THE BRAKE PAD PARTNERSHIP

Compilation of Technical Reviewers' and Stakeholders' Comments on Estimating Copper Loading to the Watershed from Non-Brake Sources Draft Report

July 26, 2005

Background

Copper in the San Francisco Bay has been a pollutant of concern since the State of California listed the Bay as a high-priority impaired water body in 1996. In 1998, the State of California listed copper and several other metals as pollutants of concern for the San Francisco Bay. These listings triggered a regulatory requirement that Total Maximum Daily Loads (TMDLs) be developed for copper and the other pollutants of concern. Since then, site specific objectives for copper have been established for the bay South of the Dumbarton Bridge, and a copper TMDL process is currently underway for the bay North of Dumbarton Bridge.

The Brake Pad Partnership's efforts are aimed at evaluating the potential impact of copper from brakepads on water quality in the South San Francisco Bay. Three environmental modeling studies are at the core of the Partnership's effort, including an air deposition model, watershed model and Bay model. The air deposition model has two time scales. For the regional background, the model uses a 5-year average set of meteorology and the temporal resolution is going to be a month. For the local (Castro Valley) scale model, the model is based on one-year daily meteorology that will be used to drive the model, with the goal to compare against air deposition monitoring data. The watershed and Bay model uses daily mean output values for multiple years, which may include roughly 1989-2003. One of the most critical inputs to the modeling efforts is the estimate of the quantity of copper released to the watershed from vehicles (brake sources) and other copper sources (non-brake sources). The Brake Pad Partnership has contracted with Kirsten Sinclair Rosselot of Process Profiles who is working with the BPP Steering Committee to develop a plan for estimating copper releases from non-brake sources. The release estimates will be used as inputs to the air deposition and watershed models.

The Brake Pad Partnership Steering Committee is seeking an independent expert review of the Draft Report for Estimating Copper Loading to the Watershed from Non-Brake Sources to ensure that the approach and results of this element of the Partnership's work are technically sound, to determine if there are feasible opportunities to strengthen this work, and to help build in-depth understanding of and confidence in the technical studies on the part of the Steering Committee and the stakeholder communities.

Charge

With the aim of meeting these objectives, the Steering Committee has developed the following questions on which it is seeking specific comments from the reviewers:

1. What is your assessment of the analysis performed and its reliability for estimating copper releases from non brake sources?

2. Does the report clearly describe the uncertainties and sensitivities in the analysis?

3. Based on your experience with similar release estimate efforts, what feasible improvements can you recommend to the Brake Pad Partnership in estimating and sources loadings from non brake sources?

4. Are the specific copper release estimates appropriate inputs for the atmospheric deposition, watershed, and bay models?

5. Is the method for allocating sources spatially in the watershed appropriate? Do you have any suggestions for how it could be improved using available data?

Comments Received

Comments of Jim Carleton, U.S. EPA Watershed Modeler, (6/14/05)

General comments: The report is well-written and well-organized. I like the way Kirsten has broken down loads from each source by watershed.

Specific comments: The estimated 200,000 kg/yr of Cu released to permeable surfaces in the Bay area caught my attention. This is a huge number! To put it in context, my early modeled estimates of total Cu runoff load to the Bay was only around 20,000 kg/year, which was, if I remember, in the ballpark of loading estimates derived by other parties via other methods. With a "background" loading to the watershed that is this high, I won't be surprised if the deposition estimates from AER's work essentially amount to noise within the uncertainty bounds on the estimate.

Regarding the Kline-McClintock equation, what is 'K'? Also, an example illustration of the use of this equation would help readers better understand how it was used in this report.

Figure 2-1 shows a watershed shapefile (overlaying some other GIS stuff) that I created in 2003. At some point after I created it, I realized that what I had called the 'Calabazas Creek' watershed is actually the Guadalupe River watershed. The watershed I called 'San Francisquito Creek' could be called Calabazas, as Calabazas Creek is actually found within this area. Sorry for the confusion on this; I'm not really sure how it happened, but the names should probably be changed to better correspond with geography.

In table 2-1, in the 'United States' row, there are several divide by zero error messages that should be removed.

For architectural Cu (sec 2.1), it wasn't clear to me how the total areas of structures and of gutters were estimated. The statements that architectural Cu is 'released directly to runoff' and is

'estimated as a point source' seem contradictory. It would be better to say that architectural Cu is released directly to storm drains. 'Runoff' implies overland flow, which (I think) doesn't come into play in this case.

I don't know how much of the Cu applied to urban land (Table 2.2-3) should be assumed to be applied to impervious vs. pervious surfaces, or how the total fits in with the 200,000 kg estimate from all sources to pervious land, previously cited.

I'm not sure whether the values in Table 2.4-1 (Cu in 'industrial runoff') represent actual runoff (rain-driven loadings from parking lots, etc.) or direct discharges to storm drains (i.e. delivered to the stream even when it's not raining).

In general, it's not clear to me where source categories in various tables might overlap with each other, and I don't want to double-count. The report would be most useful for me if it contained a table that showed, by watershed, three things: total Cu loadings (i.e. from all non-brake, non-soil sources) to pervious surfaces, total Cu loadings to impervious surfaces, and total Cu loadings directly to the storm drain system (including roof and gutter loadings).

