

## REFERENCES & NOTES

1. *National Geographic*, April 19, 2012, “Gulf Spill Pictures: Ten New Studies Show Impact on Coast,” Barbara Mulligan, <http://news.nationalgeographic.com/news/energy/2012/04/pictures/120420-gulf-oil-spill-impact-studies/>; Paul W. Sammarco et al., “Distribution and Concentrations of Petroleum Hydrocarbons Associated With the BP/ Deepwater Horizon Oil Spill, Gulf of Mexico,” *Marine Pollution Bulletin*, 73, no.1 pp. 129-143 (2013), <http://www.sciencedirect.com/science/article/pii/S0025326X13002762>; see also Reference Note 9, “Ample Studies”.
2. Siddhartha Mitra et al., “Macondo-1 Well Oil-Derived Polycyclic Aromatic Hydrocarbons in Mesozooplankton from the Northern Gulf of Mexico,” *Geophysical Research Letters* 39, L01605 (2012), doi:10.1029/2011GL049505; “Analysis of Potential Health and Environmental Impacts of Chemicals in Dispersant Products” (August 2011), Toxipedia Consulting Services; Earth Justice, [http://earthjustice.org/sites/default/files/Oil\\_Dispersants\\_Report.pdf](http://earthjustice.org/sites/default/files/Oil_Dispersants_Report.pdf).
3. *Woods Hole Oceanographic Institution Study*, <http://www.whoi.edu/news/89188/>, appearing in the American Chemical Society (ACS) online journal *Environmental Science & Technology* (January 26, 2011), is the first peer-reviewed research to be published on the dispersant applied to the Gulf spill and the first data in general on deep application of a dispersant; see also 2014 Woods Hole and Haverford Collage Study “Long-Term Persistence of Dispersants following the Deepwater Horizon Oil Spill,” *Environmental Science & Technology Letters* (2014), 1 (7), pp 295–299, doi: 10.1021/ez500168r, <http://pubs.acs.org/doi/abs/10.1021/ez500168r>
4. Using a new, highly sensitive chromatographic technique that she and WHOI colleague Melissa C. Kido Soule developed, chemist Elizabeth B. Kujawinski reports that those concentrations of DOSS in the plume of oil from the Deepwater Horizon spill indicate that little or no biodegradation of the dispersant substance had occurred. The deep-water levels suggested any decrease in the compound could be attributed to normal, predictable dilution and not as a result of the biodegradation of the dispersant substance. They found additional evidence that the substance did not mix with the 1.4 million gallons of dispersant applied at the ocean surface and appeared to have become trapped in deep-water plumes of oil and natural gas reported previously by other WHOI scientists and members of this research team. The team also found a striking relationship between DOSS levels and levels of methane, which further supports their assertion that DOSS became trapped in the subsurface.
5. Mary L. Landrieu, United States Senate, letter to Admiral Robert J. Papp, Jr., USCG (August 10, 2012), [http://www.landrieu.senate.gov/files/documents/2012\\_08\\_14\\_coastguard.pdf](http://www.landrieu.senate.gov/files/documents/2012_08_14_coastguard.pdf).
6. UPI wire story, “Hurricane Churned Up Deepwater Horizon Oil,” (2012), [http://www.upi.com/Top\\_News/US/2012/10/18/Hurricane-churned-up-Deepwater-Horizon-oil/UPI-92561350559653/?spt=hs&or=tn](http://www.upi.com/Top_News/US/2012/10/18/Hurricane-churned-up-Deepwater-Horizon-oil/UPI-92561350559653/?spt=hs&or=tn)
