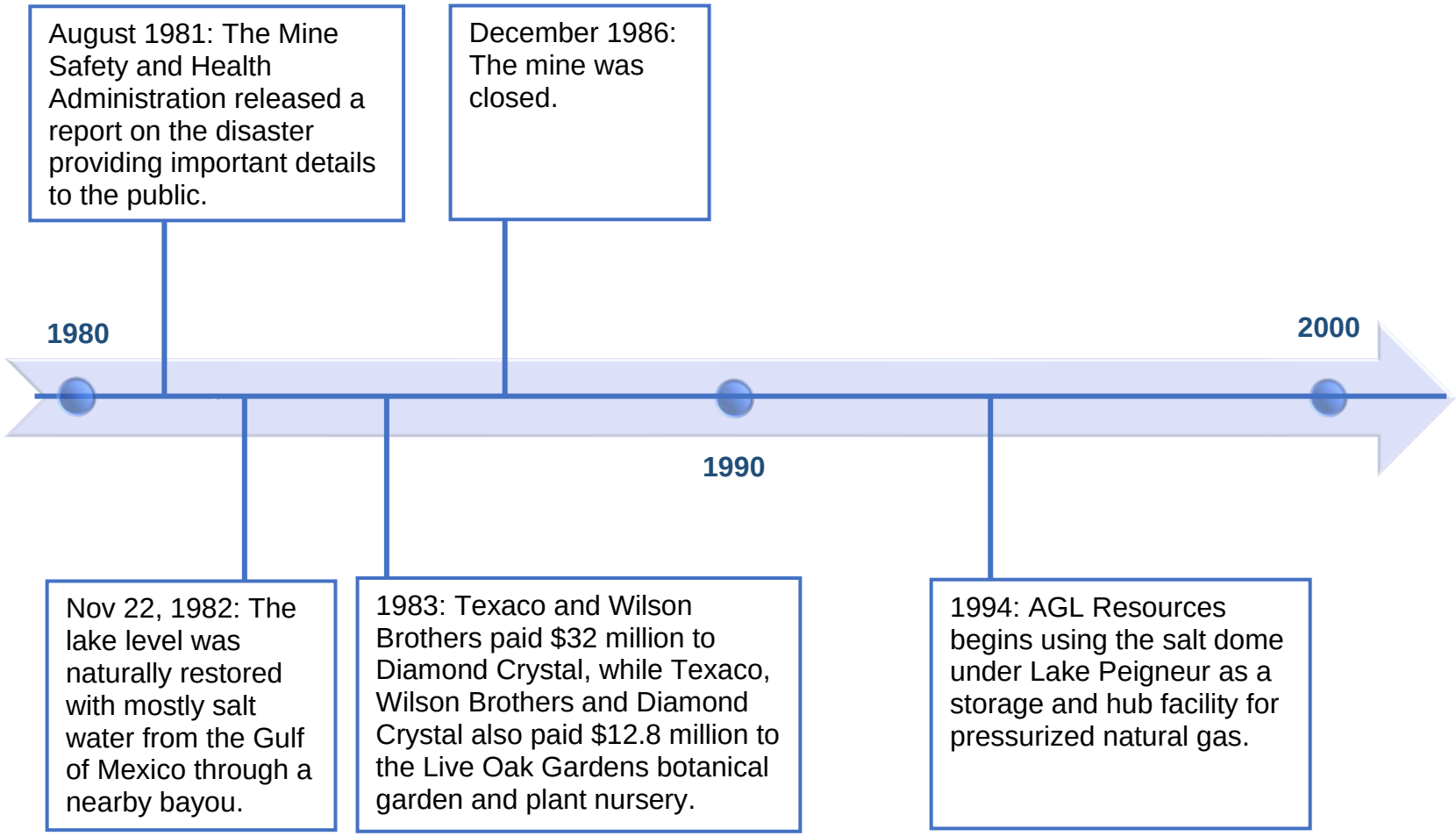
Overtime, salt water from the Gulf of Mexico slowly filled the lake back to very close to its original water level. From that day forward, the lake become a brackish saltwater lake, with a complete change in ecology. Before there were freshwater bass, perch, crappie, and catfish. Today, there are redfish and drum fish. Also, the lake is now 200 feet deep, and the deepest lake in the state of Louisiana.

