Anonymous Referee #2: Received and published 25 January 2017

Author responses are italicized in blue below the reviewer comments.

General Comments:

This article is suitable for publication in soil. It describes the difference in NO3 movement between different horizons of soil which were either present prior to the milldam being created, or deposited as sediments.

The manuscript clearly describes the context of the work, and provides a good summary into the history and formation of these anthropogenic soil profiles. The site is well described, and methodological approaches used are appropriate.

While the results and discussion section clearly outlines the results obtained, it is somewhat light on regarding discussion. I would encourage the authors to provide more insights into the processes driving the results obtained, with support from appropriate literature; furthermore, there is only a limited connection of this research with the literature, based on the limited citations present in the discussion.

Response: We expanded the discussion to better explain the potential processes driving our results by drawing more on associated literature, and included these citations throughout the text of the discussion section.

The presentation of the soil properties in the results section is quite comprehensive – maybe a bit too much so. I would like the authors to consider abridging this section and focusing on the results immediately relevant to NO3 transfer. Moreover, if this section were to presented prior to the NO3 leaching results, it would provide a greater context for discussion of those results, and the opportunity to finish off the discussion with a clear description of how the results link together, what you have learnt about each horizon, and how does all this information fit together to understand how NO3 would flow through this system if it was undisturbed?

Response: We believe the information in the soil properties section is necessary to understand NO_3^- transfer within the different soil horizons, but abridged some details when possible. We also rearranged the presentation of results at the suggestion of both reviewers, with the soil properties section now appearing prior to the NO_3^- leaching section.

Following on, some more discussion about restoration would have been helpful for those not in that space – what are the environmental benefits of restoration – magnitude changes in NO3 losses?

Response: We added more discussion about the potential environmental benefits of restoration, specifically related to expected changes in NO_3^- levels over the long-term.

Finally, it was somewhat confusing to get through most of the paper, only to read that one whole section of results (time series 15NO3 vs native NO3) is likely to have been compromised due to preferential flow. I would encourage the authors to consider the value of retaining the time series

experiment in the manuscript – how much value does it actually add, or, would it be missed if it wasn't there?

Response: We suggest that artificially-created preferential flow may have impacted the results obtained in the relict A horizon soil, but still feel the results obtained for the other two soil horizons is likely representative of actual flow regimes. For this reason we believe including the $^{15}NO_3^-$ vs. native NO_3^- time series data is still useful for interpretation purposes.

Detail:

Intro:
P2 L7: The "Williams 2000" citation was not found in the list of references

Response: The "Williams, 2000" citation was added to the list of references.

P4 L5: I'm not sure the cultural question regarding restoration was actually addressed in this manuscript. If this is an important aspect, a section at the end demonstrating the predicted in-situ effects of restoration would be of value.

Response: We believe that we addressed the cultural question regarding restoration, in that restoration efforts that seek to remove the overlying legacy sediment, leaving only the once buried relict A horizon soil, could lead to an initial decrease in NO_3^- retention capacity. We originally did not want to discuss predictions about the long-term effects of restoration, as it is outside the findings of our study, but as both reviewers commented that more discussion on the topic is needed we added text to both the discussion and conclusions sections expanding our predictions about the in-situ effects of restoration on NO_3^- cycling over longer timescales.

P5 L8: The "Brush 2008" citation was not found in the list of references.

Response: The "Brush, 2008" citation had the wrong year attributed, it was actually "Brush, 2009", which can be found in the list of references. The citation in the text was corrected to "Brush, 2009".

Materials and Methods:
P7 L6: Why was K2SO4 used as N-free water?

Response: We used a very dilute (0.001 M) solution of K_2SO_4 as N-free water so as to add some electrolytes to the solution to better mimic additions expected in rainwater.

P7 L6: How was the pore volume estimated?

