

TIDELANDS, LAW OF THE SEAS, AND OTHER MATTERS

—by Gunther Greulich

Surveyors have been the guardians of private property rights and of the public trust doctrine ever since the enactment of the Colonial Ordinance in Massachusetts in 1641 to regulate the use of tidelands. The Colonial Ordinance is history, but its successor, Massachusetts General Laws Chapter 91, is as relevant today as it was over a hundred years ago—even more so. Coastal activity has taken center stage in public consciousness, but unless one lives and works within about thirty miles of the sea shore, one may not be too concerned about riparian or littoral rights. Cape Cod surveyors, of course, are never more than five miles away from the sea.

The Colonial Ordinance of Massachusetts had codified the division line between public and private rights coincidental with the Extreme Low Water (ELW) Mark within 100 rods of Mean High Water (MHW). Massachusetts and Maine are among the only six states in the Union which do not recognize the MHW line for property purposes.

Both MHW and ELW are dynamic lines, subject to change and fluctuation. For practical and legal purposes, the U.S. has adopted the 19-year Metonic Cycle of the Moon as a temporary fixed reference to MHW (Borax vs Los Angeles, 1935).¹ The National Geodetic Survey (NGS) and the National Ocean Service (NOS) of the National Oceanic and Atmospheric Administration (NOAA) have been updating the MHW datum every nineteen years. The current applicable cycle was observed from 1983 to 2001.

Whether or not this observation frequency is sufficient to identify sudden sharp changes in the MHW or ELW due to cataclysmic events is subject to debate. Attendees at the 1994 MALSCE convention may remember a presentation by a Cape Cod scientist (I call him a genius) on one such event. Based on a lifetime of study of the history of the Earth, Dr. Chan Thomas predicted the end of our civilization to come to pass on Dec. 21, 2012, as a result of a 90° shift of the North–South pole when the Solar System passes through a magnetic null zone.^{2,3} Thomas qualified the estimated time of this event by +/- 200 years—so, no need

to panic just yet—but neither should one ignore the fact that the Earth was born through a cataclysmic event and is subject to them at any time.⁴

Indeed, there is some evidence to that effect. According to the U.S. Geological Survey, the Earth’s magnetic field strength has decreased by 35 to 40 percent in the past 350 years.² Public Broadcasting Service (PBS) reported last year that the magnetic field and shield of the Earth has been weakening in the last 300 years. In December 2006, the National Geographic reported that the North Magnetic Pole is moving towards Siberia at a rate of 25 miles a year. Trade your trusty compass for a handheld GPS!

In 2007, scientists on the TV program “The Universe—the Sun”⁴ explained that the Sun’s magnetic field reverses itself every eleven years, in what’s known as the “Schwabe sunspot cycle.” During that reversal, huge electro-magnetic solar flares with tons of high-energy plasma particles bombard the Earth, interfering with electric power lines, air traffic control, even GPS! The last incident of such coronal mass ejection⁵ was in 2001. The next one will happen in 2012!



THE SEA LEVEL

Interesting [and worrisome] as the changes in the Earth’s magnetic field may be, people become most engaged when disaster hits close to home. The decimation wrought in 2005 by Hurricane Katrina in New Orleans and along the Gulf Coast drove home the importance of timely tidal observations.

After the disaster, the U.S. Army Corps of Engineers discovered that the levees in New Orleans had been built two to five feet too low. Not surprisingly, their design was based on tidal measurements and surveys done in 1929! Since then, New Orleans has been sinking at an alarming rate, placing the city’s French Quarter and much of the surrounding land below sea level (*Associated Press*, March 27, 07). The NOAA/NGS National Water Level Observation network now has four of its 200 NWLON stations located at or near Lake Pontchartrain, collecting and transmitting data via satellites every six minutes.⁶

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Just the opposite is happening on the coast of Massachusetts. A 1991 study by a Massachusetts consulting firm on behalf of Massport found a relative sea level rise of 2.8 mm per year.⁷ In fact, since the Pilgrims had landed on Cape Cod 387 years ago (1620), the sea level on our coast has risen by about three feet.

Rising sea levels (be they caused by changes in the magnetic field or global warming⁸) will, without doubt, cause the inundation of many coastal areas worldwide. This is unrelated to Dr. Thomas's cataclysm!

A joint study by the International Institute for Environment and Development (IIED) of London, together with American researchers at Columbia University and the City University of New York warned that low-lying coastal areas are most vulnerable—in fact, any area lying at less than 33 ft above sea level. This includes much of Cape Cod and, of course, the City of Boston. Ancient c.91 licenses in South Boston, for instance, have permitted filling of tide lands up to Elevation 16 above Boston City Base. The Boston City Base datum is about 0.8 feet below MLW. Therefore, much of the city is built only six to ten feet above MHW or the sea level.

