NEVADA DIVISION OF
ENVIRONMENTAL
PROTECTION

STATE OF NEVADA
Department of Conservation & Natural Resources
Steve Sisolak, Governor
Bradley Crowell, Director
Greg Lovato, Administrator

October 24, 2019

Jay A. Steinberg
Nevada Environmental Response Trust
35 East Wacker Drive, Suite 690
Chicago, IL 60601

Re: **Tronox LLC (TRX) Facility**
Nevada Environmental Response Trust (Trust) Property
NDEP Facility ID #H-000539
Nevada Division of Environmental Protection (NDEP) Response to: *Soil Background Evaluation Report*

Dated: August 30, 2019

Dear Mr. Steinberg,

The NDEP has received and reviewed the Trust's above-identified Deliverable and provides comments in Attachment A. A revised Deliverable should be submitted **by 12/24/2019** based on the comments found in Attachment A. The Trust should additionally provide an annotated response-to-comments letter as part of the revised Deliverable.

Please contact the undersigned with any questions at wdong@ndep.nv.gov or 702-486-2850 x252.

Sincerely,

Dong Weiq

Weiquan Dong, P.E.
Bureau of Industrial Site Cleanup
NDEP-Las Vegas City Office

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Attachment A

Fatal Flaws

Specific Comment #1
The Site versus background comparisons performed seem inappropriate. It appears that the method used was to select a background data subset that matches the Site data, instead of selecting the background data subset based on a conceptual understanding of the site and performing the background comparisons using comparable Site and background data. For example, comparison of UMCf Site data with McCullough background data simply does not make sense from a conceptual model perspective – it could make sense if UMCf and McCullough Qal had similar concentrations, but they do not.

The objectives of this report are stated in terms of Site vs background comparisons, yet much of the report is focused on comparisons of the new background data with previous background data. It is preferable that the Deliverable be split into 2 reports, partly so that any future reports could reference a comprehensive update to the previous background studies, but also to provide clarity to the reporting and use of these new data.

Specific Comment #2
As the Deliverable is concerned with deep data (defined as data below 10 ft bgs) the focus of the background comparisons should be the deep data. If a report was to be written (adapted from this one) to compare all background datasets using exploratory data analysis (summary tables and plots) then inclusion of the shallow background data would be appropriate, but in this Deliverable that is ultimately focused on comparison of Site UMCf data with background data, there is little reason to include any background comparisons involving shallow Site data.

Please remove the shallow background comparisons and any related tables with appropriate explanation of the reason for inclusion of the deep data only.

Specific Comment #3
The potential new deep background data set is evaluated by making multiple comparisons to different data sets that do not make sense. It would only make sense to compare to combined background datasets if these were shown to be the same statistically, but they are not.

Please revise the Deliverable to present comparisons of the new data set to only matching lithologies it was meant to augment or replace.

General Comment #1
The report indicates that the objectives are to compare Site and background data. However, there are really two objectives, the first being to compare new background data to some of the previous background data, and the second to compare Site samples to background data. The Deliverable may be better served by splitting these two objectives into two reports. The data collected represent a specific geologic unit in the UMCf, which are intended to fill a data gap in the previous background data for the entire BMI Complex. It would be helpful if the analysis of the background data was in a separate report from the comparisons of Site and background data. This would allow for easier reference later when the

background data might need to be referenced again and/or used differently – having a comprehensive updated background report would be useful.

It would also be helpful, then, if statistical data analysis was presented of all the background data by lithologic unit. This could be done with side-by-side box plots, or dot plots with different colors for each unit (like the depth plot in Figure 2a), or other. This would also help explain why the appropriate background subset needs to be used in background comparisons.

This might also help avoid the somewhat confusing presentation where overlapping subsets of background have been used for comparison with Site data.

General Comment #2
It has been well known for more than 20 years that arsenic (As) concentrations are greater with depth (originally based on the now obsolete data collected in the 1990s). A possible reason is, as stated, different concentrations in different lithologic units, but another possible reason is movement of As in groundwater from areas in which As has been released from the soil matrix. The more extensive the background study (spatially) the less likely the latter argument holds, nevertheless, arsenic has been released from the soil matrix in some areas (e.g., RZ-A – possibly from acid solvent dumping and possibly from leaking pipes), and transport through the groundwater pathway could have affected As concentrations downgradient. In fact, it may well be that this is the reason why Arsenic concentrations are so low in RZ-A (and why other metals are low and a few are high).

