HARMFUL ALGAL BLOOMS (HABS)

KDHE Agency Response Plan

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Kansas
Department of Health and Environment

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Cover photo taken at Miami Co. State Fishing Lake in August, 2005.

Top microscopic photo is Anabaena, bottom left is Aphanizomenon, and bottom right is a microcysts colony showing individual cells within the sheath.

All photos taken by Diana Lehmann

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KDHE Blue-Green Algae Response

DATE: April, 2015

SUBJECT: Blue-green Algae Response

Section I. PURPOSE. This plan is to provide guidance for Kansas Department of Health and Environment's (KDHE) response to reduce the risk of exposure to humans, pets and livestock from blue-green algal toxins.

Blue-green algal (also known as cyanobacteria) toxins in freshwaters have been implicated in human and animal illness in at least 36 states in the United States[1]. Blue-green algae are naturally present in most Kansas surface water resources. When certain conditions are present, such as high nutrient and abundant light levels, these organisms can reproduce rapidly. This dense growth of algae is called a bloom, sometimes leading to a harmful algal bloom (HAB). These conditions tend to occur in the warmer summer months after spring rainfalls wash accumulated high nutrient loads from animal waste, agricultural fertilizers and sewage effluent into surface waters. Subsequent summer conditions improve water clarity, allowing light to penetrate deeper into waters, fueling primary productivity where nutrients are plentiful. Dry summer conditions also increase the impact of wastewater effluent on lakes and streams. Organisms most frequently responsible for these HAB outbreaks include cyanobacteria and although not as common in freshwater, dinoflagellates.

HABs are potentially toxic and may pose a direct threat to human and animal health. Recreational exposure to cyanobacteria toxin can result in adverse human health effects such as: hay fever-like symptoms, skin rashes, vomiting, diarrhea and respiratory distress.[2] Freshwater blue-green algae under bloom conditions are capable of producing potent toxins that cause specific and severe hepatic or neurological dysfunction. These toxins have also been identified as the cause of several animal deaths. Exposure to these toxins most commonly occurs when persons or animals ingest or inhale contaminated water[3].

Section II. GENERAL. This plan outlines the interaction, responsibilities and activities of KDHE and coordination with other stakeholders to ensure that the HAB investigation is conducted in a rapid and effective manner and founded on the following principles[5]:

A. Potential HAB events will be treated as harmful until proven otherwise.

B. Response to HABs will be limited to "Public Waters of the State" only. Owners/managers of waters not accessible to the public and not a public drinking

water supply lake who request assistance with HABs will be directed to the Kansas State Veterinary Diagnostic Laboratory in Manhattan, Kansas. The Veterinary Diagnostic Laboratory will be able to identify the presence or absence of cyanobacteria in a water sample.

1. In Kansas, for the purpose of the KDHE Blue Green Algae (BGA) response plan, "Public waters" and "Private water bodies" are defined as:

   a. ***Public waters****: Those waters that are referred to as reservoirs, community lakes, state fishing lakes and/or are waters managed or owned by federal, state, county or municipal authorities and all privately owned lakes that serve as public drinking water supplies or that are open to the general public for primary or secondary contact recreation. Primary contact recreation includes those activities where the body is immersed to the extent that some inadvertent ingestion of water is probable. This use shall include activities such as: boating, mussel harvesting, swimming, skin diving, waterskiing and windsurfing. Secondary contact recreation includes any activity in which the ingestion of surface waters is not probable. These uses shall include activities such as wading, fishing, trapping and hunting.*

   b. ***Private water bodies***: A*ny freshwater reservoir or pond that is both located on and completely bordered by land under common private ownership, or is not accessible to the general public (i.e., access by the general public is controlled or restricted in some manner).*

C. Response should be as rapid as practicable considering the resources available.

D. Response to HAB events and any and all advice provided will be consistent across all bureaus and responding agencies.

E. KDHE will be the primary responder unless multi-agency response is requested.

F. The response will at least include the analysis and identification of concentrations of cyanobacteria and microcystin toxins and the determination of when the issuing of public health advisories is necessary.

G. Training for all responding agencies for HAB events will be conducted by KDHE to ensure the effective coordination and consistency of response amongst agencies.

H. The KDHE Harmful Algal Bloom Response Plan is a dynamic document that is to be reviewed and maintained annually by KDHE.

Section III. PUBLIC HEALTH PROTECTION LEVELS: KDHE has established three levels of public health protection recommendations, "Harmful Algal Bloom (HAB) Watch", "Harmful Algal Bloom (HAB) Warning", or Lake Closure. These notification levels are determined by the concentration of harmful toxin level(s) **or** the concentration

of cyanobacteria cell counts. (See Table 1, p.10) When appropriate, KDHE will recommend the following actions for:

A. Harmful Algal Bloom (HAB) **Watch** notifies the public that a hazardous condition **could** exist. It has been analytically determined that the microcystin toxin concentration is greater than or equal to 4 µg/L but less than 20 µg/L[4] or cyanobacterial cell counts are greater than or equal to 80,000 but less than 250,000 cells/mL. Limited exposure to the water is encouraged.

1. The appropriate HAB Watch signage (See Attachment 1, p 32) should be posted at all primary public access locations such as beaches, marinas, boat ramps, and other main points of entry to the body of the water. Information should include:

a. that blue-green algae are present and that the body of water **may** be unsafe for people and animals;

b. contact information for the posting authority;

c. the date of the posting;

d. the symptoms of cyanobacterial poisoning;

e. what to do in case of contact with the water, and

f. whom to call in case of illness potentially associated with exposure.

The signage should also:

a. discourage people from having contact with the water, especially full body contact (e.g., no swimming, waterskiing, etc.) near visible blooms;

b. discourage allowing pets to drink or swim in the water. If pets do come in contact with the water, then they should be rinsed off with clean water immediately – not allowing them to lick the algae (and toxins) off their fur. Do not allow pets to consume dried algae on shorelines as algal toxins will remain toxic even in dry form;

c. permit boating and fishing, although boaters should be aware of the possible inhalation of harmful spray; and

d. indicate that if fish are caught, the fish should be properly cleaned and rinsed with clean water, and all internal organs removed, consuming only the fillets;

B. Harmful Algal Bloom (HAB) **Warning** notifies the public that conditions **are** unsafe for human exposure. At this level, it has been analytically determined that the microcystin toxin concentration is greater than or equal to 20 µg/L but less than or equal to 2,000 µg/L or cyanobacterial cell counts are greater than or equal to 250,000 cells/mL to less than 10,000,000 cells/mL, or there is verification of significant cyanobacterial surface scum present[4]. It is

recommended that action be taken over and above those listed in the "HAB Watch", restricting or prohibiting public exposure.

1. The appropriate HAB Warning signage (See Attachment 1, p. 32) should be posted at all primary public access locations such as beaches, marinas, boat ramps, and other main points of entry to the body of water. Information should include:

   a. that blue-green algae are present and that the body of water **is** unsafe for people and animals;

   b. contact information for the posting authority;

   c. the symptoms of cyanobacterial poisoning;

   d. what to do in case of contact with the water, and

   e. whom to call in case of illness potentially associated with exposure.

   The signage should also:

   a. restrict swimming, water skiing, boating or other activities that would involve direct contact with the affected water;

   b. warn that all contact with water should be avoided;

   c. warn owners not to allow pets to drink or swim in the water. If pets do come in contact with the water, then they should be rinsed off with clean water immediately, and not allow them to lick the algae (and toxins) off their fur. Pets should also not be allowed to consume dried algae on shorelines as algal toxins will remain toxic even in dry form;

   d. warn that if fish are caught, the fish should be properly cleaned and rinsed with clean water, all internal organs removed, consuming only the fillets;

C. Harmful Algal Bloom (HAB) Lake Closure notifies the public that extreme conditions exist. At this level, it has been analytically determined that the microcystin toxin concentration is greater than 2,000 µg/L or cyanobacterial cell count is greater than or equal to 10,000,000 cells/mL. It is recommended that the entire lake be closed and that adjacent land (e.g., approximately 100 ft. from the shoreline) be closed to the public. Actual setback distances will be determined on a site-specific basis. (See Attachments C and D, pages 33 and 34.)

D. Zoning notifies the public that a combination of conditions exists in the affected impoundment and that the public should observe the posted notices for each specific zone. Such allowance for mixed status is based on the size of the lake: only if over 10,000 acres with a shoreline sinuosity index greater than 4. These impoundments are considered large enough in size with shorelines structured in a manner that could shelter localized algal blooms sufficiently to limit those

portions of the lake to public use. Only three separate lakes in Kansas fulfill these designations: Milford, Perry and Tuttle Creek Lakes.

Further information pertaining to HABs and their effects on health can be found on KDHE's HAB website at www.kdheks.gov/algae-illness/index.htm

A. If water from an affected lake is used for irrigation, then people should avoid contact with the spray, due to the potential illness. Avoid fruits and vegetables that have come in contact with contaminated water until they have been washed with clean water. Do not allow livestock to drink irrigation water. If water is used to irrigate pastures, livestock owners should be aware that continued application of heavily affected waters can lead to significant toxin build up on foliage. Although rare, this residue can affect livestock, and

B. Areas of an affected lake may contain significantly higher HAB concentrations due to wind effects, increasing the health threats in localized areas.

C. A Public Health press release (See Attachment 5, p. 49) will:

1. not be issued by KDHE during a "Watch" status, but the affected waterbody will be identified and posted on the KDHE HAB website.
2. be issued by KDHE during both "Warning" and/or "Closure" status as well as be identified and posted on the KDHE HAB website.

Table 1. Lake Status Determination

Lake Status Determination
Blue-Green
Cell Count and Toxin Exposure Levels

Condition of lake	Alert Level	Recommendations
Microcystin toxicity at **<4 µg/L** **AND** Cell count of **<80,000 cells/ml**	None – Lake clear	None
Microcystin toxicity at **≥4 µg/L to <20 µg/L** **OR** Cell count of **80,000 cells/ml to <250,000 cells/ml**	Lake will be placed on a Public Health ***WATCH***	» Post signage » Notify health dept., doctors, vets, health providers » Post on website » **No** media release » Notify public water suppliers
Microcystin toxicity at **≥20 µg/L to 2,000 µg/L** **OR** Cell count of **≥250,000 cells/ml to ≤10,000,000 cells/ml**	Lake will be placed on a Public Health ***WARNING***	» Post signage » Restrict direct contact with water » Notify health dept., doctors, vets, health providers, etc » Post on website » Issue media release » Notify public water suppliers
Microcystin toxicity at **>2,000 µg/L** **OR** Cell count of **>10,000,000 cells/ml**	Lake is ***CLOSED***	» Recommend entire lake area including adjacent land (e.g., approximately 100 ft. from shoreline) be closed to public » Post signage » Notify health dept., doctors, vets, health providers, etc » Post on website » Issue media release » Notify public water suppliers

Section IV. KDHE RESPONSIBILITY:

Bureau of Environmental Field Services (BEFS) and Bureau of Water (BOW) – shall be responsible for:

A. collecting and validating incoming requests for the investigation of blue-green algae blooms to initiate sampling activities. BEFS/BOW will also collect, when needed; incoming reports of illness related to Blue-Green Algae (BGA) from the public and forward the information to Bureau of Epidemiology and Public Health Informatics (BEPHI). BEFS/BOW will forward all requests for general public health protection information to the EPI Hotline;

B. identifying sample type, location(s) and number of samples to be collected;

C. providing or coordinating field staff for water sample collection;

D. collecting of water samples or recruiting non-KDHE staff to collect water samples;

E. coordinating transportation of samples to BOW, as needed, if sample collection is conducted by non-KDHE entities;

F. coordinating other analytical needs with Kansas Health and Environmental Laboratories (KHEL), as needed;

G. reviewing the results of BGA analysis of water samples, determining the correct response as outlined by agency policy;

H. issuing the proper notifications to stakeholders responsible for the management of the water body and to the initial requesting entity.

1. The appropriate Bureau for notifying the stakeholders shall be determined during the initial response, depending on what impoundment is being considered and the entities involved, and shall continue until the conclusion of the response.

a. The KDHE's Topeka central office shall be responsible for all communications regarding large reservoirs, public waters owned by other state and/or federal agencies, public waters with more than one stakeholder, or if it is a source for public water supply systems. These agencies include:

i. *Kansas Department of Wildlife, Parks and Tourism (KDWP&T)*

ii. *U.S. Army Corps of Engineers (USACE)*

iii. *U.S. Department of Interior, Bureau of Reclamation (BOR)*

iv. *Kansas Department of Agriculture-Division of Animal Health (KDAH)* – shall be responsible for sending information on all public health

Watches/Warnings via Health Alert Network messaging to KDAH. KDAH will be a point of contact for the public and veterinarians regarding health effects of cyanobacteria on pets and animals. The KDAH number is 785-296-2326.

b. BEFS district offices shall be responsible for all communications regarding smaller county, city and privately owned/publicly used public waters, and will also technically assist affected public water supply systems (PWSS).

2. Communications will include consistent messaging and public health advisory information to users of state managed waters through various means including but not limited to:

a. weekly stakeholder meetings

b. prepared signage, and

c. website updates.

I. coordinating with the KDHE Public Information Officer (PIO) for the preparation and release of official KDHE Public Health Advisories/News Releases, as warranted;

J. providing technical assistance for water quality questions and interpretation of laboratory analytical results relative to initial and follow-up water samples, as needed;

K. providing technical assistance to public water supply systems when BGA affected lakes are their main source for drinking water.

L. assisting the PIO or responding to requests for information that require technical or scientific responses from agency stakeholders;

M. working with lake owners, if requested, to identify possible Watershed Restoration and Protection Strategy (WRAPS) projects for environmental remediation;

N. training KDHE and non-KDHE staff concerning sampling methods, sample submission and chain-of-custody requirements;

O. reviewing annually, the Blue-Green Algae Data Management System, with the assistance of IT;

P. maintaining the BGA website that is associated with and available through the KDHE/BOW web page. On this website, all information provided by the Bureau of Environmental Field Services (BEFS), Bureau of Epidemiology and Public Health Informatics (BEPHI) and the Bureau of Water (BOW) shall be made available to the public. Such information shall include, but is not limited to general blue-green algae information, maps, photos of HABs, analytical results, public health notices, and warning signs for the general public;

Q. hosting the "start and/or end of season" stakeholder meetings;

R. retaining scientific data relative to the water sampling and share such data when requested, and

S. tracking the HAB data over time for each affected body of water (database) for future trend and geospatial analysis.

Bureau of Water (BOW) – shall be responsible for:

A. analyzing water samples to determine the type and cell count of BGA and level of related microcystin toxins and entering the results into the Oracle Algal database;

B. advising Public Water Supply System (PWSS) of any public waters that are used as public drinking water supplies, both direct lake intakes and downstream intakes, and will work with affected public water suppliers during BGA blooms;

C. providing technical expertise related to water quality and watershed management, and technical assistance for water quality questions, and

D. assisting lake owners in identifying possible WRAP projects, when requested.

Bureau of Epidemiology and Public Health Informatics (BEPHI) – shall be responsible for:

A. developing both Human Illness and Animal Illness Report Forms to collect information on HAB-related illness or death from health care providers and the public. The forms are made available on the BGA public website;

B. answering all health related questions through the EPI Hotline;

C. completing the "Algae Bloom Reporting Form" when health related incidents for both human and animal incidents possibly due to a BGA exposure are reported. This form notifies BEFS/BOW that a response needs to be initiated;

D. providing epidemiological investigation of human and animal illness related to harmful algal blooms;

E. providing technical advice on the public health aspects of harmful algal blooms and coordinating the KDHE public health response;

F. analyzing data and providing reports of epidemiological investigations of human and animal illness/deaths, and

G. attending stakeholder meetings.

KDHE Office of Communications (OC) – shall be responsible for:

A. preparing and releasing the official KDHE Public Health Advisories/News Releases (See Attachment 5, pg. 49);

B. advising BOW and BEFS when media requests for information are received that requires technical or scientific responses from agency stakeholders, and

C. coordinating any public forum events that may be required from time to time, (i.e. press conferences, public meetings) during which KDHE representatives may be required to address issues related to BGA.

Section V. BLUE-GREEN ALGAE BLOOM RESPONSE PROCEDURES: (See Attachment 3, p. 41)

A. A complaint is received concerning a BGA bloom in public waters and an investigation is requested. Prior to any investigation, the complaint must be documented on the "Algae Bloom Reporting Form" located at www.kdheks.gov/algae-illness/index.htm. BEFS/BOW will validate the existence of the bloom and location information. If a BEFS district office receives a complaint, it will collect the location information and complete the reporting form. If BEPHI receives a health related complaint associated with an HAB, it will complete the "Algae Bloom Reporting Form".

B. If a complaint is not submitted by trained federal or state staff, then as a part of the verification process, a jar test is required. (See Attachment 6, p. 53 for additional information on jar testing.)

1. This test must be conducted by the lake management authority/manager at a KDHE designated site(s). (If no sampling sites have been previously designated, then contact BOW/BEFS for site locations.)

2. Photos of the jar test(s) must be emailed to BOW/BEFS for verification along with any other photo documentation

C. BEFS/BOW will enter the investigation request information into the KDHE BGA Data Management Database for tracking.

D. BEFS/BOW will coordinate the investigation and collect samples if warranted. Samples will be transported to the BOW/Watershed Planning, Monitoring and Assessment Section (WPMAS) central office in Topeka.

E. WPMAS (BOW) will analyze the samples collected and enter the analytical results into the BOW Oracle Algae database which will then migrate into the BGA Data Management System.

F. BEFS/BOW will review the analytical results and if warranted, a public health recommendation will be issued consistent with KDHE's blue green algae policy summarized by the Lake Status Determination chart. (See Table 1, p. 10)

G. All complaint locations will be checked to determine as to whether the water body is a drinking water supply. If so, then BEFS/BOW will notify the affected PWSS immediately to discuss the status of the source and provide technical

assistance when needed. BEFS/BOW will continue to update the affected PWSS weekly until the HAB has subsided.

H. BEFS/BOW will then notify the Secretary's Office/PIO of the status of the public water impoundment.

I. BEFS/BOW will contact agencies, municipalities, lake owner/managers, other external stakeholders and if applicable, the complainant, to provide them with the analysis results and the KDHE public health recommendations.

J. Lake Managers will determine whether to post the water body with the appropriate signage (See Attachments 1a – 1d, p. 31 - 34).

K. BEFS/BOW will coordinate any meetings between bureaus and between KDHE and other state and federal agencies.

L. BEFS/BOW will coordinate memos of recommendation for KDWP&T through the Secretary's office, if needed.

M. The Office of Communications will prepare formal agency press releases and coordinate as needed with other stakeholder's Office of Communications. (See 54, p. 48)

N. BEPHI will communicate with public health departments and animal health agencies as needed, to deliver public health Watch or Warning information.

O. BEFS/BOW will update BGA Management Database.

P. Based upon the HAB status, BEFS/BOW will coordinate proper follow-up testing consistent with the KDHE policy on blue green algae response. (See Fig. , pg. 22)

Q. BEFS/BOW will prepare information for updating of the BGA website.

R. BEPHI will conduct investigations of human and animal illness or deaths related to harmful algal blooms.

S. BEFS/BOW will update BGA Management Database contact list as needed.

T. BEPHI will analyze data and provide reports of epidemiological investigations and human and animal illness and death.

Section VI. SAMPLE COLLECTION/SAMPLING LOCATIONS:

A. Samples will be collected in accordance with BOW's, WPMAS Standard Operating Procedures (SOP's) HAB 001 & HAB 002. (See 76, p. 60)

B. Sampling locations for phytoplankton analysis will be selected based on common public access points that for this particular sampling task are primarily defined as: swimming beaches, boat docks/ramps, marinas and other frequently used areas designated for public access. All sample locations will initially be determined by

KDHE's Central Office. Once sampling locations have been identified, they will then be plotted on maps that will be provided to those conducting the sampling. If it is determined that nutrient samples are needed, they will be collected at a location, at or near BOW/WPMAS's ambient sampling station location.

1. If, upon arrival, there appears to be no bloom at any of the Central Office designated location(s), then sample collection shall be limited to one optimal phytoplankton sample collected at the designated nutrient sampling point.

2. If a bloom is observed at other areas of the lake, but is not obvious at any of the designated sampling points, then a sample shall be collected at the point where the bloom can be readily observed <u>and the public can readily access the water's edge</u>. If there is not an easily and readily available point of public access to collect this optional sample, then no additional sample is required (i.e., except, as stated above, at the designated locations). Under these circumstances, a determination of the status will be based on the observation of an obvious bloom and from the results of the samples collected at the designated locations. The status will be set at least at a Watch level, and the water body will likely be resampled the following week.

3. If, upon arrival, it appears that the sample collection at the designated locations is unattainable, i.e., flood waters, drought conditions/no water, then an alternate sample location shall be determined by the sampler within proximity of the original location.

4. If public waters are water sources for Public Water Supply Systems (PWSS) then:

- **a.** results from samples collected from the lake will be used to determine if any PWSS are to be notified, provided the PWSS source water is drawn directly from the lake or reservoir,
  - **i.** samples will be collected as close to the intake as possible, or
- **b.** discharge samples will be collected if a PWSS intake is downstream from the impacted lake/reservoir and the outflow from that lake/reservoir comprises a significant proportion of stream flow arriving at the intake of that PWSS as determined by mass balance calculations.
  - **i.** If lake samples are < 4 µg/L, then the collected discharge sample will **<u>not</u>** be analyzed.
  - **ii.** If the lake samples are ≥ 4 µg/L, then the collected discharge sample **<u>will</u>** be analyzed.
    - **a)** If the discharge sample is < 1 µg/L, then notification of the PWSS is not mandatory.
    - **b)** If the discharge sample is ≥ 1 µg/L, then notification of the PWSS is required.

c. River monitoring may also be initiated at locations above the PWSS intakes to confirm the presence or absence of microcystin toxins and their concentrations, at KDHE discretion.

5. Additional samples may be required to determine background levels, potential contaminant sources or to determine if other public water that is used by livestock is impacted. If any additional sampling locations are identified, then a GPS point should be collected or the location must be marked on a map.

Section VII. SAMPLE TYPES/ SAMPLE ANALYSIS: There will potentially be two types of samples collected for HAB events, phytoplankton samples and nutrient samples. Samples will be collected in accordance with BOW/WPMAS HAB-001 and HAB-002 and analysis will be in accordance with BOW/WPMAS HAB-003.

A. Phytoplankton samples will be analyzed for:

1. species identification
2. blue-green algal cell counts, and
3. levels of microcystin toxins using the ELISA Qualitube Kit
4. Cell biovolume (optional)

B. Nutrient samples will be analyzed for:

1. nitrate
2. nitrite
3. Kjeldahl nitrogen
4. total phosphorous, and
5. ammonia

C. Optional analysis include:

1. Chlorophyll-a
2. percent blue-green cells
3. dissolved oxygen
4. pH
5. temperature
6. Liquid Chromatography Mass Spectrometry (LCMS) analyses for microcystin variants and other algal toxins.

Sample analysis will be conducted in accordance with BOW's/WPMAS SOP (HAB-003) (See Attachment 7, p. 61). Additional analyses may be required and will be based on individual investigations and circumstances.

Section VIII. Response Prioritization: The investigation timeframe and the prioritization of water bodies shall be determined according to the following parameters:

- When there has been a human or animal health report.
- When the number of complaints **does not exceed** KDHE's capacity resources (to include sample collection and laboratory analysis).
- When the number of complaints **exceeds** KDHE's capacity resources (to include sample collection and laboratory analysis).
- When re-sampling is required.
- When the situation does not reflect the above situations, or
- When the water body is privately owned.

