APPENDIX D – OLD ANAEROBIC LAGOON CLEANOUT WORK PLAN

STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES &
ENVIRONMENTAL CONTROL
DIVISION OF WATER
89 KINGS HIGHWAY
DOVER, DELAWARE 19901

July 17, 2019

Mr. Michael Sausé
Environmental Manager
Allen Harim Foods, LLC
29984 Pinnacle Way
PO Box 1380
Millsboro, DE 19966

Re: Allen Harim, Harbeson – Old Anaerobic Lagoon Cleanout Work Plan
Conditional Approval

Dear Mr. Sausé,

The Delaware Department of Natural Resources and Environmental Control, Division of Water (the Department) has reviewed the "Old Anaerobic Lagoon Cleanout Work Plan" submitted by Allen Harim Foods LLC on June 18, 2019. Allen Harim intends to remediate an anaerobic lagoon at the Harbeson facility which has been out of service since 1998 and repurpose it as a diversion lagoon for meeting diversion requirements under the proposed Offsite Wastewater Treatment and Disposal Operation Permit. The Work Plan describes the method and schedule for sludge removal from the anaerobic lagoon; lining of the lagoon; monitoring, and diversion sequencing prior to and during lagoon cleanout.

General Comments

5. Non-Sanitary Determination

Allen Harim asserts that the sludge in the anaerobic lagoon has been anaerobically digested over the last 20 years and, therefore, should no longer be classified as sewage sludge for disposal purposes.

Department Response (#5): State and federal regulations for the land application of sewage sludge do not specify a de minimis amount of sewage that would allow for classification of sludge as "non-sanitary". In addition, there are no regulatory provisions that allow for the reclassification of sewage sludge to "non-sanitary" after a certain amount of time has passed. Therefore, sludge removed from the anaerobic lagoon is considered a Class B sludge under state and federal regulation.

6. Transportation and Land Application of Dewatered Sediment

Allen Harim has tentatively selected Denali Water Solutions for sludge disposal and land application in Maryland. Allen Harim will seek permitting in Maryland for disposal. Denali will supply Allen Harim with a record of volume and location of applied residual. Allen Harim listed Synagro as an alternate disposal option stating that Synagro would transport and dispose of liquid residual at an approved agriculture application site.

Department Response (#6): Currently neither Synagro, Denali nor Allen Harim have an Agricultural Utilization Permit for the land application of this sludge in Delaware. If during the course of the lagoon cleanout Allen Harim or its selected contractor(s) wish to land apply this sludge in Delaware, an Agricultural Utilization Permit for the utilization of sewage sludge must be applied for and obtained. In addition, it is the Department's understanding that permit modifications and/or new permits are required by the Maryland Department of the Environment for land application of this material in Maryland.

7. Groundwater Monitoring

Allen Harim installed four (4) groundwater monitoring wells surrounding the anaerobic lagoon. Monitoring Well 2 (MW2) has shown elevated ammonia concentrations. Allen Harim has tested both lagoon water and lagoon sludge, neither of which display elevated ammonia levels. In an effort to determine the source of the high ammonia, Allen Harim has inspected the liner and seals of the nearby anoxic ponds and performed integrity testing on the DAF effluent pipe; however, none of the components showed evidence of leakage. Due to the testing performed, Allen Harim does not believe the old anaerobic lagoon is the source of the elevated ammonia in MW2. Allen Harim infers that ammonia in groundwater can be persistent and last well beyond abatement of other constituents once the source is removed. Allen Harim states in the work plan that a new synthetic liner will be installed in the anaerobic lagoon following lagoon cleanout in accordance with the Regulations.

Department Response (#7): Allen Harim has made reference to the potential that the ammonia in MW2 could be "legacy" ammonia. The Department requires Allen Harim to perform additional source tracking studies to substantiate this hypothesis and/or locate any potential source.

9. Non-Compliant Water Diversion During Lagoon Cleanout

Prior to the commencement of lagoon cleanout activities in June of 2020, Allen Harim will maintain 4 million gallons of storage capacity (i.e. 2 days of production capacity) in the old anaerobic lagoon for diversion purposes. During the cleanout and lining process for the old anaerobic lagoon, Allen Harim will divert the first 2 million gallons of offspec flow to the old lined storm water lagoon; the next 2 million gallons of offspec will be diverted to the anoxic ponds; and if diversion is still needed any additional flow will be directed to the old anaerobic lagoon. Allen Harim also indicates that Artesian has additional storage in the ANSRWRF lagoon where non-compliant effluent could be diverted prior to spray irrigation.

Department Response (#9-1): Prior to and during lagoon cleanout, if a diversion event occurs Allen Harim will notify the Department. In addition, Allen Harim is required to perform enhanced monitoring of nearby monitoring wells if samples from the lagoon post diversion

shows elevated concentrations of constituents of concern. If off spec is diverted to the lined storm water pond, once the diversion event has ended, Allen Harim shall run the offspec effluent back through the WWTP for treatment. Offspec effluent shall not be stored in the storm water pond. These provisions must also be added to Allen Harim's O&M manual. Please note, the Department does not support sending offspec effluent to Artesian's lagoon at ANSRWRF as a viable diversion option and it, therefore, that provision should be removed from this work plan. Sending offspec to ANSRWRF will be a violation of Allen Harim's Operations Permit.

9. Non-Compliant Water Diversion During Lagoon Cleanout – Interim During Clean Out

Allen Harim proposes to monitor the anaerobic lagoon level daily during the cleanout process using staph gauges.

Department Response (#9-2): Allen Harim is proposing to divert to the old anaerobic lagoon in the event diversion is necessary prior to the initiation of lagoon cleanout activities. In order to establish baseline data and confirm the old anaerobic lagoon liner is currently not compromised, the Department requires a lagoon leakage assessment to begin as soon as possible. This assessment should take into account factors such as atmospheric pressure changes, evaporative losses, and rainfall input. Allen Harim needs to submit a plan for this "leakage assessment" to the Department for review and approval which describes procedures for collecting all data and performing calculations associated with the above-listed factors. Daily lagoon level monitoring should begin as soon as possible. Allen Harim shall be required to track a daily quantity of water (diverted effluent and/or storm water) pumped into or out of the lagoons in gallons and inches. All measurements must be reported to the Department monthly electronically in spreadsheet format.

10. Timeline

Allen Harim proposes a timeline that shows the initiation of cleanout activities during June of 2020 and the lagoon being ready for service in June of 2021.

Department Response (#10): Allen Harim needs to include information in the work plan explaining why this lagoon cleanout will take 2 years to accomplish and a commitment to expedite the process to the maximum extent practicable.

Work Plan Approval with Contingencies

The above-referenced work plan is approved contingent upon incorporation and completion of the following items:

1. Within fifteen (15) days of receipt of this letter, Allen Harim shall submit documentation to the Department that demonstrates Allen Harim is pursuing appropriate land application permits in Maryland. Upon receipt of permits from MDE, Allen Harim shall submit a copy of the permits to the Department for our records.