Comments of Nila Kreidich, graduate student, Department of Pesticide Regulation, UC Davis (06/14/05)

Review Comments for Section 2.2 Copper in Pesticides

To the best of my knowledge your approach for calculating uncertainty of copper pesticide sales is appropriate for this report. However, I do have one comment regarding the adjustments made to compensate for under-reporting. I think referencing Larry Wilhoit's study conducted in 2005 is a great start. Do you know what group of pesticides he was referring to when he stated that 90% of this group is reported? I am guessing that he is referring to restricted-use pesticides, which only those with a pesticide applicators license may purchase. Once you know what pesticides he is talking about I would clarify this in the paragraph. To the best of my knowledge many copper-based pesticides are not restricted use; therefore, comparing his study with copper pesticides may not be appropriate (keep in mind that I may have misinterpreted how you are using Wilhoit's findings to come up with a correction factor of 10%). A better explanation of how you got to this correction factor of 10% will help readers understand your data better and they will have more confidence with the results stated in this report.

Calculating uncertainty is a very important component of this section of the report. One other method that may be useful to your audience would be pesticide use data for more than one year. For example, on page 2.2-7 you state that 107 kg in 2003 is the estimated copper released in algaecide treatments of agricultural surface waters. Is this amount "normal" or is this amount unusually high or low? You could state the mean from 1993-2003 in parenthesis after 107 kg. Giving means or data for multiple years may help give your data more confidence and help tackle this issue of uncertainty.

One final comment: Do you know why Alameda, Contra Costa, Napa, and Marin counties had no reported used of copper-based algaecides in non-agricultural water areas in 2003? Was this true for previous years also?

Comments of Arleen Feng, member of Alameda County Public Works Agency (06-20-05)

I think in general Kirsten has done a good job with difficult and patchy data. I will be sending you more comments later today about the estimation work itself, but am sending the following comments now because they relate to the overall modeling and coordination, and you and the modelers should know that they will need to be addressed before the final version of Kirsten's report is released.

The naming conventions applied to "watersheds" are inappropriate in this presentation. Kirsten's working list is based on a URS document 4/28/05, which I understand is based in turn on watershed delineations and names provided to URS by Jim Carleton, though neither of those documents has been reviewed by anyone involved in Bay Area stormwater management or watershed management. While perhaps understandable to insiders familiar with modeling conventions, the present list of names obstructs the Bay Area stakeholders' desire that this and other BPP documents will contribute to broader management discussions of copper in the Bay Area. I think it is essential for the BPP reports to use a convention where references to individual "watersheds" or "subwatersheds" align with actual usage among Bay Area regulators and stormwater managers.

Specific suggestions to resolve this problem include:

1. Explain in each document that for modeling purposes many individual watersheds in the normal sense of the word have been subdivided or aggregated, depending on size and available data. Ideally there would be global use of a specific term such as "modeled subwatersheds" in all text and tables such as ES-1.

2. Use synthetic descriptive names for all "modeled subwatersheds" that are aggregated from multiple small individual watersheds, particularly when they include multiple individual creeks or waterbodies listed by name in the RWQCB's proposed Basin Plan update. At present most of these units appear to have been assigned an arbitrary tag for modeling convenience, but many of the names selected are either not in common usage or commonly understood to have a very different meaning. Examples from the area I'm most familiar with:

a. "East Bay slope-North" is suggested instead of "Cerrito Creek" (which properly refers only to a drainage area about 1 sq mile) when referring to the entire Richmond-to Berkeley Bay Slope region (encompassing at least a dozen existing creeks or separate culvert networks with a total drainage area of over 35 sq miles). The existing name is analogous to doing an analysis of the entire 2-county region commonly called "East Bay" but naming it for one small city such as "Berkeley metropolitan area".

b. "East Bay slope-Central" is suggested instead of "Coyote Hills Slough", which was the historic name for a minor channel in the Alameda Creek delta system. This channel was destroyed in the construction of the Alameda Creek Federal Project Channel, and is now replaced by a single very large channel conveying flow from the Alameda Creek subwatershed (which has appropriately been designated as a separate modeled subwatershed). The current BPP usage of name assigns it to a large portion of the urban East Bay slope which never drained to it, and excludes any Alameda Creek contribution.

c. "East Bay slope-South" is suggested instead of "Fremont Bayside", which includes the city of Newark as well as a portion of Fremont. The term "bayside" generally connotes low-lying areas close to the Bay margin and not watersheds extending from ridgetop to Bay.

3. Clarify the basis for subdivision of "modeled subwatersheds". This is especially confusing where mingling different criteria for delineation, for example "Upper San Francisquito Creek" seems to correspond with the actual watershed of that name, but "Lower San Francisquito Creek" is a synthetic aggregation of far more area than the actual watershed of that name. Castro Valley Creek is a tributary of San Lorenzo Creek. From the tabulated areas, it appears that the CV Creek sub-watershed (or more accurately sub-sub-watershed in BPP framework) is being calculated separately from the rest of the San Lorenzo Creek watershed, but the map in Figure 2-1 doesn't reflect this assumption. Since a significant portion of the community of Castro Valley lies in that part of the San Lorenzo Creek watershed that is not draining to CV Creek, the word "Creek" does need to be included if that is the basis for delineation.

4. From the map in Fig 2-1 it appears that a portion of San Mateo County has been included in the same modeled subwatershed as San Francisco. This area as well as the adjacent corner of San Francisco do drain to SF Bay and contain significant proportions of industrial and commercial land use. Since the overall size of this catchment is relatively small, excluding it from load estimates for non-air sources probably doesn't make much difference in overall load estimation or model results. However this exclusion should be accurately described in all BPP reports.

