Frequently asked questions regarding USGS Scientific Investigations Report 2012-5185 "Flux of Nitrogen, Phosphorus, and Suspended Sediment from the Susquehanna River Basin to the Chesapeake Bay during Tropical Storm Lee, September 2011, as an Indicator of the Effects of Reservoir Sedimentation on Water Quality" http://pubs.usgs.gov/sir/2012/5185/

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1. What is the new information contained in SIR 2012-5185?

This report shows that there is an important transition that is underway in terms of how the Susquehanna River delivers nutrients and sediments to the Bay. The Lower Susquehanna River reservoirs previously trapped a great deal of sediment, and with it they trapped large amounts of phosphorus and nitrogen that are attached to the sediment particles. The ability of these reservoirs to trap sediment now appears to be decreasing and the tendency for the sediments in these reservoirs to be scoured (and carried into the Bay) during high flow events appears to be increasing. It has been known for many years that this transition would take place, although the timing was uncertain. What is new is that we can now document, based on data from Tropical Storm Lee, that the change is well underway as the reservoirs approach their sediment storage capacity.

2. What does SIR 2012-5185 tell us about the loading of nitrogen, phosphorus and sediment from Tropical Storm Lee?

The report contains estimates of the amount of these materials that entered the Bay from the Susquehanna River during this event. The amounts of nitrogen, phosphorus and suspended sediment transported during this event were very large compared to long-term averages for the Susquehanna over the past 34 years. However, this difference is less pronounced for nitrogen than it is for phosphorus and sediment, because on-average a large part of the nitrogen flux is in the dissolved form. Specifically the amounts transported during this event were estimated to be: 42,000 tons of nitrogen, 10,600 tons of phosphorus, and 19,000,000 tons of sediment. For comparison, the estimates of the averages for the entire period from 1978-2011 were: 71,000 tons per year for nitrogen, 3,300 tons per year for phosphorus, and 2,500,000 tons per year for sediment.

3. What does SIR 2012-5185 tell us about how these loadings during Tropical Storm Lee from the Susquehanna River compare to the loadings from other rivers or other sources.

The report contains no information about the loadings from other rivers or other sources (such as point sources) during Tropical Storm Lee or the year 2011 in general. It only investigates the loadings from the Susquehanna River as measured at Conowingo Dam.

4. Does SIR 2012-5185 contain any information that compares the loadings to the Bay from the Susquehanna River to the loadings from other sources?

There is only one mention of this topic and it is in the introduction. It is a statement about a past period, 1991-2000. It states that during period 1991-2000, 41% of the nitrogen, 25% of the phosphorus, and 27% of the sediment load to the Bay came from the Susquehanna. This information is included in the report to provide context and does not derive from any analysis done within this study.

5. What fraction of the total Susquehanna River input for water year 2011 occurred during the flood from Tropical Storm Lee?

This information is provided in Table 2 of USGS Scientific Investigations Report 2012-5185. It indicates that of the total Susquehanna River loadings for 2011, 31% of the nitrogen loading, 61% of the phosphorus loading, and 78% of the sediment loading from the Susquehanna River are estimated to have moved during this event. It does not suggest any comparison with loadings from other rivers.

6. Where could one look to find estimates of the relative size of the loadings from the Susquehanna River as compared to other tributaries?

There are two publications from the USGS that make these kinds of comparisons, although none of them make the comparison for 2011.

The first report is USGS Scientific Investigations Report 2012-5093 by Langland, M.J., Blomquist, J.D., Moyer D.L., and Hyer, K.E., 2012, "Nutrient and suspended-sediment trends, loads, and yields and development of an indicator of streamwater quality at nontidal sites in the Chesapeake Bay watershed, 1985–2010." This report provides information on trends, loads, and yields in the Bay watershed, which is available on line at http://pubs.usgs.gov/sir/2012/5093/ .