2. During the lagoon cleanout, Allen Harim shall maintain records documenting that amount of sludge removal and disposal location and report this information to the Department monthly until lagoon cleanout is complete.
3. Allen Harim shall submit specifications for the diversion lagoon (i.e. old anaerobic lagoon) synthetic liner to the Department for review and approval prior to installation.
4. Allen Harim shall submit a track-back study plan to identify the source of elevated ammonia in the vicinity of the old anaerobic lagoon for Department review and approval within thirty (30) days of receipt of this letter.
5. The synthetic liner of the storm water pond must be inspected and (if necessary) repaired prior to utilization for diversion purposes. The inspection report must be submitted to the Department for review within ninety (90) days of receipt of this letter.
6. Allen Harim shall include a site map in this work plan for Department review that identifies the potential receiving areas for effluent diversion and all current monitoring well locations. The Department will then assess if additional monitoring wells near the storm water pond are required.
7. Within fifteen (15) days of receipt of this letter Allen Harim shall submit an "anaerobic lagoon leakage assessment plan" to the Department for review and approval (see Response 9-2 above). Within sixty (60) days of receipt of this letter, Allen Harim shall submit preliminary results of the assessment to confirm that in its current state the lagoon is not leaking.
8. Within fifteen (15) days of receipt of this letter, Allen Harim shall revise and resubmit the "Allen Harim Harbeson Old Anaerobic Lagoon Cleanout Work Plan" to incorporate all action items for contingent approval and to address any deficiencies or comments identified under "General Comments" above.

Please note, an Operations Permit will not be issued until all required information documenting a viable diversion option that will not result in a release to the environment has been submitted for Department review and approval. The revised work plan that incorporates all requirements detailed above must be submitted to Derrick Caruthers in the Department's Groundwater Discharges Section. If you have any questions or concerns, please feel free to contact me.

Sincerely,

John Rebar Jr.
Environmental Program Manager I
Groundwater Discharges Section

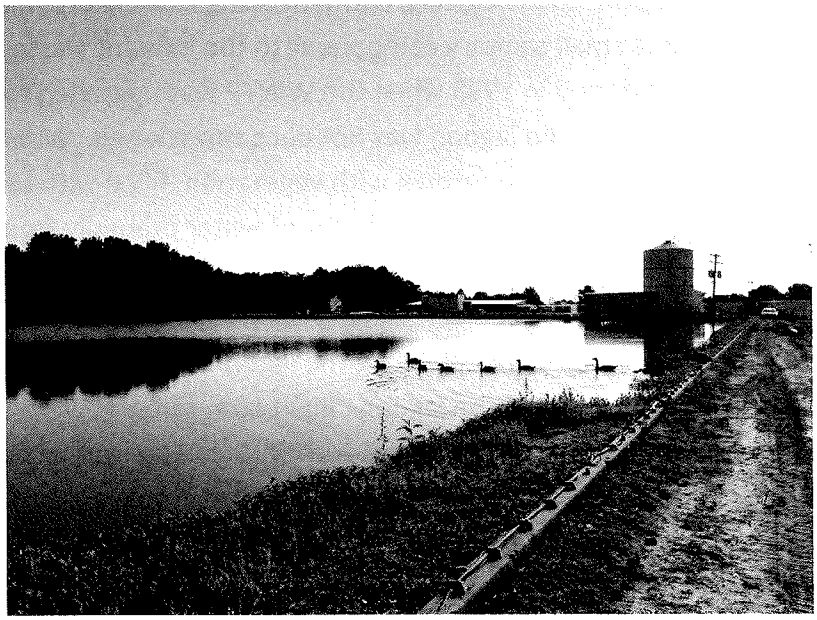
Allen Harim Harbeson
Old Anaerobic Lagoon Cleanout
Work Plan

1. Background

Allen Harim owns a poultry processing plant in Harbeson, Del., with an on-site wastewater treatment plant (WWTP). The Harim Group bought the facility from Allen Family Foods, Inc. in 2011 and it was re-named Allen Harim Foods, LLC. Prior to 1998, an anaerobic lagoon was used to treat the waste from the process plant prior to biological treatment using a Complete Mix Activated Sludge (CMAS) system. There was also a small sanitary component to the influent waste to the WWTP. The anaerobic lagoon was abandoned in 1998 when the WWTP was upgraded to include anoxic ponds and additional CMAS capacity. The lagoon was not decommissioned. When the Harim Group bought the facility the lagoon was overgrown with vegetation, filled with sediment and the top liner was in place. The lagoon held a minimal amount of water primarily from rain events.

In the summer of 2013 Allen Harim Foods, LLC began planning the lagoon cleanout. A forklift with a basket was required to perform core sampling of the lagoon. Eight core samples were obtained and analyzed. The thought process was to land apply the material on the Allen Harim company farms, however, this never happened. In January of 2014, United Construction was hired to clean the lagoon of all vegetation and remove the top liner. With the approval of Glenn Davis, Program Manager of DNREC, the vegetation and sediment were disposed of on the field owned by Allen Harim adjacent to the Processing Plant in Harbeson, DE. The liner was hauled to the landfill for disposal. On an as need basis Allen Harim pumped the remaining storm water that accumulated in the lagoon to the on-site wastewater treatment plan

The top liner removal and partial lagoon cleaning was completed in the spring of 2014. Today the lagoon is a basin that holds storm water.



In 2016 it was decided not to pursue the Phase 2 construction of the expansion for the WWTP. The treated effluent will be sent to Artesian Resources for spray irrigation at the ANSWRF facility that is located near Milton, Delaware. A DNREC requirement for this was to convert the old anaerobic lagoon into a diversion lagoon that would accept non-compliant water in extremely unlikely event that water could not be sent to Artesian. The non-compliant water would be re-treated in the WWTP until compliance with spray irrigation requirements is achieved.

2. Lagoon Clean Out Planning

Planning for the final phase of cleaning the lagoon was initiated in early 2017. Allen Harim is developing a contingency plan for the unlikely event of non-compliant effluent. With the approval of the contingency plan, the date for the effluent to spray irrigation is July 2019.