<u>Additional comments:</u>

A. In Executive summary and also in Intro, the report should state that the purpose of this document is to provide certain inputs for the BPP modeling work and is not intended to generate a comprehensive copper load estimate for the SF Bay system. It may be appropriate to mention in this context the CEP's "North of Dumbarton Bridge Conceptual Model/Impairment Assessment Report" as an example of that type of effort.

B. Many assumptions and references that were described in the workplan which aren't mentioned or explained in the text. Consider including the workplan as an appendix to the final report (again, so that it can potentially be read as a stand-alone document outside of the BPP context).

Comments of Nan Singhasemanon, Associate Environmental Research Scientist, Department of Pesticide Regulation (06-20-05)

1. Section 2.1 and 2.2: Please note that you included a release assessment on copper roof-shingle granule biocides in the Architectural Copper Section. These pesticides are also accounted for in the cuprous oxide sales data that you used in the Copper in Pesticides Section. Please make sure that you are not counting for these pesticides twice.

2. Section 2.2: Please name the eight copper-based pesticides that have reported use and no reported sales.

3. Section 2.2: For clarity, can you provide more details on the sales and use correction factors from DPR so that the reader can have a better idea of the rationale used to come up with these adjustments. In particular, what surrogate group of pesticides was the correction factor for use based on? Is this extrapolation appropriate to all copper-based pesticides?

4. Section 2.2: You mentioned in paragraph 4 that all currently registered copper-based pesticides appear in the California use and/or sales report. This statement belongs more in paragraph 2. For clarity and perspective, you should also provide the total number of copper-based pesticides currently registered in the State.

5. Section 2.2, paragraph 5: The difference between adjusted sales and adjusted reported use can be assumed to include uses by commercial, institutional, household, and industrial users. In my initial comments on the project workplan, I mistakenly omitted this class of users; however, I sent an email correction on this to include the industrial users. This user group, like the institutional user group, is not required to report as part of DPR's pesticide use reporting process. Note that if a pest control business applies to any of the four user groups mentioned above, it has to report to DPR. Also, the use of restricted use materials and potential groundwater contaminants must also be reported.

6. Section 2.2a: Your "Big Box" store sales adjustment on antifouling paint (AFP) use of cuprous oxide may not be appropriate because AFPs are not distributed and sold to these stores. These paints are typically distributed through smaller specialized dealers throughout the state. Therefore, the "Big Box" store adjustments may inappropriately inflate your estimates. This would also apply to copper hydroxide and copper thiocyanate. Moreover, the use numbers available from DPR for AFP uses on boats and pier are somewhat misleading. DPR does not require the reporting of AFP applications to boats and piers. (Please double check with Kelly on the pier applications. I ran out of time to fully verify this.) Thus, it is not clear what the reported uses represent. Again, this will affect the estimates for the other AFP active ingredients.

7. Section 2.2a, paragraph 5: For clarity, please explain why many uses of the six copper pesticides applied to water are not reported.

8. Section 2.2a, paragraph 7: You estimated the statewide number for root killer uses of copper sulfate (pentahydrate). You already know that there is no use in the 9 Bay Area counties. I thought that, in the end, you were interested in the Bay Area use estimates. So why must the statewide total be calculated?

9. Section 2.2a, last paragraph: Is the consideration that all copper pesticides applied to land are to permeable surface important? If they were applied to non-permeable surfaces, wouldn't the pesticides runoff eventually to permeable surfaces considering the persistence of copper?

10. Section 2.2c, paragraph 2: Please define "agricultural water areas". This also occurs in the footnotes of Table 2.2-2.

11. Section 2.2c, paragraph 3: Please define "rights of way (nonagricultural)". DPR considers right-of-way applications to be agricultural. Thus, this use is reported to DPR in the pesticide use reports (PUR). Are you trying to make a distinction between nonagricultural and urban right-of-way applications?

12. Section 2.2d: The estimates on wood preservative uses are inherently very gross relative to estimates based on the PUR and sales data. Moreover, the magnitude of releases from this use is quite large compare to releases from other copper sources. Therefore, the uncertainty in wood preservative releases could easily dwarf the release estimates from all the other sources combined. Isn't this a problem?

13. Section 2.2d, paragraph 3: please define "CCA-treated".

14. Section 2.2e, paragraph 1: Note that "submerged boat and structure surfaces" has a different meaning than "submerged surfaces of boats and structures". You may want to use the latter.

15. Section 2.2e, paragraph 2: You used a range of 1.3 and 2.3 lbs. Cu/boat/yr. These values were generated in San Diego Bay water conditions. You may want to note that copper emission rates in Bay Area water conditions could likely be quite different. I believe Kelly also noted this in her copper report.

16. Table 2.2-1, footnote c and Section 2.2c: How did you determine that the use of copper algaecides in drinking water reservoirs are small and not expected to be important? Note that industrial uses are not usually reported in the PUR (with minor exceptions).

17. Table 2.2-2: How do you explain cases where the standard uncertainty exceeds the estimated release?

18. Tables: In some of the tables total values of copper release are provided; however, standard uncertainties are provided for these sums. Is this the case where the uncertainties cannot be added? Can an estimate of total standard uncertainty be provided?

19. Report: I assume that you will be accounting for upstream inputs such as the loads from the Sacramento and San Joaquin Rivers?

Comments of Drew Ackerman, Southern California Coastal Water Research Project, (06-20-05)

My general impression of the report is that it does a good job of quantifying inputs that are very difficult to do so. The report appears to cover the majority of copper emissions, discharges and applications in the air, land and waters. The comments I have try to encompass clarification, consistency, and readability.

