RMP
Sources, Pathways, and Loadings Workgroups Meeting
October 24th, 2012
San Francisco Estuary Institute
Meeting Summary

In Attendance:

Arleen Feng (ACCWP for BASMAA)
Roger Bannerman (WI DNR)
Jan O'Hara (RWQCB)
Peter Mangarella (Geosyntec)
Dale Bowyer (Water Board)
Greg Schellenbarger (USGS)
Michael Stenstrom (UCLA)
Jonathan Owens (Balance Hydrologics)
Chris White (Balance Hydrologics)
Paul Salop (AMS)
Lucy Buchan (EOA/SMCWPPP)
Richard Looker (Water Board)
Med Sedlak (SFEI)
Lester McKee (SFEI)
Alicia Gilbreath (SFEI)
Jennifer Hunt (SFEI)
Meredith Williams (SFEI)
Don Yee (SFEI)
Jamie Kass (SFEI)
David Gluchowski (SFEI)
Ellen Willis-Norton (SFEI)

Via Telephone:

Barbara Mahler (USGS)

1. Introduction and Overview of SPL activities and Objectives [Meg Sedlak]

The group conducted introductions and Meg Sedlak initiated the meeting by noting that the speakers have articulated questions throughout the presentations that they would like the workgroup to address. Meg also read over action items from the previous meeting including: 1) increasing communication of STLS activities to the broader SPLWG workgroup 2) posting all workgroup meeting presentations on the SFEI website before the SPLWG meeting. Meg noted that SFEI will in the future try to post all presentations before workgroup meetings.

2. POC Watershed Studies

2a. Information: Review of WY 2011 POC Reconnaissance Study Findings [Lester McKee]

Lester McKee provided an overview of the methods and results from the 2011 reconnaissance study of 17 watersheds. He proposed three questions main questions to the workgroup:

1) Is particle normalization a useful method for ranking the watersheds between higher leverage and lower leverage pollution levels?
2) What modifications to the field methodology would improve information output?

Lester proceeded to describe the overarching field methods, which are described in detail in the "Pollutants of concern (POC) loads monitoring data, water year (WY) 2011" report. The site locations represented small to large watersheds, various land use histories, and the watersheds were within the Municipal Regional Permit (MRP) counties. Lester emphasized that the watersheds chosen were ones that could provide insight on how to abate and even remove contamination in the watersheds, helping answer management questions. Lester also explained the rationale behind ranking sites using particle normalized data. The Bay Area watersheds are characterized by variable erosion rates; therefore, there may be high sediment export with relatively low particle concentrations. By calculating the ratio of pollutant concentration in water to the SSC, the site rankings are not subject to the effects of variable erosion rates. Particle normalization was not completed for Se because it is often found in the dissolved phase.

General results from the reconnaissance study were subsequently presented. Lester noted that the sites sampled represented the gradation between low sediment yields and high imperviousness or high sediment yields and low imperviousness. The seven sites with the highest Hg concentrations were almost identical to the seven highest ranking PCB sites (although the order was changed): Santa Fe, Pulgas N., Pulgas S., Ettie, Glen Echo, San Leandro, Sunnyvale (PCB), and Z5 Line M (total Hg). Lester commented that he was surprised Marsh Creek was not ranked as a high leverage Hg site because of the known proximity to a mine. He proposed that the Hg signal may not have been detected because sampling only occurred on the rising limb of the hydrograph or because efforts to ensure Hg does not leak from the source have been successful. Results for Selenium, PAH, and PBDE concentrations were also presented.

The relationship between contaminant particle normalized concentrations and land use/cover was then described. Principle component analysis (PCA) was used to discover that there are four dominant PCs: imperviousness and old urban/industrial land, watershed area and low density residential (pulling out importance of sediment loading); and the last two PCs were the negative correlations of the first two drivers. When examining relationships between contaminants, most contaminants appear to be correlated. Lester stated that most contaminants were associated with the first PC (imperviousness and old urban/industrial land), and speculated that this may show that teasing out too much land use/cover detail in the Regional Watershed Spreadsheet Model may not be useful. The linear regression models for pollutants and various land uses are described in detail in the report, but it is important to note that the data are not rejecting any strongly held notions.

Lester then presented the loads analysis results for the watersheds, the details of which are described in the report. Flow data was not paired with concentration data, sediment concentration was used as a surrogate for flow. Lester noted that the source of

methylmercury in urban watersheds has not yet been discovered and is certainly not well understood.