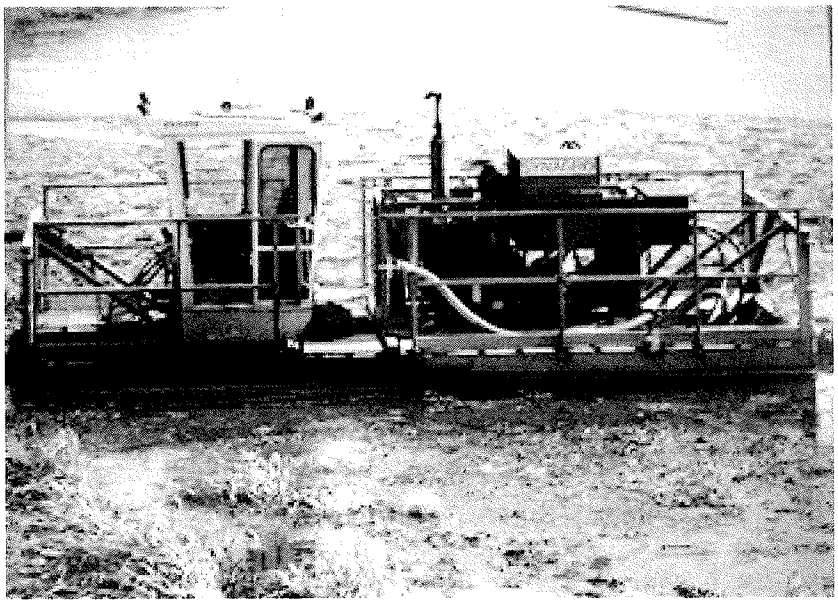
Two methods of cleaning the lagoon were considered. One method was pumping of the sludge to Geo Tubes for dewatering. This method required a Temporary Sludge Holding Permit until the dewatered sediment could be disposed of off-site at an approved location. Because of the time required for the permitting process this method was not considered desirable. The second method that was considered was to dredge and/or pump the lagoon sediment to a belt filter press for dewatering. Hauling and disposal of the dewatered material would be at an approved location.

Two companies submitted proposals. Allen Harim has tentatively decided to contract with Synagro, a company headquartered in Baltimore that is a national leader in the sludge disposal and lagoon cleanout industry.

3. Sediment Removal

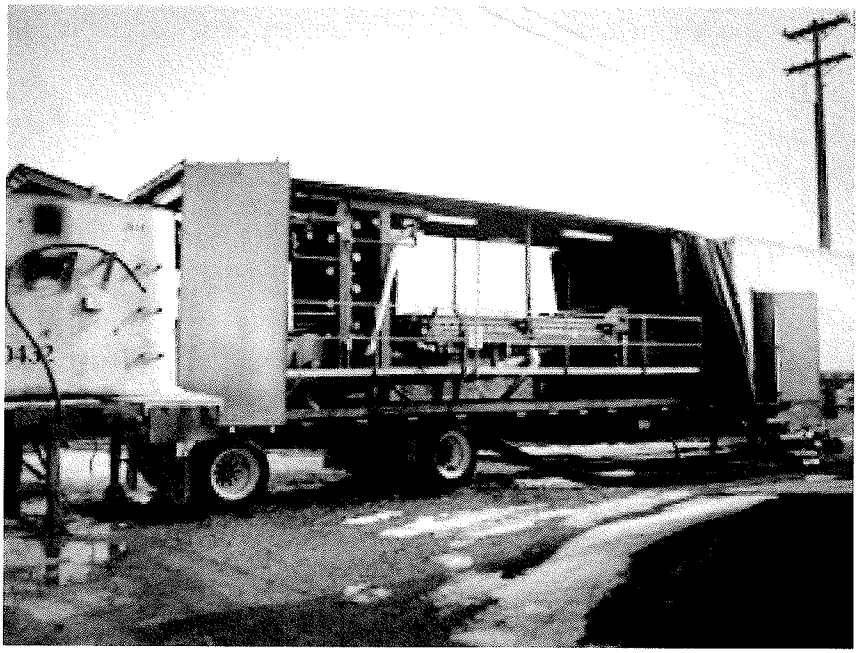
The sediment in the old anaerobic lagoon is on the average 5 to 7 feet in depth. That leaves approximately 3 feet of water on top of the sediment. A small cable driven dredge will be placed with a crane into the lagoon. The dredge will be equipped with a diesel engine and vegetable based biodegradable oil. The dredge will traverse along a cable that will be stretched across the lagoon and anchored using either temporary concrete blocks, or similar weighted wheeled machine; i.e. skid steer, telehandler. The cutter head on the dredge will be equipped with rubber tires that are adjustable for depth in order to preserve the integrity of the clay based liner and prevent damage to the existing structure. The dredge will remove the sediment down to approximately 6 inches. The remaining sediment will be finer particles that simply remain in suspension while operating the dredge. The dredge is expected to pump approximately 1000 gallons per minute (gpm) while operating. Floating pipe will be placed in the lagoon to allow the transfer of sediment to the bank of the lagoon where it will discharge into an 18,000 gallon mix tank. The float pipe will be 6 inches in diameter and will be secured with clamps to maintain integrity and prevent leaks. All fuel transfers to the dredge will occur with spill prevention practices in place and supplies for accidental spillages readily available onsite.

It is expected that 2 operators will be onsite for dredging operations in order to ensure safe work practices. One operator will be on the dredge while the other operator provides shoreline support and pipe line management. The proposed dredge is shown below:



4. Dewatering Operation

The sediment that is transferred from the dredge to the onshore mix tank will be dewatered with a belt filter press. A second belt filter press may be required. The mix tank will require 60 amps of 480 volt 3 phase electricity. The mix tank allows for consistent operation throughout the day for the belt filter presses. Each belt filter press will be 2 meters in width and be capable of processing 0.75 to 1.0 dry tons per hour. The belt filter presses are trailer mounted and fully equipped with sludge pumps, grinders, polymer makeup and injection systems, wash water booster pumps, drain basins and catch pans, and cake loadout conveyors. Each belt filter press will be equipped with electro-magnetic flow meters and totalizers. Electricity requirements for the belt filter presses are 100 amps of 480 volt, 3 phase electricity. The requirements for wash water will be 100 gallons per minute (gpm) at 40 psi. Each belt filter press will have an operator responsible for mixing polymer, maintenance and adjusting for optimal performance. It is expected that each belt filter press will operate 9 to 10 hours per day. The per cent solids on the dewatered sediment is expected to be 22%. Dewatered sediment will discharge from each press into an end dump trailer equipped with sealed tailgate and splash guards. Containment systems will be placed under each press prior to set up. Storm water and contained water will be pumped from the containments into the press filtrate or back into the mix tank for reprocessing. Filtrate water will be discharged to Anoxic Pond A for treatment in the Allen Harim Harbeson WWTP at a rate of 600 gallons per minute (gpm). The proposed belt filter press is shown below:



5. Non-Sanitary Determination

The old anaerobic lagoon at the Harbeson site has been out of service since 1998 when the WWTP expansion was completed to include anoxic ponds. The lagoon was left intact. Over the 20 year period the sludge has been anaerobically digested to meet all land application standards as a non-sanitary waste (now called sediment). As previously mentioned, Allen Harim disposed of significant tonnage of sediment and vegetation on the adjacent farm land to the Harbeson plant.

Allen Harim has retained the services of McConnell Agronomics, Reid Engineering and Vernon Rowe Environmental to confirm that the remaining sediment is sanitary free. John Reid and Vernon Rowe are both Professional Engineers experienced in Wastewater Treatment Design. Both are licensed to do business in the State of Delaware. Luke McConnell is the Agronomist for Allen Harim. Luke has extensive experience in Land Application and Nutrient Management Plans. Please see the attached reports from all three consultants on this project.