Also note that the number of background samples attributed to different lithologic units is different than recognized by NDEP (based on Neptune's report in June 2018 – attached for convenience). In general, it appears that NERT is unaware of this reference, which should be regarded as definitive, and if NERT (or anyone else) wants to suggest changes, then a formal process should be followed for doing so to maintain some consistency across the program.

Essential Corrections

Specific Comment #4 Introduction
In looking back at the Work Plan for this study, there were some persuasive arguments for collecting these data, but those are very muddled or not present in this Deliverable. Some text in this report is copied from the Work Plan, and it's unclear why more of it isn't. The rationale in the Work Plan was based on the conceptual model of the site and lithological concerns with the previous BMI deep samples south of the Site in regard to the fine-grained UMCf, in that it is known to pinch out in that area within 1,000 feet south of the site.

Rationale from the Deliverable cited a lack of deep UMCf-fgl samples (24) compared to a calculated amount needed of 35. In later sections, the UMCf-fgl and McCullough (which NERT and Rambol had, in previous work, reassigned into a combination of alluvial Qhl, alluvial Qh2, and coarse-grained UMCf). This Deliverable needs to fully explain any re-assignments made, and how that affects background, and then write an updated separate

background report with the new data included. This should be done in conjunction with Neptune's June 2018 background memo that is attached here. Comparing the NERT Site data in OU-1 does not make sense from a lithological standpoint nor is it cohesive from the rationale stating the need for more samples in Section 1, as this brought the sample total for BMI deep background to 106 – well above 35.

It is recommended that more of the rationale from the Work Plan should be included when describing the need for additional UMCf-fg1 samples. In addition, please work through NDEP to update previous work on the background data so that the update can be made available consistently across the complex.

Specific Comment #5 Section 4

The Work Plan stated a desire to reassess which samples from the BMI deep background data set may be useable and reliable as UMCf-fg1 deep samples. This was not assessed in the Deliverable. That it was not is not necessarily a criticism of this Deliverable in and of itself, though it would have been interesting to see, except that statistical comparisons to the new samples included all 24 of the previous BMI deep fine-grained UMCf samples and concluded the data sets were from different populations. If there was a concern about the suitability of some of the BMI deep UMCf samples south of the Site that should have been investigated prior to the comparison and any differences seen could plausibly be due to those concerns. If a portion of the 24 BMI deep background fine-grained UMCf samples are not really fine-grained UMCf but are coarse-grained UMCf or alluvium it might be expected that a statistical test would find concentrations to be different. This concern (as stated in the Work Plan) is not investigated or treated in this report except vaguely as a reason to combine the entire McCullough portion of the BMI deep background data set with the UMCf-fg1 samples in Section 4.

In addition, comparisons to the new deep samples, which are only from UMCf-fg1, were also done to the BMI deep McCullough data set and the combined BMI deep McCullough and UMCf data. Without further explanation, it is difficult to come up with a valid reason why these comparisons were necessary. These sorts of permutative comparisons do not make sense from the standpoint of a conceptual model in which lithology is important to background concentrations, which was at the root the Work Plan rationale for gathering the additional samples. A more appropriate, simplified comparison would be comparisons solely against the UMCf-fg1 BMI deep background samples (and perhaps only ones from sampling locations east of the Site) to the new UMCf-fg1 samples west of the Site.

No additional descriptive comparisons are made between the UMCf-fg1 deep background data sets. An example that might (or might not) have relevance is that all but three of the BMI deep background data set UMCf-fg1 samples range from 80 feet (ft) below ground surface (bgs) to 160 ft bgs. The new deep background UMCf-fg1 samples presented in the Deliverable are described as having a depth, at most, of 50 ft bgs. Part of the rationale for collecting these data is that naturally occurring concentrations (presented in arsenic in Figure 2a) could potentially increase with depth and lithology compared to surficial data collected above 10 ft bgs used as a target remediation goal. This discrepancy in depth is not brought up in the Deliverable despite it being a factor in the rationale for needing additional samples. This alone could be a data gap argument for including these new samples in deep background comparisons.