Lester finally detailed some suggested methodology improvements, such as raising the minimum number of samples from six to eight, increasing the sampling of early season storms when the contaminant load from urban landscapes is highest, and possibly switching to an unbiased site selection. Lester also suggested collecting pollutant specific SSC sample pairs to increase the particle ratios' accuracy and installing staff plates at field sites to generate flow information. Overall, the reconnaissance study successfully identified high leverage watersheds. It has also been useful for back-calculating event mean concentrations (EMCs) and for calibrating and verifying the Regional Watershed Spreadsheet Model (RWSM).

Discussion:
Roger Bannerman was interested that the PAH particle concentrations were greater in the early part of the storm and wondered if coal tar was utilized in the Bay Area. Alicia Gilbreath responded that there is some indication of using coal tar as a seal coat. Dale Bowyer stated that the primary sealer is asphalt based and Barbara Mahler confirmed that Lowe's and Home Depot do not sell seal coal tar based sealants. Roger also mentioned that if you were to separate concentrations by particle size, there might be higher PAH concentrations on the larger particle sizes.

Roger Bannerman also stated that although the correlation between imperviousness and pollutants can be strong (especially PAHs), there is always some variation that cannot be explained. One way to increase the R value is to account for seasonality, but n may become too small. Roger also mentioned his surprise that sediment load was negatively correlated with imperviousness; but, Lester explained that there is sediment eroding from rural, agricultural land in relation to underlying geology and tectonic activity.

Richard Looker believes that normalizing for particle concentrations is overlooking the fact that pollutants could be in the dissolved phase. He wondered if SFEI had observed a difference in regression quality when plotted with K_d. Lester responded that he did not plot with K_d, but he did see a worse R2 value in watersheds where there is a greater likelihood of contaminants in the dissolved phase. Lester added that in the report the contaminant load is described in terms of particle ratios, making clear that the loads are not a true representation of concentration. Richard also questioned whether one sampling effort, is able to capture within-watershed variability. Lester McKee responded that if sampling occurred during a wet year then sampling efforts could start before January and continue into April, more effectively capturing within-watershed variability.

Peter Mangarella was concerned that sediment re-suspension and erosion was included in the particle normalization calculation and was interested in seeing the data without normalization. Lester McKee replied that the non-normalized data was been presented in workgroup meetings, but that an extra graphic and paragraph of text can be added to the report illustrating non-normalized results. Lester noted that without normalization the high leverage site ranking change completely.

Lester McKee also explained that when examining PCBs you see high concentrations associated with low sediment loads (large y-intercept) in industrial areas. The y-intercept moves down as land use changes (e.g. as you move from industrial to open area/agricultural). Lester explained that the large y-intercept for watersheds associated with industrial land use may be because PCBs are in a liquid state (either an emulsion or in a dissolved phase).

Greg Schellenbarger asked about the particle sizes in different watersheds, and Lester McKee responded that the team did not measure particle size, but USGS has measured particle size over the years in many Bay Area watersheds. Particle distributions do not vary drastically between watersheds. Jonathan Owens responded that particle distribution can change as you move from low flow to high flow and Mike Stenstrom added that smaller particles wash out more quickly than larger particles. Therefore, there are a larger percentage of small particles at the beginning of a storm event. Mike noted that the majority of contaminants are on the second smallest fraction of particles (above 10 microns) and that sand particles are not as important for determining contaminant loads. Jonathan subsequently suggested finding out the ratio of sand to finer particles during sampling. Mike asked if Lester had seen any differences between insoluble and soluble contaminants since they partition differently (e.g. PCB partition to particles more strongly than Se). Mike assumed particle ratios were less effective for the soluble contaminants. However, he agrees that ranking using particle normalization is useful because it is possible to remove particle associated contamination. Instead of pollution control, managers can focus on erosion control. Paul Salop agreed that particle ratios allow managers to implement source control measures.

Roger Bannerman explained that modeling small storm contaminant loads is more accurate because imperviousness is the main driver. But, when larger storms occur, erosion and re-suspension occurs making modeling more difficult. Roger suggested sampling larger storms, when erosion occurs. Lester noted that the data collected is being compared to historic rainfall distributions to determine how relatively large the storm was. Jonathan made the final suggestion of adding continuous water level monitors to support sampling efforts.

Action Items:

1) Analyze the the ratio of the apparent solid concentration (concentration of contaminant in water) to the real solid concentration (concentration in water particulate) in terms of K_d.
2) Lester McKee will consider adding an extra graphic and paragraph of text to the report illustrating non-particle normalized results.
3) Think about measuring a sand to finer particle ratio during sampling.
4) Consider adding continuous water level monitors to support sampling efforts.