7. Operational Science Advisory Team, *Summary Report for Fate and Effects of Remnant Oil Remaining in the Beach Environment*, <http://gulfsourcedata.bp.com/external/content/document/6145/1962614/1/OSAT-2%20Report%20with%20Annexes%20-%20February%2010,%202011.pdf> (2011). Note that dispersants are only effective when applied to fresh oil; yet reports indicate Hurricane Isaac cleanup included the use of dispersants. See also, Michael M. Singer et al., “Comparison of Acute Aquatic Effects of the Oil Dispersant Corexit 9500 with Those of Other Corexit Series Dispersants,” *Ecotoxicology and Environmental Safety* (1996), 35 no.98. This article provides scientific evidence that shows that the toxicity level of the newest Corexit dispersant (9500) is very similar to all of the other Corexit series dispersants.
8. Ryan Dezember, “Ixtoc Spill Still Contaminates Coastlines; Is That Northern Gulf’s Fate?” (2010), [http://blog.al.com/live/2010/09/ixtoc\\_spill\\_still\\_contaminates.html](http://blog.al.com/live/2010/09/ixtoc_spill_still_contaminates.html); Information on dispersants, Corexit toxicity levels: see Reference Note 7 above; M. Fingas, A Review of Literature Related to Oil Spill Dispersants 1997–2008, [http://www.pwsrca.org/wpcontent/uploads/filebase/programs/environmental\\_monitoring/dispersants/review\\_of\\_alaska\\_related\\_osd\\_literature\\_2002-2008.pdf](http://www.pwsrca.org/wpcontent/uploads/filebase/programs/environmental_monitoring/dispersants/review_of_alaska_related_osd_literature_2002-2008.pdf); Charles R. Fisher et al., “Footprint of Deepwater Horizon Blowout Impact to Deep-Water Coral Communities,” *Proceedings of the National Academy of Sciences of the United States of America* 2014, <http://www.pnas.org/content/111/32/11744.full>; see also Prince William Sound Regional Citizens’ Advisory Council studies on chemical dispersants, <http://www.pwsrca.org/?s=chemical+dispersants&x=0&y=0>
9. Ample studies: [http://www.eoearth.org/article/Journal\\_articles\\_related\\_to\\_the\\_Deepwater\\_Horizon\\_oil\\_spill](http://www.eoearth.org/article/Journal_articles_related_to_the_Deepwater_Horizon_oil_spill) and [http://www.lib.noaa.gov/researchtools/subjectguides/dwh\\_bibliography.pdf](http://www.lib.noaa.gov/researchtools/subjectguides/dwh_bibliography.pdf); Mote Marine Laboratory Study-Dispersant and Oil from Deepwater Horizon Toxic to Baby Corals, Jan 2013 <http://dx.plos.org/10.1371/journal.pone.0045574>
10. Since doubt was cast by PEER on the accuracy of oil spill volume during the DWH disaster, “NOAA Declines to Probe Vast Underestimate of BP Spill,” (2013), <http://www.peer.org/news/news-releases/2013/01/03/noaa-declines-to-probe-vast-underestimate-of-bp-spill/>, and the conservative assessment made by NOAA that an estimated 25% of the oil is unaccounted for, more should be done to locate and remove at least 1 million barrels of oil still residing in the Gulf. Historically, mechanical cleanup has been able to remove 2%–8%, while dispersants do not remove any, and unknown quantities evaporate. See also *National Geographic* interview with Dr. Jane Lubchenco, former Director of NOAA, <http://channel.nationalgeographic.com/channel/explorer/videos/noaa-on-the-oil-spill/embed/>; interview with Lisa Jackson, <http://channel.nationalgeographic.com/channel/explorer/videos/the-epa-on-the-oil-spill/embed/>.
11. Catherine Kilduff and Jaclyn Lopez, “Dispersants: The Lesser of Two Evils or a Cure Worse Than the Disease?” *Ocean and Coastal Law Journal*, 16, no. 2, [http://mainelaw.maine.edu/academics/oelj/pdf/vol16\\_2/vol16\\_oelj\\_375.pdf](http://mainelaw.maine.edu/academics/oelj/pdf/vol16_2/vol16_oelj_375.pdf).