Loading are largely dependent on the size of a watershed so the report provides yield (expressed in tons per square mile per year) to compare the amount of nutrients and sediment among rivers. The yields of nitrogen, phosphorus, and sediment for 1990-2010 for nine rivers tributary to Chesapeake Bay are shown in the table below. This information is from the river-input monitoring (RIM) sites, which are the monitoring locations at the most downstream point in these watersheds. This table is derived from table 6 of the Langland and others, 2012, report.

Summary of Yields at River-Input Monitoring Sites (in tons per square mile per year)			
River	**Nitrogen Yield**	**Phosphorus Yield**	**Sediment Yield**
Susquehanna	2.14	0.08	46.45
Choptank	2.34	0.17	27.95
Patuxent	1.83	0.16	89.35
Potomac	1.75	0.12	152.86
Rappahannock	1.07	0.25	353.41
Pamunkey	0.54	0.07	42.38
Mattaponi	0.52	0.05	12.10
James	0.66	0.14	125.90
Appomattox	0.48	0.05	13.78

The two largest tributaries to the Chesapeake Bay are the Susquehanna and Potomac. For the years 1990-2010 the river with the highest nitrogen loading was the Susquehanna (132 million pounds per year) and the second highest was the Potomac (51.5 million pounds per year). For phosphorus the highest was the Susquehanna (4.6 million pounds per year) and the second highest was the Potomac (3.97 million pounds per year). For sediment, the highest was the Potomac (3,260 million pounds per year) and the second highest was the Susquehanna (2,640 million pounds per year).

It must be recognized that the results for these 9 RIM sites only describe the loadings from parts of the watershed upstream of these sites. Together the RIM sites encompass 60 percent of the Bay watershed. Sources from groundwater discharging directly to the Bay (a significant source of nitrogen but not phosphorus or sediment), from point sources and from other tributaries that are not upstream of RIM sites, or from atmospheric deposition directly on the Bay (also significant for nitrogen) are not included in the RIM loads. Nevertheless, the load and yields at these 9 sites provide valuable insights about a large portion of the Bay watershed.

The second of these is a paper by USGS hydrologists, published in the Journal of the American Water Resources Association. It is: Hirsch, R.M., Moyer, D.L., and Archfield, S.A., 2010, Weighted Regressions on Time Discharge and Season (WRTDS), with an application to Chesapeake Bay river inputs, Journal of the American Water Resources Association, v. 46, no. 5, p. 857-880. It is available on line at: http://onlinelibrary.wiley.com/doi/10.1111/j.1752-1688.2010.00482.x/full) This report (Hirsch and others, 2010) provides an analysis of loadings and trends in loading for 9 rivers tributary to Chesapeake Bay, monitored at locations that are just above the head of tide. This report uses data through the end of water year 2008. Figure 14 of that report shows the total phosphorus yields (in kg/day/km^2) across these 9 sites. Figure 15 of that report makes a similar comparison for nitrate plus nitrite yields (which make up a large

fraction of the total nitrogen yield). The recent report SIR-2012-5185 shows that adding the additional three years of data steepens the slope of the trend in phosphorus loading seen in the Susquehanna River but that trend is already evident in the prior analysis. Figures 14 and 15 allow for comparison of the relative loadings from different parts of the watershed, scaled by the area of the watershed.

7. What does SIR 2012-5185 tell us about the impacts on the Bay of the Tropical Storm Lee inputs of nutrients and phosphorus from the Susquehanna River?

The report does not address impacts. There are a number of investigations underway to assess these impacts on the water quality and biota of the Chesapeake Bay. Scientists from many State agencies, Federal agencies, universities, and other research organizations are conducting these studies.

8. Does SIR 2012-5185 describe possible solutions to the problem created by the filling of the Lower Susquehanna River reservoirs?

No, these topics are not addressed in this report. However, there is a multi-agency project underway to explore the options. It is called the Lower Susquehanna River Watershed Assessment and information about it can be found at: http://mddnr.chesapeakebay.net/LSRWA/index.cfm

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