General comments

Be consistent with the units. For example, Table 2-1.1 has units of kilograms but the text refers to grams. Also, use metric units throughout. On page 2-2.5, in the last paragraph, copper sales are reported in pounds.

Figure 2-1 is difficult to read. Streams and significant storm drains should be included to show subwatershed drainage pathways.

Areas in Table 2-1 should be in km^2. The numbers are too large to be reported in square meters. Also, why are the areas of the United States and California included?

Tables 2-2 to 2-6

- The columns are summed into the last row called "WATERSHED". What is this? Is it the SF Bay watershed? If so, it should be explicit as in Table 2-1.
- The column headings are for individual counties and should be labeled so that this is obvious.

Loads normalized to watershed area could be helpful.

The link http://physics.nist.gov/cuu/uncertainty is not active. I went to http://physics.nist.gov/cuu/index.html but was unable to download the document, which I assumed was: *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results* B. N. Taylor and C. E. Kuyatt. Washington, DC: NIST Tech. Note 1297, US Government Printing Office, 1994 ed., (1994)

Charge to Reviewer Questions

1. What is your assessment of the analysis performed and its reliability for estimating copper releases from non brake sources?

Five general sources of copper releases were discussed in the report: Architectural Copper, Copper in Pesticides, Copper in Fertilizer, Copper Released from Industrial Operations, and Copper in Domestic Water Discharged to Storm Drains. Of these, the first three would be

transported to receiving waters via stormwater runoff. Industrial would be from atmospheric emissions, direct discharge and stormwater runoff and domestic water is directly discharged to the system.

Overall, the report does a good job of overall characterization of the inputs. I didn't fully have time to review the watershed modeling work plan but I would assume that the first three inputs will be incorporated into the build-up parameters.

Copper speciation has the potential to greatly affect compliance and behavior in the streams and bay. There is no discussion of whether the copper inputs quantified will be total or particulate and dissolved.

Architectural Copper

Without seeing the Barron 2001 report, I don't have enough information to fully address the "Architectural Copper" section. "*This is based on field tests of seven rainfall events in Palo Alto (Barron, 2001).*" For example, what roof types were evaluated? How were those evaluations made? How many sites were evaluated? How many times? Was it one site 7 times or 7 sites in one storm?

"*They were estimated as a point source for the purposes of modeling because they are almost always hard-piped to storm drains.*" Is there a reference for this statement? I'm not sure that it's a good assumption. Residential areas generally discharge to the property or the adjoining street.

Copper in Pesticides

For calculating the standard uncertainty, it was assumed that 67% of pesticides fall within a range of 80-100% fully reported, so that the standard uncertainty in the correction factor is 10%. Is there a reference for this statement?

Section "*2.2a Pesticides Applied to Land in Urban Areas*" is confusing. Why are antifouling paints discussed here? Shouldn't they be in "*2.2e Antifouling Coatings*"?

P 2.2-6 6th paragraph *A reduction of 370 lb of copper per year was observed for a population base of 226,300 (Moran, 2005).* What is the typical variability before the ban? Is it near 370 lb?

Copper in Fertilizers

Page 2-3.1 2nd paragraph "0%" should be "0"

Page 2-3.1 3rd paragraph

"*Non-farm uses were assigned to sub-watersheds based on population.*" How?

"The fraction available for runoff in agricultural applications was based on a range from 50-100%, and uncertainty is half of this range divided by the square root of three." Based on what? Need a reference.

Copper Releases from Industrial Operations

Page 2-4.1 4th paragraph

"*It will be assumed that this factor has a 100% likelihood of falling between 60% and 100%, so that a factor of 80% will be used to adjust the combined land usage value downwards to be more representative of industrial land use area*." Sonoma county has 28% industrial and S.F. County has 0% (Table 2-1).

Copper in Domestic Water Discharged to Storm Drains

Page 2-5.1 2nd paragraph

"It is likely that domestic water discharges to storm drains pass through less copper piping than tap water does. In fact, in many cases, irrigation water passes through no copper piping." *Reference?*

Sources Not Included in this Inventory

Also, copper released from soil erosion will be calculated by the runoff model and was not estimated. *Is there data to support this?*

2. Does the report clearly describe the uncertainties and sensitivities in the analysis?

There needs to be a more detailed description of some of the assumptions. For example, on pg 2.2-5 *Estimated consumer sales were adjusted upwards by a factor of 20% in order to correct for unreported sales (Brank, 2005).* This is a personal communication citation. There needs to be more discussion to provide confidence in this assumption.

Some of the wording is confusing when discussing the standard uncertainty. Again on p 2.2-5, the phrasing *so that the standard uncertainty in the correction factor is 10%* implies that the range was set to achieve this uncertainty.

3. Based on your experience with similar release estimate efforts, what feasible improvements can you recommend to the Brake Pad Partnership in estimating and sources loadings from non brake sources?

My experience is generally with stormwater sampling and modeling. So, I would recommend sampling from multiple small catchments where copper applications and sources can be quantified well. This would help the modelers to calibrate the model with accuracy and confidence.

4. Are the specific copper release estimates appropriate inputs for the atmospheric deposition, watershed, and bay models?

Seems to be.

5. Is the method for allocating sources spatially in the watershed appropriate? Do you have any suggestions for how it could be improved using available data?

There are only three broad land uses detailed in the report. Is this because of poor GIS coverage or were more detailed land uses aggregated? This becomes an issue when, as in the 4th paragraph on page 2.4-1, the report tries to back out industrial loads. This is confusing and could be eliminated by a more detailed land use description.