- 11-1. Maude Barlow. “The Global Water Crisis and the Commodification of the World’s Water Supply,” 2001, <http://www.ratical.org/coglobalize/BlueGold.pdf>
12. USCG Guidance, Preapproval in US Regions, <https://homeport.uscg.mil/mycg/portal/ep/contentView.do?contentType=2&channelId=-30095&contentId=125795&programId=114824&programPage=%2Fep%2Fprogram%2Feditorial.jsp&pageType=1348>.
13. 33 U.S.C. § 1321(j)(4). The EPA and the Coast Guard, as co-chairs of the Region 6 RRT, approved the Regional Response Team Oil Spill Dispersant Use Policy in 1995; see also Dispersant Background White Paper, <https://www.thestateofthegulf.com/media/72686/Dispersant-Background-White-Paper.pdf>. Zygmunt J.B. Plater, Professor of Law, Boston college Law School. Learning from Disasters: Twenty One Years After the Exxon Valdez Oil Spill, Will Reactions to the Deepwater Horizon blowout Finally Address the Systemic Flaws Revealed in Alaska? Research Paper December 15, 2010, <http://ssrn.com/abstract=1726053>; Section II, Response System Failures.
14. 33 U.S.C. §§ 1251 et seq. (1972), <http://water.epa.gov/lawsregs/rulesregs/101a.cfm>.
15. *Toxipedia*, Toxicity of Dispersant Chemicals, Summary of 57 chemical ingredients (January 25, 2012), <http://toxipedia.org/display/toxipedia/Potential+Effects+of+Oil+Dispersant+Chemicals+on+Human+Health+and+the+Aquatic+Environment>; USCG Dispersants, On-Water Oil Removal Capacity: Dispersant Preapproval Listings <https://homeport.uscg.mil/mycg/portal/ep/contentView.do?contentType=2&channelId=-30095&contentId=125795&programId=114824&programPage=%2Fep%2Fprogram%2Feditorial.jsp&pageType=13489>; See also, Section 307 of CWA
16. Dispersants’ constituents and their ingredients are subject to regulation under the Toxic Substances Control Act; see report from Earthjustice and Toxipedia Consulting Services, “The Chaos of Clean Up”, <http://earthjustice.org/features/the-chaos-of-clean-up>.
17. Earth Justice study with citations, Patti Goldman, Marianne Engelman Lado, and Matthew Gerhart, “The Approval and Use of Dispersants in Oil Spill Responses: Proposals for Reform,” (2010), <http://earthjustice.org/library/The%20Approval%20and%20Use%20of%20Dispersants%20in%20Oil%20Spill%20Responses%3A%20Proposals%20for%20Reform>.
18. US EPA Dispersant Toxicity Testing (June 2010), <http://www.epa.gov/bpspill/reports/ComparativeToxTest.Final.6.30.10.pdf>.
19. BP response to EPA re locating a less toxic dispersant; see chart page 10, <http://www.epa.gov/bpspill/dispersants/5-21bp-response.pdf>.
