From: Miller, Barbara J
To: Howell, Tonya
Subject: Bioaugmentation within Ameren Missouri Huster Substation
Date: Tuesday, June 14, 2022 6:37:47 AM

Tonya

As we discussed last week on the phone, it has been determined that the biomass inside the Ameren Missouri Huster Substation needs feeding to enhance it's ability to breakdown the remaining COCs. All treatment materials will remain within the footprint of the substation and will not migrate off property.

The proposal by LEA is as follows:

Here is the consensus on food/nutrients/bugs.

> While there may still be some food around from last June's addition to the system, a number of wells have since had a significant uptick in ORP and some with Cis / VC or both from 2020 – 2021 which may suggest lack of food or may be due to the significant rainfall events that have occurred in that area. The lack of nutrients, and potentially Dhc, along with food in the treatment area warrant another injection of EOS Pro, BAC-9, and nutrients (the EOS has micronutrients but not really the macro nutrients [nitrogen and P].
>
> We are recommending to use 2- 55-gallon drums EOS and 2-19L casks of BAC-9 (DHC bugs), per details below. The groundwater field parameters do suggest that pH in the target treatment wells are a little on the low side (right around 6, > 6.5 is recommended for Dhc) so we will be adding a pH buffer too.

Assumptions:

- Injecting 30,000 gallons into an area of approx. 50 feet wide by 80 feet long encompassing the wells of MW-8, MW-10, MW-11, MW-12, and MW-13 (what it will take). Using an effective porosity of 0.3 in the sands, over a 10-foot vertical interval, the estimated pore volume to be on the order of 90,000 gallons.
- With a target minimum of 10^7 bacteria cells per liter groundwater we would need 2 - 19 L casks to cover that zone.
- 2-55gal drums of EOS Pro @75% digestible carbon mixed into the 90,000 gal of pore volume groundwater should give us around 900 mg/L of carbon (EOS Pro has both soluble and extended release Carbon). We will NOT see the 900mg/L in groundwater due to the slow release, but we need to maintain a min of 100 mg/L in groundwater.
- Nutrients is the biggest concern: nitrogen in particular is very low at the site and is not a reported significant ingredient in EOS Pro. Mike recommends Miracle Gro, it is 24% nitrogen. Based on his calcs, 2- 10lb boxes of Miracle Gro diluted into the 90,000 gallons of pore volume of the treatment area (10-ft interval), should provide a min of 6 mg/L nitrogen in the groundwater. We use Miracle Gro in the lab and try to maintain a 1mg/L nitrogen minimum in the reactors. We want to stay below any regulatory concern on

nitrates in groundwater which I believe is 10 mg/L as nitrate. It may be above this during the initial injection but will disperse quickly.

- A small volume of sodium bicarbonate will used as a pH buffer to get the treatment zone into more neutral range above 6.5.
- Sodium sulfide will be added to decrease the ORP as in previous injections. We already have that onsite from the previous work. Typically drop the batches to -300 or lower to better ensure anaerobic conditions and prevent bug loss during injection.

Is it okay to proceed?

Let me know if you have any questions.

Sincerely,

Barbara J Miller

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