The incident of Lake Peigneur disaster is considered a stark reminder of the potential consequences of inadequate risk assessment, geological evaluation, surveying, and incorrect drilling locations. Although it is unusual to drain a lake, it is very common for drilling and boring operations to hit utilities, buried structures, and unexpected geological formations. The lessons learned from this disaster apply to many engineering projects involving geotechnical borings and excavation work.

Timeline of Events







Ethics Case Study on Lake Peigneur Disappearance
A SunCam online continuing education course

Engineering Failures

The court cases for the disaster were settled out of court, so many details were not made public. No person or company has taken responsibility for the disaster. The following apparent failures are grouped into each party.

Texaco

- Incomplete geological survey lacking important below ground conditions. Potential approaches are a seismic/vibration survey, gravity survey, or magnetic survey.
- Poor risk management with disregard for potential consequences of a failure.
- Lack of oversight of the drilling subcontractor.

Wilson Brothers

- Located boring coordinates incorrectly.
    - For example, the boring coordinates were given in the Transverse Mercator (MTM) system, but the oil rig was positioned using the Universal Transverse Mercator (UTM) system.
    - Utilize a licensed surveyor for marking boring location.
- Quality control by double checking boring coordinates and boring progress.
- Take drilling precautions such as drill encasement, proper drilling fluid pressure, blowout prevention system, slower drill speed, and torque and drag monitoring.
- During drilling, review bored rock samples for evidence of a salt dome breech.

Diamond Crystal

- Incomplete mining maps lacking precise coordinates of the extents of each level.
- Apparent disinterest in risky oil drilling near or over the mine while workers are in the mine.

Lessons Learned

The following are lessons learned from the Lake Peigneur Crisis as applied to each of the fundamental cannons.

Canon 1: Hold paramount the safety, health, and welfare of the public.

Texaco engineers failed to conduct a comprehensive geological survey and risk assessment before drilling into the salt dome. The drilling crew did not locate the bore coordinates correctly and did not take drilling precautions. All this put the safety of the miners and community members at the lake in immediate danger and significantly and permanently altered the environment.

Miners escaped in a calm and orderly manner which saved lives.

Canon 2: Perform services only in areas of their competence.

The unqualified drilling crew chose to determine the drill location themselves instead of utilizing a certified land surveyor to mark or confirm coordinates.

Canon 3: Issue public statements only in an objective and truthful manner.

None of the engineers at the companies involved were willing to share important details with the public.

Canon 4: Act for each employer or client as faithful agents or trustees.

Engineers are entrusted to use their expertise to help avoid crises and disasters. Appears decisions were made to save time and money without thinking of the risks and consequences. A total of approximately $45 million in settlement fees were paid in addition to a lost oil rig and a collapsed salt mine.

Canon 6: Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

Engineers and staff at Texaco and Wilson Brothers skipped important steps and likely violated state regulations for safe drilling. Their actions made people question the competency of engineers and drilling technicians.

Helpful References

Felton, J. (2020). “How One Engineer's Tiny Mistake Made An Entire Louisiana Lake Completely Disappear.” https://www.iflscience.com/how-one-engineers-tiny-mistake-made-an-entire-louisiana-lake-completely-disappear-57796

Graham64.wordpress. (2020). “The Lake Peigneur sinkhole.” https://graham64.wordpress.com/2020/02/16/the-lake-peigneur-sinkhole/

Jennings, K. (2016). “How Louisiana's Lake Peigneur Became 200 Feet Deep in an Instant.” https://www.cntraveler.com/stories/2016-07-11/how-louisianas-lake-peigneur-became-200-feet-deep-in-an-instant

National Council of Examiners for Engineering and Surveying (NCEES) (2021) “Model Law”. https://ncees.org/wp-content/uploads/Model_Law_2021_web-2.pdf

National Council of Examiners for Engineering and Surveying (NCEES) (2024) “Model Rules”. https://ncees.org/wp-content/uploads/2024/01/Model_Rules_January-2024_web.pdf

National Society of Professional Engineers (NSPE) (2019) “NSPE Code of Ethics for Engineers“. https://www.nspe.org/resources/ethics/code-ethics

Wohlust, K. (2018) “Case Study: Lake Peigneur” https://blog.thinkreliability.com/case-study-lake-peigneur