2b. Update: Pollutants of Concern Sampling: Lessons Learned and future work [Jennifer Hunt]

Jen Hunt provided an overview of Water Year 2012 and a look ahead to Water Year 2013. She proposed three overarching questions to the group:

1) What modifications to the field methodology would improve information output?
2) Are there any limitations to time-based composite methodology?
3) Any thoughts on how to analyze year 1 composite sample data (flow-based)?

For Water Year 2012 four bottom-of the-watershed locations were sampled (Guadalupe River, Lower Marsh Creek, San Leandro Creek, and East Sunnyvale Channel) 3 of which were sampled in the 17 reconnaissance study. Jen noted that the average rainfall was far below average. This played an important role in only 69% of the sampling being completed; the remainder of the sampling will occur in WY 2013. Jen then described the 2012 sampling design which included discrete grab samples for priority pollutants (involving the turbidity surrogate methodology) and flow-based composite sampling for secondary pollutants and toxicity. Jen also provided some preliminary Hg and PCB data. Overall, the relationship between SSC and Hg and PCBs was strong.

Jen Hunt also provided an overview of the first year of composite sampling, when a flow-weighted design was used. She showed how toxicity and contaminant aliquots were not co-sampled during some storm events. Composite design was for co-sampled aliquots. Generally, it was difficult to obtain composite samples for the entire storm event (e.g. during one storm only samples from the peak to falling stage of the hydrograph were collected). Jen asked the group how to analyze year one composite data and if there is another sampling methodology that can characterize pollutant concentrations and keep costs low.

Jen Hunt then described the 2013 Water Year sampling design, which includes the addition of two more high leverage watershed sampling stations, North Richmond Pump Station and Pulgas Pump Station. The pump stations allow you to sample closer to the Bay margins and sample highly industrialized areas that would otherwise be influenced by tidal action. With the addition of these two stations, there are six bottom-of-the-watershed locations being sampled during WY 2013 with four storms sampled per year in each watershed, including a seasonal first flush storm and the largest storm of the season. The changes to the sampling design include switching from a flow-based to time-based composite sampling methodology, reducing composite aliquots from 24 to 16, and attempting to estimate storm duration from forecast predictions to produce 16 evenly spaced time-paced aliquots.

Discussion

Roger Bannerman asked about the rationale behind the transition from flow-based to time-based sampling. Jen Hunt responded that the switch was due to toxicity testing; organisms are exposed to pollutants on a time basis, not a flow basis. Richard Looker questioned whether the degree of rigor that is being applied is necessary. Based on management need, it is important to see how toxicity and contaminant loads vary over a hydrograph, but he is not sure how precise the sampling needs to be.

Roger also asked how first flush is defined and Lester responded that first flush in this case is the first seasonal storm. The first flush is important to capture because typically, based on the sampling we have done over the years through the SPLWG, there are higher particle ratios during the ealier season storms until about November and then after a large storm the particle ratio diminishes and is usually consistently lower in later winter and spring storms. In Guadalupe, PCB concentrations are typically higher early in the season, while Hg concentrations are higher later. Arleen Feng explained that the difference is because the sediment higher up in the watershed (where mining sites are located) dries out; only farther into the wet season is the sediment wet enough to start moving Hg into the watershed. Meanwhile, PCBs from impervious urban areas have been moving into the tributaries with most rain events on the impervious areas.

Paul Salop wondered how much uncertainty was acceptable in discharge measurements. Arleen Feng responded that discharge can be determined from a specific time point during sampling and that discharge does not have to be verified in real-time because rating curves do not generally change year to year.

Jonathan Owens responded to Jen Hunt's question about what modifications to field methodology would improve information output. He suggested collecting double or triple the volume needed to ensure there were enough samples if the storm ended early. In an event where too much volume is collected, the team could subsample. Lester thinks that subsampling would be difficult with large sample bottles. Meg Sedlak questioned whether you can add more bottles to the ISCO and then decide later how many you want to send to the lab (e.g. every other one or every third one). Alicia Gilbreath commented that adding bottles was possible, but the labs require a minimum volume for determining pyrethroid concentrations and it is already difficult obtaining the minimum volume. Adding more bottles would make obtaining the correct volume problematic.