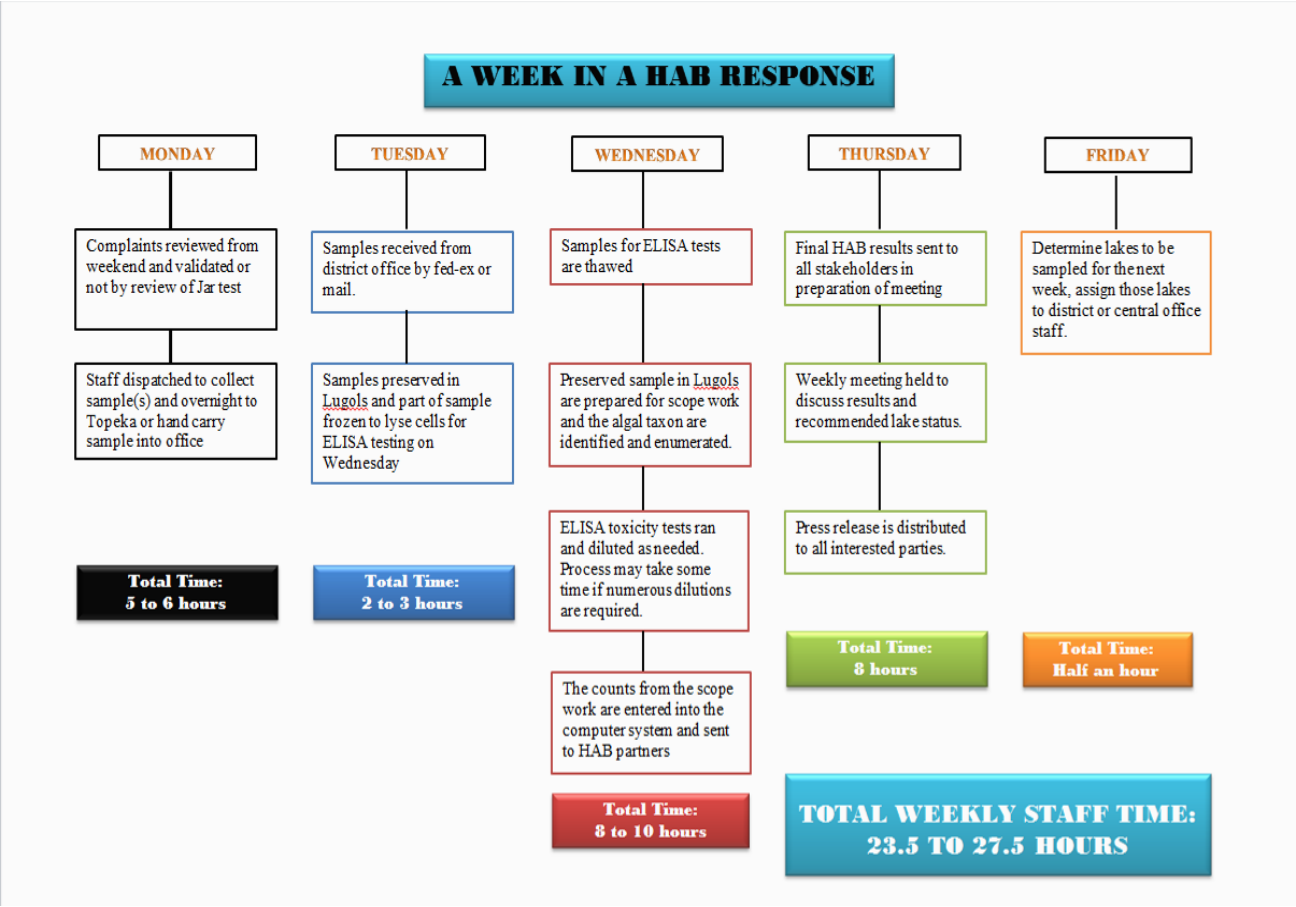
A. Health Related Reports

1. *Initial Sampling*. When a human or animal illness has been reported, a response will be initiated immediately. If district staff is unable to mobilize immediately, then staff in the Topeka office will respond to the complaint. If staff at the Topeka office cannot respond, then KDHE may request assistance from the KDWP& T or USACE for sample collection

B. Does Not Exceed KDHE Capacity:

1. *Initial Sampling*. When the number of complaints does not exceed the agency capacity, then the response will be initiated as promptly as possible. (See Table 2, p. 19). To minimize the potential of exceeding staff capacity, KDHE may request assistance from the KDWP&T or USACE for sample collection. An extended, detailed Weekly HAB Response timeline may be seen on Attachment 2 – "A Week in a HAB Response" on page 37.

Table 2. HAB Response Timeline



C. Exceeds KDHE Capacity:

1. *Initial Sampling*: When the number of complaints exceeds the agency capacity (to include sample collection and laboratory analysis), then response priorities will be determined by pre-set categories. (See Table 3, p. 20).

Table 3. Priority Response Timeframe

Lakes That:	Priority	Response
Support: Public Beach Public Water Supply Boating Full Body Contact Activities Confirm: Human Illness	**Priority 1**	Samples will be collected within the week if the HAB form was received on Monday or Tuesday. If the form was received after Tuesday, sampling will be conducted on the following Monday.
Public lakes that are publicly accessible but have no swimming beach and do not allow water skiing.	**Priority 2**	Considering that resources are available, samples will be collected within the week if the HAB form was received by Tuesday. If the form was received after Tuesday, sampling will be conducted on the following Monday.
Other public lakes that are largely inaccessible to the general public.	**Priority 3**	Will respond if capacity resources are available. Otherwise, complainant will be advised to contact their local extension office or the KS State Veterinary Diagnostic Laboratory at: KSVDL c/o Dr. Deon van der Merwe 1800 Denison Ave. Manhattan, KS 66502 785-532-4333 dmerwe@vet.ksu.deu

*** K.A.R. 28-16-28b -** Kansas Water Quality Standards **…***Public water bodies* - any surface water or surface water segment that supports or, in the absence of artificial sources of pollution, would support one or more of the designated uses of surface water defined in K.A.R. 28-16-28d(b) or K.S.A. 82a-2001(c), and amendments thereto, and that meets the criteria for classification given in K.A.R. 28-16-28d(a).

****K.S.A. 65-171d - (d) …** If a freshwater reservoir or farm pond is privately owned and where complete ownership of land bordering the reservoir or pond is under common private ownership, such freshwater reservoir or farm pond shall be exempt from water quality standards except as it relates to water discharge or seepage from the reservoir or pond to waters of the state, either surface or groundwater, or as it relates to the public health of persons using the reservoir or pond or waters there from.

D. Re-Sampling Frequency: During confirmed BGA blooms, the re-sampling frequency for affected surface waters is directly associated with the initial sampling analytical results, the water body's "Lake Visitation Potential" and three other potential factors. All water impoundments listed in the Kansas Surface Water Register were ranked within either the upper 25th percentile for "visitation potential" or in the lower 75th percentile for "visitation potential". Visitation potential is determined using the following formula:

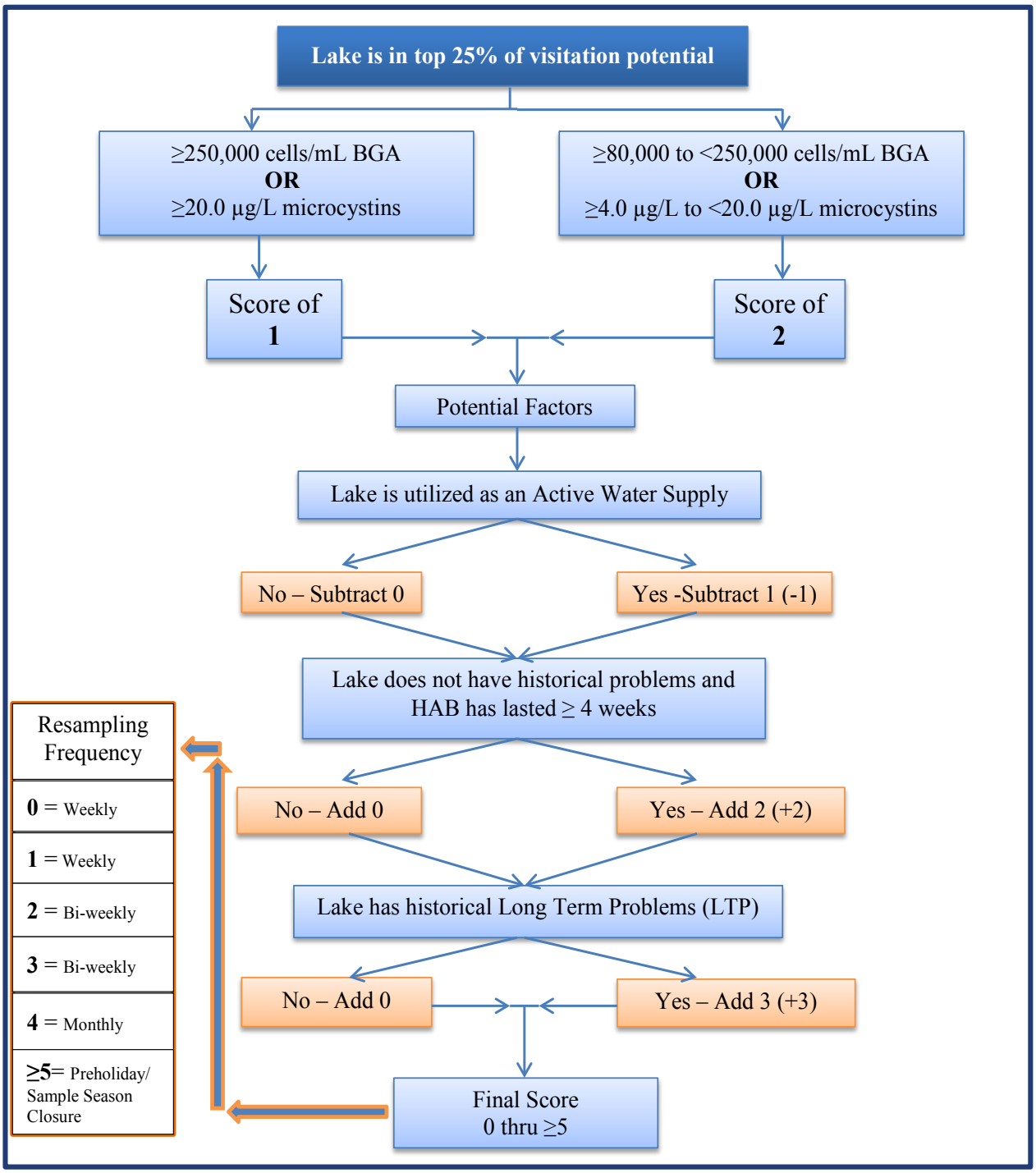
Figure 1: Visitation Potential formula.

Lake Visitation Potential = Population within 30 Miles x
Lake Size Factor x Lake Density Factor x
Public Access Factor x Contact Recreation Factor
(See Attachment 8, p. 77)

Using this "score", BEFS/BOW staff determines the resampling frequency for continued HAB monitoring.

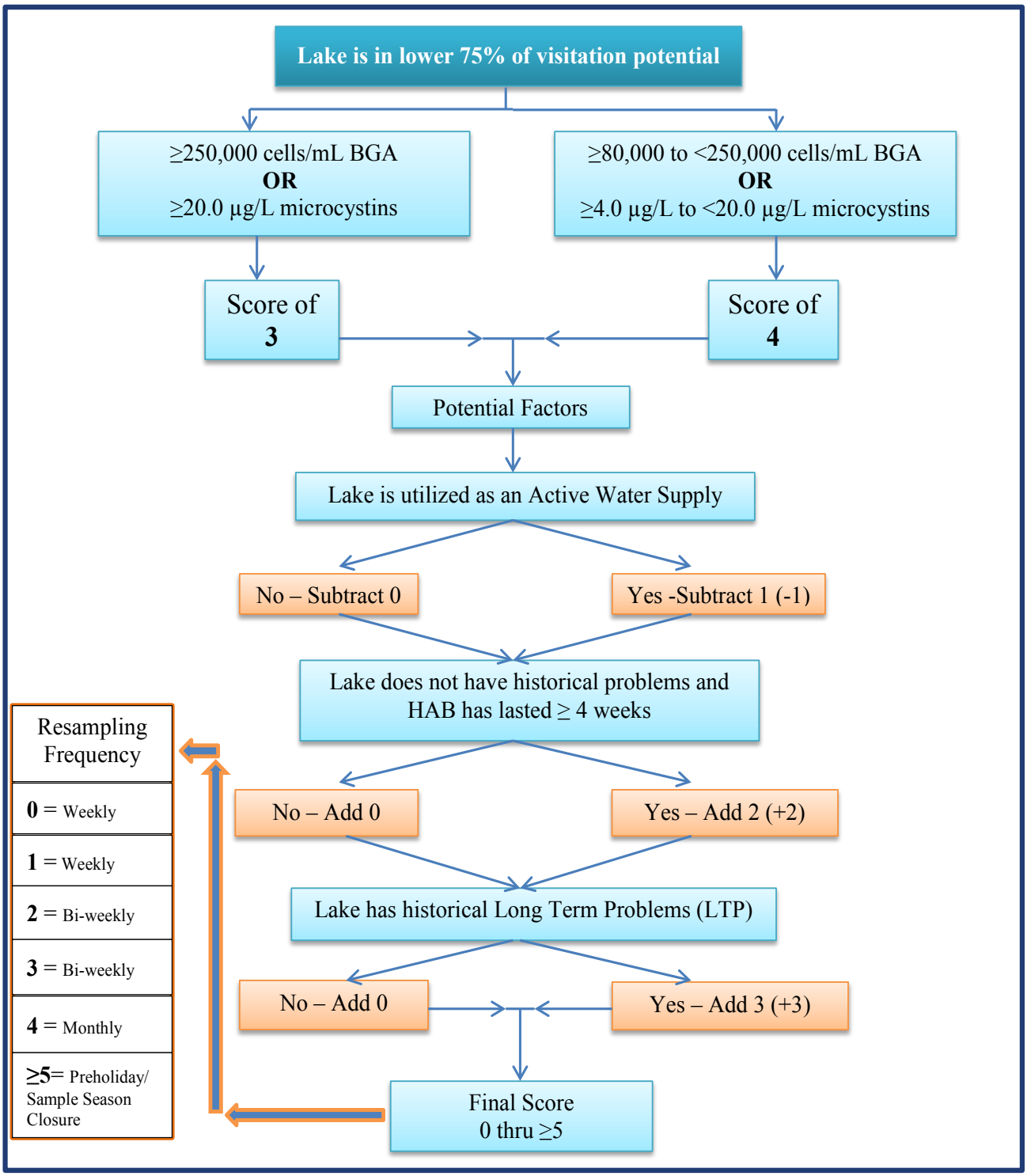
1. Determining re-sampling frequency for top 25% for visitation potential, see Figure 2.

Figure 2. Determining Resampling Frequency for Public Lakes with top 25% for Visitation Potential



2. Determining resampling frequency for lower 75% for visitation potential, See Figure 3.

Figure 3. Determining Resampling Frequency for Public Lakes with Lower 75% for Visitation Potential



E. Any situations that occur at surface waters not defined above will be considered on a case-by-case basis.

F. When the complaint is received for privately owned lakes (single owner shorelines or lakes with restricted access to the general public), the complainant will be advised to contact their local extension office or the KS State Veterinary Diagnostic Laboratory at:

KSVDL
c/o Dr. Deon van der Merwe
1800 Denison Ave.
Manhattan, KS 66502
785-532-4333
dmerwe@vet.ksu.deu

Section IX. Criteria for Lifting or Cancellation of HAB Watch, Warning and Closures:

A. A body of water with a HAB **Watch** will be tested by BEFS or other stakeholders based on the re-sampling frequency discussed above. The Watch will remain in effect until cyanobacteria concentrations are less than 80,000 cells/mL at all sample sites and microcystin toxin concentrations are less than 4 µg/L at all sample sites. (See Table 4, p. 25)

1. Exceptions: Mixed status lakes. Lakes that have more than one "zone" will be required to follow the above described procedure for each individual zone.

B. A body of water with a HAB **Warning** will be tested by BEFS or other stakeholders based on the re-sampling frequency discussed above. The HAB Warning will remain in effect until the cyanobacterial concentrations are less than 250,000 cells/mL at all sample sites for at least one week and concentrations of microcystin toxins are less than 20 µg/L for two consecutive weeks at all sample sites. Bodies of water that fall below these levels and within these time periods may still not come off a public health protection notification, but may be reduced to a "Watch" level. The HAB Watch requirements will then need to be observed. (See Table 4, p. 25)

C. A body of water with a HAB **Closure** will be tested by BEFS or other stakeholders based on the re-sampling frequency discussed above. The Closure will remain in effect until the cell counts are less than 10,000,000 cells/mL and concentrations of microcystin toxins are less than 2,000 µg/L, at all sample sites. Bodies of water that fall below these levels may still not come off a public health protection notification, but may be reduced to a "Warning" level. The HAB Warning requirements will then need to be observed.

D. Exceptions: Mixed Status lakes. Lakes that have more than one "zone" will be required to follow the above described procedure for each individual zone.

Table 4. Relisting of Weekly Lake Status

Analysis	Lake Status	Comments
<10,000,000 cells/ml at all sites for one week **AND** **<2,000 µg/l for one week**	Closure	» If cell counts and toxin levels drop below these numbers – lake status drops to a Warning level.
<250,000 cells/ml at all sites for at least 1 wk. **AND** **Toxins of <20 µg/l for 2 consecutive weeks**	Warning	» If cell counts drop below 250,000 and toxins are above 20 – stays on Warning for 2 consecutive weeks. » If cell counts drop below 250,000 but above 80,000 and toxins were never above 20 – drops to a Watch after 1 week. » If cell counts drop below 250,000 and above 80,000 and toxins drop below 20 but above 4 after the second week of sampling – lake status is dropped to a Watch. » When both cell counts and toxin levels drop below established Warning protocols, lake will then follow the Watch protocol.
<80,000 cells/ml at all sites **AND** **<4 µg/l at all sites**	Watch	» If cell counts and toxin levels drop below these levels, lake status will be lifted.

Section X. Data Management. Data is managed through the HAB Data Management Program which contains three components.

A. The APEX web application which takes complaints from the public and/or lake managers for possible blue-green algae bloom complaints, Human and/or Animal Illness complaints.

B. The Oracle HAB program which manages the complaints, field assignments, and takes the final results and comes up with recommendations. In addition this program has a web presence which shows locations and recommendations. (See Attachment 10 - DM-002, p. 101)

C. The Oracle component for algal identification, enumeration, and microcystin calculation.

Section XI. Sampling Season:

A. The HAB sampling season will adopt a sampling duration concurrent with the Water Quality Standards – Primary Contact Recreation, from April 1 to October 31. New and continued investigations will no longer be conducted after the 31st of October except in special circumstances. A final sample will be collected at all surface waters that are still under a HAB watch/warning/closure in October to document the final analytical results for the season.

1. Occasionally, winter blooms of the blue-green species *Planktothrix rubescens* have been reported in Kansas (appearing as surface scums of purple to red material or observed under thin ice covers). In the event a *Planktothrix rubescens* bloom is suspected, then it will be handled on a case by case basis.

B. <u>After Sampling Season</u>. If lakes are still under an HAB Notification (Watch/Warning/Closure) by October 31st, then it is the responsibility of the lake's management authority to conduct observational monitoring and jar testing to assess the condition of the water body. BEFS/BOW staff will contact appropriate lake management to assist with the lake assessment. Until KDHE receives evidence of a negative jar test or other compelling observational data that the bloom has expired, the water body will remain over the winter at the status that was in effect on October 31. If the jar test or other observational data confirms the lack of a significant blue-green community, then KDHE will lift the end of the season notification.

For further questions regarding sampling of lakes and cyanobacteria, contact KDHE's Bureau of Environmental Field Services at **785-296-1664**.

For further questions regarding health effects of cyanobacteria on people, contact KDHE's Bureau of Epidemiology and Public Health Informatics at **1-877-427-7317**.

For further questions regarding health effects of cyanobacteria on pets and animals, contact the Kansas Animal Health Department at **785-296-1059 during normal business hours**. If assistance is needed for an urgent issue after business hours, call the Epidemiology Hotline at 1-877-427-7317.

Works Cited

1. **Graham JL, Loftin KA, and Kamman N**. Monitoring recreations freshwaters. *Lakeline*, Summer, 2009

2. **Falconer I, Bartram J, Chorus I, Kuiper-Goodman T, Utkilen H, Burch M and Codd GA**. Chapter 5. SAFE LEVELS AND SAFE PRACTICES. [BOOK AUTH.] Chorus I and Bartram J. (eds.*). Toxic Cyanobacteria in Water: A guide to their public health consequences, monitoring and management.* Geneva: World Health Organization, 2003.

3. **Kuiper-Goodman T, Falconer I and Fitzgerald J**. Chapter 4: Human health aspects. [book auth.] Chorus I and Bartram J (eds.). *Toxic Cyanobacteria in Water: A guide to their public health consequences, monitoring and management.* Geneva: World Health Organization, 2003.

4. World Health Organization. Chapter 12: Monitoring and assessment. *Guidelines for safe recreational waters: Volume 1 – Coastal and fresh waters*. Geneva: World Health Organization, 2003.

5. Queensland HAB Steering Committee. *Queensland Harmful Algal Bloom Response Plan*, Version 1, December 2002.

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Attachment 1

Notification Signs

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1A. ”WATCH” Sign Example

WATCH

Harmful Algae May Be Present

Blue-Green Algae May Be Harmful To Humans & Animals

Keep Pets & Livestock Away From The Water

- **Use caution when contacting lake water and wash with clean water afterward**
- **Avoid areas of algae accumulation**
- **Don’t let people/pets eat dried algae or drink untreated lake water**
- **Clean fish well and discard guts**

In case of harmful algae contact, call doctor/ veterinarian if people/animals have nausea, vomiting, diarrhea, rash, irritated eyes, seizures, breathing problems or other unexplained illness

For more information: Scan this code or visit kdheks.gov/algae-illness

Report new algae-blooms to Kansas Department of Health and Environment: www.kdheks.gov/algae-illness or call **785-296-1664**

Report possible algae-bloom illness to Kansas Department of Health and Environment: www.kdheks.gov/algae-illness or call **877-427-7317**

Posted by:

Posted on:

Kansas Dept. of Health and Environment 1000 SW Jackson, Topeka, Kansas 66612, 785-296-1500 www.kdheks.gov

1B. ”WARNING” Sign Example

WARNING

Harmful Algae Present

People & Animals May Get Sick

Avoid Water Contact Such As Swimming & Wading

Avoid Water Skiing or Jet Skiing

Keep Pets & Livestock Away From Water

- **Avoid areas of algae accumulation**
- **Clean fish well and discard guts**
- **Don’t let people/pets eat dried algae or drink untreated lake water**
- **If people/pets contact lake water- wash with clean water as soon as possible**

In case of harmful algae contact, call doctor/ veterinarian if people/animals have nausea, vomiting, diarrhea, rash, irritated eyes, seizures, breathing problems or other unexplained illness

Report new algae-blooms to Kansas Department of Health and Environment: www.kdheks.gov/algae-illness or call **785-296-1664**

Report possible algae-bloom illness to Kansas Department of Health and Environment: www.kdheks.gov/algae-illness or call **877-427-7317**

For more information: Scan this code or visit kdheks.gov/algae-illness

Posted by:

Posted on:

Kansas Dept. of Health and Environment 1000 SW Jackson, Topeka, Kansas 66612, 785-296-1500 www.kdheks.gov

1C. ”DANGER - BEACH CLOSED” Sign Example

1D. ”DANGER - LAKE CLOSED” Sign Example

Attachment 2:
A Week in a HAB Response

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A WEEK IN A HAB RESPONSE

MONDAY

Complaints reviewed from weekend and validated or not by review of Jar test

- Complaint validation is completed using the KDHE Harmful Algae Bloom Management System (DM – 003)*. Validation process is completed each time we receive a complaint during the week.
- Staff is notified and/or sent out to sample the lakes that are being reported within their district office

→ 2 hours

Staff dispatched to collect sample(s) and overnight to Topeka or hand carry sample into office

- Staff leaves district office as soon as possible to travel to designated lake.
- Samples collected per HAB-001.*
- Staff must return to district office and prepare samples for overnight shipment per protocol HAB-001.*
- Samples shipped to Topeka Central Office by 1500 hours to be received on Tuesday morning in Central Office by 0900 or 0930.

