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Interactive comment on "Evaluating management-induced soil salinization in golf courses in semi-arid landscapes" *by* J. Young et al.

J. Young et al.

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Anonymous Referee #2

Received and published: 5 February 2015 ***General Overview This manuscript reports on an interesting and relevant phenomena, namely, the salinization of soil through irrigation and other management practices. While this has received a fair amount of attention in agricultural settings, it has been less studied in urban/recreational settings and is thus worthy of attention. Given the Introduction, I expected to read more about the potential use of PXRF in tracking soil salinization, including advantages and disadvantages of the PXRF itself and some comparisons to other options. Instead, the

PXRF is relegated to a rather minor mention at the tail end of the manuscript which I found to be, in my opinion, overly brief in its treatment of the topic. In addition, other means of determining soil salinity and sodicity, particularly EMI, have been highly reported on in the literature (e.g., Williams and Baker, 1982; van der Lelij, 1983; Ammons et al., 1989; Cook et al., 1989; Diaz and Herrero, 1992; Lesch et al., 1992; Nettleton et al., 1994; Doolittle et al., 2001; Williams et al., 2006; Thomas et al., 2009; Ganjegunte and Braun, 2011; Heilig et al., 2011, etc.). How, or does, the use of PXRF improve on other available techniques? What are the advantages and disadvantages in relation to these other technologies? For that matter, how, or is, PXRF an improvement over traditional sampling and laboratory analysis? In other words, why should I as a soil scientist be interested in using PXRF in an investigation of soil salinity versus the other options that are available to me? I'm sure the authors can answer these questions; doing so would significantly improve the manuscript.

We appreciate the contribution of the reviewer. However, the title of this manuscript was modified before its publication in Solid Earth Discuss., to read "Evaluating management-induced soil salinization in golf courses in semi-arid landscapes" This was done to reduce the weight on PXRF. This study was not solely PXRF-based, a portion of the work dealt with the application of the tool to urban landscape (golf courses).

Information on the advantage of this tool has been highlighted (line 101-106) and one of the major limitations (disadvantages) which is it's inability to measure a number of important elements such as Na was already mentioned (line 313-315).

Yes, EMI has been widely reported but the advantage of the PXRF over the EMI is that it can be used to examine the chemical species that contribute and or control salinity as highlighted by our findings (see section 3.4 and the abstract). Also see the changes made in line104-106

***Finally, the entire manuscript needs to be carefully read through and edited for English. I have certainly read far worse, but there are enough places where the writing is

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a bit weak that it distracts from the overall paper. Addressing the issues above would lead to a paper that, in my opinion, Soil Earth should welcome into their journal.

The entire paper has been carefully read through again.

***Specific Comments Page 92, Line 3 – An example of English that needs to be cleaned up. This should be ". . better assessments of their. . .", not ". . .better assertions of their. . .". I won't spend time pointing out all such issues, but the manuscript needs a good editing.

This has been corrected (line 29).

***Page 94, Lines 8 and 9 – The USGA reference cited gives water use in length/yr/area units, which makes more sense than the 1200 mm/yr and 600 mm/yr units given here. I assume these should be 1200 mm/yr/ha and 600 mm/yr/ha?

This represents the depth of water needed in length, irrespective of size of the area, so this is correct.

***Page 94, Lines 17-19 – The Weindorf group has done good work with the application of the PXRF to soils work, but this statement would be significantly strengthened by introducing some references that do not come from theWeindorf research group (every single reference in this list is from the Weindorf group). There are many that would work; examples include Bernick et al., 1995; Clark et al., 1999; Kilbride et al., 2006; and Jang, 2010. I suggest working references from some other research groups into the manuscript here.

Kilbride et al., 2006; and Jang, 2010 have been incorporated (line 376-380).

***Page 95, Line 8 – "...for a more rapid soil salinity examiniation. . ." More rapid than what? I assume this is a very underdeveloped attempt to work in a comparison of the use of PXRF for salinity studies versus other techniques (something I noted was needed in my general comments), but this idea needs to be developed and clearly communicated. As currently written, it is just a vague suggestion that doesn't carry any

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weight. Other techniques to investigate soil salinization could be discussed earlier in the Introduction. Then, here, you introduce the idea that this study is looking to investigate whether PXRF might be a (more rapid/less expensive/any other advantages that are applicable) technique than those currently available to investigate soil salinization.

This has been addressed. The advantages of the PXRF over the traditional wet chemistry techniques and electromagnetic induction have been highlighted (line 101-106).

***Page 97, Lines 17-18 – Study sites A-G = 7 facilities being studied. Here, the numbers of facilities providing water quality data only add up to 4 facilities. Please explain the discrepancy.

We specified that the all the golf course are pumping water from the same aquifer and thus and not all the golf course have documented water report. Since they are all pumping from the same aquifer within the same city, there is no much need for individual golf course water report (176-178).