6. Transportation and Land Application of Dewatered Sediment

The dewatered sediment cake will be discharged from the belt filter presses into end dump trailers equipped with seal tail gates and splash guards. All trailers will have current DOT inspection and be in good working order. Allen Harim has tentatively selected Denali Water Solutions as our contractor for disposal and land application of dewatered sediment cake in Maryland. Once cake is produced and conveyed into an end dump trailer, Denali will transport material to an approved agricultural application site in Maryland. Allen Harim already has a contract with Denali for land application of pressed sludge with disposal in Maryland. Denali will add the dewatered sediment cake to the existing contract and

Allen Harim will seek permitting in Maryland as an additional source. The material will be land applied in accordance with site specific nutrient management requirements. Once applied, Denali will supply Allen Harim with a record of volume and location of applied residuals.

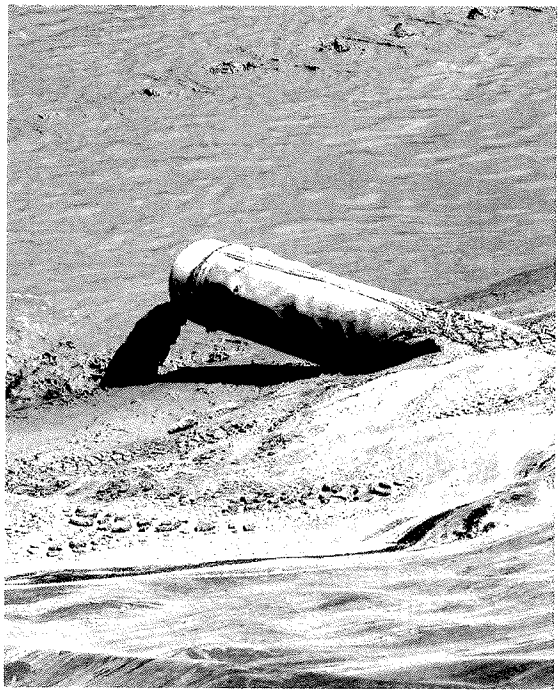
Alternate Disposal Option

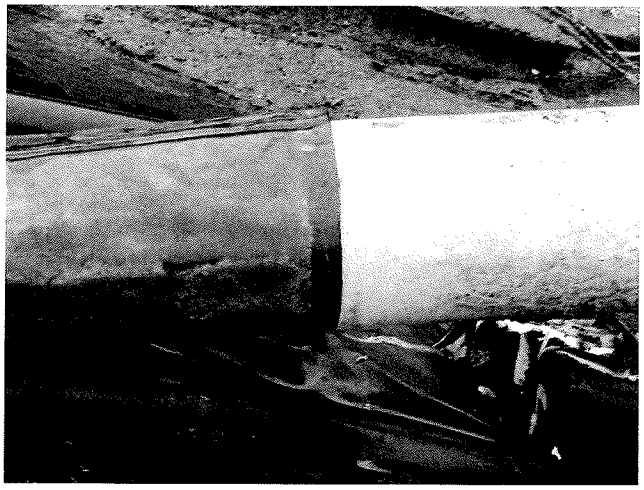
Synagro has also proposed to remove the residuals from the lagoon located at the Harbeson Allen Harim processing facility as a liquid residual and haul it to an approved agriculture application site. If this option is utilized, the material will be removed with a lagoon style pump operated by an ag tractor, transported by tanker truck and land applied in accordance with site specific nutrient management requirements. Once applied, Synagro will supply Allen Harim with a record of volume and location of applied residuals.

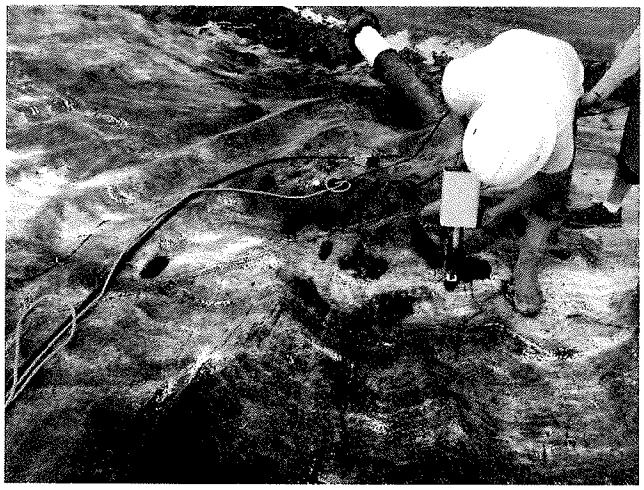
7. Groundwater Monitoring

Allen Harim installed 4 groundwater monitoring wells surrounding the anaerobic lagoon for the purpose of determining the integrity of the existing clay liner. Three sampling events on the 4 monitoring wells were conducted. The only issue that was found in the results from these events was the presence of elevated ammonia levels in Monitoring Well 2 (MW2). Allen Harim tested the old anaerobic lagoon for ammonia and found the results to be in the range of 8 to 10 mg/L which was far less than the levels of ammonia reported in MW2 (38.7 mg/L average for the 3 sample events). Allen Harim does not believe the high levels of ammonia in MW2 are in any way related to the anaerobic lagoon, as the levels of ammonia in the lagoon are too low to cause elevations of ammonia in MW2 that we have reported.

Even though there is no regulatory limit for ammonia in groundwater, Allen Harim decided to further investigate what may be the cause of the elevated ammonia levels in MW2. During the weekend of May 12th - May 13th, Allen Harim lowered Ponds A and B to a very low level that was approximately 3 feet below all pipe penetrations. On Monday, May 14th, the company inspected the pipes that penetrate the pond liner to ensure that the integrity of the seals on these pipes had not diminished to where leakage could occur. The soil in the area was also tested where the pipes penetrate the pond liner, but those reports showed no significant signs of ammonia. While the Ponds were at a low level, preventive maintenance was performed to reinforce all seals on the pipes that penetrate the lagoon. Please see the attached Anoxic Pond Liner report prepared by Hopkins Construction who performed the work. The pictures below show examples of the work that was performed.







Allen Harim contracted with Choptank Environmental, LLC to perform groundwater monitoring for the 1st quarter of 2019. The sampling was performed on March 19, 2019. The ammonia level in MW1 and MW 2 was 17.6 mg/L and 58.8 mg/L respectively. Because MW1 and MW2 have reported a high result for this sampling event, Allen Harim is continuing our investigation as to what may be the cause. Hopkins Construction was contracted to perform integrity testing on the DAF effluent pipe. This work was complete on June 3, 2019. Hopkins Construction was able to confirm that the DAF effluent pipe passed the integrity testing and is not the source of ammonia in the groundwater.