Comments from Robert Frosch, Belfer Center for Science and International Affairs, Harvard University, (06-21-05)

I have only one comment on the report, and it is not very important. (I found the document interesting, but have no way of having a view on most of its content. The handling of the data and the uncertainties and variances is clear and to the point.)

On Page 1-1 in the third paragraph it is said that "Sources estimated to contibute less than one thousand pounds of copper per year....are not included..." This bothered me because 500 lbs X (eg) 5 sources would be 2500 lbs; more than some others that are included, although, given the other uncertainties, these sources are unlikely to affect any results. However, this matter is discussed at the end, on Page 3-1, so, strictly speaking, the sources are included, but the numbers are left out for the reasons given there. I suggest the sentence might read something like: "...are discussed in the report, but no numbers are included in the inventory."

I'll be very interested to see how this all comes together in the end, and what the conclusions look like, uncertainties and all.

Comments from Tom Barron, (06-22-05)

Thanks for the opportunity of reviewing your work. I have two comments about the copper loading estimate that you prepared for Sustainable Conservation. Both questions have to do with the architectural copper runoff calculations in Section 2 of the 6/10/05 report.

1. Residential Land Use Area in San Francisquito Creek Watershed

In the 2001 study for Palo Alto, we estimated that residential properties comprise 70% of the land use in the Regional Water Quality Control Plant (RWQCP) service area (i.e., 107 million sqm out of 153 million sqm). Further, we estimated that 30% of the 107 million sqm (or, 32 million sqm) are occupied by residential roofs.

Your Tables 2-3 and 2-5 together show San Francisquito Creek watershed as having 251 million sqm residential out of 485 million sqm total area, or about 52%. The difference in percentage

(70% versus 52%) probably comes from the fact that the full watershed has more open, undeveloped land than the RWQCP service area.

The observation that I would make is that the percentage of residential land taken up by roof area in the full San Francisquito Creek watershed (and in the other watersheds that contain significant numbers of larger lot sizes) is probably less than the 30% that we used in the RWQCP service area.

You may want to consider using a residential roof area percentage in Table 2.1-1 that is smaller than 0.3 (30%).

2. Copper Emission Factors for Architectural Features

Here is my understanding of the emission factors that you have used in your analysis for the annual net release of copper from buildings:

Copper Roof Areas
1.8 g/sqm/yr (area = full roof area) - Based upon He (2001)

Copper Gutters & Downspouts
4.0 g/sqm/yr (area = feature area, not roof area) - Based upon Uribe (1999)
(presumably discounted by 0.0325 when calculating with full roof area)

Algae-Resist Shingles
0.2 g/sqm/yr (area = full roof area)

I would comment that there is a range of opinions about emission factors for copper roofs. I've misplaced my copy of the He report, but note discussions of it in three locations:

- Karlen, Wallinder, et al. (2002) - search PubMed;
  [Copper emission factors from 1.0 to 1.5 g/sqm/yr]

- Parametrix (2003) - CDA.org; and
  [Copper emission factors from 1.04 to 1.24 g/sqm/yr]

- Arnold (2003) - CDA.org.
  [Copper emission factor of 2.04 g/sqm/yr]

You may wish to reconsider these other references, and utilize an emission factor somewhat lower than 1.8 g/sqm/yr.

Also, please confirm that the estimate of copper released by gutters and downspouts includes an additional factor to discount the 4.0 g/sqm/yr when total roof areas are used in the calculation.

Comments of Kevin Reinert, Principal Toxicologist, AMEC Earth & Environmental (07-22-05)

1. Ms. Rosselot has done an excellent job working with many varied sources of widely varying quality and quantity in order to complete the non-brake pad loading document.

There is some overlap between some of the loadings for soils when considering pesticides, fertilization, etc. The report is not as clear on what is included in each category and it seems that some categories are discussed twice, and their contributions are (may be) included in the overall loading several times.

Pie charts, which describe the loadings on a holistic basis and by loading category, would be good to include in the report.

The use of Cu in roofing shingles should be listed under pesticides and not architectural as it tends to inflate the architectural estimate even if only by a slight amount. The report should strive for accuracy wherever possible in order to place each source in the proper context, to avoid misinterpretation and to help develop an appropriate copper management plan for the Bay.

2. For the most part, the uncertainties, variabilities and sensitivities in the data are described appropriately. It might be possible to bound some of these issues more closely using Monte Carlo or other probabilistic approaches, although the effort required to use such techniques were probably out of scope for this current effort.

3. For completeness, the report should include inputs from the Central Valley (some 20X higher than the local watershed inputs) and the near shore inputs that are listed in other reports produced for the Bay area.

Several sources, marine antifoulant paints (MAF) and parking lot and other hard surface runoff have either been underestimated or neglected. San Francisco Bay is home to major shipping industries and by counting only the berths in marinas the potential releases from ocean going vessel, ferries and other commercial ships is not captured. The level of copper in the MAF (often higher because they spend more time at sea) and the larger surface area of these vessels make it important to quantify the contribution to the loadings. Parking lots have been shown to be significant contributors to copper loading, especially on first flush after a rainfall.

4. Some attempt to discuss the dissolved and bioavailable fraction associated with each source should be made. Unless the atmospheric, watershed and bay models with determine the bioavailable faction, loading based on totals will produce erroneous results and be less useful in development of the overall Bay management strategy.

5. Division of the watershed into distinct units (e.g., sub-watersheds) upon which the entire mass balance 'model' can be calibrated is essential. Addressing the locations and contributions of these sources with respect to location in the watershed is important. Correct spatial placement will better ensure that the models developed and the overall management plan will be a useful and successful tool.

