September 15, 2020

To: Steven Blackburn, blackburn.steven@epa.gov,

From: Caron Balkany, balkany@aol.com,

John R. Coon, Esq, Ph.D., jrcoonlaw@gmail.com

Re: Comments on proposals for study of shallow injection wells in Marathon

This letter is written on behalf of several thousand Keys residents, part of the community organizations listed below which have been actively involved in helping to improve Keys water quality. We hope to be able to assist and support the studies of migration to surface waters of shallow sewage well injection which are being considered for upcoming EPA funding.

Our objective here is to provide some comments now about one specific study proposal we received which might be helpful either in further development of its work plan prior to its completion for this study, or which might be of assistance to whatever proposal is selected for funding.

Our ultimate goal, which we know you share, is that whatever study is selected to investigate the concerns about the migration of shallow sewage well effluent to nearby surface waters, result in data and conclusions on which the communities, the regulated entities, and the regulators can all rely.

Our scientific team – John Coon, Esq., Ph.D., Hanna Coon, MS, and Donald Maynard, FL PG, LWD (retired) - has some comments about the Pennsylvania State University grant proposal for the shallow well testing which Jon sent us. I'm attaching their comments. It is doubtful that the principal investigators would disagree; perhaps these issues are already being addressed in their study work plan, which we haven't yet seen. We have copied them on this communication.

We are specifically concerned about the choice of sites for the first year of the proposed study, where half of the study's monitoring wells would be utilized.

1. Since a high-concentration sucralose plume has already been documented nearby the Area 4 shallow well site by test results from an EPA-certified and highly respected lab, and since Area 4 is a .400 mgd facility, that seems a much more scientifically appropriate site for the first year of study than Area 3, the .250 mgd site being proposed.

2. We know that flow volume impacts the adsorption/sorption of N and P in the discharge, the scouring effect, and the speed of the flow. Therefore, a thorough study of the higher volume Area 4 shallow well site will result in data which are transferrable to the lower volume well sites (all but one of the

Marathon shallow well sites). However, the data from even a thorough study of the smaller volume Area 3 shallow well site would not necessarily be applicable to Area 4.

3. Even assuming development of a thorough work plan, and adequate resources to implement it, capturing the complexities of the migration of the buoyant sewage effluent through the karst geology of the Florida Keys is challenging. There are several confounding factors which can impact the study results, including the variable ages of the wells, impacting sorption/adsorption of N and P, and the fact that the well sites all have at least two shallow wells, and according to the Marathon Utilities Director, they "generally use both wells to divide the flow." There is no record of this variable usage required by the regulators, and no known documentation available.

4. Site selection based on enhancing the probability of capturing transferrable data concerning sewage effluent migration to nearshore waters despite confounding factors is imperative. This is particularly true because if the results of the study indicate that a shallow well is serving as a "functional equivalent" of a direct discharge, it is likely and reasonable that a deep well would be required.

5. We understand that the City of Marathon has facilitated use of Area 3 for monitoring wells for the study, which is certainly helpful and was the basis for the selection of Area 3 for the study. However, conversations with City officials indicate that the City has no preference over the site selected and can facilitate access at Area 4 as well. Area 4 also has adequate City-owned acreage for location of monitoring wells. They have stated that nearby Crane Point Museum and Nature Trails may also be available. The documented high-concentration sucralose site was in the mangroves offshore the Crane Point complex.

It is important to us that our scientific team be able to observe during whichever studies are selected, assist if requested, and hopefully be able to meet with the principal investigators before finalization of their work plan. We are hoping to promote community acceptance of the studies and their results, and this is only achieved with scientific transparency and community involvement.

Please consider reviewing these comments when the various study proposals are being considered for funding. Please also distribute them to the principal investigators for the proposals, and to the Water Quality Protection Plan Steering Committee, along with your excellent suggestion that the scientists involved in the selected studies meet with the local scientists and

citizen stakeholders prior to finalizing their work plans.

We appreciate this opportunity to provide comment on the Penn State proposal which we think would be an important transparent and scientifically defensible study supported by the communities in the Florida Keys.

Cc: Florida Keys Chapter of the Izaak Walton League of America, Florida Keys Citizens Coalition, Inc., Friends of the Lower Keys (FOLKs), Key Deer Protection Alliance, Inc., Last Stand, Save Summerland Native Areas

Cc: Jon Iglehart, Karen Bohnsack, Gus Rios

Cc: Dr. Miquela Ingalis, Dr. Lee Kump, Pennsylvania State University,

Cc: Dr. Rene Price, Dr. Dean Whitman, Dr. Piero Gardinali, Florida International University

Attachment A

September 15, 2020

Comments and Suggestions - Pennsylvania State University Grant Proposal dated July 30, 2020:

Quantifying the impact of shallow wastewater injection on groundwater nutrient fluxes to surface waters in the Florida Keys National Marine Sanctuary: a pilot study

Prepared by Donald Maynard, FL PG, LWD (retired); John Coon Esq., PhD; Hanna Coon, MS

1) Proposed Test Location

   The PSU grant proposal suggests conducting initial investigation in the vicinity of the Marathon Area 3 injection well system. That system is permitted for treatment and disposal of 0.25 million gallons per day (MGD) sewage plant effluent into two wells, and is located adjacent to Boot Key Harbor. The PSU proposal further suggests that data from the Area 3 well investigation can be applied to other injection wells in Marathon and elsewhere in the Keys.