20. Right to Know Hazardous Substance Fact Sheet: 2-Butoxy Ethanol, NJ Department of Health & Senior Services (August 2008), <http://nj.gov/health/eoh/rtkweb/documents/fs/0275.pdf>; Agency for Toxic Substances and Disease Registry ToxFAQs (August 1999), 2-BUTOXYETHANOL and 2-BUTOXYETHANOL ACETATE, CAS # 112-07-2 and 111-76-2, <http://www.atsdr.cdc.gov/toxfaqs/tfacts118.pdf>. [It has been stated by the manufacturer of Corexit 9500 that it does not contain 2-Butoxyethanol. Minimally, since the 1999 EPA NCP Notebook record showed that Corexit 9500 contained 2BE, failure to update the NCP listing with this information made this product questionable for use. If Corexit 9500 does not contain 2BTE, then it does contain chemicals equally toxic (e.g., propylene glycol and DOSS at minimum); because when the MSDS’s of 9500 and 9527 are compared, they are identical, i.e., causing kidney failure and mortality, etc.]
21. Oil Pollution Act of 1990, <http://www.epa.gov/oem/lawsregs.htm#ncp>.
22. Each EPA regulation is referenced by its location in the Code of Federal Regulations (CFR). For example, “40 CFR 300” means that the regulation is in Title 40, Part 300, of the CFR.
23. Roberto Rico-Martínez, Terry W. Snell, and Tonya L. Shearer, “Synergistic Toxicity of Macondo Crude Oil and Dispersant Corexit 9500A® to the *Brachionus plicatilis* Species Complex (Rotifera),” *Environmental Pollution* 173 (February 2013): 5–10. This recently published study indicates toxicity levels of Macondo oil plus Corexit 9500A were 52 times more toxic than the oil itself. Woods Hole Oceanographic Institution, *Dispersant from Deepwater Horizon Spill Found to Persist in Environment* (July 2014) <http://www.whoi.edu/news-release/dwh-dispersant>; see note 25 “Synergistic Toxicity of Macondo Crude Oil and Dispersant Corexit 9500A® to the *Brachionus plicatilis* Species Complex (Rotifera)”
24. Interagency Coordinating Committee on Oil Pollution 2010- 2011 Research Report, [http://www.iccopr.uscg.gov/iccopr/i/files/Biennial%20rpt\\_FY2010%20and%202011\\_4Jun2012.pdf](http://www.iccopr.uscg.gov/iccopr/i/files/Biennial%20rpt_FY2010%20and%202011_4Jun2012.pdf)
25. Oil Spill Commission Action report, *Assessing Progress—Implementing the Recommendations of the National Oil Spill Commission* (April 17, 2012), <http://oscaction.org/wp-content/uploads/OSCA-Assessment-report.pdf>.
26. EPA Inspector General recommendations (August 25, 2011), <http://www.epa.gov/oig/reports/2011/20110825-11-P-0534.pdf>.
27. The National Oil and Hazardous Substances Pollution Contingency Plan, more commonly called the National Contingency Plan or NCP, is the federal government’s blueprint for responding to both oil spills and hazardous-substance releases. Full text at <http://www.epa.gov/oem/lawsregs.htm#ncp>.
28. Preamble to the Proposed RRT VI Bioremediation Position Paper, RRT VI Science & Technology Committee (January 2001), [http://gisweb.glo.texas.gov/atlas/atlas/misc\\_doc/rrt6\\_bio\\_position.pdf](http://gisweb.glo.texas.gov/atlas/atlas/misc_doc/rrt6_bio_position.pdf).