Comments of Kelly Moran, TDC Environmental (07-25-05)

A. Architectural Copper

A1. Residential installations. Colloquial information (based on my own observations and other observations of my colleagues) suggests that most residential copper roofs in the Bay Area are installed on multifamily structures. Higher density residential developments are more likely to be directly connected to storm drains (which is often required by local building codes for structures other than single-family homes) or surrounded by impervious surfaces than low-density single-family homes.

A2. Land use data. The land use-based roof area estimates used in the Barron report were based specifically on a set of land use data from the Association of Bay Area Governments (ABAG). These data are not consistent with the land use data provided for Process Profiles' use in this report. While the residential land area is close (less than 10% difference for 9 counties—and almost the same for watershed), the commercial/industrial/institutional/transportation value is about 40% (about 1/3rd for watershed) of the ABAG value for these land uses. To apply the percentages used by Barron, it will be necessary to use the ABAG data. Since the ABAG data is not currently available by watershed, it will be necessary to use an adjustment factor to develop estimates for each watershed (e.g., use the 9-county ABAG data to develop a 9-county copper estimate, and then scale that estimate based on watershed-specific population or land use data).

B. Pesticides

B1. Application of correction factors for sales and use data. I recommend that the correction factors be applied at the end of the calculations, rather than at the beginning. I believe that introducing the corrections at the beginning has inadvertently given us some values that are residuals from the subtraction of two adjusted numbers.

B2. Limit application of sales correction factors. DPR identified a problem with its sales data that is specifically linked to retail sales of pesticides. It may have error in sales to professionals, but—according to DPR—the systems for fee collection from distributors that sell to professional applicators (who report pesticide use) are much stronger and less likely to understate sales significantly. Thus, for pesticides with no significant "over the counter" sales, the sales correction factor appears to be unnecessary. I recommend that the sales adjustment only be applied to the retail part of the sales data (i.e., to the difference between sales and reported use).

FYI, shelf surveys at major Bay Area pesticide retailers have identified few copper-containing products in small quantities (see 2004 and 2003 San Francisco Bay Area retail shelf surveys, available at http://www.up3project.org/up3_use.shtml). My observation when conducting these annual shelf surveys at the Bay Area's major pesticide retailers is that copper-containing landscaping pesticides are sold only in small containers (1 quart

and smaller). These pesticides are given little shelf space and are often dusty (indicating low sales volume). This information suggests that retail sales are unlikely to be important for copper active ingredients other than pool, spa & fountain algaecides, root killers, and possibly self-applied wood preservatives. (As the report acknowledges, copper-based root killers are not allowed to be used in the Bay Area, but which are sold at retail throughout the rest of the state.)

B3. Consider need for pesticide reported use adjustment factor. While pesticide use reporting is not audited, the under-reporting of pesticide use varies among pesticides. An analysis by Pesticide Action Network showed that pesticides that have been highly controversial have relatively low reporting rates (sales are much higher than reported use). Since copper-based pesticides are often considered "safer substitutes", it is unlikely that they would be subject to systematic under-reporting. For this reason, I'm not sure that the adjustment is needed. (I recognize that the error estimation method does not seem to provide for a "not less than" function on one side of the estimated value, making it difficult to avoid an adjustment.)

B4. Descriptions of reporting. Text on page 13 should also note that pesticides not reported include those formulated into consumer products such as marine antifouling paint and treated wood. While many drinking water applications are not reported, the footnote on Table 2.2-1 is not exactly correct. It is not clear that drinking water applications are not reportable. (I think this gap is appropriately handled in the surface water applications section.) Also, statewide, drinking water applications are probably not small, as I understand from colloquial information from colleagues who work with water suppliers that outside of the Bay Area (where copper discharges have not been a concern and the water board asked water suppliers not to use copper), copper applications can be frequent and involve large quantities of copper (hundreds of pounds per application).

B-1. Urban land

B5. Using label information to improve estimates. In reviewing the estimates, I found some that could be improved by using information from the product labels. I reviewed the DPR product/label database to identify allowable uses of some copper-containing pesticides. For certain products, I also reviewed EPA-approved labels for products of interest. The notes below are informed by these reviews. The estimates will be improved if this information is used to develop revised estimates (note that it primarily affects the urban land application estimates in Table 2.2-2).

- Copper Thiocyanate is only registered for marine antifouling paint use. All sales should be assumed to be used for marine antifouling paint. Urban land applications should be zero.
- Copper Oxide (Cuprous). There are 220 products, only 5 of which have non-antifouling paint uses. Of the five, one is wood preservative (Osmose brand CCA); one is the copper used in roofing shingles (3M Copper granules); one is labeled "for agricultural use only"; and the other two are labeled in a manner that suggests that the products would only be used by professionals (and only one of these lists non-crop application sites—these are for ornamental landscaping). Thus it is reasonable to

assume that all use would be reported or accounted for in the wood preservative and roof estimates (since CCA and roof shingle impregnation materials are not retail products). Urban land applications should be estimated on the basis of urban reported use. Sales that are not accounted for by reported use can be assumed to be comprised of marine antifouling paint, preserved wood products, and roofing products, all of which are estimated by other means.

