

# Estimating How Much Oil The Gulf Spill Released

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Oil on water has many appearances. In this photo-image, acquired by the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Terra satellite on June 7, 2010, at least part of the oil slick is pale gray. A large area of oil is southeast of the Mississippi Delta, at the site of the leaking British Petroleum well. Traces of thick oil are also visible farther north. Credit: NASA Goddard MODIS Rapid Response / Holli Riebeek

Official government estimates now say that around 27,000 barrels of oil per day have been pouring out of the damaged well in the Gulf of Mexico since the leak began. This estimate comes from the report of the Flow Rate Technical Group, a team of scientists from various government agencies and academia assembled by Coast Guard Adm. Thad Allen to come up with definitive figures for the Gulf oil spill. BP says that approximately 15,000 barrels per day are being captured by a cap placed on the pipe.

These flow rates are higher than the earlier estimates of 5,000 barrels per day by BP and the National Oceanic and Atmospheric Administration, but also significantly lower than some unofficial estimates that placed the rate as high as 100,000 barrels per day.

"The difficulty here is we are using a technique that has been developed for laboratory experiments," said Alberto Aliseda, an assistant professor of mechanical engineering at the University of Washington in Seattle who is on the FRTG team. "This has never been done before and we have to do it in a very short time frame."

The FRTG pegs the amount of oil flowing out of the wreckage of the Deepwater Horizon oil well to within a margin of error of 6,000 barrels a day. However, some reports have indicated that BP's attempts to cap the leak last week may have actually caused an increase in the spill rate, so the estimates cover only the period prior to June 3. The group is currently preparing another estimate to cover the period since it was installed.

The team used the same techniques as other researchers to come up with the current estimate. But the FRTG had access to better data than these outside scientists, leading to the huge disparity in estimates.

Initially, scientists had only the original 30 second video clip that BP posted on May 12 to go on. The clip consisted of low-resolution video from only one angle and featured a dramatic change in the amount of methane gas spewing out with the oil-making the flow nearly white at first and completely dark at the end. All of these uncertain factors led to the huge variations in estimates. Scientists working for the FRTG had greater access to footage and high-resolution video as well, so they were better able to average the rate over long periods of time.

"If we had good quality images and knew what we are looking at and had

a sense of scale, seeing it from all sides, we could do a much better job to pinpoint this number," said Mirko Gamba of Stanford University in California who is not associated with the FRTG. Gamba's initial estimates put the flow between 30-90,000 barrels per day.

Outside scientists who analyzed the video clip said that they were always up front about the limitations of estimating the flow. "It's really only meant to give an order of magnitude," said Eugene Chiang at the University of California, Berkeley. He estimated that 25-100,000 barrels per day are pouring into the Gulf.

One of the group's methods and the one most commonly applied by outside experts, uses cameras to track how fast one fluid is spewing into another, in this case oil into seawater. Scientists combine the speed of the spurting oil with the size of the pipe to estimate the total volume of gushing oil.

This method, called Particle Image Velocimetry, or PIV, is commonly used in fluid dynamics labs to measure a liquid gushing out of a pipe.

"It's basically just feature tracking," said Steven Wereley, a member of the FRTG. "You can do this all with a pencil and paper, and maybe a physics degree." On May 17 he testified before Congress that the flow rate could be as much as 100,000 barrels per day, but has since lowered his estimates.

In a lab, PIV can usually accurately pinpoint a flow rate; however, the bottom of the [Gulf of Mexico](#) is far from a pristine laboratory environment. The biggest uncertainty confronting scientists has been the ratio of oil to methane in the leaking pipe. How much of this component of natural gas is in the mix is unclear, and the ratio can change dramatically over just a few seconds.

Because of these limitations, the group used other methods to complement PIV. For one technique, called mass balancing, a plane carrying NASA's Airborne Visible InfraRed Imaging Spectrometer instrument flew over the Gulf and measured how much oil had reached the surface. The AVIRIS mapped how much area the oil spill covers and the thickness of the oil. These results were then combined with estimates of how much oil had already evaporated or been dispersed, burned or skimmed away to come up with a figure of 12-19,000 barrels per day.

Scientists on the committee checked these numbers against a physical measure of oil shooting out of the end of the 21-inch broken pipe. The Riser Insertion Tube Tool, a plug connected to a 4-inch tube which then feeds up to a processing ship on the surface, has been collecting roughly 15,000 barrels of oil per day.

BP and NOAA did not return requests for comment on how they came up with the original estimate of 5,000 barrels per day. Media reports have said that the technique they relied on the most in the beginning used airplanes and satellites to map the spill area and then extrapolate the total amount spilled. This method could not account for [oil](#) that had not breached the surface.

The results from another team of scientists examining the flow rate at the Woods Hole Oceanographic Institute were also released yesterday. The team directly examined the two separate leaks using sound-based techniques and a remote-controlled underwater vehicle. The Woods Hole team's estimate is twice what was found by the Flow Rate Technical Group and places the daily rate at as much as 50,000 barrels, or 2 million gallons a day.

Though both teams were contracted by the government to create an estimate of the spill size, estimate coordinator and U.S. Geological Survey Director Marcia McNutt said in a press conference that the

FRTG estimates were likely the more credible.

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