Regarding Jen's question about limitations to time-based composite methodology, Mike Stenstrom commented that time-based samples sacrifices the accuracy of loads estimates. Lester replied that the record of turbidity allows a back-calculation determination of weighting for loads estimates. Don Yee asked if the toxicity measurements could be time-based while the contaminant measurements remain flow-based. Jen responded that pyrethroids most likely affect toxicity so the sampling methodology should be the same for both measurements. Richard Looker and Arleen Feng commented that, from a management perspective, determining the net toxicity over the entire storm event is sufficient.

Action Items:

1) Lester McKee will follow up off line with Dale Bowyer to discuss sediment mobilization and the Hg and PCB time lapse (elevated concentrations early versus late in the season).
2) Field team will consider adding more sampling bottles to the system to capture the whole hydrograph.

3. Overview of the Regional Watershed Spreadsheet Model (RWSM) [Alicia Gilbreath]

Alicia Gilbreath provided an overview of the purpose and data needs in relation to the management questions for the Regional Watershed Spreadsheet Model (RWSM). She proposed three questions from the MRP that have sparked this tool:

1) Looking at a Region 2 boundary, what are the regional loads?
2) What are the highest leverage watersheds?
3) What are the projected management actions?

There are disproportionate loads entering the SF Bay from small tributaries compared to the Central Valley. Getting a more accurate understanding of the regional scale load as well as loads from higher leverage watersheds will aid management. The objective of the model is to generate an average annual discharge volume, sediment load, and POC load for each watershed using a simple model (runoff volume x concentration = load). Alicia then went over the basic plan for the RWSM:

1) Develop fact sheet/methodology
    a. Modeling 8 constituents (hydrology, sediment, Cu (test case), Hg, PCBs, Selenium, OC Pesticides, and PBDEs)
2) Develop GIS layers
3) Collate input data and calibration data
4) Run version 1 of the model
5) Improve model structure or input data
6) Run version 2 of the model
7) Complete final input dataset
8) Run version 3 (final) of the model if/as needed
9) Complete model packaging and user manual

The RWSM requires spatial data layers for land use (alternatively imperviousness), soils, slope, rainfall, watershed boundaries, and source areas. It also requires numerical parameters such as runoff coefficients and land use specific concentrations either in water (EMCs) or on sediment (particle ratio data), as well as empirical calibration data.

3a. RWSM – New and Improved User Interface [Jamie Kass]

Jamie Kass presented an overview for the user interface that has been developed for the RWSM and proposed two questions for the workgroup:

1) How best to improve the user interface?
2) Are we satisfied with the nature of the outputs?

The model is written in arcpy (an ArcGIS module for Python) and is loaded into an ArcGIS script tool. The user inputs shapefiles (watersheds, land use, and soils), rasters (slope and precipitation), and lookup tables (land use and runoff). The output of the model is two geodatabases (one for all intersected watersheds and one for all temporary files), as well as a Microsoft Access database (watersheds statistics table and descriptive land use table). The watershed boundary layer was improvised and collated regionally

through an SFEI Prop 13 grant (http://www.sfei.org/urbanstormwaterBMPS) and with augmentation by CalWater watersheds as necessary for areas not covered by the grant. Dammed areas were removed, leading to large chunks of Alameda County [and Santa Clara County] not modeled. The watershed boundary layer is also attributed by Bay segment so it is easy to relate results to other RMP activities and projects.

Jamie described the tool input interface as one that will look familiar to ArcGIS users, but is also fairly straight forward to new users because all of the parameters have a detailed help text. When you input a shapefile with multiple watersheds – the tool will loop through each watershed and intersect (takes soil, land use, and watershed shape to come out with unique hydrologic units) so each watershed will have a unique product. The watershed statistics table has each unit attributed by average precipitation, slope per soil, and land use type for each watershed. The second output table lists the percentage of descriptive land use by type and is the only table where they are not lumped together (industrial, urban, etc).

Discussion

Jonathon Owens asked why the dammed areas were not incorporated into the model and if no outflow from the dam is being assumed. Alicia Gilbreath responded saying that they haven't determined how to treat dammed areas yet, but haven't lost the option to model the dammed areas because they are in a separate shapefile and can be run through the model separately.

Mike Stenstrom wondered who is going to use the RWSM. Jamie responded saying that it was designed so anyone can use it; you don't have to be a GIS user. Richard Looker said that the Water Board might use it for rough estimates and prioritizing loads. Arleen Feng added that storm water programs are being asked for an approach to estimate loads.