The IIED report gives no time frame for the predicted flooding (*Associated Press*, 3-28-07). Nevertheless, concerned governments everywhere will want to know the risks and locations of future potential flooded areas. Surveyors will have to monitor the areas identified to be at risk by re-surveying them periodically and updating their GIS databases.

The issue of sea water levels is being addressed at the federal level, as various articles published in the *ACSM Bulletin* in 2007 by NOAA/NOS attest. The February issue celebrates the 200th anniversary of NOAA⁹ which had begun under President Thomas Jefferson as the "Survey of the Coast." The article describes ongoing Tidelands Currents programs of NOAA/NOS in an expose peppered with a slew of new and mysterious acronyms—NWLON, GOES, PORTS, NOCMP, ADCP, COOPS, COASTAL, CORMS and IOOS. The newly formed "COASTAL" Program (Coastal Oceanographic Applications and Services of Tides and Lakes) is of particular interest, focusing on long-term sea-level assessment. Also, the *ACSM Bulletin* published in its April issue an invitation for comments on the FDGC draft of proposed National Shoreline Data Content Standards. Since our national shoreline¹⁰ is a baseline for legal boundaries (see also "Territorial Seas"), the standard will provide a shoreline prediction analysis and indicate the effects of relative sea rise.

GPS AND THE LAW OF THE SEAS

Invented by scientific teams of the United States Navy and the US Air Force about 40 years ago, the Global Positioning System (GPS) is highly accurate. Both the British and the Iranian Navy think so, otherwise they would not have equipped their vessels with GPS. In April, both claimed

to know exactly where they were: Iran claimed a British merchant ship was within its territorial waters, while the British Navy insisted that according to their GPS, their ship was 1.7 miles within Iraqi waters, not in Iranian territory. Ironically, both may have been right—or both may have been wrong! This is because no matter how precise the coordinates of a ship in the middle of an ocean are, they do not automatically tell us the exact distance to a mathematical line, such as the internationally observed 12-mile territorial sea line.

The United Nations Convention on the Law of the Seas (which the U.S. has not yet signed) proscribes a somewhat complex Low Water baseline from which the 12 nautical miles are to be measured.¹¹ Each nation is allowed to utilize its own customary and traditional Low Water mark along its coastline as the baseline—but there are exceptions, such as that pertaining to a bay or cove, where a straight connection across the bay, not exceeding 24 nautical miles, may be used instead of the actual Low Water Line. But even this exception may not make things easy.

"The 1994 World Physical Map by the National Geographic depicts the ragged irregular coastline of Iran at the northern end of the Persian Gulf. Although small-scale, as surveyors, we can surmise the many complex zig-zags of the Low Water Line there. It would indeed be difficult to find the exact stretch of LW on that coastline that must be used to calculate exactly the 12-mile limit of a ship sailing in the Gulf.

Other problems may occur if national borders are either in dispute or not recorded. The Law of the Sea treaty requires each country to submit charts and maps of its claim along its coastline for review. Upon approval, the maps are available to other nations, and a copy of the published chart of each coastal member state is on file with the Secretary General of the United Nations. The Territorial Seas line between Iran and Iraq in the Persian Gulf may well be unknown as Iran is not a signatory to the Law of the Sea.

According to Article 15, Section 2, Part II of the international code on the Determination of Territorial Seas between States with opposite or adjacent coasts, the "Territorial Sea [line] is the median line to which every point is equidistant from the nearest point on the baselines from which the breadth of the territorial seas of each of the two States is measured..."

I would speculate that the British Navy relied on the official coordinates of the official Iraqi claim maps. Iran, on the other hand, may have based their action on coordinates of its unrecorded/unofficial claim. The Territorial Seas lines that they referred to most likely overlaps.

As if this were not enough, the border between Iraq and Iran at the northern end of the Persian Gulf is located directly above a fault line between the Eurasian and the Arabian Tectonic Plates. Historically there have been many

earthquakes of magnitude 5 or greater along this fault line. The movement of the coastline caused by these events is likely to have shifted the Law Water baseline and hence, the Territorial Sea Line as well.

GPS or not, I suspect that neither the British nor the Iranians knew exactly where the Territorial Sea limit was, even within 1.7 miles, as reported. It may explain why after two weeks of political grandstanding, reason, disguised as an Easter present, prevailed and the British sailors were set free.