29. Of the recent toxicity studies of dispersed oil, most researchers found that chemically dispersed oil was more toxic than physically dispersed oil, and biodegradation is not supported by the use of chemical dispersants. M. Fingas, *A Review of Literature Related to Oil Spill Dispersants 1997–2008*, <http://www.pws-osri.org/programs/projects/annual-reports/2008/08-10-08-a.pdf>
30. J. W. Tunnell, Jr., Texas A&M University, *An expert opinion of when the Gulf of Mexico will return to pre-spill harvest status following the BP Deepwater Horizon MC 252 oil spill* (January 31, 2011), [http://media.nola.com/2010\\_gulf\\_oil\\_spill/other/Tunnell-GCCF-Final-Report.pdf](http://media.nola.com/2010_gulf_oil_spill/other/Tunnell-GCCF-Final-Report.pdf).
31. Bob Marshall, *Hurricane Isaac Showed That BP Oil-Spill Woes Remain* (September 23, 2012), see interview with Robert Barham, Secretary of the Louisiana Department of Wildlife and Fisheries, [http://www.nola.com/sports/index.ssf/2012/09/hurricane\\_isaac\\_showed\\_that\\_bp.html](http://www.nola.com/sports/index.ssf/2012/09/hurricane_isaac_showed_that_bp.html).
32. Crisis in the Gulf Documentary, <http://earthorganization.com/News.aspx?tid=108>.
33. Jong Nam Kim et al., “Effects of Crude Oil, Dispersant, and Oil-Dispersant Mixtures on Human Fecal Microbiota in an *In Vitro* Culture System,” *mBio* (2012), 3(5):e00376-12, doi:10.1128/mBio.00376-12, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3482501/>. “Dispersed oil affected the intestinal microbiota more than either oil or dispersant alone. This may be due to the increased solubility of dispersed oil, which could provide more surface area of hydrophobic and toxic compounds for microbial contact than oil alone. Therefore, dispersed oil may be more bioavailable to the microbiota than oil alone. Previous studies reported that chemical dispersants may increase the concentration of PAHs in the water column. The toxicity of dispersed oil showed that chemically dispersed oil increased the toxicity and concentrations of TPHs and PAHs in fish more than mechanically dispersed oil, dispersant alone, water-soluble oil fractions, or seawater alone.”
34. Sample Toxicity Comparison LC 50 Values on chart can be found at EPA/BP Tests, <http://www.epa.gov/bpspill/reports/ComparativeToxTest.Final.6.30.10.pdf>; Environment Canada Reports, <http://www.etc-cte.ec.gc.ca/databases/SpillTox/Default.aspx>.
35. *OSEI Corporation Summary of the US EPA Regional Response Team VII Testing of OSE II on Heavy Waste Oil*, February 1 to March 8, 2012, <http://www.osei.us/pdf%20files/RRT%20plus%20testsing.pdf>. Oil Spill Cleanup Demonstration on Arabian Gulf, <http://osei.us/archives/1135>. See also the US Department of Interior study showing that Oil Spill Eater II is far more successful at remediating oil when compared to Corexit 9500 and Corexit 9527, “Characteristics, Behavior, & Response Effectiveness of Spilled Dielectric Insulating Oil in the Marine Environment,” (Jne 2011), [http://www.bsee.gov/uploadedFiles/BSEE/Research\\_and\\_Training/Technology\\_Assessment\\_and\\_Research/aa%283%29.pdf](http://www.bsee.gov/uploadedFiles/BSEE/Research_and_Training/Technology_Assessment_and_Research/aa%283%29.pdf).
36. Complaint for Declaratory and Injunctive Release Case 1:12l-cv-01299, Document 1, filed 08/06/12, <http://www.shb.com/newsletters/EUC/Etc/ACATvEPA.pdf>.
37. 40 CFR, Part 300, Appendix C, 2.5, numbers 5, 6, and 7, describes the 20-minute time test on the shaker table, then 10 minutes of settling, for a total of 30 minutes, to allow the oil to sink. This section of 40 CFR is where the EPA derived its statement regarding the test of dispersant “effectiveness.”
38. *The Nation*, May 7, 2012, <http://www.thenation.com/article/167461/investigation-two-years-after-bp-spill-hidden-health-crisis-festers>; J. H. Diaz, “The legacy of the Gulf oil spill: Analyzing acute public health effects and predicting chronic ones in Louisiana,” *American Journal of Disaster Medicine* 6, no. 1 (January/February 2011): 5–22, doi:10.5055/ajdm.2011.0040.
39. Minnesota Department of Natural Resources report, MPR News (May 16, 2012): *BP Oil Spill Residue Found on Pelicans in Minn*, <http://www.mprnews.org/story/2012/05/16/environment/oil-residue-found-on-pelicans>.
40. Magdalena Pacwa-Plociniczak et al., “Environmental Applications of Biosurfactants: Recent Advances,” *International Journal of Molecular Sciences* 12, pp. 633–654 (2014), doi:10.3390/ijms12010633; see also Rita de Cássia F. S. Silva et al., “Applications of Biosurfactants in the Petroleum Industry and the Remediation of Oil Spills,” *International Journal of Molecular Sciences* 15, doi:10.3390/ijms150712523.
41. An LAEO Science and Technology Committee Review: Water/Soil Pollution Cleanup Technology Oil Spill Eater II – *Enzyme Type Bioremediation – For the Removal of Oil and Chemical Spills*: <http://protectmarinelifenow.org/?ddownload=10992> ; Referenced in LAEO Review Paper: Bio Aquatic Lab NCP Complete Testing: <http://protectmarinelifenow.org/?ddownload=10984> ; Referenced in LAEO Review Paper: OSE II Efficacy Documentation: <http://protectmarinelifenow.org/?ddownload=10983>; King Fahd University of Petroleum & Minerals, Research Institute, Dharan, Saudi Arabia; A Report on the Evaluation of Oil Spill Eater II.