Mike Stenstrom also asked how the RWSM was being tested. In his experience users can try to do odd things with code written for them. Jamie responded saying that Alicia has a beginner's understating of GIS/coding and that she has been the first line of testing. Lester chimed in saying it would be a good idea to have BASMAA and the Water Board test out the model. Meredith Williams added that SFEI puts together user groups to help test the user interface.

Lucy Buchan was curious as to how much improvement should be done at this scale versus at the next resolution with more data added. She wants to better understand the trajectory of the model development and then decide on how to provide input/feedback.

Roger Bannerman wondered if the RWSM can interface with other models. Arleen Feng responded saying that the RWSM is for regional loads because the source data doesn't support looking at individual watersheds; refined source data would help. Lester added that we can rely on the outputs of this model at the regional and subregional scale. When we get down to whether this watershed is more contaminated than that, we can estimate top 20 watersheds and lower 20, then have the whole middle. Lester also asked what

management questions might be down the track. Roger responded with "sequential focusing". He wants to see it work at a smaller scale and understand the sources better.

Peter Mangarella wanted to know how the model generated watershed boundaries and if you can input your own. Jamie responded saying the model does not generate watershed boundaries (the user must upload a shapefile of their choosing; the model then generates unique land use/soil patches.

3b. RWSM – Copper Model [Alicia Gilbreath]

Alicia Gilbreath presented the Copper Model module of the RWSM. The Copper Model is being used as the test case for contaminant modeling because of the available copper data. She proposed three questions to the workgroup and Richard Looker added a fourth question:

1) What implications or difficulties can be foreseen as we develop other pollutant modules?
2) Are there improved techniques for the calibration procedure that could be applied?
3) Should we improve the hydrology model before moving forward?
4) What are ways to sanity check the results of the model, in particular the regional distribution? (Note this one was added by the group)

The Hydrology Model is the base of the Copper Model. The inputs are watersheds, soils, land use, slope, runoff coefficient, precipitation, and a mean concentration lookup table. The model applies a concentration based on the land use and calculates a load by multiplying by volume. The copper concentration lookup table was based on land use.

The transportation layer has a big impact on contaminant load because of brake pads and high imperviousness, and the quality can vary. When you zoom in close you can see some discrepancies in the transportation layer. It would take a lot of effort at this point to make improvements for this small project. Lucy Buchan added that you can take the inverse of the parcel data layer to get all of the transportation information.

For the input concentrations, one concentration for each land use category was used. Data was collated from local, southern California, and world literature. All of the data represents data points of central tendency and can be averages of 3 or 70 watersheds. Medians for land use categories are similar between local and southern California until you add world literature and then the median concentration drops. There is no local agricultural data. Southern California has a high median concentration of 64 ug/L, but when data from the world literature is added, the median drops to 4 ug/L.

Several Event Mean Concentration (EMC) calibration watersheds were used– EMC data was collected in late 80's early 90's. In the calibration, the load and volume outputs for each watershed were used to estimate a Flow Weighted Mean Concentration (FWMC), which is what was compared to the EMC data. Loads and EMC watersheds did not calibrate well together, and the EMC calibration resulted in higher concentrations. The

loads watershed calibration results were driven by the hydrology model results. Only minor improvements were seen by allowing the input concentrations to be split between the land uses. Decisions will have to be made in how many land use categories to use when Hg and PCB models are created.

The point of the model is not to rank watersheds 1-100, but to identify the highest copper yielding watersheds. The industrial land use category drives the highest yielding watersheds. The SPL team is still unsure how to deal with watersheds that have low imperviousness, but are within a land use class that is considered highly impervious; we may even want to re-consider using impervious cover to underlie the hydrology model rather than land use, or re-examine the general classification of the land uses.

The new PRISM dataset just came out as well, and the new version is quite a bit better, but the hydrology model has been calibrated on the old dataset. The average watershed difference between the two datasets is 3% (range +/- 12%).

Discussion

Alicia started the discussion asking if we move forward with the hydrology model calibrated with the old PRISM dataset, or re-calibrate the hydrology model first. Lester responded saying his opinion is that we should use the new PRISM dataset and base the hydrology model on percent imperviousness. Alicia responded saying it would take time to see if they had to update the runoff coefficients based on the new PRISM. Greg asked how good the current hydrology model is at predicting flows and if there are large error bars. Alicia responded saying there were 18 calibration watersheds in the hydrology model and the results were +/- 70%. Lester added that is a good reason to separate the generation of hydrology from the generation of runoff coefficients and go back to basing it off percent imperviousness. Lucy Buchan asked what the impervious layer's source is. Alicia responded saying the source is NLCD 2006, which uses remote sensing. Meredith Williams added that SFEI will have the ability in two years to refine land use thanks to an ESRI grant.