→ 6 hours

Total Time:

6 to 8 hours

TUESDAY

Samples received from district office by fed-ex or mail.

- Samples are received in Mailroom by 0900 or 0930.
- HAB staff receives sample, preserves sample as soon as possible to prevent degradation, and completes Chain of Custody paperwork.

→ .5 hours

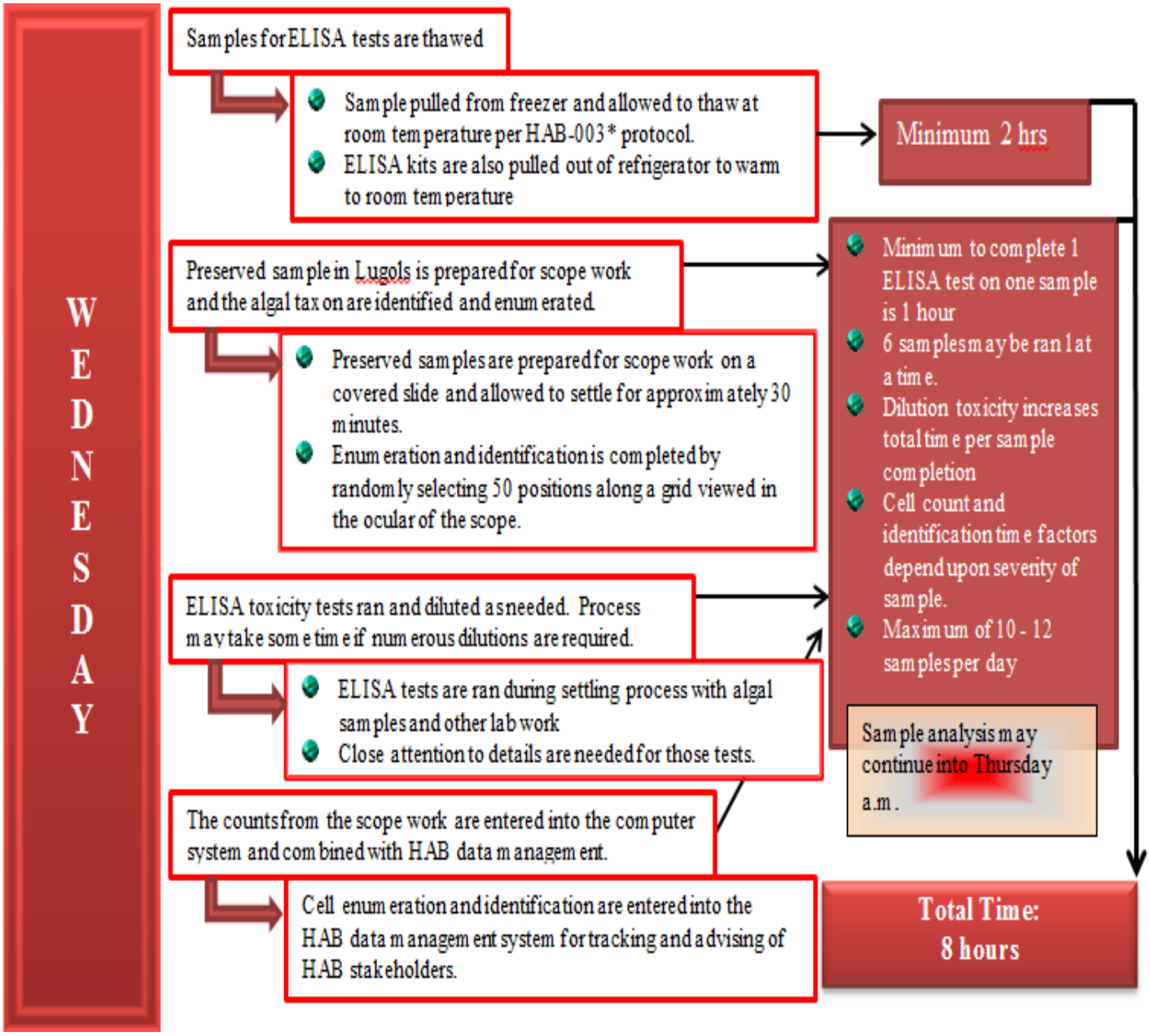
Samples preserved in Lugols and part of sample frozen to lyse cells for ELISA testing on Wednesday

- HAB lab staff receives samples from mail room.
- Staff preserves samples per HAB-002 protocol*..
- Part of sample must be frozen overnight for lysing of cells in order to complete ELISA testing on Wednesday.

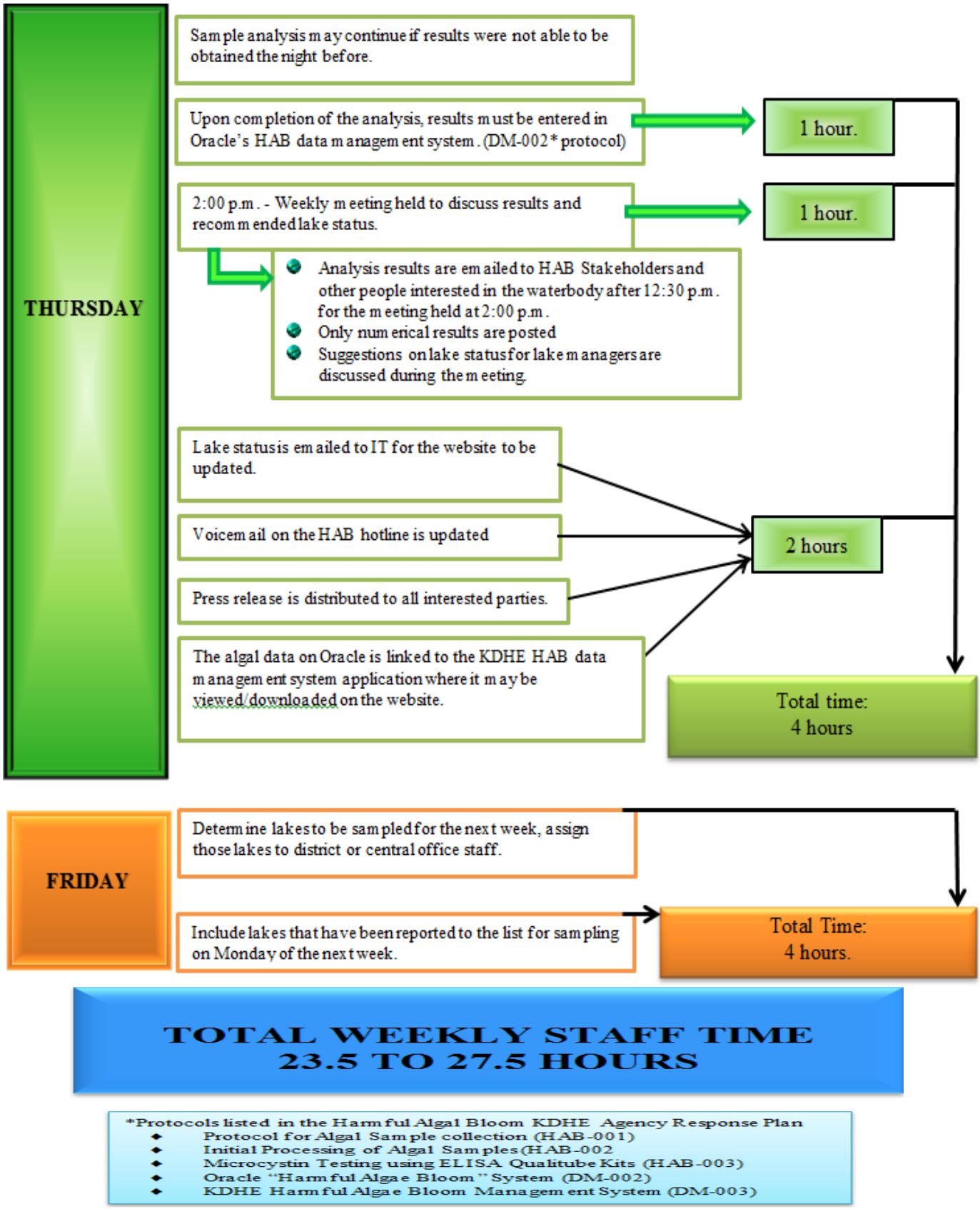
→ 2.0 to 2.5 hours – depending upon

Total Time:
2 to 3 hours

Week continues on next page



Week continues on next page



TOTAL WEEKLY STAFF TIME 23.5 TO 27.5 HOURS

*Protocols listed in the Harmful Algal Bloom KDHE Agency Response Plan

- Protocol for Algal Sample collection (HAB-001)
- Initial Processing of Algal Samples (HAB-002
- Microcystin Testing using ELISA Qualitube Kits (HAB-003)
- Oracle "Harmful Algae Bloom" System (DM-002)
- KDHE Harmful Algae Bloom Management System (DM-003)

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Attachment 3

KDHE's Blue-Green Algae Response Procedures Flow Chart

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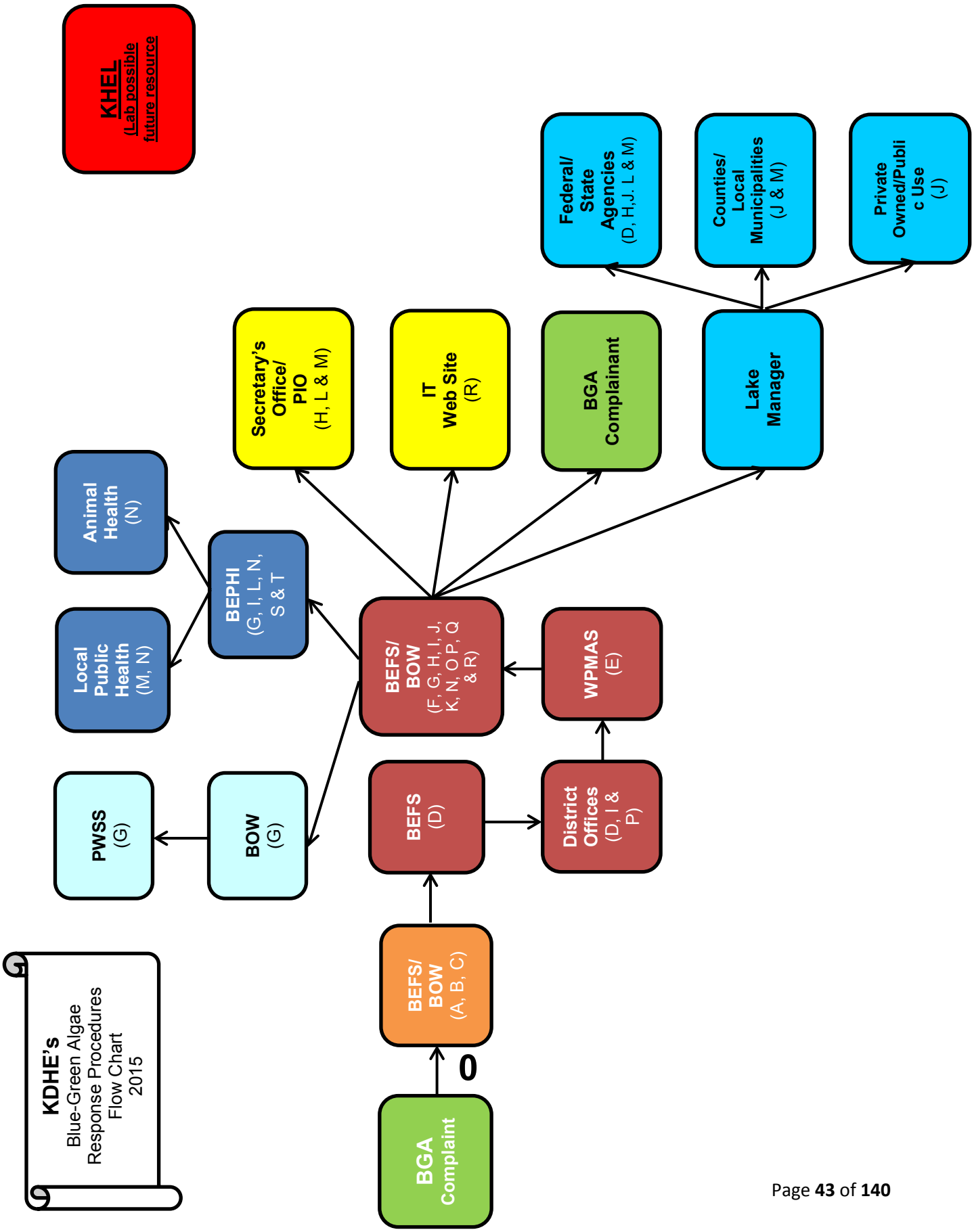
KDHE's
Blue-Green Algae
Response Procedures
Flow Chart
2015
BGA
Complaint
0
BEFS/
BOW
(A, B, C)
BEFS
(D)
District
Offices
(D, I &
P)
BOW
(G)
PWSS
(G)
BEFS/
BOW
(F, G, H, I, J,
K, N, O P, Q
& R)
WPMAS
(E)
BEPHI
(G, I, L, N,
S & T
Local
Public
Health
(M, N)
Animal
Health
(N)
Secretary's
Office/
PIO
(H, L & M)
IT
Web Site
(R)
BGA
Complainant
Lake
Manager
Federal/
State
Agencies
(D, H,J. L & M)
Counties/
Local
Municipalities
(J & M)
Private
Owned/Publi
c Use
(J)
KHEL
(Lab possible
future resource

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Attachment 4

Algae Submission Form/ Chain-of-Custody

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Algae Sample Submission Form (Reproduce as needed for each sample)

Send this form with samples to:

Diana Lehmann
Watershed Planning, Monitoring, and Assessment Section
Kansas Department of Health and Environment
1000 SW Jackson Ave., Suite 440 (Curtis State Office Building)
Topeka, Kansas 66612-1367

NOTE: Use cubetainers with no preservatives for algae (leave some airspace in cubetainer).
If multiple sites are sampled for algae, submit more than one cubetainer.
If submitting aquatic plants, use a ziplock bag with only a tiny amount of water in the bag.
Ship them ASAP using only a small amount of ice (too cold can damage some species).

Lake/Waterbody Name
Include LM Number and Suffix
Example: Central Park Lake LM0609

Collector, Date, Time

Check which type(s) of problem are being investigated:
_____ Blue-Green Bloom
_____ Taste/Odor Incident
_____ Aesthetic Complaint
_____ Livestock/Pet Kill
_____ Other (briefly describe in space to left)

Check type of waterbody samples collected from:
_____ Lake/Pond
_____ Stream/River
_____ Other (briefly describe in space to left)

If this is a taste/odor incident, please provide any additional data related to the treatment plant, weather, etc.

Also check the boxes appropriate to the qualities of the "taste" and "odor" of the finished or raw water.
("raw" or "finished" can be put in the appropriate field)

Odor:
_____ Earthy/Musty
_____ Chlorinous
_____ Grassy/Woody
_____ Marshy/Septic
_____ Fragrant/Flowery
_____ Fishy/Aquarium
_____ Medicinal
_____ Hydrocarbon/Chemical

Taste:
_____ Sour/Acidic
_____ Salty
_____ Bitter
_____ Sweet
_____ Mouthfeel _____

"Mouthfeel" covers a number of characterisitics of sensation, such as "powdery," "metallic," "burning," etc. Please indicate the type of mouthfeel to the right.

If this is not a taste/odor incident (i.e., fishkill, bloom, etc.), please indicate any other data or information related to the incident (including field conditions, other chemical data, current and preceding weather, etc.). If chemical data are sent to KHEL, please copy Diana Lehmann, WPMAS, on these.

On the back of this form, please include a sketch map of the site.

Edited 3/2015

_____ Location

_____ GPS Coordinates _____ GPS Unit Type

_____ PHL

Sketch map of site

Chain of Custody:

Date _____ Relinquished By _____ Received By _____

Date _____ Relinquished By _____ Received By _____

Date _____ Relinquished By _____ Received By _____

Date _____ Relinquished By _____ Received By _____

Additional Reports Routed To:

Name _____ Address _____

Name _____ Address _____

Name _____ Address _____

Attachment 5

Public Health Press Release Example

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Curtis State Office Building
1000 SW Jackson St., Suite 540
Topeka, KS 66612-1367

Kansas

Phone: 785-296-0461
Fax: 785-368-6388
www.kdheks.gov

Robert Moser, MD, Secretary
Department of Health & Environment
Sam Brownback, Governor

Public Health Warnings Concerning Blue-Green Algae in Kansas Waters

Six Lakes Under Warning

TOPEKA, Kan. – (July 2, 2015) The Kansas Department of Health and Environment (KDHE) samples publicly accessible bodies of water for cyanobacteria, commonly called blue-green algae, when the agency is alerted to a potential algae bloom in Kansas lakes. KDHE, in cooperation with the Kansas Department of Wildlife, Parks and Tourism (KDWPT) and other lake managers where appropriate, responds by informing the public of harmful conditions.

Lakes under a Warning are not closed. Marinas, lakeside businesses and park camping facilities are open for business. If swim beaches or lakes are closed, it will be specifically noted. Drinking water and showers at parks are safe and not affected by algae blooms. Boating and fishing are safe on lakes under a Warning, but contact with the water should be avoided. It is safe to eat fish caught during a harmful blue-green algae outbreak, as long as the fish is rinsed with clean water; consume only the fillet portion and discard all other parts. Hands should also be washed with clean water after handling fish taken from an affected lake.

Kansans should be aware that blooms are unpredictable. They can develop rapidly and may float around the lake, requiring visitors to exercise their best judgment. If there is scum, a paint-like surface or the water is bright green, avoid contact and keep pets away. These are indications that a harmful bloom may be present. KDHE and KDWPT urge pet owners to be particularly mindful of the presence of blue-green algae. Pets that swim in or drink water affected by a harmful algal bloom or eat dried algae along the shore may become seriously ill or die.

Public Health Warning: High levels of toxic blue-green algae have been detected. A Public Health Warning indicates that activities like boating and fishing may be safe; however, direct contact with water (i.e., wading, skiing and swimming) is strongly discouraged for people, pets and livestock.

Kansas public waters currently under a Warning status:

BROWN COUNTY STATE FISHING LAKE, Brown County
CHISHOLM CREEK PARK LAKE, Sedgwick County
LOVEWELL RESERVOIR, Jewell County
MARION RESERVIOR (Not Marion County Lake), Marion County
MEMORIAL PARK LAKE, Barton County
WEBSTER LAKE, Rooks County

When a Warning is issued, KDHE recommends the following precautions be taken:

- Lake water is not good to drink for pets or livestock
- Lake water, regardless of blue-green algae status, should never be consumed by humans
- Water contact should be avoided
- Fish can be eaten as long as they are rinsed with clean water, consume only the fillet portion, and discard all other parts

- Do not allow pets to eat dried algae
- If lake water contacts skin, wash with clean water as soon as possible
- Avoid areas of visible algae accumulation

KDHE will update these statements as conditions warrant.

MEDIA Contact Information:

Ashton Rucker
Kansas Department of Health and Environment
785-291-3684
communications@kdheks.gov

Ron Kaufman, Director of Information Services
Kansas Department of Wildlife, Parks and Tourism
785-296-2281
ron.kaufman@ksoutdoors.com

David Kolarik, Chief, Public Affairs
U.S. Army Corps of Engineers – KC District
816-389-3072
david.s.kolarik@usace.army.mil

PUBLIC Contact Information:
Receive up-to-date lake conditions at this Toll Free Number: (785) 296-1664

For information on blue-green algae and reporting potential harmful algal blooms, go to:
http://www.kdheks.gov/algae-illness/index.htm.

###

KDHE's mission is to protect and improve the health and environment of all Kansans.

Attachment 6

Jar and Stick Tests

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5A. Jar Test

The Jar and Stick Tests

Option for testing your pond:

There are a couple simple tests a pond owner can do, at no cost, to determine if a green pond even has a blue-green algae community, or if any algal material visible at the water surface is a blue-green surface scum.

NOTE: No test is 100% perfect, and that includes the jar test for blue-greens. The test relies on the buoyancy adaptation of most free-floating (planktonic) blue-green algae. In Kansas, bloom complaints are overwhelmingly the result of the forms that are buoyant. However, there is a small possibility (<2%) that the algae in your particular test happen to be non-buoyant species for blue-greens, resulting in a false negative test. Likewise, some swimming forms of non-blue-green algae (like Euglenoids) may form a surface layer during a jar test, resulting in a false positive. Fortunately, most Euglena blooms will be reddish in color rather than green, allowing for their identification. Although the jar test does provide a quick and inexpensive way to confirm whether you have a blue-green community in your lake, it does not tell you what species are present, nor does it tell you whether they are actually producing toxins. Be aware, however, that just having blue-green algae present does not mean your pond is automatically hazardous. Many lakes and ponds in Kansas typically have blue-green algae in them. Hazardous conditions may occur when the amount of blue-green algae is large, and composed of species capable of generating toxins. For that information, a microscopic examination of the water, combined with a chemical test for toxins, would be required for a more complete picture.

The Kansas Department of Health and Environment only tests samples from public water bodies. Kansas State University will assist you with issues regarding private water bodies. If you are conducting one or both of these tests on your private farm pond or lake and you determine that you do have a blue-green bloom occurring in your pond, you may obtain further assistance by going to this website:

http://www.kdheks.gov/algae-illness/private_waters.htm

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THE JAR TEST PROCEDURE

Purpose
Look out over the pond and see if the water looks very green. To decide whether the "green" is blue-green algae in the pond, or just an overabundance of some of the more beneficial types of planktonic algae, a simple test can be conducted called the "**jar test**." Follow this step by step process to make an initial assessment of the pond in question.

Materials
- Clear jar (pint to quart size) – A Mason (canning) jar or a store bought pickle jar with the label removed works well.
- Rubber or latex gloves.

Procedure
1. Find an appropriate clear glass jar with a screw top lid.
2. For safety reasons, use rubber or latex gloves to collect a sample of water from the pond in question to prevent skin exposure.
3. Collect the water just below the surface of the water.
    a. DO NOT collect sample directly from the surface, but collect just under the surface to avoid collecting just the scum on the top layer of the water.
4. Fill the jar about ¾ of the way full with the pond water. (See Photo 1.)
    - (DO NOT fill the jar completely to the top. Algae will give off gases and may cause of buildup of pressure inside the jar causing it to break.)

Photo 1 - Initial Sample

5. Wipe off any scum that may be on the outside of the jar.
6. Screw the lid onto the jar.
7. Place the jar in a cold refrigerator and leave it completely undisturbed overnight.
8. The next day, **carefully** remove the jar from the refrigerator and look to see where the algae have accumulated.
    a. **IT IS VERY IMPORTANT**, that you do not shake or agitate the jar in any way. If you do, this will mix the algae into the water again and you will not get test results that are useable.