This luckily peacefully avoided international incident brings home the point that it is in the best interest of our country, that coastal survey data are recorded as accurately as possible, rather than being based on an assumed datum still favored by some as a cheap substitute. One never knows who will make use of it and for what purpose.



Cape Cod National Seashore park.



PHOTOGRAMMETRY AND SEASHORE TAKING

Back in the 1960s, as an employee of New England Survey Service of Boston, I was involved in delineating a small part of the federal taking of 43,500 acres of real estate along the 40-mile northeastern shoreline of Cape Cod. At the time, my boss, Mr. H.B. Ullian, was one of the first few surveyors of New England who believed in the reliability of good aerial photogrammetry. Many were skeptical. I remember an EMAPELS/MALSCE meeting, where one of our most respected, prominent surveyors declared that his firm would never apply photogrammetry to its topographical surveys, because he could not trust it. Well, times have changed.

The plans for the Cape Cod National Seashore park were based on field-edited aerial orthophotos. As I recall, besides the external perimeter, we had to identify interior property boundaries of certain residential parcels which were temporarily exempt from the taking.

I remember a particular lesson we learned on that project: Never trust just one historic monument without inde-

pendent verification. An ancient stone bound, referenced in many deeds and located in the woods of Cape Cod, in the middle of nowhere, had existed for probably a hundred years. It had been used by local surveyors over and over to tie every subdivision in its vicinity. But to us it looked suspect. While assembling subdivision plans and assessor's maps over the orthophoto aerial maps, and through field checks, we found that a second similar ancient stone bound existed about 500 ft. away. It was the "right one." Although over the years, the "wrong" bound had triggered a long chain of recorded subdivisions, nobody ever complained. Without aerial photogrammetry, we would have never discovered the problem.

CHAPTER 91

In the 1960s, when we were working on plans for the Cape Cod National Seashore park, we did not concern ourselves with c.91 issues. Filled tidelands have, however, increased in value and importance since. Even with our best effort in researching old records and historic maps, our work may be challenged by public interest as well as private abutters. Two cases with opposite results may give you an idea of what to expect when you accept an assignment to prepare a MGL c.91 License Plan.

When Walmart wanted to build a store on filled tideland at Lynn Harbor in 1994, I assembled all the old plans and charts I could find to locate the original historic MHW line from which to calculate the 100-rod line. The DEP challenged my plan and forced the owner to dig fifteen test trenches across the property to take core samples of the soil. Boston University's laboratory found upland vegetation (*Spartina patens*) on one side of our graphic historic MHW line and tideland vegetation (*Spartina alterniflora*) on the other. Subsequently, DEP approved our c.91 License plan.¹³

In the Island End River case at Boston Harbor, the DEP disclaimed jurisdiction over the planned construction of non-water-related facilities on ancient filled tidelands. The abutter, a yacht club, objected, because the Department had based its decision on a topographical plan of 1908.

The DEP regulation (310 CMR 9.02) defines the Historic High Water Mark (HHWM) as "the high water mark which existed prior to human alteration of the shoreline by filling, dredging ... or other means." When we researched data preceding 1908, the case went before an Administrative Law Judge. I even consulted soils maps of the U.S. Soils Conservation Service.

The filled tideland is an oyster shell fill of about seven feet underlain by a pre-existing tidal mud flat. Prior to 1908, the land had been severely disturbed twice. After a major storm in 1786, a six-foot dike 1,500 ft. long was built to protect the City of Chelsea. Also prior to 1908, a gas pipe line was built across the marsh.¹³ Nevertheless, after



Obelisk in Grand Forks commemorating the 1997 flood. The flood's high water mark is indicated by the line around the smooth section just below the point of the obelisk. Previous historic flood levels are also represented. [http://www.answers.com.]

almost three years, and ignoring the "human alterations," the Judge decided that the 1908 survey was the oldest record applicable to this case. Fortunately, for my client, the abutter, the developer threw in the towel. The facility was not built; not yet, anyway.

REGULATORY ISSUES

As much as we try to follow regulations, they are not cast in stone. In February 2007, the Massachusetts Supreme

Judicial Court (SJC) threw out DEP regulation Title 310, Code of Massachusetts Regulations 9.04 and/or 9.02 of 1994 pertaining to land-locked filled tidelands. The Court decided that the "department had exceeded its authority by promulgating a regulation that relinquishes its obligations under G.L. c.91," issuing an admonition that "a proper public purpose should not be confused with preserving the public's rights in tidelands" (such as fishing, fowling and navigation). According to the ruling, the public rights in tidelands (filled or land locked) cannot be relinquished by DEP regulations. "This authority belongs to the Legislature alone." Currently, the Massachusetts Legislature is considering a bill to end this administrative dilemma. We will learn soon how many waterfront development projects of the last 13 years may be in jeopardy.