***Page 101, Lines 4 and 8 – It refers to “2-folds” and “2-11 folds” here. It would be better to use “2-times” and “2-11 times”. These have been modified (line 264-269).

***Page 101, Lines 5-7 – It speculates here that pollutants in the retention pond water were taken up by vegetation and/or settled to the bottom of the pond. What about the idea that the pollutants were never there to begin with? My bet is the source of the salt ions in the well water is the geologic formations that water flows through, and the salts are dissolved into the groundwater as it makes its way through the rocks and sediments. The water in the retention pond is from runoff, which never interacted with these deeper geologic units. Ideally you would have water quality data for runoff entering the retention pond, which would clarify the situation, but that data probably isn’t available. Given that, a more complete discussion of potential reasons the retention pond water is lower in dissolved ions would be appropriate.

This has been modified to read: These differences could be most likely attributed to

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the inherently low pollutant concentration in rain water, filtration of pollutants as it flows over vegetation on its way to the pond, and further settling of pollutants and uptake by vegetation in the reservoir (line 265-268)

***Page 101, Line 13 – Again, should this be 120 cm/yr/ha? Also, back on page 94 the units were mm, now they are cm. This should be changed to 1200 mm to be consistent in unit use. We appreciate this and it has been changed. The correct number and unit is 1200 mm yr-1 (line 273)

***Page 101, Line 21 – It is Terrel and Johnson, 1999, not Terrel et al., 1999.

These have been modified to read "Terrel and Johnson, 1999; Terrel et al., 2002" (line 280-281).

***Page 101, Line 23 – I have passed by many writing issues, but can't pass this one by.". . .water sources justifies the. . ." The water sources don't justify anything, however, they probably "explain" the higher SAR and ESP values.

This has been changed to "likely explains" (line 283).

***Page 101, Line 26 – ". . .that still impacted higher. . ." should be ". . .that still led to higher. . ."

This has been changed to "led" (line 285)

***Pages 102-103, Section 3.4 – Comparisons of PXRF to other methods of determining soil salinity? Strengths and weakness of PXRF itself and as compared to other methods? This section should be expanded to be a more complete discussion of where PXRF may fit, based on this study, within the various methods we have available to investigate soil salinity issues. We appreciate this suggestion. This has been done as earlier suggested (line 101-106)

***Page 102, Line 28 – ". . .that could be. . ." should be ". . .that could possibly be. . ." This study does not demonstrate that the PXRF technique will work in other places,

but it does provide justification for researching that possibility.

We agree, thus, the use of the word “could”.

***Page 103, Line 16 – Delete “. . .in the semi-arid region of the USA. . .” It has already been established that the study took part in a semi-arid region of the USA.

This has been deleted (327).

***Page 104, Lines 2 and 3 – The word “quantity” is used twice here, but the way the sentence is written it seems like one of these should be quantity and the other quality.

Thanks! The second “quantity” has been changed to “quality” (line 338).

***Page 104, Author contributions – The contributions of every author except D.C. Weindorf are explained, the Weindorf contributions should be added.

The contribution of D.C Weindorf has been added (line 346-347)

***Tables – Retention pond needs to be used consistently in these. On Table 1 “surface” is used, I assume that should be “retention pond”. On Table 3 “lake” is used, again I assume that should be “retention pond”. Consistency in labeling is very important.

All the changes have been made with respect to retention pond in Tables 1, 2, and 3.

***Figure 2 – The choice of pattern for the bar graphs is poor. While I can tell the difference between the patterns in the bar graphs, they don’t differentiate in the small windows for the key. Solid Earth is an online journal that doesn’t charge for color. I suggest using a dark color for managed and a light color for non-managed. This will show up well on a computer screen and will also work if someone prints out and then photocopies the paper in black and white (grayscale).

Figure 2 has been modified as suggested and legend enlarged to show the difference.

***Figure 3 caption – Is this data for a golf course or for multiple golf courses? Please reword to make this more clear. Also, Table 3 says the n for the wells is 15, but adding

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up the n values in the Figure 3 caption gives 21. Why the difference?

Thanks for the observation. Clarification: “n” in Table 3 has been changed to number of years, while “n” in Figure 3 represents number of data point used, all from one golf course that has well documented history of water quality (as indicated in the title). Note in some years, the golf course in question conducted water analysis twice. Suggested References:

We appreciate the contribution of the reviewer. A number of the suggested references relevant to the study has been selected and incorporated into the manuscript.

Jang, M., 2010. Application of portable X-ray fluorescence (pXRF) for heavy metal analysis of soils in crop fields near abandoned mine sites. Environmental Geochemistry and Health 32(3), 207-216.

Kilbride, C., Poole, J., Hutchings, T.R., 2006. A comparison of Cu, Pb, As, Cd, Zn, Fe, Ni and Mn determined by acid extraction/ICP–OES and ex situ field portable X-ray fluorescence analyses. Environmental Pollution 143(1), 16-23.

Interactive comment on Solid Earth Discuss., 7, 91, 2015.