Please remove comparisons of new deep UMCf-fg1 data to any deep McCullough data (i.e. remove the BMI combined and BMI McCullough comparisons) or add a well-reasoned explanation for why this comparison would be meaningful.

Specific Comment #6 Section 4

The Deliverable is evaluating a new background data set *and* comparing site samples to this new background data set. Thus, as mentioned previously, the Deliverable should be split into two reports with separately focused purposes: one to evaluate the background data set, and later, and one to evaluate the site samples to an appropriate and approved background data set. It is assumed that the purpose here of the background comparisons in Section 4 is to give some perspective as to how the new background samples may affect background comparisons and not to substitute the comparisons presented here to COPC selection in the forthcoming RI. Additionally, enough information was not included about the Site data used in this report to review section 4.

There is mention of a forthcoming OU-1/OU-2 RI report. Please explicitly state that these comparisons will be redone and/or included in the forthcoming RI and are not presented for approval here. Although a question remains as to why the Site vs. background comparisons are performed in this report if they are to be repeated in the RI report. As noted above, we would prefer that this report by split into 2 – the 2nd part could simply be part of the RI report.

Specific Comment #7 Section 4

There are three basic conclusions reached in Section 5:

- "The RI UMCf background data set was found to be appropriate for supporting future assessment and decision making with respect to UMCf soils, with the exception of niobium."
- "... the RI UMCf background data set was generally found to be from a different population than the BMI deep background data set, for both deep McCullough alluvium data and fine-grained UMCf data."
- "[Because both deep datasets are from offsite], it is appropriate to perform comparisons of Site data below 10 ft bgs to both the RI UMCf background data set and the BMI deep background data set."

As for the first bullet point, there does not seem to be anything presented that would detract from that statement, though it would be interesting to see plots similar to Figure 2a that also included the new deep data and the existing BMI deep data set fine-grained UMCf data by chemical. The fact that the new UMCf deep data set is considered different from other background data could cause concern about its appropriateness without a plausible explanation.

In addition to the statistical comparisons presented, please provide a lithologic mechanism by which this data west of the Site still represents Site background conditions and is from a different enough population to be kept separate from the existing BMI deep UMCf-fg1 data set.

The second conclusion is not surprising for the McCullough alluvium data, but it's unclear why this comparison was necessary. Doing a comparison only against UMCf samples in the BMI deep data set would resolve the inconclusive results for barium, lead, and vanadium.

There is also no discussion about the different depths of the two UMCf data sets compared. Perhaps this is the mechanism driving some of their differences.

Please compare and summarize only new deep UMCf data to existing BMI deep UMCf data in Section 3 to support this conclusion. Please adjust Table 3 to reflect only UMCf-fg1 BMI deep data.

The third conclusion is problematic, especially in the way it is applied to background comparisons with Site data.

The Deliverable is arguing that the new data set should be separate from the BMI deep background data set, not included as additional samples for that data set, yet that both data sets should be used for background comparisons to Site data in a way that a metal from a particular Site data set could be declared consistent with the BMI deep background data set and another metal from the *same* Site data set could be found consistent with the new NERT RI deep background data set but not necessarily with the BMI deep background data set. This report also suggests that the same should be done for shallow Site data, that it should be compared to both the RZ-A and BMI shallow background data sets. Whichever dataset is found consistent with Site data will be used for COPC selection for a given analyte. However, if a chemical is only consistent with one data set, the argument could be flipped around. One could even say that any chemical not consistent with *both* data sets will be retained as a COPC. But none of these options make sense. There should be a single appropriate, comparable and approved background data set for a given Site data set.

There is a path to a more logical argument in which Site data below 10 ft bgs in the fine-grained UMCf is compared only to the new deep background data presented in this report solely due to uninvestigated concerns about the validity of samples in the BMI deep dataset actually being UMCf-fg1. Or perhaps an argument could be made that deep site data 50 ft. or less should be compared to the new deep background data set. Site data from other lithologies below 10 ft bgs are still compared to the other lithologies collected in the BMI deep background data set (putting aside concerns about Qh1 vs. Qh2 for now). However, that was not the argument made, and concerns about the existing UMCf-fg1 BMI deep background data were barely raised.

This argument to 'find' any background data set that is consistent with Site data and the opening sentence of the Summary and Conclusions section that mentions previous investigations (perhaps opening the door to retroactively use any data set that matches) is concerning even if it has little bearing on the results. The logic needed seems to have been reversed. The report seems to be looking for a background data subset that matches the Site data, instead of identifying the appropriate background data subset to use for comparison by lithology.