## GLOSSARY

**biocatalyst.** A substance, such as an enzyme, that starts or increases a chemical reaction in a living body.

**biocide.** Any toxic chemical that has the potential of destroying life forms by poisoning.

**biodegradable.** Capable of being decomposed into nontoxic components by bacteria or other living organisms.

**biodegradation.** The process that microbial organisms use, through metabolic or enzymatic action, to break down toxins into their nontoxic components.

**bioremediation.** Utilization of the metabolic and enzymatic processes of microorganisms to remove pollutants from the environment.

**biosurfactants.** Substances produced by microorganisms that lower the surface tension of water and increase the ability of organic compounds, like crude oil, to more easily dissolve in water, thereby making them more available for microbial degradation. (See also *surfactant*.)

**carcinogen.** A substance that is capable of causing cancer in humans or animals.

**Clean Water Act (CWA).** The Clean Water Act establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. The basis of the CWA was enacted in 1948 and was called the Federal Water Pollution Control Act, but the Act was significantly reorganized and expanded in 1972. "Clean Water Act" became the Act's common name with amendments in 1972. Source: <http://www.epa.gov/lawsregs/laws/cwa.html>.

**Corexit.** A line of solvent products licensed by Exxon to Nalco Holding Company for production and distribution. They are primarily used as dispersants for breaking up oil slicks and sinking the oil out of sight below the surface waters. Corexit was used as the primary dispersant in the British Petroleum Deepwater Horizon oil blowout in the Gulf of Mexico. It causes the oil to break up into small globules that remain suspended in the water, eventually sinking to the seabed and then ultimately washing up on beaches as currents and storms churn the oil up off the seabed and from the water column. See "NALCO Corexit and Crude Oil: A Laboratory Experiment," <http://www.bust-video.info/v/yt:BdAtvB9OtRs/1>.

**Deepwater Horizon.** An offshore oil drilling rig owned by the Transocean corporation and leased to British Petroleum. On April 20, 2010, during drilling in a geographical area of the Gulf of Mexico called the Macondo Prospect, a blowout killed 11 crewmen. Two days later, after a second explosion, the rig sank, leaving at least one well and a crater in the seabed floor gushing oil uncontrollably, causing the largest offshore oil spill disaster in US history.

**detergent.** A surfactant or a mixture of surfactants that facilitate the mixing of compounds like oil and grease with water, normally used for cleaning purposes.

**dispersant.** A liquid or gas added to a mixture such as oil in order to promote dispersion of the oil or to maintain suspension of the dispersed oil particles.

**DOSS** (*dioctyl sodium sulfosuccinate*). A toxic surfactant that is a component of Corexit. Common side effects of exposure to DOSS include a breakdown of the cellular walls of red blood cells and subsequent rectal bleeding, stomach pain, diarrhea, serious allergic reactions, and cramping.

**ecosystem**. Short for ecological system. The symbiotic relationships between all living organisms in a particular geographical area and the nonliving components of their environment, such as air, water, and soil. These organisms and components operate together through nutrient cycles and energy flows.

**emulsification**. The resulting blended mixture of two or more liquids that are normally not able to be mixed or blended, such as oil and water. In an emulsion, the particles of one liquid are dispersed in the other, rather than dissolved.

**Environmental Protection Agency (EPA)**. A US federal government agency whose mission statement is to protect the health of the public and the environment by writing and enforcing regulations based on laws passed by Congress. Led by a senior administrator appointed by the US president and approved by Congress, the EPA, although not a cabinet department, is directly under the president and is responsible for fulfilling the president's constitutional mandate to protect and defend the natural resources of the US.

**enzymes**. Biological molecules that increase the rate of chemical reactions. They are responsible for the thousands of chemical interconversions that sustain life.

**federal On-Scene Coordinator (OSC)**. See On-Scene Coordinators.

**finishing-up product**. A term used to describe an oil spill cleanup product that cannot successfully address fresh oil because of the oil's high level of toxicity.