Jonathon Owens said that the concentration of copper increases as flow increases and asked if that could be worked into the model. Lester responded saying that this is a conceptual model and is at an average annual time-step. There is no interface between the hydrology model and a real storm hydrograph.

Mike Stenstrom asked how different the average rainfall is between the PRISM datasets. Alicia responded saying there is a 3% difference in watersheds between the datasets. Arleen Feng asked if there is a difference in resolution. Lester responded saying the new model has done a better job of incorporating the effects of aspect and topography and Jamie Kass added that the resolution is spatially the same. Mike Stenstrom said he would improve the current model before moving on to new territory.

Richard Looker said that the model results should be compared to other estimates because he is looking at the high leverage watersheds and it doesn't make sense to him. He encourages the use of RMP data to help with the sanity check of the loading

estimates; the surficial sediment estimates from the RMP can be used as a proxy for what's coming out of local watersheds. Arleen Feng asked how the load estimates compare with the brake pad partnership estimates. Alicia responded saying EMC and loads had slightly different calibrations, but it matters which agricultural concentrations you are using (64ug/L vs. 4ug/L). The numbers with the high agricultural concentrations were similar to the brake pad partnership estimates. Mike Stenstrom asked how good the brake pad load estimates are and Arleen responded saying that they were good enough to help change legislation.

Regarding copper sources, Jonathon Owen said that some reservoirs add copper to control algae. Arleen responded that CuSO4 sits at the bottom of reservoirs, when cleaned a lot gets downstream. Lucy Buchan added that there are lots of illicit swimming pool releases.

Action Items:

1) Consider looking at the inverse of the parcels to pull-out roads when examining land use.
2) Think about reducing the number of land-use classifications
3) Use RMP data to apply a "sanity check" to the copper model's results.

3c. RWSM: PCB and mercury preliminary model runs [Alicia Gilbreath]

Alicia Gilbreath and Lester McKee presented this section together and posed two questions to the workgroup:

1) Are the GIS layers in relation to land uses and source areas prioritized appropriately?
2) Should we base the PCB and/or mercury models on hydrology or sediment alone, or a combination (hybrid)?

The development of the PCB/Hg model has to start with the decision of the model architecture (water, sediment, or hybrid). Then the GIS layers will be developed followed by the concentration input data being developed. The model interface would then be developed and calibration watersheds would be chosen.

Possible model architectures include volume concentrations, mixed volume concentration and particle concentration, empirical sediment and volume concentration, and empirical sediment and particle concentrations. The development of different GIS layers has been prioritized and several are already completed or in progress.

If water concentrations are applied to the hydrology model, data from local studies could be ranked/organized using world literature on particle concentrations. Conversion of the particle concentrations derived from back calculations to water concentrations using suspended sediment EMCs for each land-use might be wishful thinking. But we could also skip the hydrology model and apply particle concentrations to a suspended sediment model. Local Bay Area bed sediment and soil studies (issue of grain size) as well as data

from the world literature (issue of differing regulations) can be used. It may be best to use both ideas and see how they work together in the model.

For the back calculations, a Monte Carlo approach was used. It selected one concentration for each watershed, ran it through an optimization scheme, and the output was a distribution of optimized concentrations for each land use. It is possible that land use or source area monitoring for PCBs and Hg will be necessary, but initial model runs will help prioritize what is needed. As soon as the GIS layers are complete, model runs will be initiated.

Discussion
Roger Bannerman said that the sediment at the bottom of the stream seems to be the larger data set. But, if you look at the water column then how do you use that? Lester replied saying that the dataset contains the sand/fine split and the data can be normalized. Mike Strenstrom added that if changes are made, what is the sanity check? Lester replied saying collated local agricultural sediment data could be used as a conceptual check.

Peter Mangarella argued for a dataset that provides more spatial resolution, which leads him to sediment data. He suggests looking at PCB/SSC correlation and the slope of that line is the enrichment factor. If there is a relationship between SSC and bedload, use embedded data to generate runoff curves. Lester replied and said we used bed sediment data and all of the particle ratio data as calibration. We will have spatial interpretation on the output side, and use local and world data on the input side. If we put bed sediment on the input side then have an enrichment factor problem.