It is not necessarily that the newly collected data set should not be used or that it is not representative. It is that this report does not provide a well-reasoned argument that it should be

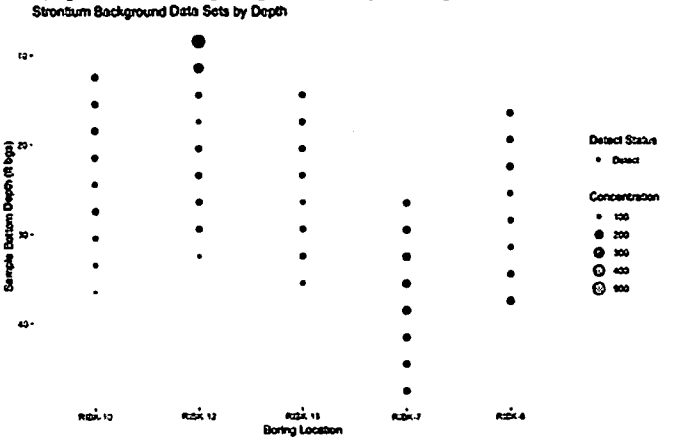
used in the stead of, or not combined with, previously collected data, both from a conceptual standpoint and from the standpoint of how this new data may be applied to any investigations.

Please provide an argument why and when the recent NERT UMCf deep data set should be used in background comparisons with fine-grained deep UMCf NERT site data instead of the fine-grained UMCf BMI deep background data, why and when the deep BMI UMCf fine-grained data should be used, or why and when they should be combined for use in background comparisons.

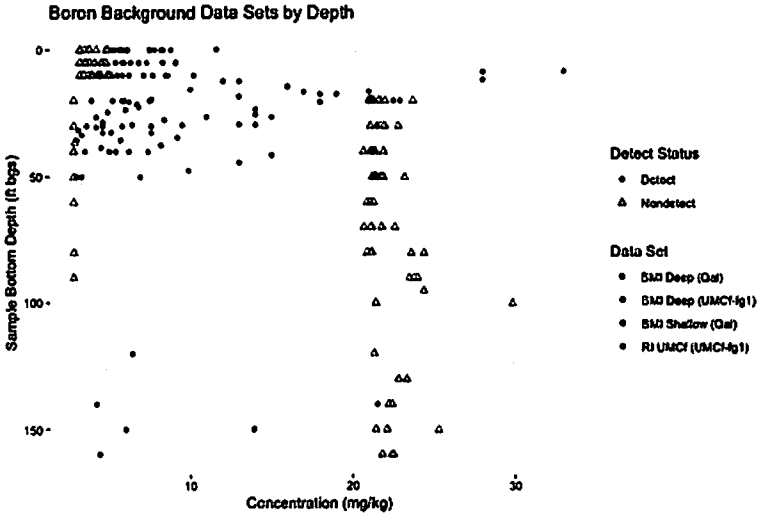
Specific Comment #8 Figures

The existing boxplots and quantile plots are nice compliments to the Deliverable, but it would be better to see more by-analyte plots of the RI UMCf data set by itself and with other data sets, such as depth profiles of each analyte by sampling location and figures similar to Figure 2a to give some idea of how each metal and radionuclide behaves with depth in different data sets.

An example intensity plot of a depth profile by sampling location:



To follow is another example of plotting the depth profiles by analyte and data set. The site data could also be included for comparison:



Specific Comment #9 Section 1.3, subsection "RZ-A Background Data Set".
In regards to the RZ-A background data set, NDEP has suggested that the northern portion of the NERT Site is more in line with shallow McCullough data, and the RZ-A data should only be used for comparison in the southern portion of the site. Please amend this in the text. This can/should be referenced to a technical memorandum written by Neptune for NDEP in June 2018 (attached for convenience).