   It is recommended that one of the other Marathon shallow injection wells be chosen in lieu of the Area 3 well; specifically, the Area 4 injection well system permitted for 0.4 MGD is better suited for the initial investigation for the following reasons:

   A. The proposal hypothesizes that short residence times of shallow injected wastewater effluent in carbonate aquifers reduce the efficiency and permanence of nutrient removal. However, the duration and volume of prior use of a shallow well also impacts the amount and persistence of renovation possible from the residence time of the effluent, as the rock first adsorbs nutrients, then releases them as sorption sites on the surface of the rock are filled, then release, nitrogen and phosphorous from the rock. The volume of flow is thus an additional important factor in selection of the appropriate

site for study of the proposal's hypothesis. Area 4 is permitted for 0.4 MGD; the larger injection rate compared to Area 3 may produce shorter residence times than in Area 3. As a result, the larger capacity Area 4 is better suited to evaluate renovation of the effluent in the subsurface, and more useful for applying that data to other locations. In other words, longer residence times in Area 3 may be more likely to renovate effluent, and thus Area 3 data will not be applicable to Area 4.

B. Testing in 2019 by a respected certified lab has already demonstrated that sucralose is present in high concentrations in a surface water plume near the mangroves on the Gulf Side of Marathon (near Crane Point) within 1500 feet of the Area 4 shallow injection well. Rather than neglecting the existing data, additional testing of Area 4 is recommended to evaluate that evidence of a direct hydraulic connection between the injection well and nearshore surface water. The location of the previously identified high concentration levels of sucralose is fairly easily accessible from land through Crane Point Hammock, a non-profit natural history museum and nature center which could be approached for support of this study.

C. The Area 3 well is adjacent to Boot Key Harbor, which has more than 240 moorings (https://www.ci.marathon.fl.us/marinaandports/page/anchorage-areas) many of which are used as "live-aboard" boats. The potential for sewage from these boats to be discharged into Boot Key Harbor adds a significant but unmeasurable complication and uncertainty as to the source of any nutrients or other sewage/effluent related compounds detected in surface water. If elevated nitrogen and/or phosphorous are detected in groundwater and surface water, the portion in surface water could be from the Area 3 injection well, from live-aboard boat related sewage, or a combination of both. This will make any evaluation of the impact of Area 3 effluent injection on surface water quality unnecessarily difficult and uncertain.

2) Quality Control

It is anticipated that the PSU study will include the preparation of a Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP) in accordance with accepted EPA practice prior to performing the investigation. If preparation of, and adherence to, a QAPP and FSP is not included, the data accumulated in the study are unlikely to be of sufficient quality to represent actual in-situ conditions or to draw any reasonable scientific conclusions.

3) Pre-test Screening

A. The PSU proposes initial screening designed to determine the optimal locations for monitoring wells and surface water sampling. The fluorescent dye testing should utilize experienced people for the testing of surface water, in addition the proposed use of (well supervised) high school students, and should be performed at low tide, after an extended period of effluent injection. Details about locations and frequency of testing (including testing within an hour of low tide) are critical to the success of this screening method and are not supplied in the proposal, but will presumably be provided in detail in the FSP and QAPP.

B. The proposed geophysics resistivity testing should be conducted within an hour of low tide, and when effluent injection has been on-going for an extended period. The point of this testing, conducted three times, is to map the low resistivity ("fresh" low saline injectate) plume and the highest discharge to surface water will occur at the time of maximum gradient (i.e. at low tide when the effluent is being injected).

C. Given the tortuous characteristics of the limestone karst in the area which results in multiple preferential pathways for subsurface effluent migration and discharge to surface water, it is strongly suggested that aerial infrared photography be used to screen for discharge locations prior to initiating the well drilling and surface water sampling. Infrared photographs can be taken offshore from drones, at night, during low tide and low wind conditions, during and after effluent injection. This method often shows locations where cooler groundwater (and effluent) discharge as plumes into surface water. These locations of discharge

can then be used as surface water sampling locations and to direct the location of monitoring wells between the discharges and the injection well.

4) Well Construction

Some recommendations regarding well drilling and construction are provided below; they are incomplete, as the QAPP and FSP have not been made available for review.

A. PSU suggests installation of nested/multi-level monitoring wells to a depth of 15 meters. Since the existing injection wells are typically drilled to 100 feet, and completed with casing to 60 feet, it is strongly recommended that the minimum depth of the monitoring wells be approximately 20 meters (i.e. at the depth of the uppermost zone of injection).