Once in the groundwater ammonia is persistent and can be long lasting. Appendix contains a document prepared by Choptank Environmental, LLC that is "intended to demonstrate that a portion of the literature provides evidence, that in certain hydrogeochemical environments, Ammonium can persist long after more mobile wastewater constituents (e.g. Nitrate) are gone or the Nitrogen source has been abated."

The Groundwater Monitoring Report for Q1/2019 has been submitted to DNREC. Due to damage of MW2 by a contractor working on the Artesian project, MW2 has been replaced with a new monitoring well. It was located in the same area as the original MW2.

Allen Harim has sampled and analyzed the surface water bodies of the old anaerobic lagoon, the old Storm Water lagoon and the Storm Water 004 lagoon (see attached analytical reports). In addition, Allen Harim has sampled and analyzed the sediment of the old anaerobic lagoon. The ammonia levels (NH3-N) in the old anaerobic lagoon, old storm water lagoon and SW 004 lagoon were 1.12 mg/L, 0.31 mg/L and 1.11 mg/L respectively. Allen Harim believes the water contained in all three lagoons is consistent with storm water runoff and not the cause of elevated ammonia levels in two of the groundwater monitoring wells. See attached analytical reports.

Allen Harim will install a new synthetic liner that will meet all DNREC regulations.

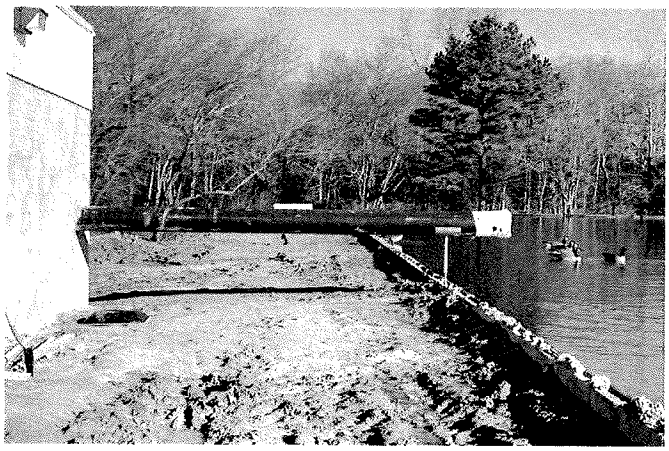
8. Odor Control and Management

Synagro does not anticipate unacceptable odor to be generated from the dredging, dewatering and transportation activities. In the event that odor does become an issue, Synagro will deploy an odor control and management plan to include, but not limited to deodorizers, aerial odor reducer and carbon capture systems. Each method of managing odor will be dependent upon the application necessary to mitigate unacceptable conditions. Often it is necessary to employ multiple techniques in order to obtain satisfactory results to continue the operation. Synagro has extensive experience in managing these conditions and has committed to working with Allen Harim to resolve unacceptable odor conditions.

9. Non-Compliant Water Diversion During Lagoon Cleanout

Prior to the issuance of the Harbeson Operations Permit, Allen Harim will pump the down the lagoon three to four feet. This will give a minimum of 4 million gallons of storage capacity at the time the WWTP effluent comes out of the stream and goes to Artesian for spray irrigation. Due to land application requirements in Maryland, the cleanout of the old anaerobic lagoon is not expected to begin until June, 2020. For the time prior to cleanout Allen Harim will maintain the 4 million gallon storage capacity by pumping any water that may accumulate with a portable pump to the Allen Harim Harbeson WWTP. This will be at least a 3 to 4 feet depth after freeboard. The temporary pump will be available 24 / 7 to maintain the storage capacity of 4 million gallons or 2 days of production capacity.

During the dredging and cleanout operation Allen Harim and Synagro will maintain the 3 to 4 feet of open volume from the top after freeboard. If at any time the plant effluent becomes non-compliant with the limits in the Operations and Maintenance Plan, Allen Harim will divert the non-compliant flow to the old storm water lagoon, the anoxic ponds and lastly the old anaerobic lagoon. See the inserted photo below of the discharge pipe to the lagoon.



Sequence Diversion

If diversion is required due to the ongoing exceedance of any action limit, Allen Harim will divert in a sequential manner. The first 2.0 million gallons of diverted flow will be directed to the old storm water lagoon. The next 2.0 million gallons will be diverted to the anoxic ponds. Any additional flow that may have to be diverted will then go to the old anaerobic lagoon. It is understood that the lagoon will be in the process of cleaning and liner installation. This is the reason that the old anaerobic lagoon will be the last choice for diversion.

Once the lagoon has been dredged and all sediment dewatered and disposed of at the Maryland disposal site the old clay liner will be inspected and a new liner installed. Allen Harim will utilize the 2

million gallon storm water lagoon in the unlikely event of a diversion during the new liner installation.

Artesian has indicated that they will have additional storage available in their lagoons located in Milton, Delaware. If non-compliant water is diverted to the Artesian lagoons, it would have to be diluted prior to spray irrigation to ensure compliance with spray irrigation regulations and Artesian permitting.

Lagoon Level Monitoring – Interim During Clean Out

During the lagoon cleanout period, Allen Harim will monitor the lagoon level on a daily basis using staph gauges. Allen Harim utilizes a staph gauge in the anoxic ponds. Allen Harim will begin with the purchase and installation of two staph gauges this week.

Off Spec Water Diversion

Synagro will be performing dredging operations to remove residuals from the old anaerobic lagoon at the Allen Harim Harbeson Facility. Synagro has stated that "dredging operations will not be impacted by the introduction of additional wastewater that may need to be discharged from the processing facility." Synagro further states that "Dredging operations require that some water remain in the lagoon allowing the transfer of solids from the lagoon to the dewatering equipment." A small amount of water in the lagoon will ensure that the dredging operation does not impact the clay liner. With the clay liner intact, contamination of the groundwater is not likely.

During the lagoon cleanout period, Allen Harim will monitor the lagoon levels on a daily basis using staph gauges. Allen Harim utilizes a staph gauge in the anoxic ponds. Allen Harim will begin with the purchase and installation of two staph gauges this week.

During the period when the new synthetic liner is installed, will utilize the following alternate diversion option. Allen Harim has 3.0 MG of capacity in the anoxic ponds. We typically operate the Harbeson WWTP with levels between 0.5 MG and 2.5 MG. Alternate Diversion or diversion sequencing will be required during the short time period that the liner installation is underway. Allen Harim will utilize up to 2.0 MG of this capacity for interim diversion in the unlikely event that it is required

Allen Harim will begin the pumping down of the old storm water pond today followed by the pumping of the old anaerobic lagoon. We will inspect the old storm water lagoon this week. This old storm water lagoon has an estimated 2.0 MG capacity and it is synthetically lined. On the surface the liner appears in-tact and in good shape.