Specific Comment #10 Section 1.3, subsection "BMI Shallow Background Data Set".
The description of this dataset is incomplete. First, the BMI shallow background data set also includes data sampled by Environ in 2002 as part of the 120 samples. The first sentence of this subsection makes it sound like all 120 samples were collected by TIMET/BRC in 2005. Please include the Environ sampling dates as well for the 16 Environ samples generally included in the TIMET/BRC BMI shallow background data set. Second, the 19 excluded samples mentioned in the third sentence of this subsection are described as being River Range samples. Only 8 of these samples (all from the Environ data set) are fully River Range samples. The other 11 are considered 'Mixed' (representative of areas where the McCullough alluvium and River Range alluvium are considered integrated). If this subsection is retained, please amend this sentence to explain this difference.

Further, the 101 samples includes the ENVIRON dataset, which have not been used for a while (except by Montrose in 2017). The reference provided is incorrect as the 101 includes ENVIRON data. These 101 samples are entirely McCullough – 95 from BRC/TIMET and 6 from ENVIRON. Most BMI studies use the 95 from BRC/TIMET only, and the ENVIRON data have been marginalized or completely removed from most assessments. To be consistent with all other work (except an anomaly from Montrose), this analysis should be based on the 95 McCullough samples from BRC/TIMET. See attached report submitted by Neptune to NDEP in June 2018.

Specific Comment #11 Section 1.3, subsection "BMI Deep Background Data Set".
The second sentence of this subsection lists 71 samples for the River Range or mixed River/McCullough, but there are only 68. Additionally, NERT and Ramboll Environ previously reclassified many of the McCullough deep samples as UMCf-cg and the existing UMCf as UMCf-fg1. Additionally, the remaining McCullough samples have been split into two separate geologies: Qh1 and Qh2. Qh2 does not exist on Site. Please include this information when describing this background data set and any issues that may still remain after that effort. Please also double check the number of River Range and Mixed samples excluded.

Specific Comment #12 Section 1.4
How was 35 samples determined as needed? There are no calculations, data quality objectives (DQO), etc. Twenty-four samples is often enough for statistical analysis, but 35 is fine if that's the outcome of some form of DQO process. Collecting more for other possible consequences (different concentrations by MCf layers) is fine, but again, more justification should be provided.

Specific Comment #13 Section 2.1, second paragraph.
It is worth noting that one sample and its field duplicate (RIBK-12-8.0-20180613 and RIBK-12-8.0-20180613-FD) are technically sampled above 10 ft bgs and that in general, 'deep' data is considered that which is below 10 ft bgs. Please include this note.

Specific Comment #14 Section 2.3.
There is no discussion how field duplicates were handled. Please include a sentence or two about how field duplicates were assessed and treated in the RI UMCf data set.

Specific Comment #15 Section 2.3
It is not clear if the niobium data were compared to previous niobium data at the site. Please clarify. Matrix spike data are not always a good reason to reject data, and comparison to previous data could be made for final determination of the efficacy of the matrix spike data to support such a decision. Data validation takes only a rote chemistry view of the data, whereas statistics takes a more holistic view. Some attention should be paid to the actual data before rejection is confirmed based on data validation alone.

Specific Comment #16 Section 2.4
NDEP guidance indicates the need to use all radionuclide data, and to not censor the data in any way. This can require using reported negative data. This does not appear to have been done here.

However, it is noted that for some of the analyses presented here, the older data might not be available without censoring. If using fully uncensored data is not possible, then the treatment of the data needs to be the same across all data sets.

Specific Comment #17 Section 2.5
While outliers do not appear to have been removed, this analysis seems largely unnecessary. 1.5 x the IQR is an arbitrary cut-off for an outlier that is intended to be used qualitatively to identify potential issues. All data should be included in subsequent analyses unless there are physical reasons to not do so. In this case the final conclusion that all data should be included (please verify) is appropriate.

Specific Comment #18 Section 3.
Nowhere in the report is it explicitly stated that all results in the RI UMCf data set were confirmed to be from fine-grained UMCf (specifically UMCf-fg1). This has implications when assessing which other background data sets it was compared to. Please add a sentence explicitly confirming that all results in the RI UMCf data set are considered fine-grained UMCf.

Specific Comment #19 Section 3.1, *t*-tests.
The section on *t*-tests (the first bullet point) states that both data sets would be tested to see if they were both normal or log-normal, and if not, that the *t*-test would not be used. It would be easier to see which *t*-test was used in the comparison if the alternate *t*-test (using logged vs. non-logged data) not used was left blank.