9. If the algae are all settled out near the bottom of the jar, then that is a likely indication that the lake does not have a lot of blue-green algae growing in it. (See arrow on Photo 2.)

Photo 2 – No Blue-greens

10. If the algae have formed a green ring around the top of the water in the jar, or just seem to be collected at the air/water divide, there is a strong possibility that the pond does have a blue-green algae community present. (See arrow on Photo 3.)

Photo 3 – Yes Blue-Greens

THE STICK TEST PROCEDURE

Purpose
Look out over the pond and see if a mat of green material is floating on the surface. Is it blue-green algae forming a surface scum, or is it a mat of floating filamentous green algae (often called “fisherman’s moss” and “string” algae)? A simple test to determine what the material might be is called the “stick test.”

Materials

- Sturdy stick – Make sure it is long enough to reach into the water without getting algae on your hands.
- Rubber or latex gloves

Procedure

1. Find a sturdy stick.
2. Put rubber or latex gloves on before attempting to retrieve a sample of the green material from the pond to prevent skin exposure.
3. Thrust the stick into the surface mat and slowly lift out of the water.
    a. Make sure you do not fall into the water while attempting to retrieve material.
4. Look at the end of the stick to see what came out of the water.
    a. If the stick comes out looking like it has been thrust into a can of paint, the mat on the pond is likely to be a blue-green algae scum.
    b. If the stick pulls out strands that look like green hair or threads, the mat on the pond is likely filamentous green algae. (Although filamentous green algae can be a nuisance when over-abundant, they do not pose a danger to your health.)(See Photo 1.)

Photo 1 - Filamentous algae

Note: The stick test can fail when a particular type of blue-green algae is present. This type of algae is called *Lyngbya wollei*. This species of blue-green algae can form tough filamentous mats that float to the surface, similar to the mats formed by harmless filamentous green algae. However, *Lyngbya wollei* typically will have a very putrid sewage-like odor which filamentous green algae do not. *Lyngbya wollei* mats also will often release a purple pigment in the water around them, which is something filamentous algae do not do. (See Photo 2.)

Photo 2 - *Lyngbya wollei*

Attachment 7

Standard Operating Procedures For Algal Samples and Analysis

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Procedure	Rev. No.	Date
Protocol for Algal Sample collection (HAB-001)	New	02/27/15
Initial Processing of Algal Samples (HAB-002)	New	02/27/15
Microcystin Testing using ELISA Qualitube Kits (HAB-003)	New	02/27/15

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PROTOCOL FOR ALGAL SAMPLE COLLECTION

(HAB-001)

I. INTRODUCTION

A. Purpose

The following paragraphs describe the procedures for the collection, preservation, and transport of algal samples from water bodies with a validated HAB complaint.

B. Minimum Staff Qualifications

Personnel implementing this SOP should meet the minimum classification requirements for Environmental Scientist I published by the Kansas Department of Administration. They also should be experienced in the measurement of the physicochemical and microbiological properties of surface water and in the performance of environmental field investigations.

C. Equipment/Accessories

1. Cubitainers – 1 per sample location
2. Nutrient Bottle - 1 per HAB event
3. Water proof permanent marker
4. Pole sampler, bucket
5. GPS unit
6. Paper Towels
7. Cooler
8. Cold packs or ice
9. Zip lock plastic bags for ice if needed.
10. Tap or distilled water
11. Trash bags
12. Map of area.

II. PROCEDURES

A. Collection of Phytoplankton Samples - (one cubitainer per site)

1) Using a pole sampler with an attached beaker, either a “grab” or “composite” sample can be collected.

a. *“Grab” Samples:*

1. Verify that the designated sampling location(s) where a sample is to be collected is representative of a major public access area where the public will have full access to the water.

2. Mark the cubitainer (clear, plastic, 1 liter cube shaped bottle, non-preserved; see Attachment 7) with the following information:

a. Sample location I.D. number
b. Sample Collection Time
c. Sample Collection Date
d. Sample Collector’s Name or Initials

3. Inflate the cubitainer. Inflating the cubitainer can be done by removing the cap, gently exhaling into the opening until it completely inflates. (Do not contaminate the cube by expelling salvia into the container.)

4. Submerge the pole sampler’s beaker open end down through the water until completely covered. Slowly turn the sample pole until the beaker is sideways and approximately 1 -2” under the water’s surface. Once the beaker is filled pull the sample pole and attached beaker out of the water.

5. Pour collected sample into the inflated cubitainer. It generally takes two of these processes to fill one cubitainer.

6. Leave a headspace in the container of no less than ½” for gas expansion.

7. Secure the lid and wipe the cubitainer until it is clean and dry. Place in a cooler.

8. Move to your next sampling location.

9. If sample collection is required in the future at that same public access area, then collect as close as possible to that exact initial point. <u>(Don’t go chasing scum that might appear a few feet away from your original sampling point.)</u> This will maintain consistency of the sampling activities.

b. *“Composite” Samples:*

1. Verify that the designated sampling location(s) where a sample is to be collected is representative of a major public access area where the public will have full access to the water.

2. Mark the cubitainer (clear, plastic, 1 liter cube shaped bottle, non-preserved; see Attachment 7) with the following information:

   a. Sample location I.D. number
   b. Sample Collection Time
   c. Sample Collection Date
   d. Sample Collector's name or initials

3. Inflate the cubitainer. Inflating the cubitainer can be done by removing the cap, gently exhaling into the opening until it completely inflates. (Do not contaminate the cube by expelling salvia into the container.)

4. Submerge the pole sampler's beaker open end down through the water until completely covered. Slowly turn the sample pole until the beaker is sideways and approximately 1 -2" under the water's surface. Once the beaker is filled pull the sample pole and attached beaker out of the water.

5. Pour collected sample into a clean bucket. Continue this process collecting samples from various locations around the dock, (e.g., one from each side of the dock).

6. Once all samples have been collected and poured into the bucket, swirl the bucket to mix.

7. Pour the mixed sample into the inflated cubitainer.

8. Leave a headspace in the container of no less than ½" for gas expansion.

9. If sample collection is required in the future at that same public access area, then collect as close as possible to that exact initial point. (Don't go chasing scum that might appear a few feet away from your original sampling point.) This will maintain consistency of the sampling activities.

B. How To Collect Nutrient Samples - (one Cubitainer and one Nutrient bottle per site)**:**

1) Using a pole sampler with an attached beaker, a "grab" sample can be collected.

a. Nutrient samples will be collected only from designated locations believed to be representative of the lake's normal ambient sampling station. Verify that the location where the sample is to be collected is at the normal ambient sampling station or as close as possible to that station location.

1. Mark the nutrient container, (brown, opaque, plastic 250 milliliter bottle, Sulfuric Acid preserved; see attachment 7 and a cubitainer, with the following information:

a. Sample location I.D. number
b. Sample Collection Time
c. Sample Collection Date
d. Sample Collector's name or initials

2. Submerge the beaker's open end down through the water until completely covered. Slowly turn the sample pole until the beaker is sideways and approximately 1 -2" under the water's surface. Once the beaker is filled pull the sample pole and attached beaker out of the water.

3. Carefully open the Nutrient bottle. (The bottle contains a Sulfuric Acid preservative and will burn the skin or clothing.)

4. Slowly pour collected sample into the bottle making sure not to overfill as a loss of preservative will affect the integrity of the sample.

5. Secure the lid tightly and wipe clean and dry. Place the sample container in a zip lock bag and secure bag. (Placing the container in its own individual bag will minimize the potential of cross contamination).

6. Follow the "How To Collect Phytoplankton Samples" directions to fill the cubitainer for nutrients.

7. Place containers in a cooler.

*****REMINDER: All samples collected should be taken 1 to 2 inches under the water surface. Samples do not need to be taken at deeper depths when sampling for blue-green algae. Do not collect the sample at the surface (the air/water interface).**

C. Cleaning Equipment Between Samples:

1) "Between Sampling Locations at the Same Water Body"

a. After the sample has been collected, discard any remaining water from sampling equipment.

b. Wipe all equipment dry with paper towel

c. Once at the next sampling location, rinse sampling equipment with ambient water at a different, but nearby, location than where the sample is to be collected.

d. Discard rinsate water then move to sampling location to collect sample.

2) "Between Different Water Bodies"

a. Clean all sampling equipment with tap water.

b. Once at sampling location, rinse sampling equipment several times with ambient water at a different, but nearby, location than where the sample is to be collected.

c. Discard rinsate water then move to sampling location to collect sample.

d. Follow the above directions if additional samples are to be collected at the same waterbody.

C. Preparing Samples for Shipment:

1) Wipe dry the exterior of all cubitainers.

2) Place all containers in a cooler along with a cold pack(s). If ice is used, double bag it first before placing in the cooler. This will minimize the potential of cross-contamination or making a mess when the ice melts. Plastic pop bottles filled with water and then frozen can also be used in place of cold packs. Place enough cold packs or ice in the cooler to keep the samples cool. **DO NOT FREEZE THE SAMPLES.**

3) Fill out both sides of the algae submission/chain-of-custody form (see Attachment 4).

4) If the samples are to be sent by a carrier company, then place the submission form(s) inside a plastic bag and tape inside the cooler on its lid.

5) If samples are to be transported to the lab(s) by the collector or handed off to another partner, then keep the forms out and readily available to be signed by the next handler.

6) Secure the cooler.

D. Shipment of Samples:

1) Samples must be shipped no later than overnight.

2) At any time that the samples exchange to a different handler, then the chain-of-custody must be signed. Exception is if shipment is sent by commercial carrier, then note what company the samples were "relinquished to …".

3) All phytoplankton samples are to be sent to:

Diana Lehmann
1000 SW Jackson
Suite 440
Topeka, Kansas 66612

4) All nutrient samples are to be sent to the:

KHEL Lab
Forbes Field, Building 740
Topeka, Ks. 66620-0001

If samples are to be shipping by carrier, to minimize shipping costs, send all samples to Diana Lehmann, including nutrient samples and we will carry the nutrient samples to the lab.

Further question? Contact:

Mike Butler – 785-296-5580
Pattie Haines-Lieber – (785) 291-3267
Diana Lehmann - (785) 296-5576

INITIAL PROCESSING OF ALGAL SAMPLES
(HAB – 002)

I. INTRODUCTION

A. Purpose

The following paragraphs describe the procedure for the collection, preservation, and transport of algal samples from water bodies with a validated HAB complaint.

B. Minimum Staff Qualifications

Personnel implementing this SOP should meet the minimum classification requirements for Environmental Scientist I published by the Kansas Department of Administration. They also should be experienced in the measurement of the physicochemical and microbiological properties of surface water and in the performance of environmental field investigations.

C. Equipment/Accessories

1. Lugol's solution
2. Sample bottles with lids
3. Yellow round labels
4. Chain of Custody sheet.

II. PROCEDURES

A. Receiving samples

1) Staff from mailroom will call or bring coolers containing samples to someone in the office. This is usually around 9:30 to 10:00 on Tuesday or Wednesday depending upon the carrier bringing in the samples.

2) Upon receiving the coolers, remove the samples and paperwork.

3) Place samples in refrigerator in the algal laboratory until ready to process. Make sure the refrigerator door closes completely.

4) On the back of the Algae Sample Submission Form (see Attachment 4) and under the Chain of Custody section, date and sign by the Received By line.

5) The Algae Sample Submission Forms are to be kept with the samples and are placed by the algal taxonomist's scope.

B. Algal Preservation

1) When ready to process samples, remove them from the refrigerator and place on the black shelving unit in middle of algal lab room in the order they will be processed in.

2) In the drawer directly to the left of the sink, remove the yellow stickers and a pencil to mark each bottle used to preserve samples.

3) In the chlorophyll lab room (small room) and directly to the left of the door on a cart, remove one bottle for each sample to be preserved. Lids to the bottles are in the far right bottom cabinet and on the bottom self.

4) Line the bottles and lids up on the counter by the refrigerator in the algal lab. Write on the yellow stickers the lake number and sampling point (for example – Milford would be 190 as the lake number and AA is one of the sample points). Place the stickers on top of the lids prior to preserving sample.

5) In the same room and under the sink is the brown Lugol's container. It has a small needleless syringe attached to it. Place 5 drops of Lugol's in each bottle. Be careful with this as Lugol's does stain just about everything it comes in contact with, including the counter, hands, and clothes. Place bottle back under the sink.

6) Take the first sample and shake cubitainer vigorously to thoroughly mix the water and contents. Over the sink, carefully pour sample water into one of the small bottles containing the Lugol's until it is about to the line where the neck begins (about ¼ inch from the top). Double check that the lid you put on the bottle matches the sample you poured into it. Screw that lid onto the bottle securely.

7) A portion of the sample will need to be frozen to conduct the ELISA toxicity test so pour a good portion of the sample down the drain but retain at least a ½ inch in the bottom of the cubitainer.

8) Continue this process with all the remaining samples.

9) Place the preserved samples on the table with the older scope. This scope has a black trash bag over it.

10) Place the cubitainers with the saved water into the freezer in the main lab (middle) room. Make sure the lid to the freezer is closed tightly.

MICROCYSTIN TEST USING ELISA QUALITUBE KIT (ET 022) (HAB – 003)

H. INTRODUCTION

A. Purpose

The following paragraphs describe the procedures for the collection, preservation, and transport of algal samples from water bodies with a validated HAB complaint.

B. Minimum Staff Qualifications

Personnel implementing this SOP should meet the minimum classification requirements for Environmental Scientist I published by the Kansas Department of Administration. They also should be experienced in the measurement of the physicochemical and microbiological properties of surface water and in the performance of environmental field investigations.

C. Equipment/Accessories

1. Envirologix qualitube kit for Microcystin.
2. Wooden block to place tubes in for analysis.
3. Timer.
4. Use of water in sink area.
5. Thawed water samples from freezer of lakes that are under investigation.
6. Paper and pencil.

II. PROCEDURES

A. Preliminary procedures:

1. Remove frozen samples from freezer to begin thawing.
2. Read all the instructions before running the kit.
3. Allow all reagents to reach room temperature before beginning (at least 30 minutes with un-boxed tubes and reagents at room temperature – do not remove tubes from bag with desiccant until they have warmed up).

4. Organize all samples and reagents so that steps 1 and 2 can be performed in 3 minutes or less.

5. Do not run more than 6 tubes at a time.

B. Completing the assay.

1. Place tubes in wooden tube rack. The Calibrator tubes are the two tubes behind the six in front. These will be the tubes used to compare color intensity between 0.5 ppb and 3.0 ppb results. See Photo below.

2. Rapidly add **5 drops** of Microcystin Assay ***Diluent*** to each tube in the assay.

3. Using the sample pipette provided, immediately add **2 drops of 0.5 ppb Microcystin *Calibrator*** to the first tube. Add 2 drops of 3.0 ppb **Microcystin *Calibrator*** into the second tube. Add 2 drops of sample to each of the subsequent tubes up to a total of 4 samples. **Do Not Add Microcystin-enzyme Conjugate in this step.**

4. Thoroughly mix the contents of the tubes by moving the tube holder in a rapid circular motion on flat surface for a full 20 - 30 seconds.

5. Incubate tubes at ambient temperature for 5 minutes.

6. Add **5 drops of Microcystin-enzyme *Conjugate*** to each tube. Do not empty the tub contents or wash the tubes at this time. Thoroughly mix the contents of the tubes as in step 3.

7. Incubate tubes at ambient temperature for 20 minutes.

8. After incubation, vigorously shake the contents of the tubes into a sink or other suitable container. Flood the tubes completely with cool tap water,

and then shake to empty. Repeat this wash step 3 times. Invert the tubes on a paper towel and tap to remove as much water at possible.

9. Add **10 drops of *Substrate*** to each tube. Thoroughly mix the contents of the tubes, as in Step 3. Incubate substrate in tubes for 10 minutes at ambient temperature.

   NOTE: If blue color does not develop in the 0.5 ppb Calibrator tube, the assay is invalid and should be repeated.

10. This assay is designed to be read visually with un-stopped tubes (blue solution). If tubes are to be read using the tube photometer pipette 0.7 mL of Stop Solution into each tube and mix thoroughly. This will turn the tube contents yellow.

    a. Tubes should be read **within 30 minutes** of the addition of Stop Solution.

11. Interpret the results of tubes immediately following the 10 minute substrate incubation.

C. Interpreting the results

1. Compare the intensity of the blue color of each sample tube to the intensity of the blue color in the 0.5 and 3.0 ppb calibrator tubes.

2. Score each sample tube as having less than, more than or equal color to the two calibrator tubes.

3. Use the chart below to determine the level of microcystin in the samples.

Samples with OD values…..	Contain…..
Greater than OD of 0.5 ppb Calibrator	Less than 0.5 ppb Microcystin
Between OD of 0.5 ppb and 3.0 ppb Calibrator	Between 0.5 and 3.0 ppb Microcystin
Less than OD of 3.0 ppb Calibrator	More than 3 ppb Microcystin

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Attachment 8

Lake Visitation Potential

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Lake Visitation Potential Multiplicand Explanation

In determining a lake's visitation potential, the following equation was used:

Population 30 x Lake Size Factor x Lake Density Factor x Public Access Factor x Contact Recreation Factor = Lake Visitation Potential

The following table is an explanation of the multiplicands in the above equation.

Population 30 Population within 30 mile radius

Lake Size Factor Based on lake size in acres, divided into classes and then assigned size factors:

Size Class	Size Factor
<1 acre =	**.001**
1 – 5 acres =	**.01**
5 – 50 acres =	**0.1**
50 – 500 acres =	**0.5**
500 – 1000 acres =	**1.0**
> 1000 acres =	**2.0**

Lake Density Factor Based on number of lakes within 30 mile diameter and then assigned density factors:

Number of Lakes	Density Factor
1 to 3 lakes =	**1.0**
4 to 6 lakes =	**0.8**
7 to 16 lakes =	**0.6**
> 16 lakes =	**0.4**

Public Access Factor

Private Lake	Open to Public
1.0	**0.1**

Contact Recreation (CR) Factor

Definition	Primary Contact Attainability	Recreation Factor
CR A - Swimming beach/boating/skiing facilities provided.	Attainable	**1.0**
CR B - Swimming/boating facilities not provided but water depth greater than 18 inches.	Attainable	**0.5**
CR a - Waterbody less than 18 inches in depth. Full immersion not likely.	Not Attainable	**0.1**

Once the visitation potential was calculated for all the lakes on the Kansas Surface Water Register, they were then ranked from the highest lake visitation potential to the lowest. A HAB Kansas Lake Ranking for Visitation Potential list was developed and divided into 25/75 percentile. The HAB Kansas Lake Ranking for Visitation Potential list can be found in Attachment 8.

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Attachment 9

Kansas Lake Ranking for Visitation Potential

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HAB Kansas Lake Ranking for Visitation Potential

Lake Name	Pop_30	Acres	Size Class	Size Factor	Lake_30	Lakes_ Factor	Private	CR	Contact Factor	Final Score
Top 25% highlighted										
Atchison Co. SFL	89512	61.0	50-500	0.50	2	1.0	1.00	B	1.0	44756
Augusta City Lake	509828	175.7	50-500	0.50	2	1.0	1.00	A	1.0	254914
Augusta Santa Fe Lake	535020	259.6	50-500	0.50	2	1.0	1.00	A	1.0	267510
Banner Creek Lake	145753	487.1	50-500	0.50	4	0.8	1.00	A	1.0	58301
Big Hill Lake	84056	1094.3	>1000	2.00	2	1.0	1.00	A	1.0	168112
Bone Creek Lake	60750	502.6	500-1000	1.00	3	1.0	1.00	B	1.0	60750
Bourbon Co. SFL	61420	92.0	50-500	0.50	2	1.0	1.00	B	1.0	30710
Butler Co. SFL	99034	106.7	50-500	0.50	1	1.0	1.00	B	1.0	49517
Carey Park Lake	152484	77.6	50-500	0.50	2	1.0	1.00	A	1.0	76242
Cedar Bluff Lake	32321	4271.9	>1000	2.00	1	1.0	1.00	A	1.0	64642
Cedar Creek Lake	65034	308.5	50-500	0.50	3	1.0	1.00	A	1.0	32517
Cedar Lake	781930	62.2	50-500	0.50	11	0.6	1.00	B	1.0	234579
Chanute Santa Fe Lake	66349	73.4	50-500	0.50	1	1.0	1.00	B	1.0	33175
Cheney Lake	368923	9664.1	>1000	2.00	1	1.0	1.00	A	1.0	737846
Clinton Lake	381928	7389.9	>1000	2.00	4	0.8	1.00	A	1.0	611085
Council Grove City Lake	71922	387.7	50-500	0.50	2	1.0	1.00	A	1.0	35961
Council Grove Lake	77452	2730.7	>1000	2.00	2	1.0	1.00	A	1.0	154904
Douglas Co. SFL	602250	175.8	50-500	0.50	5	0.8	1.00	B	1.0	240900
Edgerton City Lake	717271	7.1	5-50	0.10	6	0.8	1.00	B	1.0	57382
El Dorado Lake	173182	7697.9	>1000	2.00	1	1.0	1.00	A	1.0	346364
Elk City Lake	63744	3414.6	>1000	2.00	2	1.0	1.00	A	1.0	127488
Emery Park Lake	546896	6.6	5-50	0.10	10	0.6	1.00	A	1.0	32814
Empire Lake	55092	416.4	50-500	0.50	1	1.0	1.00	B	1.0	27546
Fall River Lake	25456	2190.9	>1000	2.00	2	1.0	1.00	A	1.0	50912
Gardner City Lake	792878	105.5	50-500	0.50	10	0.6	1.00	A	1.0	237863
Geary Co. SFL	117663	95.6	50-500	0.50	2	1.0	1.00	B	1.0	58832
Hargis Lake	389436	60.2	50-500	0.50	3	1.0	1.00	B	1.0	194718
Harvey Co. East Lake	449243	180.8	50-500	0.50	3	1.0	1.00	A	1.0	224622
Harvey Co. West Park Lake	327562	12.4	5-50	0.10	1	1.0	1.00	A	1.0	32756
Herington City Lake	65571	168.7	50-500	0.50	3	1.0	1.00	A	1.0	32786