- Cupric Oxide. Of the five registered products, two are for manufacturing use only, and the other three have labels that restrict use to industrial application to wood by pressurized treatment. This means that all cupric oxide should be assumed to be included in pressurized wood (and none applied directly to urban land by consumers). There is reported use of cupric oxide for landscape maintenance and structural pest control (both of which may have involved applications to wood). This is either an error (could have meant cuprous oxide) or application of very old products (perhaps once products were registered that allowed self-application). Rather than figure out the cause of these odd data, given the small quantity statewide, it would be appropriate to simply estimate the urban land applications on the basis of the use report data.
- Copper Ammonium Carbonate. All 3 registered products are only for pressure treatment of wood. This means that all copper ammonium carbonate should be assumed to be included in pressurized wood (and none applied directly to urban land by consumers). There is reported use of copper ammonium carbonate for landscape maintenance. As with cupric oxide, this is either an error or application of very old products (perhaps once products were registered that allowed self-application). Rather than figure out the cause of these odd data, given the small quantity statewide, it would be appropriate to simply estimate the urban land applications on the basis of the use report data.

B6. Some of the urban land applications are actually wood preservatives. The report should recognize this is the case by so noting in the text or a footnote. This note would apply to 100% of copper ammonium carbonate and copper naphthenate and portions of several other compounds. (This topic is further discussed below).

B7. Use all reported urban use data. In Table 2.2-2, I recommend adding a column that contains reported urban applications that are not already reflected in the table (I believe that this should only be urban land applications) and a column for difference between sales and reported use (this is the initial estimate of retail sales prior to any adjustments). The use reporting data will form the basis for urban land application estimates for a few active ingredients: Cuprous oxide and cupric oxide (see above), and copper sulfate pentahydrate.

The one copper sulfate landscaping product is a professional product. There are not any other products labeled for urban land application. This means that for copper sulfate, urban land application estimates can be based on reported use. (Unreported use is algaecides and root killer).

B8. Overlap between wood preservatives and other uses. Some copper compounds are used as wood preservatives, but are also used for urban land applications and/or algaecide applications. Pesticide use reports cannot be used to separate out these applications, because pesticide used in manufacturing consumer products do not have to be reported (though they are sometimes reported anyway). This overlap needs to be considered in two places:

- Algaecide estimates—Copper metal and copper ethanolamine complexes (mixed). Copper metal and copper ethanolamine complexes (mixed) have wood treatment uses that need to be considered in developing algaecide use estimates. The two copper metal products that are not algaecides or fungicides are both components of ACQ and are labeled for use only in making pressure treated wood (and thus overlap with the wood preservative estimates). The three copper ethanolamine complex wood preservatives are labeled for surface treatment of wood that is already in service (and thus overlap with the urban land estimate). This means that pool, spa, and fountain uses of these products will be overestimated under the current method.
- Urban Land estimates—cuprous oxide, cupric oxide, and copper ammonium carbonate. There may be some overlap between the wood preservatives estimated in the urban land applications and the estimates of wood preservative copper releases from factory-treated wood. In comment B5, I suggest a manner for disaggregating these uses for all three pesticides.

To address the overlap noted in the first bullet, I recommend an additional estimate (perhaps another table) of wood preservative uses, using the market data attached. This will entail some judgment calls, as multiple copper compounds are used in wood preservatives, while industry data is only supplied in totals (rather than by individual active ingredient). (Ultimately the judgment calls will not be important, as they will not change the total estimates of copper released.) The analysis should be able to identify the amount of copper that is currently double counted (i.e., estimated as released in algaecides or to land *and* included in the treated wood estimate).

To complete this analysis, it is necessary to know how much of the treated wood sold in California is manufactured in California. I have enclosed a market description obtained from the Western Wood Preservers Institute internet site (see http://www.wwpinstitute.org/mainpages/Cal_issues_2003.shtml), which says that at least 450,000 of the 550,000 board feet of treated wood sold in California is treated in California. This means that at least 80% of the copper estimated to be contained in treated wood in California would be included in the copper pesticide sales data. Another as much as 50,000 board feet of wood treated in California is estimated to be sold outside of California—the copper from these pesticide sales should ideally be removed from the estimation (if it is possible to do so).

B9. Copper ethylenediamine complex estimates in Table 2.2-1. I can't figure out why the estimated pool, spa, and fountain use of copper ethylenediamine complex is not zero. The values for this low-use compound are all based on reported use data, since sales data are not public. There is no reported pool, spa, or fountain use. If this isn't an error generated by the adjustment factors (the most likely cause), I'd appreciate if it could be checked further to ensure that it is not indicative of a systematic calculation problem.

B-2 Surface water algaecides

B10. Agricultural applications to surface water and rights of way. I spoke with staff from the Alameda County Agricultural Commissioner's office and a consultant who does aquatic pesticide permitting about these applications. They both said that farmers treat water ponds and conveyance channels flowing to their fields, but don't care about discharges (which are usually from tile drains under soil; this isn't water they can re-use). Since water applied on fields would lose essentially all of its copper when it goes into the ground, it would be safe to assume that no discharges occur from the agricultural treatments.

B11. Non-agricultural surface water treatments. I recommend that a few more words be added regarding the uncertainty of this estimate. Some of these treatments involve drinking water, rather than surface waters adjacent to the Bay. Given the way the reporting occurs, I think that we're probably missing a lot of these applications. From my review of the data, it looks like maybe half of these applications might be in drinking water—but that maybe half aren't getting reported to DPR. So the general assumption that an amount equal to the reported amount discharges to the Bay seems very reasonable. It would help to add some additional caveats about this to clarify that some copper is used for drinking water and some copper is not reported (see page 38 of the Copper Sources in Urban Runoff report for an example).