KNOWLEDGE AT YOUR FINGERTIPS

Coastline issues have always required the diligent attention by registered professional land surveyors. As the years go by, more and more records accumulate and soon become "historic". Don't think for a moment, that our computer technology has made the recovery and retrieval of ancient tideland plans any easier. It hasn't! Surveyors still have much digging to do at various public agencies—research, we call it. And field work! Think of New Orleans before you accept old tidal observations without updated verification. Inform yourself about international interests and how your work in coastal zones impacts them. Use new determinations of MHW, MLW, ELW, and the national Law Water so you can tell your clients, without a shred of doubt, where they are on the coast or on the sea. If all goes well, we'll talk again after 2012. By the way, Dr. Thomas strongly recommends the following disaster preparedness strategy—take a course in surveying and buy the best sextant you can find, just in case!

Footnotes

¹ U.S. Supreme Court in *Borax vs. City of Los Angeles* (296 U.S. 10, 1935).

² *The Adam and Eve Story—The History of Cataclysms* by Chan Thomas, Bengal Tiger Press, South Chatham, MA, 1993.

³ Apart from Thomas, other authorities have predicted the imminence of a cataclysmic event to change life on Earth. Among them, the History Channel pointed in its recent program "Decoding the Past: Doomsday 2012," to the Mayan calendar (decoded in the 1800s and known as the Dresden Codex), as well as the Bible, the Chinese 5000-year-old oracle called "I ching," and medieval England's wizards, Merlin and Mother Shipton. In America, Indian chief Black Elk of the Dakotas and the Hopis have made similar predictions [of a life-changing event] when they spoke of the "coming of the 5th World." Ominously, they all seem to zero in on the year 2012! Coincidentally, the Kyoto Protocol expires in 2012, too.

⁴ "Mysteries of the Millenium," TLC, Oct. 11 1997. "Nova: "Magnetic Storm," PBS, Oct. 24, 2006. "Modern Marvels—Quarries," History Channel, Dec. 31, 2006. "Decoding the Past—Doomsday 2012, The End of Days," History Channel, March 1, 2007. "Decoding the Past—Mayan Doomsday Prophecy," History Chanel, April 9, 2007. "The Universe—the Sun," History Chanell, June 5, 2007.

⁵ "Exploring Space Weather," National Geographic Maps, Evergreen, Colorado, July 2004.

⁶ "Coastal Hazards," *ACSM Bulletin* No. 226, pp. 35-42 (April 2007). ACSM, Gaithersburg, MD, USA.

⁷ "Potential effects of Sea level rise in Boston Inner Harbor," Nucci Vine Associates, Inc., Newburyport, MA, 1991.

⁸ Under much discussion are the effects of "global warming" on sea level. Contrary to Al Gore's "Inconvenient Truth," however, there is no scientific consensus on global warming. Although the movie has earned the former VP a share of a 2007 Nobel Prize, just days before, the British high court had ruled against the distribution of Gore's film on global warming to 3500 schools in the UK, because it violated school laws on political indoctrination. In Germany, a 2003 poll of 530 climate scientists from 27 countries found that two-thirds of poll respondents did not believe "a reasonable assessment of the effect of greenhouse gases" could be reached because the science is still in its infancy. Note, however, that the ancient Greek philosophers Plato (ca 400 BC) and Aristotle (ca 350 BC) had talked about the cycles of global warming in their dialogues "Timaeus" and "Meteorologia," S. Fred Singer, an environmentalist lecturing at the University of Virginia, and founding director of the U.S. National Weather Satellite Service, published a book recently entitled *Unstoppable Global Warming: Every 1,500 years*. He found that "climate will continue to change, regardless of human action and that the geological record shows "a persistent 1,500-year cycle of warming and cooling extending back at least one million years." Singer discusses climate change in his latest book on *Global Warming: Man-made or Natural?* (Imprimis, Hillsdale College, MI, August 2007).

⁹ "NOAA Tides & Currents Program," by Michael Szabados. *ACSM Bulletin* No. 225, pp. 26-27 (February 2007). ACSM, Gaithersburg, MD.

¹⁰ See also the NGS diagram "Importance of Shoreline."

¹¹ The United Nations Convention on the Law of the Sea Treaty, 1982, Part II, sec. 2, Articles 3,5,7,10,15,16.

¹³ "Historic MHW or Shoreline? The ongoing littoral dilemma," by Gunther Greulich. *Surveying and Land Information Science* 66(1): 27-44. 2006.