Lake Name	Pop_30	Acres	Size Class	Size Factor	Lake_30	Lakes_ Factor	Private	CR	Contact Factor	Final Score
Top 25% highlighted										
Herington Reservoir	61796	522.5	500-1000	1.00	3	1.0	1.00	A	1.0	61796
Hillsdale Lake	647463	4295.0	>1000	2.00	5	0.8	1.00	A	1.0	1035941
Inman Lake	137270	133.4	50-500	0.50	2	1.0	1.00	B	0.5	34318
John Redmond Lake	61949	8158.4	>1000	2.00	3	1.0	1.00	A	1.0	123898
Kanopolis Lake	91811	2933.5	>1000	2.00	1	1.0	1.00	A	1.0	183622
Kirwin Lake	15952	1535.1	>1000	2.00	1	1.0	1.00	A	1.0	31904
La Cygne Lake	49815	2371.2	>1000	2.00	2	1.0	1.00	B	1.0	99630
Lake Afton	506353	249.9	50-500	0.50	2	1.0	1.00	A	1.0	253177
Lake Shawnee	315903	378.2	50-500	0.50	12	0.6	1.00	A	1.0	94771
Leavenworth Co. SFL	811776	150.7	50-500	0.50	2	1.0	1.00	B	1.0	405888
Lebo City Lake	65139	63.2	50-500	0.50	3	1.0	1.00	A	1.0	32570
Lone Star Lake	368604	175.6	50-500	0.50	4	0.8	1.00	A	1.0	147442
Louisburg Old Lake	481872	22.0	5-50	0.10	3	1.0	1.00	A	1.0	48187
Louisburg SFL	262726	269.0	50-500	0.50	3	1.0	1.00	B	1.0	131363
Lyon Co. SFL	68250	128.5	50-500	0.50	1	1.0	1.00	B	1.0	34125
Madison City Lake	54446	94.6	50-500	0.50	1	1.0	1.00	A	1.0	27223
Marion Co. Lake	54200	123.4	50-500	0.50	2	1.0	1.00	A	1.0	27100
Marion Lake	63460	6195.8	>1000	2.00	3	1.0	1.00	A	1.0	126920
Melvern Lake	85020	6221.7	>1000	2.00	5	0.8	1.00	A	1.0	136032
Miami Co. SFL	106927	110.1	50-500	0.50	3	1.0	1.00	B	1.0	53464
Milford Lake	121813	15182.0	>1000	2.00	1	1.0	1.00	A	1.0	243626
Miola Lake	445952	182.7	50-500	0.50	5	0.8	1.00	A	1.0	178381
Montgomery Co. SFL	67401	85.4	50-500	0.50	3	1.0	1.00	B	1.0	33701
Neosho Co. SFL	92321	56.6	50-500	0.50	2	1.0	1.00	B	1.0	46161
New Olathe Lake	798253	141.8	50-500	0.50	12	0.6	1.00	A	1.0	239476
Osage City Reservoir	159618	50.3	50-500	0.50	3	1.0	1.00	B	1.0	79809
Osage Co. SFL	312092	131.1	50-500	0.50	6	0.8	1.00	B	1.0	124837
Oskaloosa Lake	411385	12.5	5-50	0.10	4	0.8	1.00	A	1.0	32911
Ottawa Co. SFL	74729	95.3	50-500	0.50	1	1.0	1.00	B	1.0	37365
Parsons Lake	84602	803.1	500-1000	1.00	4	0.8	1.00	A	1.0	67682
Perry Lake	357757	10587.6	>1000	2.00	3	1.0	1.00	A	1.0	715514
Pomona Lake	292313	3720.9	>1000	2.00	5	0.8	1.00	A	1.0	467701
Pottawatomie Co. SFL #2	115674	70.2	50-500	0.50	3	1.0	1.00	B	1.0	57837

Lake Name	Pop_30	Acres	Size Class	Size Factor	Lake_30	Lakes_ Factor	Private	CR	Contact Factor	Final Score
Top 25% highlighted										
Prairie Lake	96519	61.3	50-500	0.50	4	0.8	1.00	A	1.0	38608
Shawnee Co. SFL	222703	121.5	50-500	0.50	1	1.0	1.00	B	1.0	111352
Shawnee Mission Lake	797476	115.5	50-500	0.50	13	0.6	1.00	A	1.0	239243
Strowbridge Reservoir	313569	241.1	50-500	0.50	5	0.8	1.00	B	1.0	125428
Toronto Lake	39413	2476.0	>1000	2.00	3	1.0	1.00	A	1.0	78826
Tuttle Creek Lake	120588	11987.0	>1000	2.00	2	1.0	1.00	A	1.0	241176
Wabaunsee Co. Lake	143131	207.2	50-500	0.50	2	1.0	1.00	A	1.0	71566
Waconda Lake	18075	10050.0	>1000	2.00	1	1.0	1.00	A	1.0	36150
Watson Park Lake	555774	21.1	5-50	0.10	11	0.6	1.00	B	1.0	33346
Wellington Lake	149226	384.8	50-500	0.50	3	1.0	1.00	A	1.0	74613
Wellington New City Lake	120188	206.3	50-500	0.50	3	1.0	1.00	A	1.0	60094
Wilson Lake	19430	7760.8	>1000	2.00	1	1.0	1.00	A	1.0	38860
Winfield City Lake	162563	1041.3	>1000	2.00	2	1.0	1.00	A	1.0	325126
Wolf Creek Lake	63817	4983.9	>1000	2.00	3	1.0	1.00	B	1.0	127634
Wyandotte Co. Lake	744936	323.0	50-500	0.50	6	0.8	1.00	A	1.0	297974
Alma City Lake	152934	24.5	5-50	0.10	2	1.0	1.00	B	1.0	15293
Altamont City Main Lake (#1)	73347	21.3	5-50	0.10	4	0.8	1.00	B	1.0	5868
Altamont City West Lake (#3)	73347	11.0	5-50	0.10	4	0.8	1.00	B	1.0	5868
Antelope Lake	10724	1.6	1-5	0.01	2	1.0	1.00	B	1.0	107
Anthony City Lake	16874	113.2	50-500	0.50	1	1.0	1.00	A	1.0	8437
Antioch Park Lake	712904	2.4	1-5	0.01	8	0.6	1.00	A	1.0	4277
Atchison Co. Park Lake	58120	70.7	50-500	0.50	3	1.0	1.00	B	0.5	14530
Atwood Township Lake	9400	39.6	5-50	0.10	1	1.0	1.00	B	0.5	470
Barber Co. SFL	19820	44.1	5-50	0.10	1	1.0	1.00	B	1.0	1982
Bartlett City Lake	71317	15.9	5-50	0.10	5	0.8	1.00	B	1.0	5705
Barton Lake	44053	13.6	5-50	0.10	3	1.0	1.00	A	0.1	441
Belleville City Lake	17370	18.3	5-50	0.10	1	1.0	1.00	B	1.0	1737
Beymer Lake	53364	4.9	1-5	0.01	1	1.0	1.00	A	1.0	534
Big Creek Oxbow	40730	3.0	1-5	0.01	1	1.0	1.00	B	0.5	204
Big Eleven Lake	680789	3.4	1-5	0.01	5	0.8	1.00	B	0.5	2723

Lake Name	Pop_30	Acres	Size Class	Size Factor	Lake_30	Lakes_ Factor	Private	CR	Contact Factor	Final Score
Top 25% highlighted										
Blue Mound City Lake	55737	21.3	5-50	0.10	3	1.0	1.00	B	0.5	2787
Boy Scout Lake	37943	4.2	1-5	0.01	3	1.0	1.00	A	1.0	379
Bronson City Lake	60865	13.7	5-50	0.10	3	1.0	1.00	B	0.5	3043
Brown Co. SFL	41704	69.1	50-500	0.50	2	1.0	1.00	B	1.0	20852
Buffalo Park Lake	544397	11.9	5-50	0.10	8	0.6	1.00	B	0.5	16332
Caney City Lake	48681	64.7	50-500	0.50	1	1.0	1.00	B	0.5	12170
Carbondale West Lake	311608	7.1	5-50	0.10	6	0.8	1.00	B	0.5	12464
Cedar Creek Reservoir	52918	198.5	50-500	0.50	6	0.8	1.00	B	1.0	21167
Cedar Crest Lake	297115	2.6	1-5	0.01	11	0.6	1.00	B	0.5	891
Central Park Lake	306380	1.3	1-5	0.01	12	0.6	1.00	B	0.5	919
Centralia Lake	34278	232.9	50-500	0.50	1	1.0	1.00	A	1.0	17139
Chase Co. SFL	53635	104.1	50-500	0.50	1	1.0	1.00	A	1.0	26818
Chisholm Creek Park Lake	553034	2.7	1-5	0.01	9	0.6	1.00	B	1.0	3318
Cimarron Lake (Moss Lake Middle)	9837	1.1	1-5	0.01	3	1.0	1.00	B	0.5	49
Circle Lake	47404	21.7	5-50	0.10	3	1.0	1.00	B	0.5	2370
Clark Co. SFL	35045	292.5	50-500	0.50	1	1.0	1.00	B	1.0	17523
Colby City Lake	13208	1.6	1-5	0.01	1	1.0	1.00	B	0.5	66
Concannon SFL	46289	13.4	5-50	0.10	1	1.0	1.00	B	1.0	4629
Cowley Co. SFL	41133	77.1	50-500	0.50	1	1.0	1.00	B	1.0	20567
Critzer Lake	50000	212.0	50-500	0.50	4	0.8	1.00		1.0	20000
Crystal Lake	70301	13.8	5-50	0.10	4	0.8	1.00	B	1.0	5624
Dillon Park Lakes	133976	2.9	1-5	0.01	2	1.0	1.00	B	0.5	670
Dornwood Park Lake	314838	0.0	<1	0.00	12	0.6	1.00	B	0.5	94
Eagle Lake (BelAire Lake)	552268	4.6	1-5	0.01	9	0.6	1.00	B	0.5	1657
Edna City Lake	61240	11.8	5-50	0.10	4	0.8	1.00	A	1.0	4899
Elkhorn Lake	120243	4.4	1-5	0.01	4	0.8	1.00	B	0.5	481
Ellis City Lake	35480	8.6	5-50	0.10	1	1.0	1.00	B	1.0	3548
Elm Creek Lake	66006	78.5	50-500	0.50	8	0.6	1.00	A	1.0	19802
Eureka Lake	21111	251.3	50-500	0.50	2	1.0	1.00	A	1.0	10556
Finney Co. SFL/W.A.	20521	5.0	5-50	0.10	1	1.0	1.00	B	0.5	1026
Ford Co. Lake	40554	15.2	5-50	0.10	3	1.0	1.00	B	1.0	4055
Fort Scott City Lake	62490	333.4	50-500	0.50	6	0.8	1.00	A	1.0	24996

Lake Name	Pop_30	Acres	Size Class	Size Factor	Lake_30	Lakes_ Factor	Private	CR	Contact Factor	Final Score
Top 25% highlighted										
Fossil Lake	39866	42.2	5-50	0.10	1	1.0	1.00	B	0.5	1993
Francis Wachs W.A.	9717	7.7	5-50	0.10	1	1.0	1.00	A	0.1	97
Frisco Lake	846692	3.4	1-5	0.01	16	0.6	1.00	B	0.5	2540
Gage Park Lake	301669	2.8	1-5	0.01	11	0.6	1.00	B	0.5	905
Garnett North Lake	74584	44.1	5-50	0.10	4	0.8	1.00	A	1.0	5967
Goodman SFL	7777	23.5	5-50	0.10	1	1.0	1.00	B	1.0	778
Gridley City Lake	59484	33.7	5-50	0.10	1	1.0	1.00	A	1.0	5948
Gunn Park East Lake	52215	2.6	1-5	0.01	6	0.8	1.00	B	0.5	209
Gunn Park West Lake	52215	6.3	5-50	0.10	6	0.8	1.00	B	0.5	2089
Hain SFL	39804	27.5	5-50	0.10	2	1.0	1.00	B	1.0	3980
Hamilton Co. SFL	7000	43.8	5-50	0.10	1	1.0	1.00	B	1.0	700
Harrison Park Lake	525905	2.2	1-5	0.01	8	0.6	1.00	B	0.5	1578
Harvey Co. Camp Hawk Lake	516016	3.6	1-5	0.01	3	1.0	1.00	A	1.0	5160
Harveyville Lake	225876	17.1	5-50	0.10	1	1.0	0.01	A	0.5	113
Herington City Park Lake	61958	2.0	1-5	0.01	3	1.0	1.00	B	0.5	310
Heritage Park Lake	738651	38.9	5-50	0.10	11	0.6	1.00	A	0.5	22160
Hiawatha City Lake	45520	7.1	5-50	0.10	2	1.0	1.00	B	0.5	2276
Hillsboro City Lake	73989	0.6	<1	0.00	2	1.0	1.00	B	0.5	37
Hodgeman Co. SFL/W.A.	37843	251.2	50-500	0.50	3	1.0	1.00		0.0	0
Hole In The Rock	416361	0.1	<1	0.00	4	0.8	1.00	B	0.5	167
Horseshoe Lake	545822	11.0	5-50	0.10	11	0.6	0.01	B	0.5	164
Horsethief Cayon Lake	37943	450.0	50-500	0.50	1	1.0	1.00	A	1.0	18972
Jerry's Lake	65499	1.0	1-5	0.01	4	0.8	1.00	B	0.5	2502
Jetmore Lake	37582	30.9	5-50	0.10	3	1.0	1.00	A	1.0	3758
Jewell Co. SFL	18382	39.2	5-50	0.10	1	1.0	1.00	B	1.0	1838
Jones Park Lake	54297	1.2	1-5	0.01	2	1.0	1.00	B	0.5	271
Kid's Lake	545822	9.6	5-50	0.10	11	0.6	1.00	B	0.5	16375
Kingman Co. SFL	32787	125.0	50-500	0.50	1	1.0	1.00	B	1.0	16394
Kiowa Co. SFL	13954	20.1	5-50	0.10	1	1.0	1.00	B	1.0	1395
KWP Hatchery and Ponds	23156	80.5	50-500	0.50	3	1.0	1.00	B	0.5	5789
La Claire Lake	62827	6.4	5-50	0.10	2	1.0	1.00	B	1.0	6283

Lake Name	Pop_30	Acres	Size Class	Size Factor	Lake_30	Lakes_ Factor	Private	CR	Contact Factor	Final Score
Top 25% highlighted										
Lake Charles	40878	1.4	1-5	0.01	2	1.0	1.00	B	0.5	204
Lake Coldwater	8547	231.1	50-500	0.50	1	1.0	1.00	A	1.0	4274
Lake Crawford State Park #2	65383	120.2	50-500	0.50	4	0.8	1.00	A	1.0	26153
Lake Dabanawa	575103	77.8	50-500	0.50	4	0.8	0.01	A	1.0	2300
Lake Idlewild	24899	6.1	5-50	0.10	1	1.0	1.00	B	1.0	2490
Lake Jayhawk	390956	19.7	5-50	0.10	4	0.8	0.01	A	1.0	313
Lake Jewell	18382	57.0	50-500	0.50	1	1.0	1.00	A	1.0	9191
Lake Jivaro	321526	73.2	50-500	0.50	6	0.8	0.01	A	1.0	1286
Lake Kahola	50283	359.0	50-500	0.50	1	1.0	0.01	A	1.0	251
Lake Meade State Park	26648	66.2	50-500	0.50	1	1.0	1.00	A	1.0	13324
Lake Quivera	786119	159.5	50-500	0.50	10	0.6	0.01	A	1.0	2358
Lake Scott State Park	11895	108.6	50-500	0.50	1	1.0	1.00	A	1.0	5948
Lake Sherwood	286615	239.9	50-500	0.50	11	0.6	0.01	A	1.0	860
Lake Tanko (Cherryvale City Lake)	83475	15.4	5-50	0.10	2	1.0	1.00	B	1.0	8348
Lake Warnock (Atchison City Lake)	102602	33.0	5-50	0.10	2	1.0	1.00	A	1.0	10260
Lakeview Estates Lake	293903	16.9	5-50	0.10	11	0.6	0.01	B	0.5	88
Lakewood Park Lake	80197	10.9	5-50	0.10	2	1.0	1.00	B	1.0	8020
Lansing City Lake	756118	2.9	1-5	0.01	5	0.8	1.00	B	0.5	3024
Lebo City Park Lake	64185	2.3	1-5	0.01	3	1.0	1.00	B	0.5	321
Lemon Park Lake	22434	1.9	1-5	0.01	3	1.0	1.00	B	0.5	112
Leonard's Lake	45999	7.4	5-50	0.10	3	1.0	1.00	B	0.5	2300
Little Lake	53889	9.3	5-50	0.10	3	1.0	1.00	B	0.5	2694
Logan City Lake	16653	8.0	5-50	0.10	1	1.0	1.00	B	1.0	1665
Logan Co. SFL	5751	44.3	5-50	0.10	1	1.0	1.00	B	1.0	575
Lovewell Lake	11987	2626.8	>1000	2.00	1	1.0	1.00	A	1.0	23974
Lyndon City Lake	127546	56.2	50-500	0.50	4	0.8	0.01	B	0.5	255
Mahaffie Farmstead Lake	784664	1.3	1-5	0.01	12	0.6	1.00	B	0.5	2354
Mallard Lake (Moss Lake E.)	11365	0.5	<1	0.00	3	1.0	1.00	B	0.5	6

Lake Name	Pop_30	Acres	Size Class	Size Factor	Lake_30	Lakes_ Factor	Private	CR	Contact Factor	Final Score
Top 25% highlighted										
Mary's Lake	724098	4.2	1-5	0.01	4	0.8	1.00	B	0.5	2896
McPherson Co. SFL	110756	39.9	5-50	0.10	1	1.0	1.00	B	1.0	11076
Memorial Park Lake	43200	12.7	5-50	0.10	3	1.0	1.00	B	0.5	2160
Merrit Lake	463067	5.5	5-50	0.10	4	0.8	1.00	B	0.5	18523
Mined Land Lake 01	71174	3.1	1-5	0.01	10	0.6	1.00	B	1.0	427
Mined Land Lake 02	71384	1.6	1-5	0.01	10	0.6	1.00	a	0.1	43
Mined Land Lake 03	70818	0.5	<1	0.00	10	0.6	1.00	B	0.5	21
Mined Land Lake 04	70818	10.2	5-50	0.10	10	0.6	1.00	B	1.0	4249
Mined Land Lake 05	89393	6.3	5-50	0.10	12	0.6	1.00	B	1.0	5364
Mined Land Lake 06	89393	6.8	5-50	0.10	12	0.6	1.00	B	1.0	5364
Mined Land Lake 07	84357	12.5	5-50	0.10	17	0.4	1.00	B	1.0	3374
Mined Land Lake 08	82348	11.3	5-50	0.10	18	0.4	1.00	B	1.0	3294
Mined Land Lake 09	80138	8.4	5-50	0.10	24	0.4	1.00	B	0.5	1603
Mined Land Lake 10	82093	1.0	1-5	0.01	25	0.4	1.00	B	0.5	164
Mined Land Lake 11	83477	5.8	5-50	0.10	30	0.4	1.00	B	1.0	3339
Mined Land Lake 12	82093	16.0	5-50	0.10	28	0.4	1.00	B	1.0	3284
Mined Land Lake 13	82093	4.6	1-5	0.01	26	0.4	1.00	B	0.5	164
Mined Land Lake 14	82093	7.9	5-50	0.10	26	0.4	1.00	B	0.5	1642
Mined Land Lake 15	82093	13.6	5-50	0.10	24	0.4	1.00	B	0.5	1642
Mined Land Lake 17	86726	17.3	5-50	0.10	36	0.4	1.00	B	1.0	3469
Mined Land Lake 18	86333	13.7	5-50	0.10	36	0.4	1.00	B	1.0	3453
Mined Land Lake 19	85712	15.0	5-50	0.10	35	0.4	1.00	B	1.0	3428
Mined Land Lake 20	89283	16.9	5-50	0.10	32	0.4	1.00	B	1.0	3571
Mined Land Lake 21	88129	15.1	5-50	0.10	34	0.4	1.00	B	1.0	3525
Mined Land Lake 22	86889	22.2	5-50	0.10	31	0.4	1.00	B	1.0	3476
Mined Land Lake 23	88129	31.6	5-50	0.10	34	0.4	1.00	B	1.0	3525

Lake Name	Pop_30	Acres	Size Class	Size Factor	Lake_30	Lakes_ Factor	Private	CR	Contact Factor	Final Score
Top 25% highlighted										
Mined Land Lake 24	88910	35.0	5-50	0.10	28	0.4	1.00	B	1.0	3556
Mined Land Lake 25	88296	9.9	5-50	0.10	26	0.4	1.00	B	1.0	3532
Mined Land Lake 26	84491	9.5	5-50	0.10	24	0.4	1.00	B	1.0	3380
Mined Land Lake 27	89166	32.7	5-50	0.10	28	0.4	1.00	B	1.0	3567
Mined Land Lake 28	88910	0.5	<1	0.00	28	0.4	1.00	a	1.0	36
Mined Land Lake 29	88910	12.2	5-50	0.10	29	0.4	1.00	B	1.0	3556
Mined Land Lake 30	90064	30.6	5-50	0.10	28	0.4	1.00	B	1.0	3603
Mined Land Lake 31	86889	61.5	50-500	0.50	31	0.4	1.00	B	1.0	17378
Mined Land Lake 32	86889	14.2	5-50	0.10	34	0.4	1.00	B	1.0	3476
Mined Land Lake 33	90064	42.9	5-50	0.10	28	0.4	1.00	B	1.0	3603
Mined Land Lake 34	90064	32.7	5-50	0.10	28	0.4	1.00	B	1.0	3603
Mined Land Lake 35	88910	27.9	5-50	0.10	29	0.4	1.00	B	1.0	3556
Mined Land Lake 36	90812	20.8	5-50	0.10	28	0.4	1.00	B	1.0	3632
Mined Land Lake 37	86333	3.9	1-5	0.01	36	0.4	1.00	B	1.0	345
Mined Land Lake 38	86333	6.1	5-50	0.10	36	0.4	1.00	B	1.0	3453
Mined Land Lake 39	89283	14.3	5-50	0.10	34	0.4	1.00	B	1.0	3571
Mined Land Lake 40	88129	16.9	5-50	0.10	34	0.4	1.00	B	1.0	3525
Mined Land Lake 41	87495	41.8	5-50	0.10	36	0.4	1.00	B	1.0	3500
Mined Land Lake 42	86333	11.9	5-50	0.10	36	0.4	1.00	B	1.0	3453
Mined Land Lake 43	86333	9.9	5-50	0.10	36	0.4	1.00	B	1.0	3453
Mined Land Lake 44	86333	77.2	50-500	0.50	36	0.4	1.00	B	1.0	17267
Mined Land Lake 45	86333	47.5	5-50	0.10	35	0.4	1.00	B	1.0	3453
Mingenback Lake	140443	3.2	1-5	0.01	2	1.0	1.00	B	0.5	702
Mission Lake	52543	136.5	50-500	0.50	3	1.0	1.00	A	1.0	26272
Moline City #1 (Santa Fe Lake)	17924	12.9	5-50	0.10	4	0.8	1.00	A	1.0	1434
Moline City Lake #2	15945	25.0	5-50	0.10	3	1.0	1.00	B	1.0	1595

Lake Name	Pop_30	Acres	Size Class	Size Factor	Lake_30	Lakes_ Factor	Private	CR	Contact Factor	Final Score
Top 25% highlighted										
Moline Reservoir	21124	160.9	50-500	0.50	4	0.8	1.00	A	1.0	8450
Moss Lake	545822	13.6	5-50	0.10	11	0.6	1.00	B	0.5	16375
Mound City Lake	49818	122.9	50-500	0.50	4	0.8	1.00	B	1.0	19927
Murray Gill Lake	32540	401.6	50-500	0.50	3	1.0	1.00	A	1.0	16270
Myer's Lake	319862	13.1	5-50	0.10	10	0.6	1.00	B	0.5	9596
Nebo SFL	160582	30.0	5-50	0.10	4	0.8	1.00	B	1.0	12847
Neosho Falls City Lake	47404	1.7	1-5	0.01	3	1.0	1.00	B	0.5	237
New Strawn Park Lake	70143	3.0	1-5	0.01	3	1.0	1.00	B	0.5	351
New Yates Center Lake	49996	168.0	50-500	0.50	5	0.8	1.00	B	1.0	19998
Newton City Park Lake	470621	34.2	5-50	0.10	3	1.0	1.00	B	0.5	23531
North Park Lake	795260	2.3	1-5	0.01	5	0.8	1.00	B	0.5	3181
Norton Lake (Sebelius Lake)	11357	782.4	500-1000	1.00	1	1.0	1.00	A	1.0	11357
Ogden City Lake	125126	13.7	5-50	0.10	2	1.0	1.00	A	1.0	12513
Olathe Waterworks Lakes	779776	9.8	5-50	0.10	12	0.6	1.00	B	0.5	23393
Olpe City Lake	51343	75.3	50-500	0.50	1	1.0	1.00	A	1.0	25672
Osawatomie City Lake	242417	24.5	5-50	0.10	3	1.0	1.00	B	0.5	12121
Otis Creek Lake (Eureka)	31373	240.1	50-500	0.50	2	1.0	1.00	B	0.5	7843
Overbrook Lake	321788	6.0	5-50	0.10	7	0.6	1.00	B	1.0	19307
Paola City Lake	501558	23.9	5-50	0.10	4	0.8	1.00	B	0.5	20062
Parker City Lake	68429	7.5	5-50	0.10	1	1.0	1.00	B	1.0	6843
Peter Pan Lake	55838	2.8	1-5	0.01	2	1.0	1.00	B	0.5	279
Pierson Park Lake	722265	11.4	5-50	0.10	9	0.6	1.00	B	0.5	21668
Pittsburg College Lake	70254	2.1	1-5	0.01	12	0.6	1.00	B	0.5	211
Plainville Township Lake	34838	23.5	5-50	0.10	1	1.0	1.00	B	1.0	3484
Playter's Lake	74794	3.8	1-5	0.01	12	0.6	1.00	B	0.5	224
Pleasanton City Lake #1	47058	24.4	5-50	0.1	5	0.8	1.00	B	1.0	3765