The core of a *t*-test is that it is based on comparison of the means of the data. Tests for lognormality or normality of the data are not needed and are often inappropriate. The bottom line statistically is that if the data are normal then the means are normal and *t*-tests apply, and if the data are not normal, but there are plenty of them, then the mean is probably approximately normal and a *t*-test applies. Tests for normality or for any distribution are always fraught with problems and should be avoided.

Further, these tests that are used to compare different background datasets should all be 2-sided tests. The basic assumptions of 1-sided tests do not apply here. This is not a case of Site vs background, where Site must be greater than or equal to background, assuming an appropriate background dataset has been identified. Performing separate 1-sided tests is statistically inappropriate and increases the chances of finding differences by random chance alone.

Specific Comment #20 Section 3.1
It is not clear why the BMI Combined or BMI McCullough-only data would be compared to the RI fine-grained UMCf data. Please exclude these comparisons and update Table 3 to reflect only these data.

Specific Comment #21 Section 4.
There was not enough information given on the source of the OU-1 Site data to gather the data needed to do a statistical review, however that review should be saved for the forthcoming RI document. If it is requested that section 4 statistics be replicated and checked in this document, please supply the EDD information and/or list of sample ids.

Specific Comment #22 Section 4.1, first paragraph.
In general, if there is uncertainty about which lithology a Site data set belongs to, and one can reasonably assume there is some mixture of lithologies present, it may make sense to compare it to a combined data set. However, it does not make sense to also then compare it to another data set composed of only one type of lithology. Please explain why the unsaturated alluvium below 10 feet is not compared to just the BMI deep alluvial portion of the data (i.e. the 82 McCullough samples). Are the 24 UMCf potentially alluvial? Or is the unsaturated alluvium below 10 feet bgs potentially UMCf? It was not clear in the text where the concern was, or if it was with both data sets. Additionally, state why a potentially mixed lithology on the Site should be then be compared to an almost assuredly unmixed potential background data set (e.g. the RI UMCf data set).

Specific Comment #23 Table 1.
The number of detects listed in Table 1 do not always match what is shown in the BMI Regional Database, and the censored values do not always match the sample quantitation limits listed in the BMI Regional Database. For example, antimony is listed as having 3 detects in the RZ-A background data set in the BMI Regional Database but is shown as having 13 in Table 1. Censored values for selenium range from <4.1 to <4.4 in Table 1 but are generally around <0.7 in the BMI Regional Database. Please double check this and make changes if necessary. If no changes are made, please comment from where the data for the RZ-A background data set is sourced.

Specific Comment #24 Figure 1.
In section 2.1 it is mentioned that the UMCf-fg1 extends to the RI UMCf sampling area as well as under the site and that this is known due to previous geological studies. If available, it would be better to show a figure that shows the UMCf geology and not surficial geology. Please swap out this figure with one that shows deeper geologies if possible.

Specific Comment #25 Figure 2b and associated discussion on pp. 3-4.
Showing lognormal lines on the plots is not useful. The data do not follow lognormality, should not be expected to do so, and is simply not useful. There is no scientific reason why the data would follow a lognormal distribution – use of any distribution is always an approximation to reality. A distribution is basically a model that allows simplification and processing. Lognormality is not natural for environmental data. Right (or positive) skew often occurs, but that does not mean the underlying data follow a lognormal distribution. Such data can sometimes be approximated with a lognormal distribution, but this is all that can be said. Also, on page 4, it is not clear what is meant by "ideal lognormal distribution". Please revisit and clarify as necessary.

Specific Comment #26 Figure 4
Radionuclides should be separated into decay chains for correlation purposes. The conceptual model should be that radionuclides in the same chain in unimpacted soils should be in approximate secular equilibrium. The Ra-228 data are not included in the correlation plots, but no explanation is provided. Of concern is that the Ra-228 data and the Th-228 data are not in secular equilibrium (see summary statistics in the tables). This suggests a problem with the Ra-228 data. Please revisit and revise as necessary.

Specific Comment #27 Figure 5 series
Some apparent differences for metals are possibly analytical artifacts. This is more likely when the concentrations are very small. A general conclusion that the Qal and UMCf have different background characteristics is reasonable, but for some metals individually such conclusions are more difficult because of low concentrations combined with likely analytical differences. Palladium is probably an example of this, maybe niobium as well. Some consideration should be given to this considering different analytical conditions are likely for the previous background data and this recent effort.