**fishery**. An ecosystem in a particular geographic area of water or seabed, which includes the people involved, method of fishing, class of fishing boats, one or more species or type of fish, including shellfish, and the purpose of the activities—i.e., recreational or commercial.

**genetic**. Pertaining to the heredity of traits.

**hydrocarbons**. Organic compounds made up solely of hydrogen and carbon. There are many types of hydrocarbons, and the majority found on earth naturally occur in crude oil. Some forms of hydrocarbons are carcinogenic and/or otherwise toxic and harmful to most forms of life.

**indigenous**. A description of a living organism (plant or animal) that is native to a specific geographical region.

**in situ burning**. An oil spill response method of controlled burning of oil at the spill location. The particulates released into the atmosphere by in situ burning are a concern to many people. This spreads toxic oil compounds into the atmosphere, which eventually arrive somewhere else. See NOAA website for more information <http://response.restorationnoaa.gov/oil-and-chemical-spills/oil-spills/resources/in-situ-burning.html>.

**insoluble**. Incapable of being dissolved in water or another liquid.

**Ixtoc I**. An exploratory oil well being drilled by the semisubmersible drilling rig Sedco 135-F

in the Bay of Campeche of the Gulf of Mexico, about 100 km (62 mi) northwest of Ciudad del Carmen, Campeche, in waters 50 m (160 ft) deep. On June 3, 1979, the well suffered a blowout resulting in one of the largest oil spills in history.

**Lawrence Anthony Earth Organization (LAEO).** An environmental and conservation nonprofit founded in 2003 by South African conservationist, author, and humanitarian Lawrence Anthony. As of this writing, the organization has 23 chapters in 21 countries. Since the beginning of the BP-DWH blowout and oil spill, the US chapter has focused on finding and getting implemented workable solutions that will result in returning the Gulf of Mexico's contaminated waters to their pre-blowout condition, as a part of the organization's larger campaign to return polluted waters of the world to their pristine condition. The LAEO's mission is to work with governments, industry, and the broad public to stably reverse decaying environmental and conservation situations through education and hands-on projects. Among their many accomplishments, they have created two large game reserves in South Africa, reopening migration corridors for the wildlife and aiding local tribes in transferring from poaching to eco-tourism as an economic base. Three books have been written about Lawrence Anthony's achievements—*Babylon's Ark*, *The Elephant Whisperer*, and *The Last Rhinos*—and a Hollywood feature film is being produced about his life. LAEO coined a new term, *Cooperative Ecology*, to clearly define the philosophical basis upon which the organization operates. Commonly shortened to "Co-Eco," the term is defined fully on page 28 of this document.

**lyse.** To cause dissolution or destruction of cells by lysins.

**lysins.** Antibodies or other agents that cause red blood cells or bacterial cells to break down.

**Macondo.** The Macondo Prospect (Mississippi Canyon Block 252, abbreviated MC252) is a geographic area in the Gulf of Mexico off the coast of Louisiana containing a massive geological trap for oil and gas. It was the site of the British Petroleum Deepwater Horizon oil blowout disaster of April 20, 2010.

**mechanical cleanup.** Generally, in oil spill cleanup, this is the use of booms to try to contain oil or keep it away from sensitive areas, and skimmers designed to skim as much of the oil off the surface as possible. *In situ* burning of the oil is also a common method, but this is potentially hazardous to human health.

**metabolism.** The chemical processes occurring in living organisms that result in growth of the organism, production of energy, elimination of waste, and other basic organic functions.  
 —v. *metabolize*.

**microbe, microorganism.** Any living organism too small to be seen without the use of a microscope.

**microbiological.** Having to do with the structure, function, uses, and modes of existence of microscopic organisms.

**miscible.** Applies to liquids: capable of mixing together completely to form a solution.

**mutagenic.** Capable of causing or increasing the rate of unnatural mutations in living organisms.

**mutation.** An unnatural change within the structure of a living organism caused by exposure to a mutagenic toxin.

**National Contingency Plan (NCP).** The National Oil and Hazardous Substances Pollution Contingency Plan, more commonly called the National Contingency Plan or NCP, is a government document delineating required response protocols and methods in circumstances where oil and hazardous substances have been released into the environment.