B12. Non-agricultural rights of way (etc.) treatments. Like the above, some of these are used for drinking water conveyance—but we don't know how much—so it is not possible to adjust for these applications. It would be good for the report to note uncertainty. The bigger issue is one that I think should be identified for the modeler—data from monitoring programs (e.g., the surface water permit monitoring requirements from the aquatic pesticide applications permits required by the California State Water Resources Control Board) apparently show that most of the copper applied in surface water conveyance channels is quickly removed into sediments in those water bodies. I can't access this data right now, so I think the appropriate course of action is to flag this as an issue for the water quality modeling, so that the release can be adjusted to reflect the losses to sediments (which then become enriched in Cu and a long term source of low-level Cu leaching until they are buried or removed).

B-3 Wood Preservatives

B13. Amount used. The market share for treated wood in California is lower than it is nationally, probably due to the availability of redwood, which does not require preservatives for many of its uses. An industry-sponsored market analysis provides California-specific data that can be used to create better estimates for Bay Area wood use (*Economic Evaluation of Alternate Materials To Treated Wood In California*, prepared for the Western Wood Preservers Institute, enclosed). The report covers all treated wood sold at retail (not just pressure-treated wood). My apologies for forgetting about the existence of these data (which I also neglected to use in my own report). In that report,

"waterborne" treatment includes copper-containing preservatives. "Oilborne" is primarily pentachlorophenol. (There is at least one oil borne copper-containing product, a formulation of copper naphthenate.) There are also some water borne non-copper products (zinc-containing preservatives). The most common water-borne preservative has been CCA.

B14. Leaching rate estimate should be reduced. California market data (referenced above) shows that only about 4% of treated wood is used in aquatic applications (and some of this does not contain copper). This suggests that using the water leaching–based estimate could greatly overestimate leaching rates. I found measurements of annual leaching rates from new CCA-treated wood from a U.S. Forest Service study (enclosed). These rates translate to about 9.5 µg/square cm Cu-treated wood/year of Bay Area rainfall—an amount that is in the range of the loss in one day in samples submerged in water (per the rates provided in the CDA report). Note this is an initial leaching rate and that the Forest Service authors thought that the rate was higher than would be normally experienced.

B15. Copper concentration in treated wood. The California market data shows that wood preservative concentrations for the outdoor uses dominating the California market have lower copper concentrations than 1 kg/cubic meter (the assumed copper concentration). Using the CDA copper concentration data and the market study referenced above, it appears that products treated with 0.5 kg Cu/cubic meter dominate the market volume, followed by products treated with about 0.9 kg Cu/cubic meter. Higher treatment rate products exist in the marketplace; however, these have relatively low market share in CA (e.g., wood for aquatic applications) or they are not used in manners exposed to urban runoff (e.g., foundation piles, structural wood).

B16. Comment on future market shift. Although our focus for this project is past discharges (when CCA remained in use), the report correctly notes that future market shifts may modify copper release rates from treated wood. Non-CCA copper-containing alternatives, as it mentioned, do release more copper; however, other alternatives (e.g., non-wood composite materials) have been gaining significant market share (at least according to the press and to personal observation). At this point, I think that it is not certain that the overall outcome of the market shift in response to CCA cancellation will be to increase copper releases in urban runoff.

C. Industrial

C1. Clarification. In the Copper Sources in Urban Runoff report, the estimate is based on the number of acres of industrial facilities that have filed NOIs to be covered under the SWRCB's Industrial General Permit for urban stormwater runoff in the San Francisco Bay Watershed. This is not the same as the total industrial acreage. (Note: The NOI filers are a specific subset of all industrial facilities.)

C2. Adjustment of land use data. The industrial land area from the NOI data are for the SF Bay watershed—not for the 9 county region. The State Water Resources Control Board

provides the data by watershed, so it definitely excludes facilities outside of the watershed.

D. Sources not included

D1. Name of earthquake. Please substitute "1906 earthquake" for "Loma Prieta earthquake". The Loma Prieta earthquake was in 1989 and did not result in any demolition being dumped around the shoreline of any city (modern permit requirements preclude such dumping). Also please replace "city" with "San Francisco."

Comments of Bob Peters, Director – Systems and Analysis Engineering, Akebono Corporation (08-02-05)

To my knowledge all brush-type D-C motors and generators (including car and truck alternators) use copper in their commutators. While the commutator on such devices are typically not designed to be the primary wear item they do, from my experience, show signs of wear. For on- and off-road vehicles I expect that the commutator wears anytime the engine is running and as alternators are typically pretty well vented the brush and commutator wear debris escapes to atmosphere. I am trying to find out what type of commutator wear rate is expected.

I'm nowhere close to an expert on light rail systems - but from the tour pictures it looks as though the BART rail trains use a 3rd rail type of electrical power system and it would seem like the contact to the third rail has a high probability of being made from copper. I expect that this contactor pad or shoe rubs on a charged rail and this pad or shoe would be the wear item in that friction pair. Even though the 3rd rail is covered, the friction is dry and would probably produce debris that gets dispersed as trains pass by. I think each rail car has it's own motor which probably means that each car has it's own electrical pick-up.

Both of these items are undoubtedly small relative to the other loads but, in my opinion, should be mentioned in Kirsten's report if for no other reason than to avoid this question in the future. I see in section 3 of the report that the electric transit vehicles are mentioned but the paragraph in the report indicates this is only at points where the vehicle is powered by an overhead wire. Restricting consideration of potential copper wear debris to only areas operating with overhead wires seems to disregard a significant part of the system. It would be really desirable if a study could be located that investigated debris around the rail bed areas of electric powered light rail systems. Alternatively, BART should know from maintenance records how many contactor pad or shoes are consumed each year.