Lake Name	Pop_30	Acres	Size Class	Size Factor	Lake_30	Lakes_ Factor	Private	CR	Contact Factor	Final Score
Top 25% highlighted										
Pleasanton City Lake #2	47058	15.3	5-50	0.1	5	0.8	1.00	B	1.0	3765
Pleasanton Reservoir	45226	100.1	50-500	0.5	4	0.8	1.00	A	1.0	18090
Point of Rocks Lake (Moss Lake West)	4369	1.0	1-5	0.01	3	1.0	1.00	B	0.5	22
Polk Daniels Lake (Elk Co. SFL)	24510	64.8	50-500	0.50	3	1.0	1.00	B	1.0	12255
Pony Creek Lake	25509	103.6	50-500	0.50	3	1.0	1.00	B	1.0	12755
Pottawatomie Co SFL #1	93146	17.3	5-50	0.10	1	1.0	1.00	B	1.0	9315
Potter's Lake	667491	1.2	1-5	0.01	3	1.0	1.00	B	0.5	3337
Pratt Co. Lake	23156	46.4	5-50	0.10	3	1.0	1.00	B	1.0	2316
Prescott City Lake	27862	16.6	5-50	0.10	4	0.8	1.00	B	1.0	2229
Quarry Lake	45414	16.9	5-50	0.10	4	0.8	1.00	B	0.5	1817
Richmond City Lake	76745	12.7	5-50	0.10	3	1.0	1.00	B	1.0	7675
Riggs Park Lake	523717	1.2	1-5	0.01	3	1.0	1.00	B	0.5	2619
Rimrock Park Lake	124316	2.5	1-5	0.01	3	1.0	1.00	B	0.5	622
Rock Creek Lake	57709	52.8	50-500	0.50	6	0.8	1.00	B	1.0	23084
Rocky Ford W.A.	120579	7.7	5-50	0.10	3	1.0	1.00	B	0.5	6029
Rooks Co. SFL	14433	28.4	5-50	0.10	2	1.0	1.00	B	1.0	1443
Rose's Lake	788410	2.3	1-5	0.01	13	0.6	1.00	B	0.5	2365
Sabetha City Lake	26388	105.9	50-500	0.50	3	1.0	1.00	B	0.5	6597
Sabetha Watershed Lake (Niehues)	31775	0.3	<1	0.00	3	1.0	1.00	B	0.5	16
Saline Co. SFL	81073	21.9	5-50	0.10	2	1.0	1.00	B	1.0	8107
Scranton City Lake	306324	10.3	5-50	0.10	6	0.8	0.01	B	0.5	123
Sedan City North Lake	29588	40.2	5-50	0.10	3	1.0	1.00	B	1.0	2959
Sedan City South Lake	29588	64.2	50-500	0.50	3	1.0	1.00	A	1.0	14794
Severy City Lake	21892	11.6	5-50	0.10	2	1.0	1.00	B	1.0	2189
Sheridan Co. SFL	8681	43.4	5-50	0.10	2	1.0	1.00	B	1.0	868
Smith Lake	463048	3.4	1-5	0.01	4	0.8	1.00	B	0.5	1852
Smoky Hill Garden Lake	8509	12.7	5-50	0.10	2	1.0	1.00	B	0.5	425
South Lake Park	705078	6.0	5-50	0.10	11	0.6	1.00	B	0.5	21152
Spring Creek Park Lake	519850	11.3	5-50	0.10	4	0.8	1.00	B	0.5	20794
Spring Hill City Lake	768642	33.3	5-50	0.10	10	0.6	1.00	B	0.5	23059

Lake Name	Pop_30	Acres	Size Class	Size Factor	Lake_30	Lakes_ Factor	Private	CR	Contact Factor	Final Score
Top 25% highlighted										
St. Jacobs Well (Big Basin W.A.)	8562	15.0	5-50	0.10	1	1.0	1.00	B	0.5	428
Sterling City Lake	85980	8.3	5-50	0.10	1	1.0	1.00	B	0.5	4299
Stohl Park Lake	763134	1.6	1-5	0.01	12	0.6	1.00	B	0.5	2289
Stone Lake	45526	37.4	5-50	0.10	3	1.0	1.00	B	1.0	4553
Sunflower Park Lake	829896	1.4	1-5	0.01	3	1.0	1.00	B	0.5	4149
Thayer New City Lake	71381	16.8	5-50	0.10	3	1.0	1.00	B	1.0	7138
Thayer Old City Lake	70838	23.5	5-50	0.10	3	1.0	1.00	A	1.0	7084
Timber Lake	68236	20.6	5-50	0.10	1	1.0	1.00	B	0.5	3412
Topeka Public Golf Course Lake	285001	3.3	1-5	0.01	10	0.6	1.00	B	0.5	855
Troy Fair Lake	37607	5.1	5-50	0.10	1	1.0	1.00	B	0.5	1880
Vic's Lake	545822	11.4	5-50	0.10	11	0.6	1.00	B	0.5	16375
Wamego City Lake	109648	0.8	<1	0.00	2	1.0	1.00	B	0.5	55
Warren Park Lake	304134	0.2	<1	0.00	12	0.6	1.00	B	0.5	91
Washburn Rural Environmental Lab Lake	300128	3.7	1-5	0.01	11	0.6	1.00	B	0.5	900
Washington Co. SFL	18735	77.8	50-500	0.50	1	1.0	1.00	B	1.0	9368
Webster Lake	13063	1337.9	>1000	2.00	2	1.0	1.00	A	1.0	26126
Wilson Co. SFL	50955	109.4	50-500	0.50	2	1.0	1.00	B	1.0	25478
Windmill Lake	547874	17.4	5-50	0.10	11	0.6	1.00	B	0.5	16436
Winfield Park Lagoon	123647	6.1	5-50	0.10	2	1.0	1.00	B	0.5	6182
Woodson Co. SFL	51694	112.5	50-500	0.50	5	0.8	1.00	B	1.0	20678
Xenia Lake	50005	65.5	50-500	0.50	3	1.0	1.00	B	0.5	12501
Yates Center Reservoir	49547	112.8	50-500	0.50	3	1.0	1.00	A	1.0	24774

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Attachment 10
Standard Operating Procedures for HAB Data Management Systems

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Procedure	Rev. No.	Date
The APEX Web Application (DM-001)	New	02/27/15
Oracle “Harmful Algae Bloom” System (DM-002)	New	02/27/15
KDHE Harmful Algae Bloom Management System (DM-003)	New	02/27/15

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The APEX Web Application

(DM-001)

The APEX Web Application is the public facing web interface to the KDHE's complaint tracking system, http://www.kdheks.gov/algae-illness/index.htm . It has three distinct entry forms:

1) Algal Bloom complaint
https://www.dhe.state.ks.us/Community/se.ashx?s=11B9BDC9137C980B ,

2) Human Health complaint
https://www.dhe.state.ks.us/Community/se.ashx?s=11B9BDC955117283 , and

3) Animal Health complaint
https://www.dhe.state.ks.us/Community/se.ashx?s=11B9BDC95DA38790 .

The algal complaint form is routed simultaneously to environmental staff in BOW and BEFS. The human and animal health complaints are simultaneously routed to staff in BPIPI. Complaints are responded to by the respected staff.

1. Algal bloom complaints are reviewed by environment staff to determine if the complaint is valid and whether the water body is a "public" lake and/or a Public Drinking water supply source.
2. Human and Animal health complaints are reviewed by the EPI staff to determine if the illness is association with HAB exposure. The EPI staff is required to transfer complaint information to the algal bloom component to initiate the investigation.

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Oracle "Harmful Algae Bloom" System

(DM-002)

I. Separate from the HAB system but linked to and required by the system are two oracle databases. The first oracle database is the Site ID system. The locations of all sites sampled for any water quality parameter are entered into this database. It gives the geographic location of the sites, names and other fields explained below. A site not existing in the system needs to be entered prior to associating/entering any data. The second database is the algae database It contains percent cell counts and percent biomass for green, blue green, diatoms, dinoflagellates, crytophytes, euglenophytes, and other algae. It also contains counts of the individual blue-green species along with measured toxin levels. Data must be entered into this database prior to the HAB system being able to evaluate its status. Both databases are used by the monitoring networks outside of the HAB system. The procedures to enter both databases are as follows.

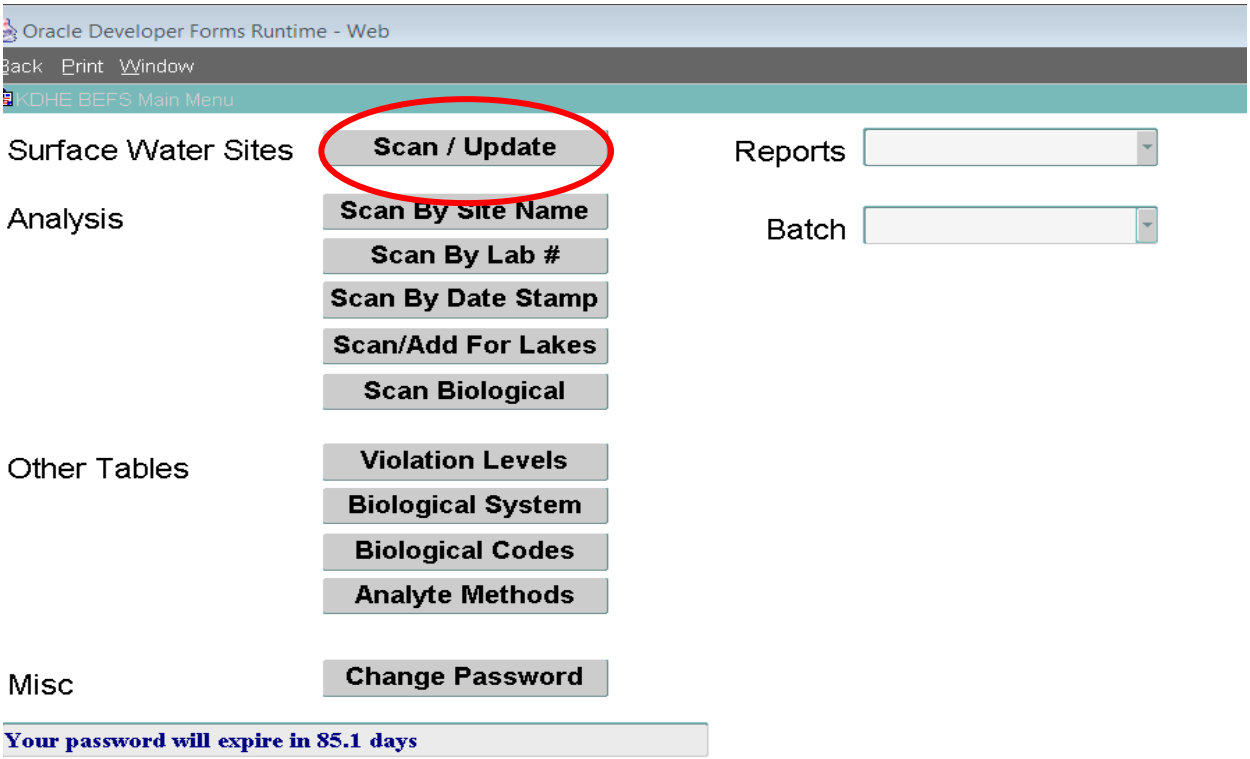
A. Site ID System

Creating a Header: In order to enter HAB data into KDHE's Oracle database, first a header has to be created in Oracle Forms for the HAB site. If a header already exists for the site then proceed to **B.**

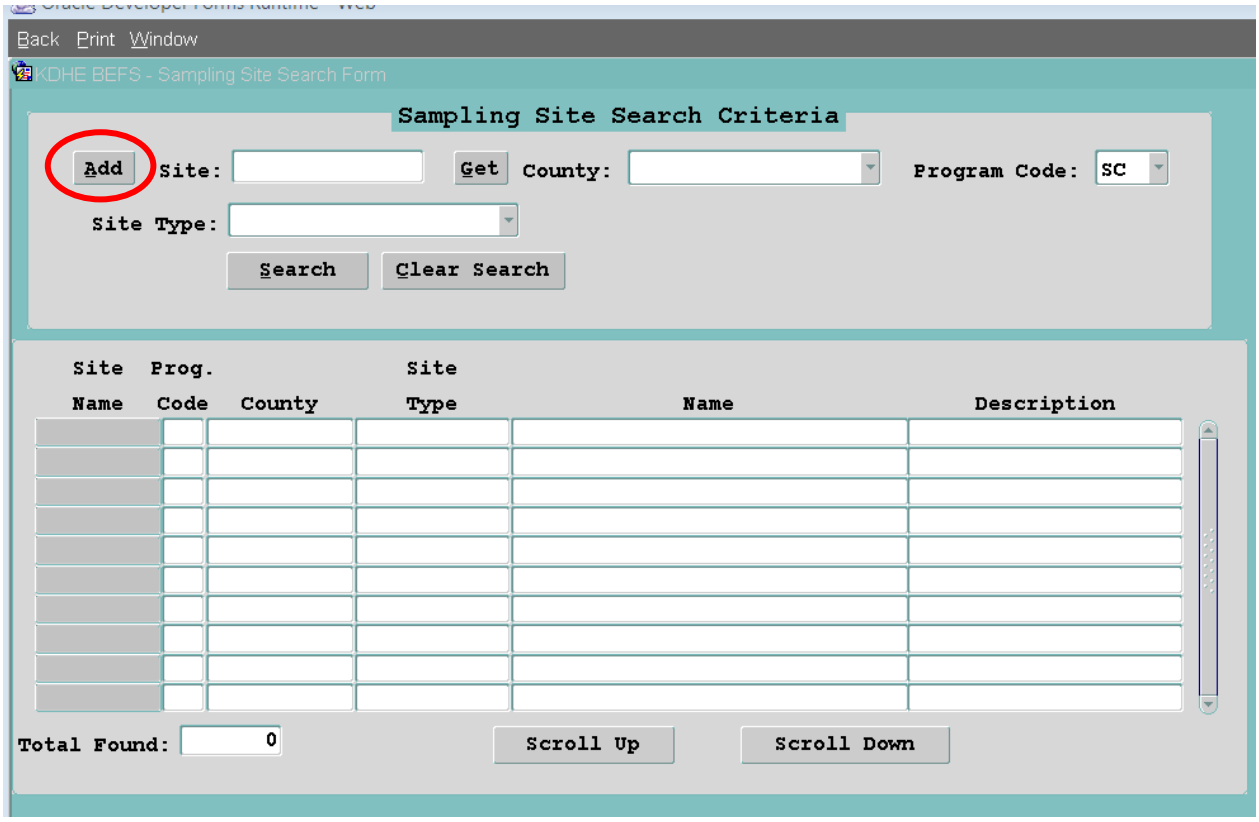
1. Logon to Oracle has to be authorized by IT:

http://oraapp/forms/frmservlet?form=D:\OraForms\SC\SCMainMenu.fmx&buffer_records=NO&debug_messages=NO&array=NO&query_only=NO&quiet=YES&RENDER=YES

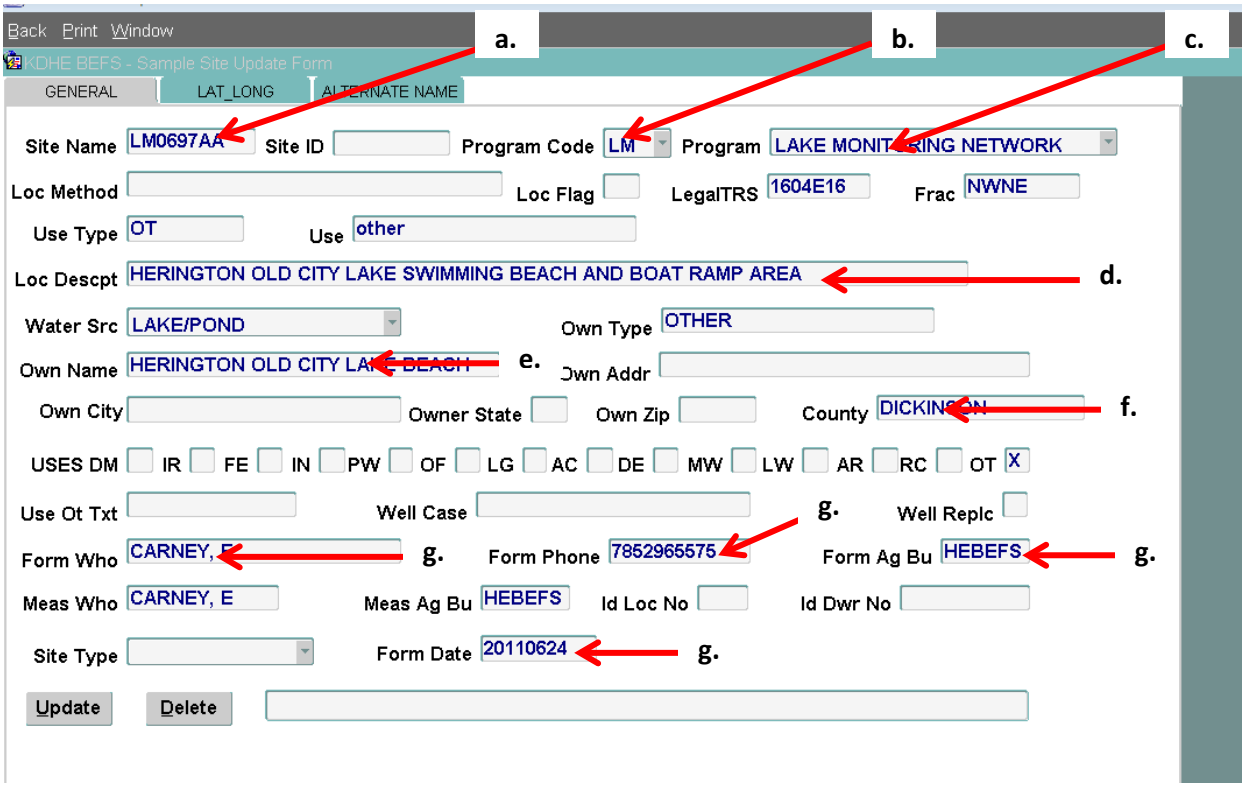
2. Log onto Oracle, and click on 'Scan/Update' to add HAB site header:



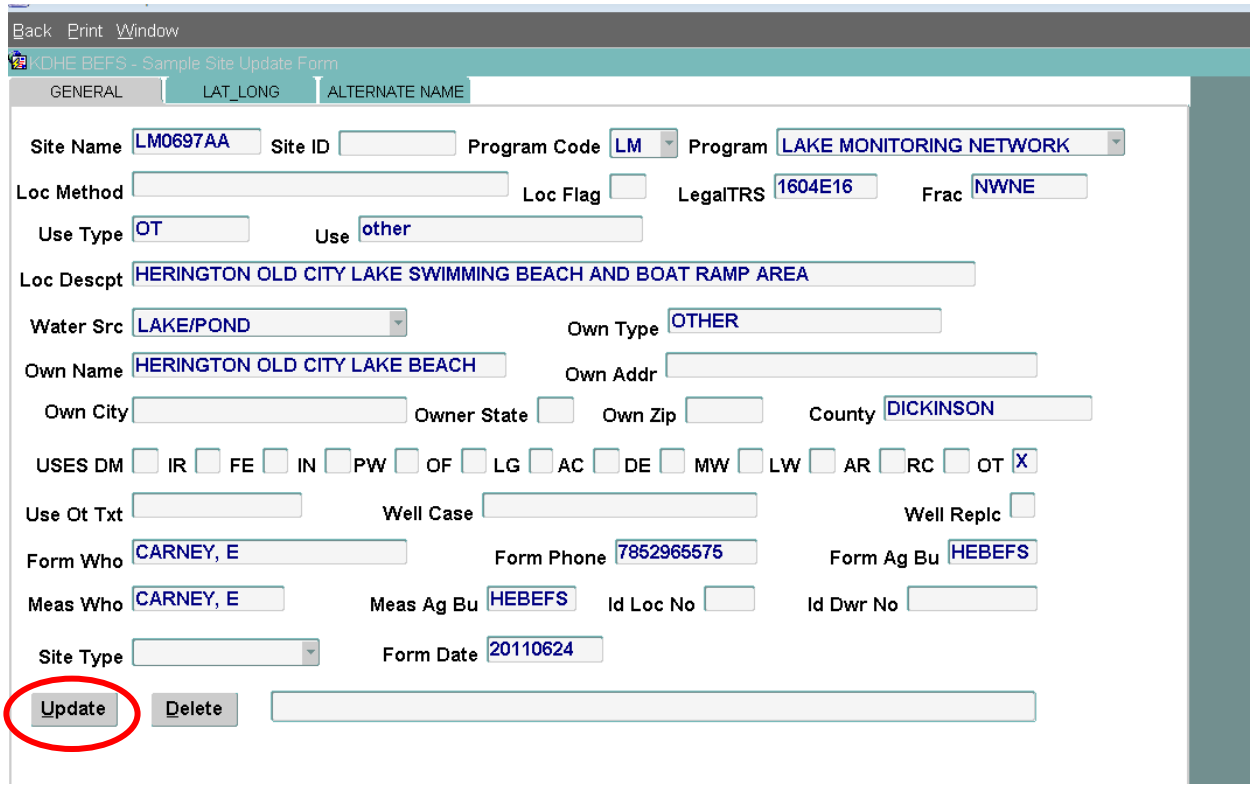
3. Click on 'Add'



4. Enter required minimum information (the site name will be decided by HAB group) on screen:
   - **a.** Site Name,
   - **b.** Program Code
   - **c.** Program
   - **d.** Loc Description
   - **e.** Own Name
   - **f.** County, and
   - **g.** Who entered the info (Form Who),
     - **i.** Date
     - **ii.** Phone, and
     - **iii.** Form Ag Bu.