Response: Pore volume in the soil cores was estimated by multiplying the approximated average dry soil volume in the cores by the approximated average percent pore space. The average percent pore space was estimated as: % pore space = 100 - (100*(bulk density/particle density)), assuming a particle density of 2.65 g cm^{-3} and an average bulk density across the soil horizons of 1.00 g cm^{-3}. We believe this is too much detail to add to the text, but did add that pore space was estimated based on bulk density measurements.

P7 L27: what was the soil:solution ratio of the 2M KCl extraction, and what were the conditions for mixing?

Response: The 2M KCl extraction followed standard procedures (c.f. Bremner and Keeney, 1966) and was based on a 1:10 soil:extractant ratio – i.e. ~12-15 g of fresh weight soil (expected to be equivalent to ~10 g of dry weight soil) was measured into 100 mL of 2M KCl. Samples were extracted on a reciprocating horizontal mechanical shaker at room temperature for 1 hr, after which they were filtered through Whatman Grade 1 qualitative filter paper. Given this is a standard procedure we do not believe all the details are needed in the text. We did, however, add the soil:extractant ratio for reference.

P9:L1: The 15N recovery vs retention section is not well explained. Please articulate more clearly the value of presenting the results in both ways, or consolidate Fig 2 and 3, which appear to show equivalent results.

Response: Recovery of 15N shows how much of the added tracer 15N showed up in the three main pools we measured (in leachate vs. pore water in the soil column vs. soil). This is depicted in Figure 2, with most of the tracer (i.e. close to 100%) ending up in the three measured pools for the mid-layer legacy sediment and the relict A horizon. That we only saw ~60% recovery of the added tracer in these three pools in the surface legacy sediment horizon suggests that there are other important pools that may retain or lose 15N that we did not measure. We applied the term 15N retention to that still being held in the soil columns (i.e. 15N in the pore water and the soil). We believe both figures are needed. Figure 2 shows that for the deeper soil horizons we accurately measured the three main pools through which 15N moves, with much of the 15N we added initially lost in leachate prior to drought. Figure 3 shows that added 15N that stays in the soil columns can be greatly reduced when the soil experiences a drought-rewetting event. We incorporated some of this explanation into the text to better articulate the difference between 15N recovery vs. 15N retention and to justify the use of both figures.

Results and discussion:
P11 L23: please spell out “atm%”

Response: We added the definition for atom percent (and its shortened form of atom %) to the text, as suggested by Reviewer #1, as well, and so adjusted the wording to atom % at this and all other instances the text.

P13 L9: If it is proposed that low NO3 uptake is the reason for the large NO3 leaching losses, please discuss some of the processes which may be governing NO3 uptake, and why these are low in this soil - . . . how does this compare with other milldams or equivalent textured soils?

Response: We discussed some processes that may explain low NO_3^- uptake in the soil, such as kinetic N saturation or preferential uptake of NH_4^+ over NO_3^-. We do agree, however, that comparing and contrasting the occurrences of these processes in similar soils is very useful, and added such a literature analysis to the discussion.

P14 L24: I’m not familiar with the term “well-sorted soil”.

Response: Sorting describes the distribution of grain sizes within the soil. A well-sorted soil is composed of grains that are similar in size. We added this explanation to the text: "…a well-sorted soil, composed of grains of similar size,…".

Conclusions:
P15 L20: The comment regarding restoration of the site may lead to an initial decrease in NO3 retention capacity – some comments around the magnitude and importance of this proposed decrease would be of value – how does it rate compared to the landscape as a whole?

Response: As suggested in the general comments above, we added more discussion about the potential environmental benefits of restoration related to expected magnitude changes in NO_3^- levels over the long-term, as it relates to the stream banks and the surrounding landscape as a whole.

References:
-Castellano and Kaye (2009) not mentioned in paper

- Merrits et al (2010) not mentioned in paper.

Response: The Castellano and Kaye (2009) reference was a remnant of previous edits to the manuscript and its removal from the references list must have been overlooked. We removed it from the current references list. The "Merritts et al (2010)" article, however, was cited in a note in Table 2, so it was left in the references list.