Jonathon Owens wanted to know if the model would look at MeHg and if so wetland GIS layers should be brought in. Arleen Feng responded saying that the model only looks at total mercury based on the permit and TMDL. Lester said that according to Ben Greenfield's analysis, we cannot predict MeHg based on the current data. Meredith Williams noted that SFEI has investigated using song sparrows as biosentinals for MeHg. It may not work for the level of detail for the model, but there are opportunities to look at landscape factors to get a handle on methylation. Paul Salop added the Hg sediment data collected by the RMP is not generated for this purpose. It is targeted at hotspots and is inherently biased. The overall consensus was to create Hg/PCB model and learn from it.

Action Items:
1) STLS team should work on defining more explicit criteria for a successful Hg and PCB model. We need to know how much effort is enough.

3d. RWSM: Sediment/OC pesticide/PBDE models [Lester McKee]

Lester McKee presented about the development of the sediment, organochlorine pesticides (OC pesticides), and PBDE modules of the RWSM. He proposed three questions to the workgroup:

1) Can the methods for improving regional estimates of suspended sediment loads be improved?
2) Are there improvements to the proposed methodology for developing the basis for the model structure for OC pesticides and PBDEs?
3) Should we include worldwide or just California EMC data?

The current suspended sediment model (Lewicki and McKee, 2009; 2010) is comprised of three different classes: Class 1 uses a watershed specific regression for watersheds with empirical field data, Class 2 uses a regional regression specific to three provinces for watersheds without empirical field data dominated by non-urban land use, and Class 3 employs a land use based method adjusted for delivery ratio (NRCS, 1983) for watersheds without empirical field data dominated by urban land use.

The first step in the process for improvements to the model is to complete a status review of weaknesses. Necessary literature review and data development needs to be completed. The current sediment model is done in an actual spreadsheet, Jamie can transfer it to the RWSM and complete model runs.

In the current sediment model, 28 watersheds are lumped together into whole watershed inputs to the Bay margin and 454 are split into land use based estimates and then re-aggregated. There are two ways to go about improvements: either back calculate land use geology erosion coefficients, taking into account delivery ratios and then disaggregate, or do nothing and estimate a weighted average PCB and Hg particle concentration for these watersheds. Another challenge is dealing with the lack of treatment of storage in flood control channels in larger or mixed land use watersheds. SFEI is working in partnership with SFEP, BCDC, and SFBJV on conceptual designs for coarse sediment management on the Bay margin which could lead to a regional database of sediment storage and flood control channels. The third challenge is dealing with variable erosion in mixed use watersheds. Three possible options for managing that challenge are a literature review pertaining to erosion rates in relation to geology/tectonics, back calculating land use geology erosion coefficients taking into account delivery ratio, and developing coefficients using generalized geological classes.

There was no previous model for OC pesticides or PBDEs so the model would be started from scratch. The first steps include looking at the CMIA reports for the Bay and uses/use areas for each substance. There is much less local and world sediment/soils literature than there is for Hg and PCBs. The team needs to determine the sources and concentrations (ideally EMCs) in stormwater and develop GIS layers in relation to the appropriate model structure.

Discussion

Lucy Buchan asked about the current methodology for generating estimates of sediment delivered and if they are looking for a sediment risk erosion model. Lester replied they are examining the sediment production rate for the urban component of the Bay Area system. The results from the land use method were reliable, but not great.

Jonathan Owens said there is a lot more sediment data out there that can be used as calibration data. Lester asked if that data is owned by the clients or if it is publically available. Jonathan replied that a lot of it was publically available. Most of the data is biased toward high sediment areas because that is where the concern is.

Jonathon Owens also asked about landslide GIS layers and fault zone GIS layers and their relationship with higher sedimentation rates and uplift rates. Lester responded saying there should be an expert workshop to put together a conceptual model and commented that the USGS hazards landslide mapping may not be entirely suitable since it was developed for an entirely different endpoint.

Richard Looker said there should be an emphasis on the sediment model because it has an opportunity to be a surrogate for particle-based contaminants. Lester replied saying that Se seems to be a geologically based contaminant and may work well with this model. Dale Bowyer said there are different types of sediment (coarse and fine), and this model is not geared at looking at the differences. Lester responded saying there is a lack of understanding of coarse sediment production. Lester said the highest priority is the lack of treatment for mixed use lands in our upland areas for our urbanized East Bay and Peninsular watersheds.

Action Items:

1) Lester McKee will email Balance Hydrologics and ask for list of Public Clients to obtain sediment data.

5. Workgroup General Discussion [Jennifer Hunt and Meg Sedlak]

Discussion questions raised throughout the meeting were compiled by Jen Hunt and the workgroup proceeded to rank the questions based on their priority level. The following questions and subsequent discussion were ranked as high or medium priority.