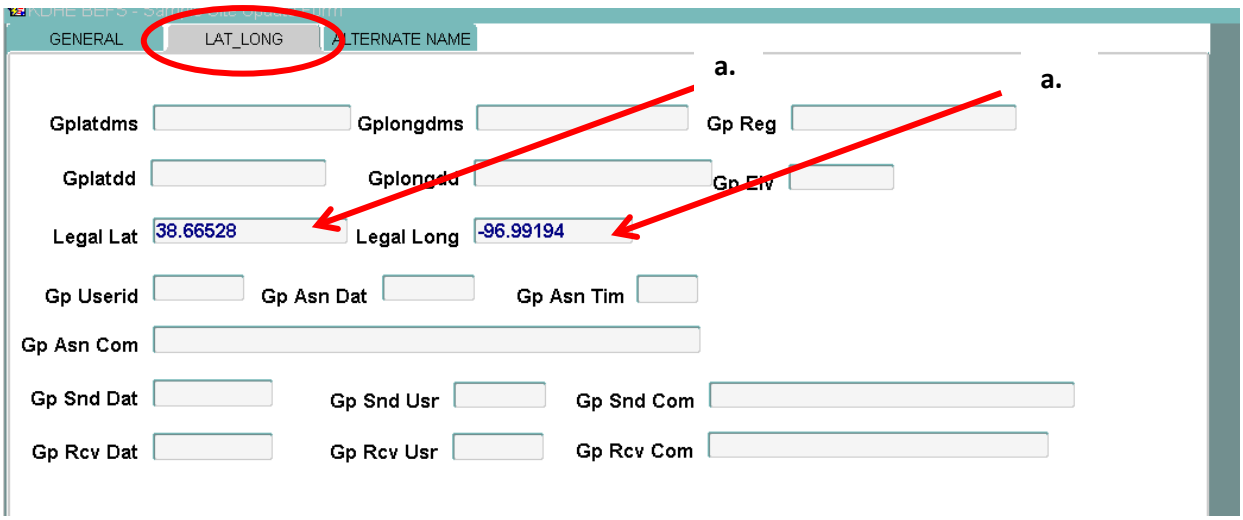


5. Click on 'Update' when done

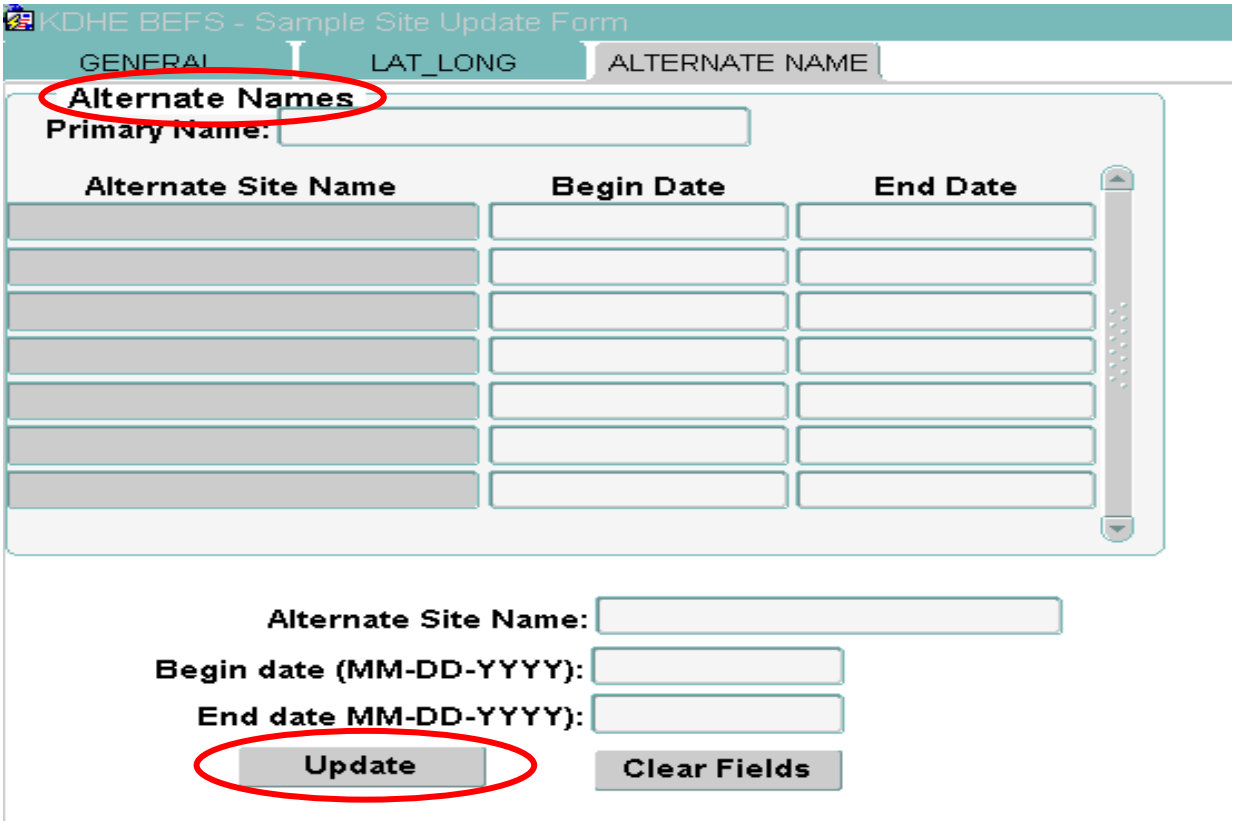


6. Click on Latitude-Longitude tab.

   a. Add latitude and longitude in decimal degrees under 'Legal latitude and Legal longitude (get latitude & longitude from Google, if needed, and use an Internet converter to change to decimal degrees).



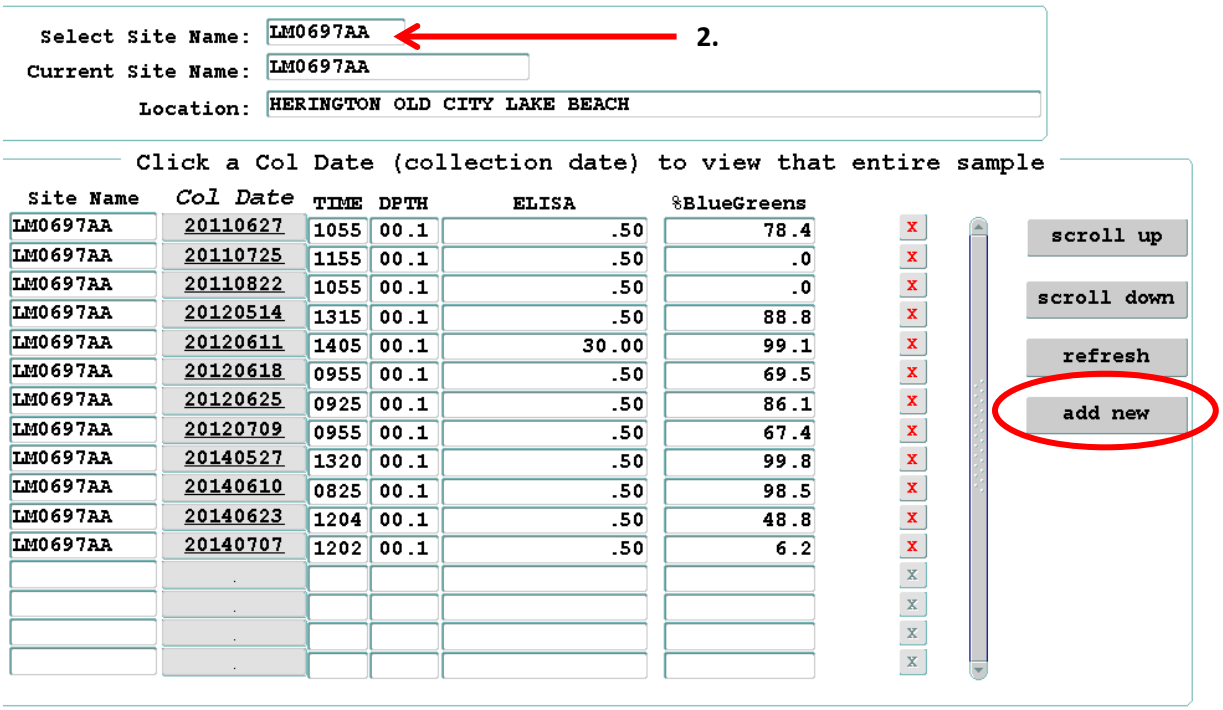
7. Click on 'Alternate Name' tab then on 'Update' to save



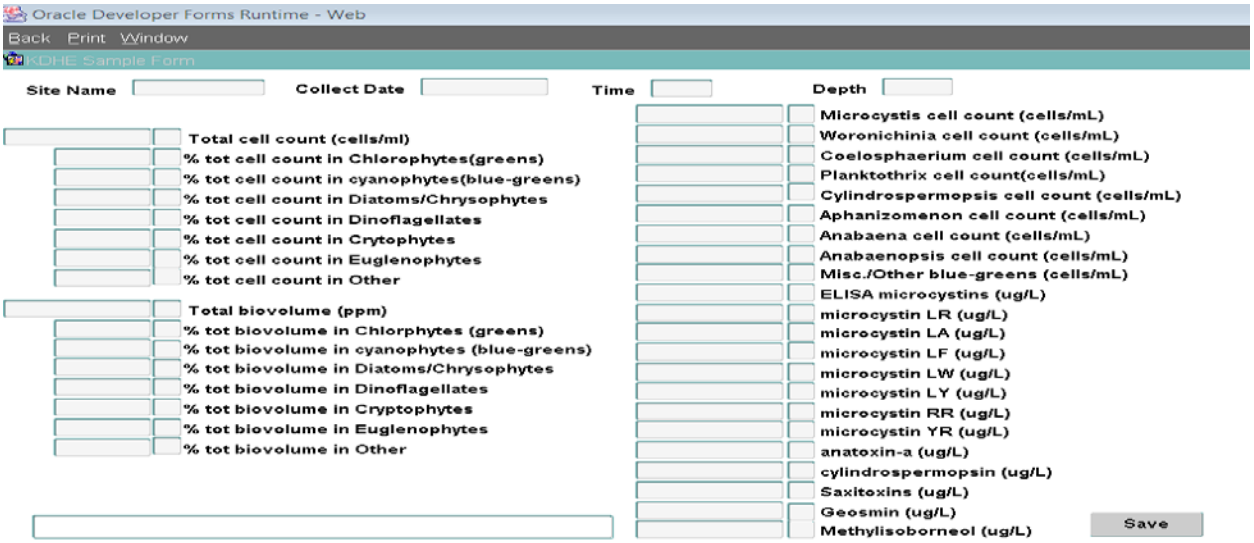
B. Algae Database

Entering Data: Once there is a header for the site, the actual data can be entered into Oracle's Algae database; again, logon needs to be authorized by IT
http://oraapp/forms/frmservlet?form=D:/OraForms/SC/ALSCAN.fmx&buffer_records=NO&debug_messages=NO&array=NO&query_only=NO&quiet=YES(&RENDER=YES

1. Logon Oracle
2. Type in 'Site Name' and hit "Enter"
3. Click on 'add new'

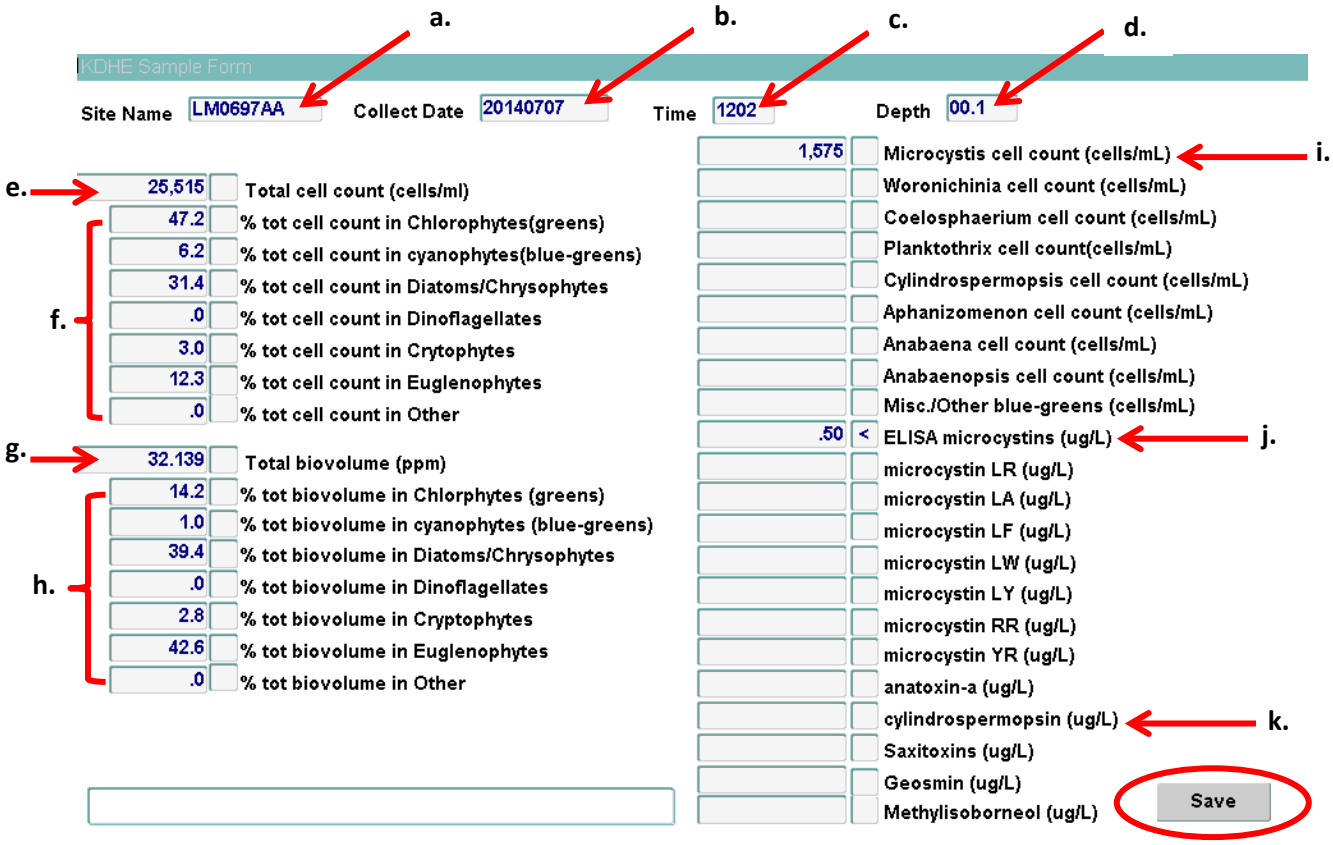


This will bring up a blank page to which the new information for the site can be added



4. From the lab sheets, obtain the following information to be entered:

- **a.** Site Name (Required)
- **b.** Collection Date (Required)
- **c.** Time sample was collected (Required)
- **d.** Depth of sample (Depth is 00.1 m for all algal data, required field)
- **e.** Total cell count
- **f.** % Greens, Blue-greens, etc.
- **g.** Total biovolume
- **h.** % total biovolume in greens, blue-greens, etc.
- **i.** Microcystis cell count
- **j.** ELISA Microcystins
- **k.** Cylindrospermopsin (if required)
- **l.** Click on'Save' when finished



The data can be retrieved from the Algae database located in Oracle/Environment. The algal data on Oracle is automatically linked to the KDHE Harmful Algae Bloom Management System application where it can be viewed/downloaded.

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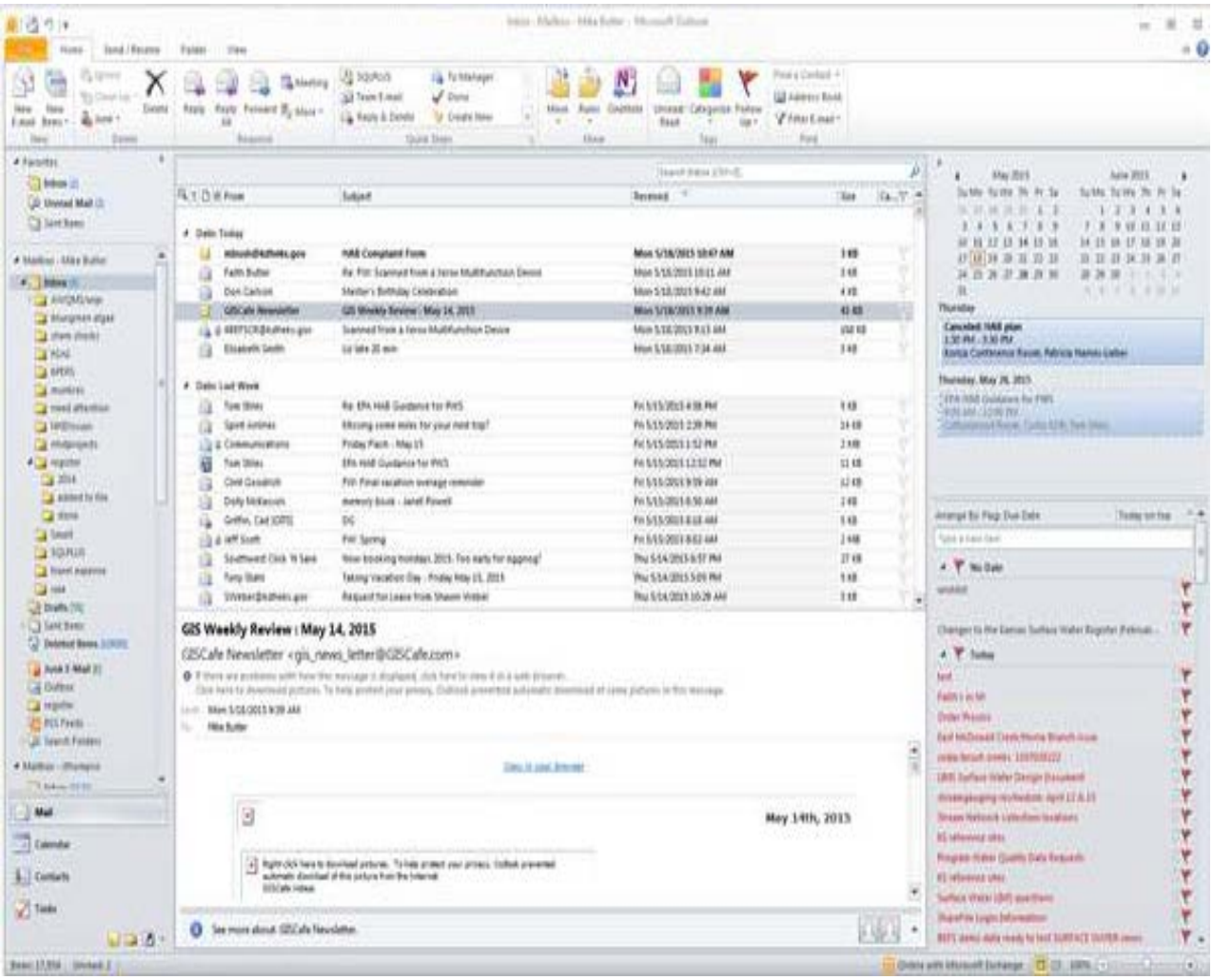
KDHE Harmful Algae Bloom Management System

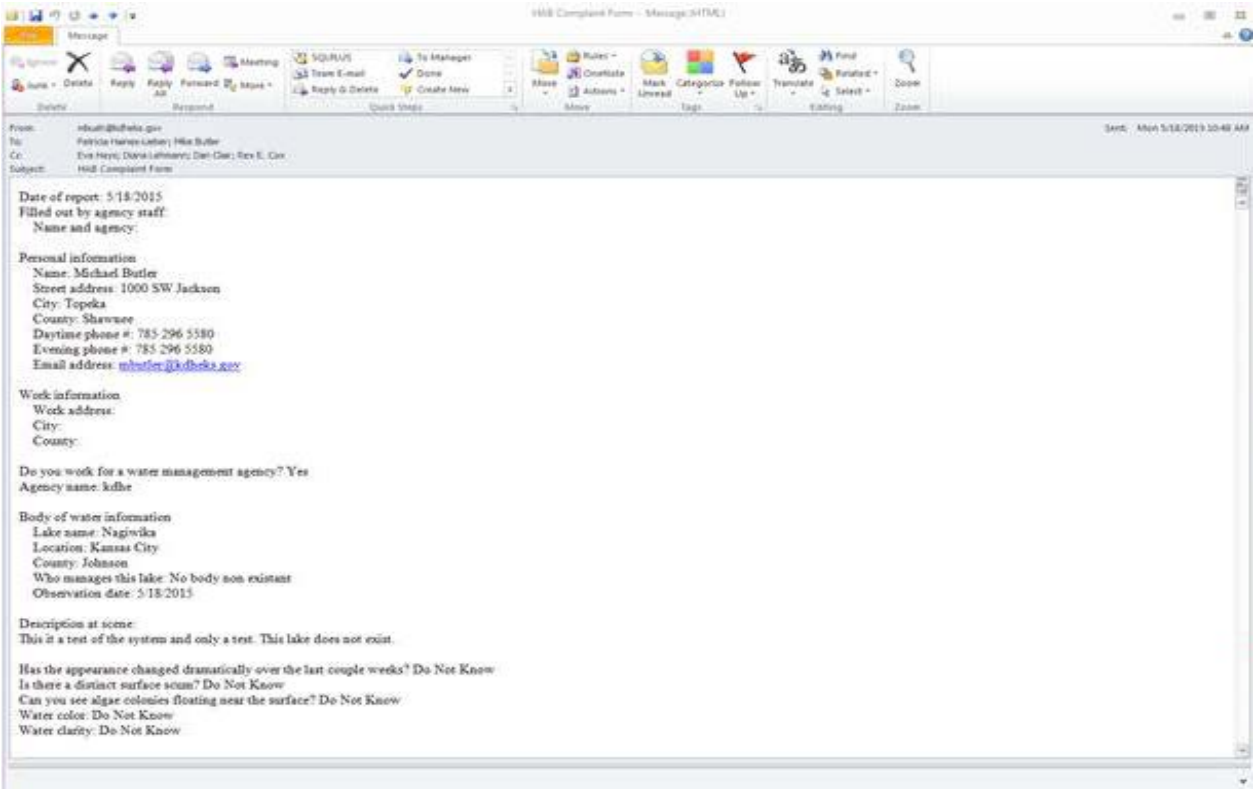
(DM – 003)

I. Initiating a Bloom Response

An algal report form is completed and sent. If the report form completed is either the human or animal health form, then those are sent to designated personnel in the BEPHI section. Those designated persons must then complete the HAB report form for the response process to be initiated. The report form generates an email which is sent to designated BEFS/BOW personnel.