10. Time Line

Contract Signed	October 2019
Mobilization	May 2020
Dredging	June 2020-April 2021
Dewatering	June 2020-April 2021
Land Application	June 2020-April 2021
Wastewater Effluent to Spray Irrigation	July 2019
Lagoon Ready for Service	June 2021

Choptank Environmental, LLC
34 Mt Pleasant Avenue
Easton, MD 21601
Phone: 443.309.2713

MEMORANDUM

TO: Michael Sausé, Allen Harim Foods
FROM: Gary Lasako
DATE: May 20, 2019
PROJECT: AH-140-01
RE: Ammonium Retardation and Persistence in Groundwater

The following is a limited literature review of certain studies that demonstrate the retardation or persistence of Ammonium in groundwater. This is not intended to be a comprehensive literature review of Ammonium fate and transport; rather, it is only intended to demonstrate that a portion of the literature provides evidence that, in certain hydrogeochemical environments, Ammonium can persist long after more mobile wastewater constituents (e.g. Nitrate) are gone or the Nitrogen source has been abated.

Ammonium transport in groundwater may be retarded by physical processes, e.g. sorption or volatilization, or biological processes including microbially-induced transformations, e.g. nitrification, depending on the hydrogeochemical environment (Bohlke et al. 2006). Sorption of Ammonium chiefly occurs through cation exchange with negatively charged mineral surfaces (Buss, S.R. et al. 2004). Cation exchange occurs primarily on clay surfaces in groundwater of below-neutral to neutral pH, whereas it chiefly occurs with metal oxides (e.g. Manganese and Iron oxides) in groundwater neutral to above-neutral pH (Buss, S.R. et al. 2004). Sorption in groundwater exhibiting reduced conditions was the primary mechanism controlling Ammonium attenuation in a study of a wastewater-contaminated aquifer in California (Izbicki 2014). In a study of Ammonium and Potassium transport in a sewage-contaminated gravel aquifer, Ceazan et al. (1989) showed that sorption (cation exchange) can influence the rate of Ammonium transport. In their study, Ammonium was retarded at a rate of 3.5 times that of Bromide, a non-reactive tracer, even with the clay content in the aquifer being less than 0.1% (Ceazan et al. 1989). DeSimone and Howes (1998) studied a shallow wastewater-contaminated aquifer in Cape Cod and found that sorption played a role in retarding Ammonium transport in the shallow aquifer; specifically, approximately 16% of the Nitrogen mass recharged to groundwater was removed via Ammonium sorption. This was primarily limited to the anoxic zone within the aquifer being monitored, where nitrification was prevented (DeSimone and Howes, 1998).

Certain bacteria can oxidize Ammonium in a two-stage process known as nitrification. Nitrification is commonly an aerobic process; however, it can occur as an anaerobic process (Anammox) and be a controlling attenuation mechanism at certain sites (Robertson et al. 2012). Where Ammonium attenuation is limited by cation exchange capacity, nitrification can be the primary process that controls the development and longevity of an Ammonium plume (Christensen et al. 2001).

Bohlke et al., 2006, in a study of a wastewater-contaminated sand and gravel aquifer in Cape Cod, Massachusetts, concluded that Ammonium was retarded by a factor ranging from 3 – 6 relative to water and more mobile groundwater constituents. Ammonium oxidation (nitrification) was an unimportant

attenuation control on the core of the plume and Ammonium transport retardation was chiefly controlled via sorption (Bohlke et al. 2006). . The authors also note that if the wastewater source were shut down and redox conditions in the aquifer remain unchanged, it could take in excess of 100 years for the Ammonium to reach the discharge area, whereas other more rela tively mobile constituents, such as Nitrate and Boron, would be flushed out of the aquifer during this period (Bohlke et al. 2006).

References

Bohlke, J. K., R. L. Smith, and D. N. Miller (2006), Ammonium transport and reaction in contaminated groundwater: Application of isotope tracers and isotope fractionation studies, Water Resources Research, 42, W05411, doi:10.1029/2005WR004349.

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145 Jefferson Pittsburg, Texas 75686
(903) 856-5133 FAX (903) 856-5134
email rowenvironmental@hotmail.com

January 15, 2019

Mr. Michael Sause
Allen-Harlm Foods LLC – Harbeson
P.O. Box2n
Harbeson, DE 19951

RE: Off-Line Anaerobic Lagoon Residual Solids Management
Allen-Harim, Harbeson, DE

Dear Mr. Sause:

Per your request I have performed an assessment of the nature of the residual solids in the off-line anaerobic lagoon at the Allen-Harim, Harbeson, DE poultry processing plant as relates to management options.

Background

The Harbeson processing plant wastewater treatment system footprint includes an off-line anaerobic lagoon that was previously used for anaerobic treatment of processing plant wastewater upstream of an activated sludge treatment system. The lagoon was taken out of service over 20 years ago. There has been no input of processing plant or sanitary wastewater since that time. The residual solids that were in the bottom of the lagoon when it was taken off-line have remained in place for over 20 years and have continued to biodegrade and stabilize under anaerobic conditions.

Allen-Harim is evaluating options for management of the residual solids in the off-line lagoon which include land application or dewatering and landfilling.

Nature of Residual Solids and Suitability for Land Application

The USEPA and state environmental regulatory agencies have established requirements for land applying sludge. Three main crjteria in the regulations are:

- Priority Pollutant Concentrations
- Pathogen Reduction
- Vector Attraction Reduction

Priority Pollutant Concentrations

Table No. 1 shows the priority metal pollutants listed in the regulations and levels measured in the off-line lagoon. All the pollutants in the lagoon sludge are below the "ceiling" levels established by the regulations to allow land application.

Table No.1
Priority Pollutant Ceiling Limits vs Actual Levels

Pollutant	Ceiling (mg/kg) Drvweinht	Lagoon Sludge, August 17, 2017
Arsenic	75	19
Cadmium	85	3.6
Chromium	3.000	73
Coooer	4 300	437
Lead	840	31
Mercurv	57	I*I
Molvbdenum	75	71
Nickel	420	40
Selenium	100	3.6
Zinc	7 500	2 010

'Mercury data not available in thrs data set. Facility has never used mercury in the process and levels In the Sludge are eicpected to be well below the celling limit of 57 mg/l.

Pathogen Reduction

The regulations require that all sludges prepared for land application must at a minimum be treated by an approved process to significantly reduce pathogens (PSRP). One of the approved PSRP processes is anaerobic digestion that meets the following requirement:

> *Anaerobic digestion - Treatment in the absence* of *air for* a *specific* mean *cell residence time at a specific temperature. Values for the mean cell residence time and temperature shall be between 15 days at 35* to *55 degrees Celsius and 60 days at 20 degrees Celsius.*

The residual solids in the off-line anaerobic lagoon have remained in the lagoon under anaerobic conditions for over 20 years, or over 7,300 days. The worst case mean cell residence time of 60 days has been exceeded many times over, indicating the PSRP requirement can reasonably be assumed to have been met.

Actual test results from the off-line lagoon indicate fecal coliform levels of less than 23,000 Most Probable Number (MPN) per gram of total solids on a dry weight basis as compared to the limit of 2,000,000 MPN per gram of total solids on a dry weight basis allowed in the regulations.