**NCP Product Schedule.** Subpart J of the National Contingency Plan is a Product Schedule that contains dispersants and other chemical or biological products that have gone through the EPA's testing requirements to be considered for use in carrying out the NCP when oil or other hazardous substances have been spilled. Being on the NCP list does not give automatic approval status for the various products that are listed on the Product Schedule. Each time an oil or hazardous substance spill occurs on US navigable waters, approval for which product(s) can be utilized on that specific spill must be obtained by Regional Response Teams and Area Committees, or by the federal OSC, in consultation with EPA representatives. It is interesting to note that, in the past 23 years, the only product that has ever been approved for use when an actual oil spill on US navigable waters has occurred is Exxon's product line called Corexit, despite the existence of other products on the NCP list that are less expensive, more effective, and have fewer damaging side effects.

**nutrients.** As used in this paper, these include nitrogen and/or phosphorous which form the building blocks needed to grow microorganisms.

**On-Scene Coordinators (OSCs).** Federal officials predesignated by the US EPA and Coast Guard to coordinate response resources in disaster situations. Under the National Contingency Plan, if federal involvement is necessary because state and local resources have been exceeded, the OSC is obligated to coordinate the use of these resources to protect public health and the environment.

**PAH.** Polycyclic aromatic hydrocarbon, a molecule made up of hydrogen and carbon, with multiple carbon rings. PAHs are persistent, bioaccumulative, and toxic pollutants (PBT), which include carcinogenic substances and environmental toxins.

**Persistent organic pollutant.** (PBTs or POPs) are of greatest concern in the broad range of chemicals that are considered pollutants. PBTs are organic compounds that are resistant to degradation. As such they persist in the environment, bioaccumulate in human and animal tissue and food chains. (See Wikipedia for more information)

**plankton.** Tiny organisms occurring in a body of water, primarily comprising microscopic algae and protozoa.

**pollutants.** Toxins that contaminate water, soil, and air.

**Regional Response Team (RRT).** Regional planning and coordination of preparedness and response actions for disasters are accomplished through the RRT. There are 13 RRTs, one for each of ten federal regions, plus one for Alaska, one for the Caribbean, and one for the Pacific Basin. Each RRT maintains a Regional Contingency Plan (RCP) and has state, as well as federal government, representation. EPA and the Coast Guard co-chair the RRTs. Standing RRTs are planning, policy, and coordinating bodies and do not respond directly to disaster scenes. The

RRT provides assistance as requested by the On-Scene Coordinator during an incident. Source: <http://www.rrt.nrt.org/>.

***solubility.*** The relative ability of a substance to be dissolved in water or other liquid.

***solubilization.*** The action of dissolving in a liquid.

***solvent.*** A substance that has the capacity to dissolve another substance.

***surfactant.*** A substance that lowers the surface tension of water, making it easier for organic compounds to be dissolved in the water. Detergents are an example of surfactants, as they help remove organic compounds from a given material by making them dissolve more readily in the water in which the material is washed. Both toxic man-made surfactants and nontoxic natural surfactants exist.

***teratogenic.*** Capable of causing birth defects and negatively impacting the development of a fetus.

***toxin.*** Any substance that is poisonous to live organisms.

***trade-offs.*** A trade-off is a circumstance or situation that involves making a decision that has a downside that is considered offset by an upside. An *environmental trade-off* could be defined as assessing a benefit as being greater than a negative or destructive aspect of a method or action. An environmental compromise that is considered reasonable by decision makers in one point in time may be subject to debate when new data becomes available.

***volatile organic compounds (VOCs).*** Organic chemicals that have a high vapor pressure at ordinary room-temperature conditions. VOCs are numerous, varied, and present everywhere. They include both human-made and naturally occurring chemical compounds. Harmful VOCs are typically not acutely toxic, but instead have compounding long-term health effects.