B. There is an internal lack of consistency in the PSU proposal: "5 wells with nested piezometers sampling at 3 discrete depths will be installed proximal to the injection wells (Fig. 1). Each well will be drilled to 15m with 1"PVC piezometers fitted with 1.5m slotted well points installed at 15m and 5m depth." It is unclear if three or two vertical sampling intervals are proposed. We suggest that three intervals would better meet the goal of the investigation, with a third interval added circa 20 meters deep. It is suggested that the FSP be written so that the actual installed sampling interval can be adjusted in the field based upon drilling data, core and/or borehole geophysics; ideally each sampling interval will contain hydraulically effective preferential pathways. This field adaptability is needed to ensure that the sampling intervals are completed in the porous "cavernous" conduit/tunnel zones observed during the injection well drilling, and not in intervals of low-permeability rock that is unlikely to provide representative samples.

C. The wells should be completed with bentonite chips (a swelling clay) a minimum of 2 meters above the silica sand pack. The proposed use of

cement grout is likely to seal off the wells from the conduits (tunnels, etc.).

D. After the monitoring wells are drilled, but before they are completed, it would be helpful to run wireline borehole geophysical tools to determine the best depths for sampling intervals. Ideally, at a minimum, these tools would include a downhole video (with depth indicator) to identify caverns, tunnels, and other geological features that will affect effluent transport, and temperature logs (conducted at various tides under non-pumping conditions, and while pumping) to identify conductive fractures/tunnels/caverns. The temperature logs in particular are helpful in distinguishing "dead-end" holes in the rock from those which act as preferential pathways for effluent migration in the subsurface.

5) <u>Field Sampling Timing and Methods</u>
Some recommendations regarding field sampling methods are provided below; they are incomplete, as the QAPP and FSP have not been reviewed.

A. Area 3 and Area 4 each has two injection wells. Discussions with Marathon officials indicate that the use of one or both injection wells in each Area (3 and 4) is controlled by the local treatment plant operators, and is not reported in the monthly reports. For instance, injection can occur into both wells simultaneously, into just one well, or alternately into one and then the other well. These changes in injection location and rate will cause variation in the subsurface nutrient concentrations and location, as well as in the hydraulic gradient that may confound the results of the investigation. It is recommended that conversations with the operators be conducted so that a single well be used for injection for several weeks prior to, and during each field-testing effort. If use of one well does not provide sufficient injection capacity, an alternative of injecting identical rates into both wells simultaneously is an option. Ideally, the injection rate and timing will result in a dynamic steady-state hydraulic condition before and during testing, with the only variable being the tidal fluctuation. It is recommended that prior to, and during

field work, automated water level loggers and flow meters be used to document the hydraulic conditions at 5-10 minute intervals in the injection wells, monitoring wells, and surface water, both on the ocean and the gulf sides.

B. Groundwater sampling should be performed using the EPA slow purge/low stress sampling method, which includes measurement of dissolved oxygen, specific conductance, oxidation/reduction potential (ORP), temperature and other field measured parameters, in order to ensure that representative samples are collected, and to provide data for the field parameters which can affect fate, transport and sorption, but which can change during sample storage and transport to a laboratory.

C. Well and surface water sampling should be conducted within one hour of low tide, during and after an extended period of effluent injection, when the maximum groundwater gradient (and therefore the maximum transport of contaminants to surface water) is expected to occur.

D. Treatment plant inflow and injection rates should be documented for several days or a week prior to sampling, preferably on an hourly basis, rather than the daily averages required by the permit. This will allow comparison, and potentially correlation, of the effluent injection rate (and quality) with the monitoring well and surface water data.

E. The fluorescent dye test equipment, field parameter instruments and other instruments should be calibrated, and have the calibration checked at the end of each day, in accordance with a QAPP/FSP.

F. The methods of determining the location, elevation, bathymetric depth and other positional data should be specified in the QAPP/FSP, including acceptable limits of accuracy.

G. Methods and details of sampling and analysis are needed in the QAPP/FSP for dissolved gas species testing intended to quantify the

magnitude of microbial denitrification along the flow path, and δ15N of dissolved N2 and NO3- to quantify the contribution of denitrification to N removal in the aquifer.

6) Sampling Handling, Shipping and Analysis

It is anticipated that the QAPP/FSP will be prepared to ensure that all methods required for sample cooling/temperature control, preservation, quantity, holding times are met. The QAPP/FSP should require standard quality control (QC) samples: field blanks, blind duplicates, matrix spike/matrix spike duplicates, and laboratory QC samples. If the sampling and analyses do not meet standard practices, the data will be of limited or no value, as it will not be possible to determine if the data is reliable and represents in-situ conditions.

7) Models

The PSU proposal includes reference to multiple models of groundwater flow, dye study injection rates/concentrations, and contaminant fate and transport. Computer modeling is an excellent way to predict subsurface and surface water conditions, if, and only if, the models are calibrated to existing data, and their accuracy and precision are confirmed by testing that corroborates the model predictions. In order to insure this is the case; details of the modeling quality control need to be included in the project, including variation in predicted effects correlated to variation in the range of the input parameters (input variables would likely include transport time, residence time, groundwater velocity, gradient, concentrations in effluent and natural water, groundwater chemistry, Eh, Ph, ORP, temperature, CaCo2 concentration, Mg concentration to evaluate dolomitic "dogs tooth" reprecipitates observed FL Keys limestone tunnels, and others.