Vector Attraction Reduction

The regulations require that the mass of volatile solids in the sludge shall be reduced by a minimum of 38 percent in order to meet vector attraction reduction requirements. Table No. 2 summarizes the total solids and volatile solids levels for the residual solids in the off-line anaerobic lagoon. The table also shows the estimated volatile solids reduction that has occurred over the life of the off-line lagoon.

Table No. 2
Estimated Volatile Solids Reduction
Off-Lina Anaerobic Lagoon

Parameter	Value
Total Solids lwet basis)	7.3%
Total Volatile Solids wet basis\	3.45%
Total Volatile Solids dn, basis)	47.95%
Assumed Volatile Solids (dry basis) from wastewater discharged to anaerobic lacoon when in use	80%
Assumed Reduction in Volatile Solids over life of anaerobic Jaaoon	40.1%

Given the over 20 years the residual solids have been in the off-line anaerobic lagoon it Is reasonable to assume the volatile solids reduction has been equal to or greater than 40 percent over the time period.

Summary

In summary, the residuals solids in the off-line anaerobic lagoon at the Allen-Harim Harbeson DE poultry processing plant have been in the lagoon for over 20 years and are believed to be very stable as a result of the anaerobic biological process that has occurred over the life of the lagoon. While it is acknowledged that relatively small volumes of sanitary wastewater were discharged to the anaerobic lagoon when It was in use, the residence time of the sludge in the lagoon has provided a high degree of stability and any residual impacts from sanitary wastewater are believed to have been assimilated years ago. The measured fecal coliform levels in the residual solids are less than 1.5 percent of the levels allowed by the regulations.

The residual solids in the off-line anaerobic lagoon meet the USEPA and state regulations required for management through land application. It is ryiy professional opinion that the preferred and most environmentally sound method of handling the residual solids in the off-line lagoon is through land application for beneficial reuse in accordance with applicable USEPA

and state rules and regulations. To require disposal of this sludge In a landfill would be an inefficient use of resources and an Increased risk to the environment

Please advise If there are questions.

Very truly yours,

Varnon D. Rowe, P.E.
Delaware PE No. 22022

Reid Engineering Company, Inc.

Environmental and Civil Engineering Consultants
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January 16. 2019

Mr. Michael Sause
Environmental Manager
Allen Harim Foods, LLC
18752 Harbeson Road
P.O. Box277
Harbeson, DE 19951

SUBJECT: ALLEN HARIM FOODS. LLC - HARBESON.DELAWARE

Dear Michael:

Fecal coliform test data provided to Reid Engineering Company (REC) by Allen Harim for **the old Anaerobic Lagoon bottom solids sludge indicates an average Fecal** Coliform **density** (FCMPN) of approximately 12,000 MPN/grarn of total solids dry weight. The typical FCMPN **for anaerobically digested sanitary sewage sludge that meets Class B land disposal requirements** is less than 2,000,000 MPN/grarn. The FCMPN density required for Class A land application is less than 1,000 MPN/gram.

The residual solids in the old Anaerobic Lagoon at the Allen Harim plant in Harbeson, **Delaware is therefore so completely digested that the solids almost comply with the Class A disposal level for FCMPN. This extremely low value for FCMPN indicates that there is essentially no sanitary sewage residual in the bottom solids to be removed and land disposed from the old Anaerobic Lagoon.**

Best Regards,

John H. Reid, PE
President

)frtomu,Jlo'jgl'OIIDllks
Independent Agricultural Consultants

7735 Oyer Road, Denton, MD 21629 · office: 410-479-3664 · fax; 410-479-0564 · mccagro22@gmail.com

January 16, 2019

Mr. Sause:

I have reviewed the data from the Harbeson lagoon and at this time believe thet the sludge could be applied on agricultural land. The heavy metal content is within the EPA standards for agricultural bio solids and the low level nitrogen and phosphorus content would allow for an **economic rate of application.**

The lagoon sediments will have some level of biological activity but should not, after 20 years of no additional waste and on site anaerobic digestion, exhibit typical characteristics of sanitary waste. Initial bacterial analysis indicates that it is well within the levels allowed for land application for bio-solids,

Please see the attached analytical data, analysis of the data, and Land Application Pollutant Limits from the EPA Bio solids Management Handbook.

It is my professional opinion thet the lagoon sediment would be far more ecologically and economically utilized by applying it to agricultural land then placing it in a landfill.

Luke McConnell

Luke McConnell CPAg
McConnell Agronomics, Inc.

435 Williams Court, Suite 100
Baltimore, MD 21220
www.synagro.com

SYNAGRO

June 6, 2019

Tracy Allen

Senior Director

Operations and Environmental

Allen Harim Foods, LLC

18752 Harbeson Rd

Harbeson, DE 19951

Re: Request for Clarification of Lagoon Operations during Dredging Operations

Dear Ms. Allen,

Synagro Central LLC will be performing dredging operations to remove residuals from the lagoon at the Allen Harim facility in Harbeson DE site. Dredging operations will not be impacted by the introduction of additional wastewater that may need to be discharged from the processing facility. Dredging operations require that some water remain in the lagoon allowing the transfer of solids from the lagoon to the dewatering equipment. In the event that Allen Harim would need to divert wastewater flow from the existing treatment facility to the residuals lagoon, Synagro will coordinate dredging operations as necessary to continue service to the Allen Harim facility.

Respectfully,

Brian Ryerson

Brian Ryerson
Area Sales Manager

51 Clark St. Harrington, DE 19952
PH: 302.398.4313 FX: 302.398.4312
ANALYTICAL SERVICES: NPDES, RCRA, GROUND WATER MONITORING

ANALYTICAL RESULTS

Allen Harim Foods, LLC - Harbeson
P.O. Box 277
Harbeson, DE 19951

Attention: Michael Sause

Lab ID:	274186	Matrix:	Waste Water	Sample Start:	4/11/19 9:30
Description:		Site:	Old Lagoon Water	SampleEnd:	
Type:	Grab			Date Received:	4/11/19 11:35

Parameter	Units	Result	Analyzed	By	Method
Nutrient					
Ammonia as N	mg/L	1.12	4/16/19 12:10	CC	SM4500-NH3-G
Nitrate+Nitrite as N	mg/L	0.16	4/16/19 12:36	CC	SM4500-NO3-H
Total Kjeldahl Nitrogen	mg/L	18.3	4/16/19 14:02	CC	SM4500-Norg-C
Total Nitrogen as N	mg/L	18.5	4/17/19 10:18	RLF	Calc
Total Phosphorus as P	mg/L	6.31	4/16/19 15:13	CC	SM4500-P-F(w/Dig)
Oxygen Demand					
BOD5	mg/L	36.5	4/11/19 13:08	HJG	SM5210-B
Physical					
Total Suspended Solids @103-105 C	mg/L	70.7	4/16/19 10:30	SLB	SM2540-D