1) *Discuss the inclusion/removal of watershed area above dams.*
Lester McKee noted that the default is to remove reservoirs from the watershed. Mike Stenstrom is interested in the implications of excluding the watershed areas.

2) *Discuss including bed-sediment concentrations in the output side of the RWSM.*
Peter Mangarella maintained that including sediment in the RWSM would reveal whether the RWSM results are realistic. Roger Bannerman noted that understanding the particle size distribution is important and will affect contaminant concentrations.

3) *Discuss regional vs. subregional use of the model.*
Arleen Feng and Dale Bowyer noted that this question does not imply the regional use of the model would be abandoned, but that experimenting with new model input would start at the sub-regional scale and then expand to the regional scale if the effort was successful.

4) *Discuss moving to an impervious cover model for hydrology.*

Lester McKee first wanted to make clear that there are only two data sets that are being used to calibrate the copper model currently, adding data sets to the calibration portion of the model may reduce the chance of accidental calibration. Peter Mangarella mentioned that when he looked at satellite imagery from Santa Barbara that there was little correlation between land use and imperviousness. Thus, using land use as a surrogate for imperviousness is tough and Peter suggested switching to an impervious model. Roger Bannerman added that there are land use files where the labeling of the files was wrong (e.g. salt ponds labeled as industrial land). But, Roger also mentioned that percent impervious does not define what the impervious surface is, which is critical for modeling. Therefore, if percent impervious is used it's important to define the areas carefully and for land use it's critical to look for anomalies.

Dale Bowyer brought up that pollutant runoff is currently based on land use and is not normalized for imperviousness. Richard Looker added that the impervious cover model was rejected previously; Lester responded the model was "rejected" two years ago when only the hydrology model was complete (not any of the contaminant models); at that time land use performed better for the hydrology model. But we always reserved the possibility of ramping back up on the IC based model if the pollutant models provided a rationale to do so. Richard replied that model should only be evaluated based on how well it modeled hydrology; he does not think that the model should change because it might perform better for contaminants. Arleen Feng noted that when the hydrology model was created, some high impervious areas were missing, which may account for poorer performance of the IC model.

Mike Stenstrom suggested that if land use was utilized, lumping industrial and commercial areas together may improve accuracy and perform better than percent impervious. Dale Bowyer suggested that the land use model's accuracy would improve if parcels above a certain size were analyzed individually to check for errors. Lucy Buchan added that the team could look for outlier results to see if the land use data was incorrect, but Lester responded it is difficult to determine what numbers are wrong. Jonathan Owens suggested using a multiplier, land use times percent imperviousness, to solve the problem. Lucy Buchan mentioned that there is an impervious model that includes land use in development that could be employed.

5) *How can we analyze year 1 composite data since the sampling design was not met?* Jonathan Owens suggested calculating the average flow so the team could analyze concentration versus the average flows. Don Yee proposed estimating the flow at tail end of the hydrograph using turbidity data and then calculating what percentage was missed. Peter Mangarella recommended just plotting the data with the portion of the hydrograph the data is representing and determining if the concentrations are toxic. Greg Schellenbarger noted that sediment loads will decrease faster than the hydrograph; therefore, the team may not have lost too much data.

6) *Review changing the definition of "old urban" land use from 1954-1974 to 1950-1980 (Jan O'Hara wished to discuss)*

Jan O'Hara is interested in increasing the number of years captured by "old urban" land use. Currently, old urban land use only spans 20 years and Jan wants to increase the number to 30 years. Arleen Feng noted that 1950 predates ABAG planning data. Jan replied that the layer may not have to be changed, but maybe the approach for looking at the layer could change (e.g. indicate that the old urban land use data is 1/3 off).

Action Items:

1) Write up a 1-page document detailing repercussions of removing reservoirs from watershed and send to SPLWG for review.
2) Alicia Gilbreath will look at original results from the hydrology model with percent impervious included instead of land use.
3) Consider calibrating the PCB model with both land use and percent impervious to see which performs better and report back to workgroup.
4) Consider using both percent impervious and land use in the model (either with a multiplier or with the impervious model in development that includes land use).
5) Alicia Gilbreath will look into land use layers predating 1954 to see if "old urban" land use can span from 1950-1980.

6. Review meeting outcomes/ Plan next meeting/ Adjourn [Meg Sedlak]

The action items from the meeting were reviewed and the meeting was adjourned.