ND = Not Detected
* = Above Specified Limit
** = Above Client Limit

51 Clark St. Harrington, DE 19952
PH: 302.398.4313 FX: 302.398.4312
ANALYTICAL SERVICES: NPDES, RCRA, GROUND WATER MONITORING

ANALYTICAL RESULTS

Allen Harim Foods, LLC - Harbeson
P.O. Box 277
Harbeson, DE 19951

Attention: Michael Sause

Lab ID:	274187	Matrix:	Waste Water	Sample Start:	4/11/19 9:35
Description:		Site:	Old Lagoon Water	SampleEnd:	
Type:	Grab			Date Received:	4/11/19 11:35

Parameter	Result	Units	Method	Date Analyzed	Analyst	Reference
Biological						
Fecal Enterococcus Enterolert	119.4	#/100 mls		4/11/19 14:05	RD	Enterolert

ND = Not Detected
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** = Above Client Limit

51 Clark St. Harrington, DE 19952
PH: 302.398.4313 FX: 302.398.4312
ANALYTICAL SERVICES: NPDES, RCRA, GROUND WATER MONITORING

ANALYTICAL RESULTS

Allen Harim Foods, LLC - Harbeson
P.O. Box 277
Harbeson, DE 19951

Attention: Michael Sause

Lab ID:	274188	Matrix:	Waste Water	Sample Start:	4/11/19 9:30
Description:		Site:	Old Lagoon Water	SampleEnd:	
Type:	Grab			Date Received:	4/11/19 11:35

Organic Compounds					
Oil & Grease	mg/L	5.6	4/24/19 10:40	MJM	EPA 1664A

ND = Not Detected
* = Above Specified Limit
** = Above Client Limit

ENVIROCORP, INC.
CHAIN OF CUSTODY REPORT

Allen Foods – Harbeson
18752 Harbeson Rd.
PO Box 227
Harbeson, DE 19951
Michael Sause – 302-359-1975

Lagoon Water Grab

Terrell Mackey
SAMPLER'S SIGNATURE

COLLECTION

Rush - 4/16/19

PRESERVED

LAB I.D.	TIME	DATE	DESCRIPTION	YES	NO	ANALYSES
274180	0930	4-11-19	Lagoon Water Grab		Ice	BOD, TSS, TN
	0930	4-11-19	Lagoon Water Grab	H2S04		TP, TKN, NO3O2 NH3 - Michael added 4/16/19
274187	0935	4-11-19	Lagoon Water Grab		Ice	FENT
274188	0930	4-11	Oil & Grease Grab #1	HCL		Oil & Grease
			[redacted]	[redacted]		Oil & Grease
			[redacted]	[redacted]		Oil & Grease

RELINQUISED BY	DATE	TIME	RECEIVED BY	COMMENTS
Michael Sause	4-11-19	1135	ABuNS	4/11/19 1135

EI Labs Cooler Temperature 1.9 °C

ENVIROCORP LABS
51 Clark St. Harrington, DE 19952
PH: 302.398.4313 FX: 302.398.4312
ANALYTICAL SERVICES: NPDES, RCRA, GROUND WATER MONITORING

ANALYTICAL RESULTS

Allen Harim Foods, LLC - Harbeson
P.O. Box 277
Harbeson, DE 19951

Attention: Michael Sause

Lab ID:	274863	Matrix:	Waste Water	Sample Start:	4/22/19 7:00
Description:		Site:	SW004 Lagoon	SampleEnd:	
Type:	Grab			Date Received:	4/22/19 10:06

Parameter	Units	Result	Date Analyzed	Analyst	Method
Nutrient					
Ammonia as N	mg/L	1.11	4/22/19 13:57	CC	SM4500-NH3-G
Nitrate+Nitrite as N	mg/L	0.19	4/22/19 13:49	CC	SM4500-NO3-H
Organic Nitrogen as N	mg/L	4.47	5/2/19 16:35	SLB	Calc
Total Kjeldahl Nitrogen	mg/L	5.58	5/2/19 16:11	CC	SM4500-Norg-C
Total Nitrogen as N	mg/L	5.77	5/2/19 16:35	SLB	Calc

ND = Not Detected
* = Above Specified Limit
** = Above Client Limit

51 Clark St. Harrington, DE 19952
PH: 302.398.4313 FX: 302.398.4312
ANALYTICAL SERVICES: NPDES, RCRA, GROUND WATER MONITORING

ANALYTICAL RESULTS

Allen Harim Foods, LLC - Harbeson
P.O. Box 277
Harbeson, DE 19951

Attention: Michael Sause

Lab ID:	274864	Matrix:	Waste Water	Sample Start:	4/22/19 7:10
Description:		Site:	Old SW Lagoon	SampleEnd:	
Type:	Grab			Date Received:	4/22/19 10:06

Nutrient					
Ammonia as N	mg/L	0.31	4/22/19 13:57	CC	SM4500-NH3-G
Nitrate+Nitrite as N	mg/L	<0.05	4/22/19 13:49	CC	SM4500-NO3-H
Organic Nitrogen as N	mg/L	4.45	5/2/19 16:35	SLB	Calc
Total Kjeldahl Nitrogen	mg/L	4.76	5/2/19 16:11	CC	SM4500-Norg-C
Total Nitrogen as N	mg/L	<4.81	5/2/19 16:35	SLB	Calc

ND = Not Detected
* = Above Specified Limit
** = Above Client Limit

ENVIROCORP LABS
51 CLARK ST · HARRINGTON, DE 19952
SINCE 1984
ANALYTICAL SERVICES

Client Name:	Allen Harim Foods
Contact:	Michael Sauré
Address:	18752 Harbeson Rd
	Harbeson, DE 19951
Phone	
cell	302-359-1975
Email	michael.saure@allenharim llc.com

Payment Rec. Cash_____ Check #_____ Invoice__X___

Email Reports O *Fax Reports* O

Containers Received:
Type: UP M N/P Bacti
Quant: 1
Temperature Upon Receipt 12.8 °C

Administrators Notes

Lab I.D	Sample Description/Location	Sample Date	Time	Matrix	Field		Please check appropriate box for each test requested							
							Total Nitrogen	NH3	Nitrite Nitrate	Organic N	TKN			
274863	SW 004 Lagoon	4-22-19	0700	DW			✓	✓	✓	✓	✓			
274864	Old SW Lagoon	4-22-19	0710				✓	✓	✓	✓	✓			
	RUSH NH3 BL													
	9.00 4/23/19.													

UP=(Unpreserved), M=Metals (HNO_3), N/P=Nutrients (H_2SO_4), Bacti=P/A Colilert® (Sodium Thiosulfate)

Sampled by: Michael Sauré Date 4-22-19 /Time 0700 / 0710 Received by Gibbons Date 4/22/19 /Time 1004

Reliniquished by:_____Date_____/Time_____ Received by_____Date_____/Time_____