A. A HAB notification is received.



Date of report: 5/18/2015
Filled out by agency staff:
Name and agency:

Personal information
Name: Michael Butler
Street address: 1000 SW Jackson
City: Topeka
County: Shawnee
Daytime phone #: 785 296 5580
Evening phone #: 785 296 5580
Email address: mbutler@kdheks.gov

Work information
Work address:
City:
County:

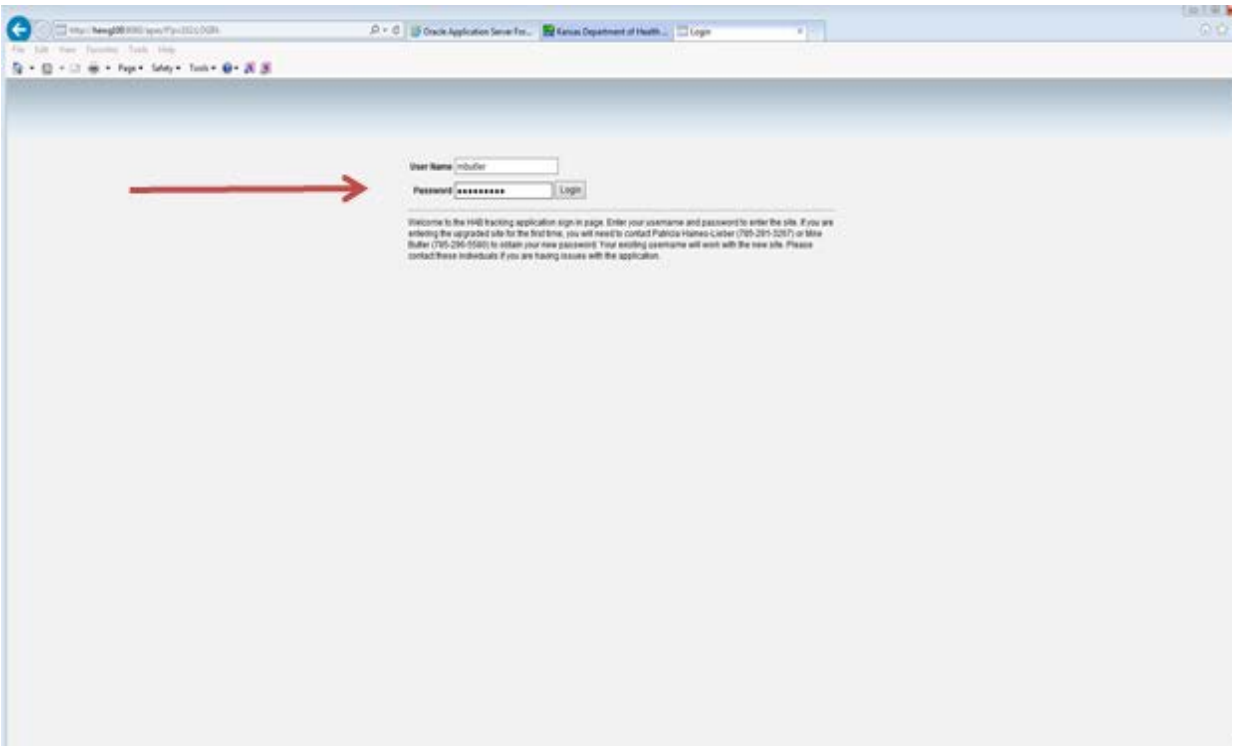
Do you work for a water management agency? Yes
Agency name: kdhe

Body of water information
Lake name: Nagiwika
Location: Kansas City
County: Johnson
Who manages this lake: No body non existant
Observation date: 5/18/2015

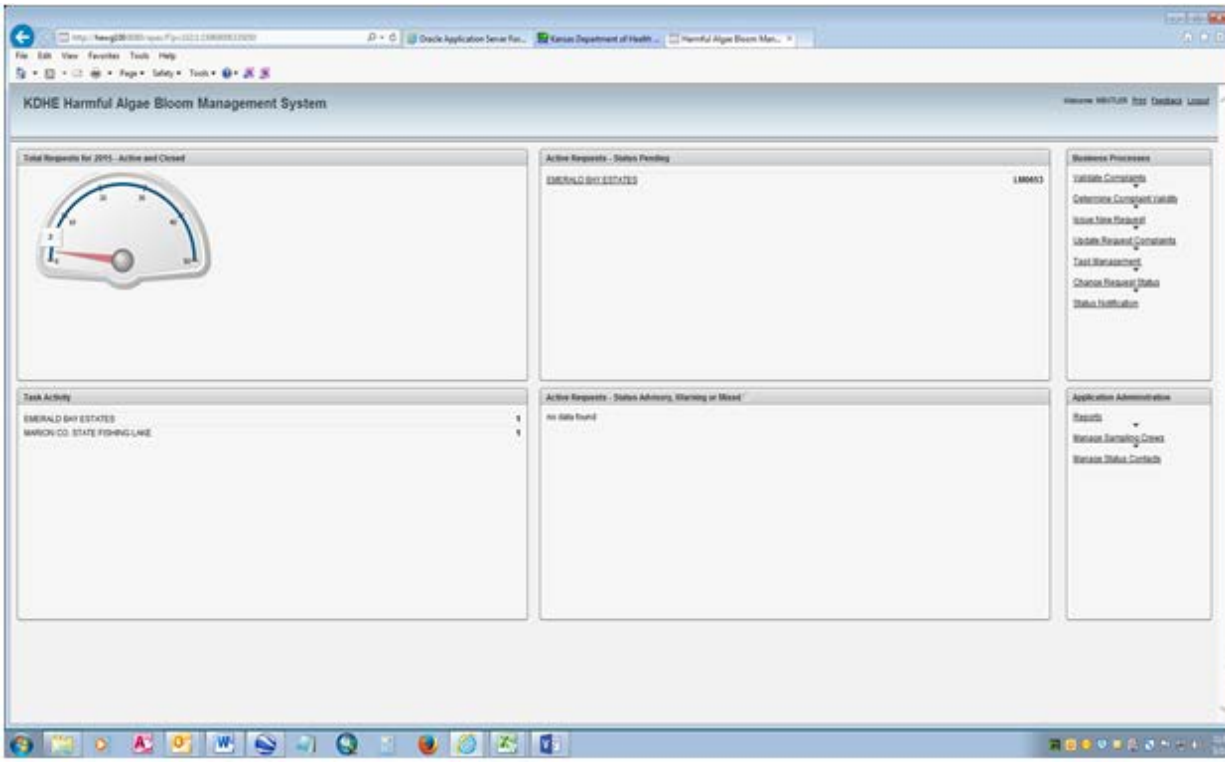
Description at scene:
This it a test of the system and only a test. This lake does not exist.

Has the appearance changed dramatically over the last couple weeks? Do Not Know
Is there a distinct surface scum? Do Not Know
Can you see algae colonies floating near the surface? Do Not Know
Water color: Do Not Know
Water clarity: Do Not Know

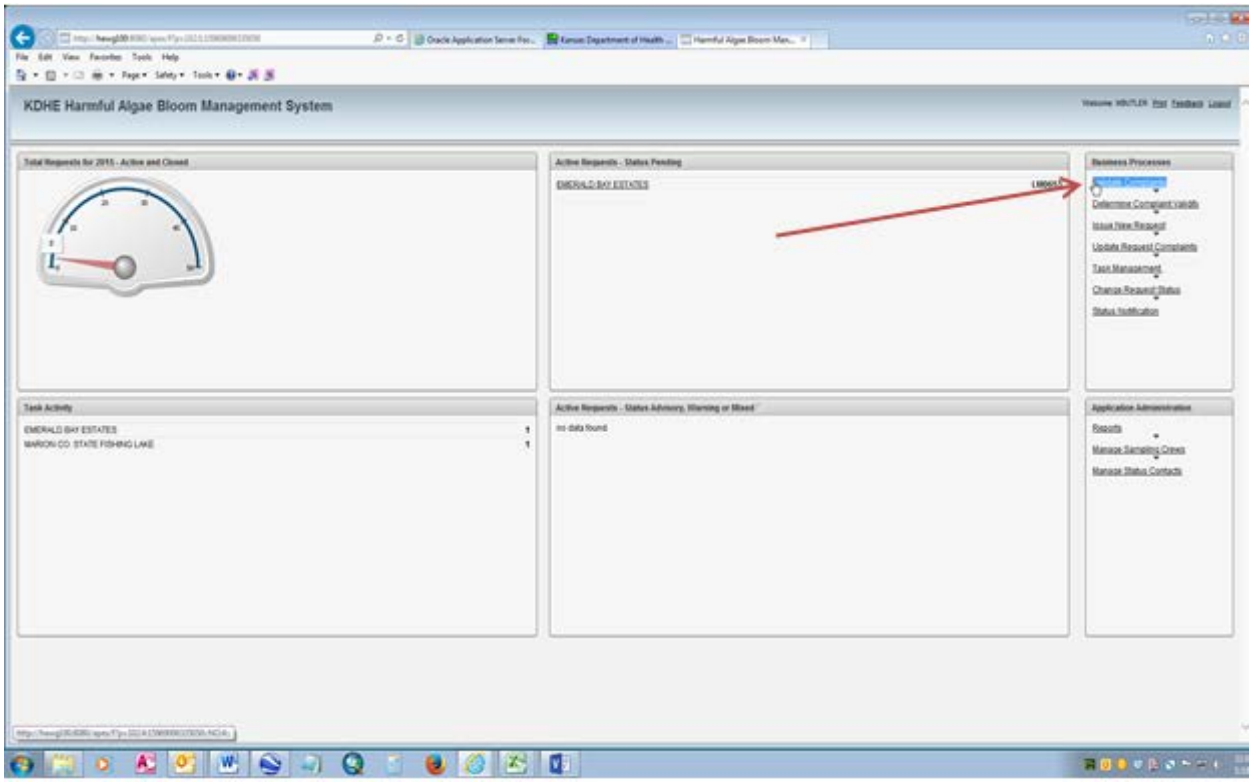
B. Log on to the HAB system. Password is provided by IT.



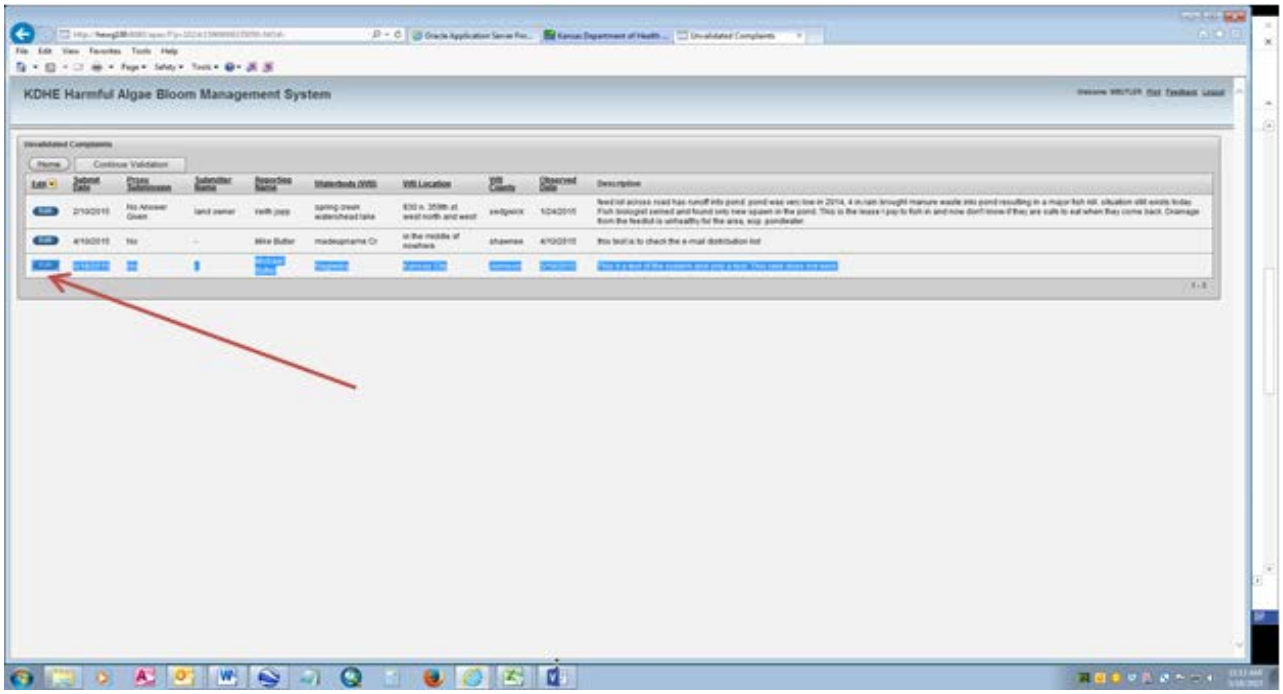
First Screen appears.



C. Validating complaint. Click on “Validate Complaint” tab.

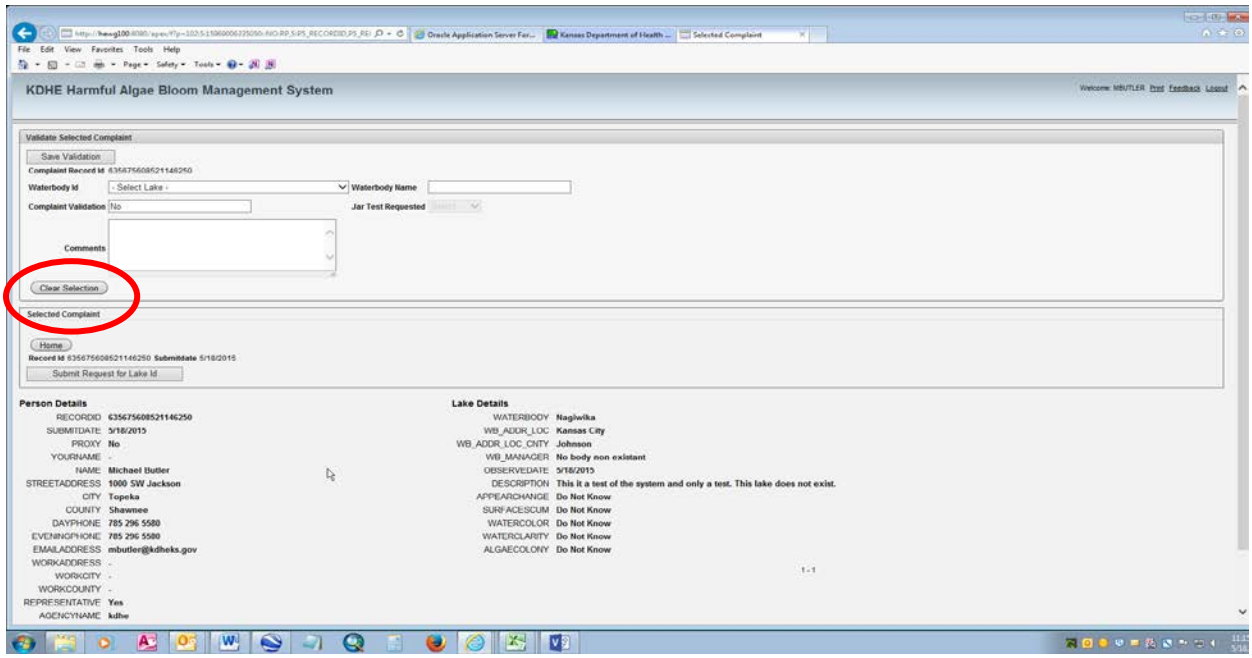


D. Select the correct complaint



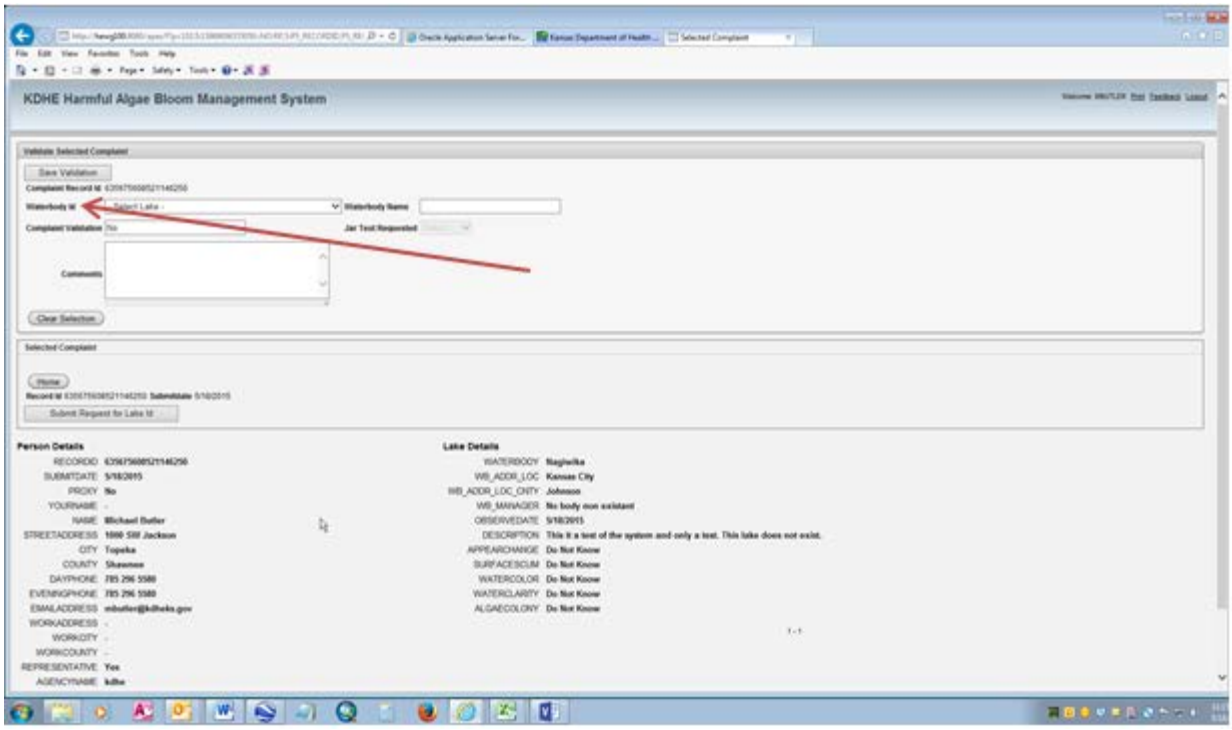
E. Based upon the contact information and information provided, determine whether the complaint is valid or invalid. (A call to the complainant can also be made to validate information.)

1. If it is <u>invalid,</u> then click the "Clear Selection" button. (If it is not a public water body and a HAB is present, then direct complainant to the KDHE HAB website for further information and to the K-State Diagnostic Lab for assistance.)

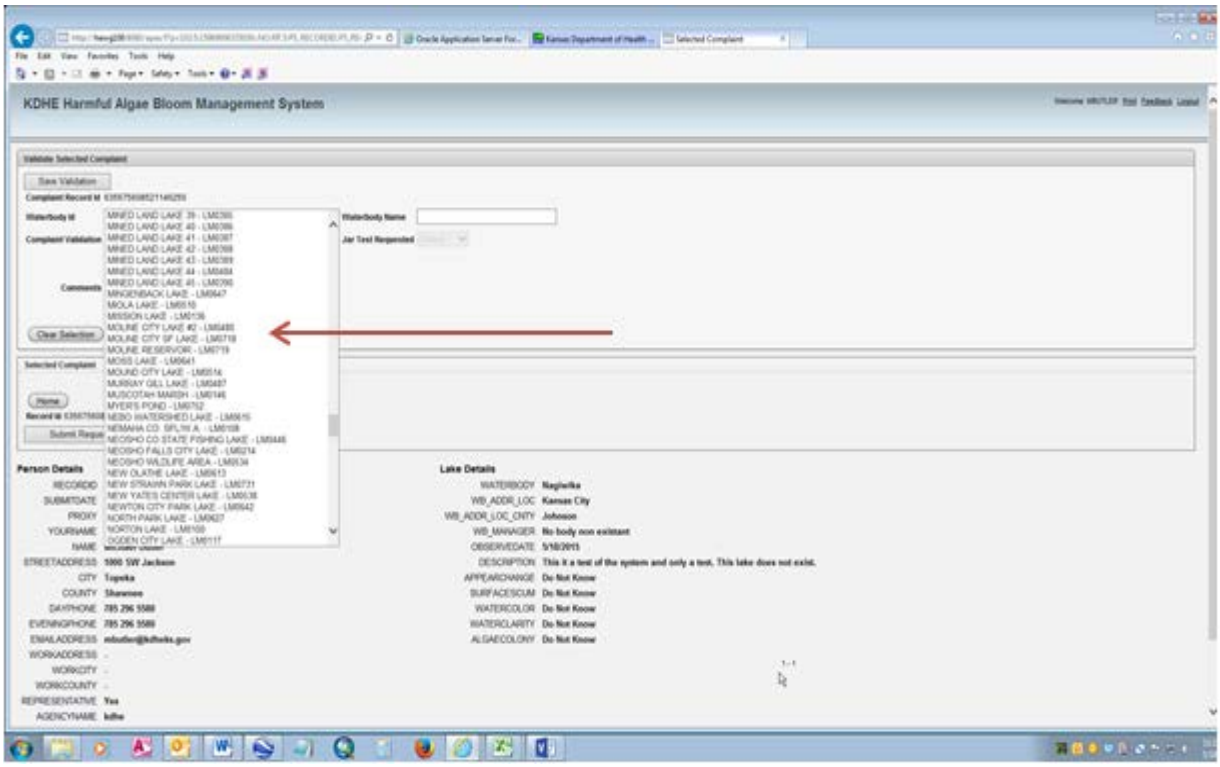


2. If the lake is <u>valid</u>, then the lake manager is contacted and a jar test is requested. (See HAB website for "Jar Test" instructions.) Go to Step F.

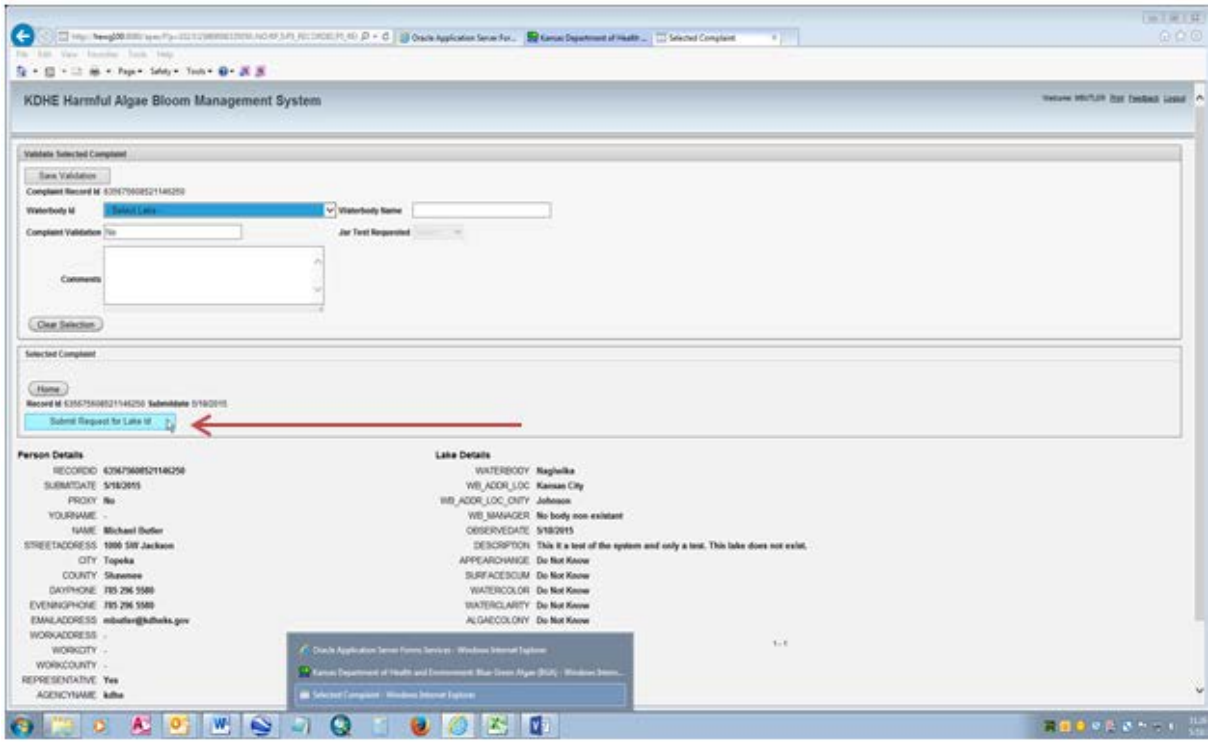
F. Go to "Waterbody ID".



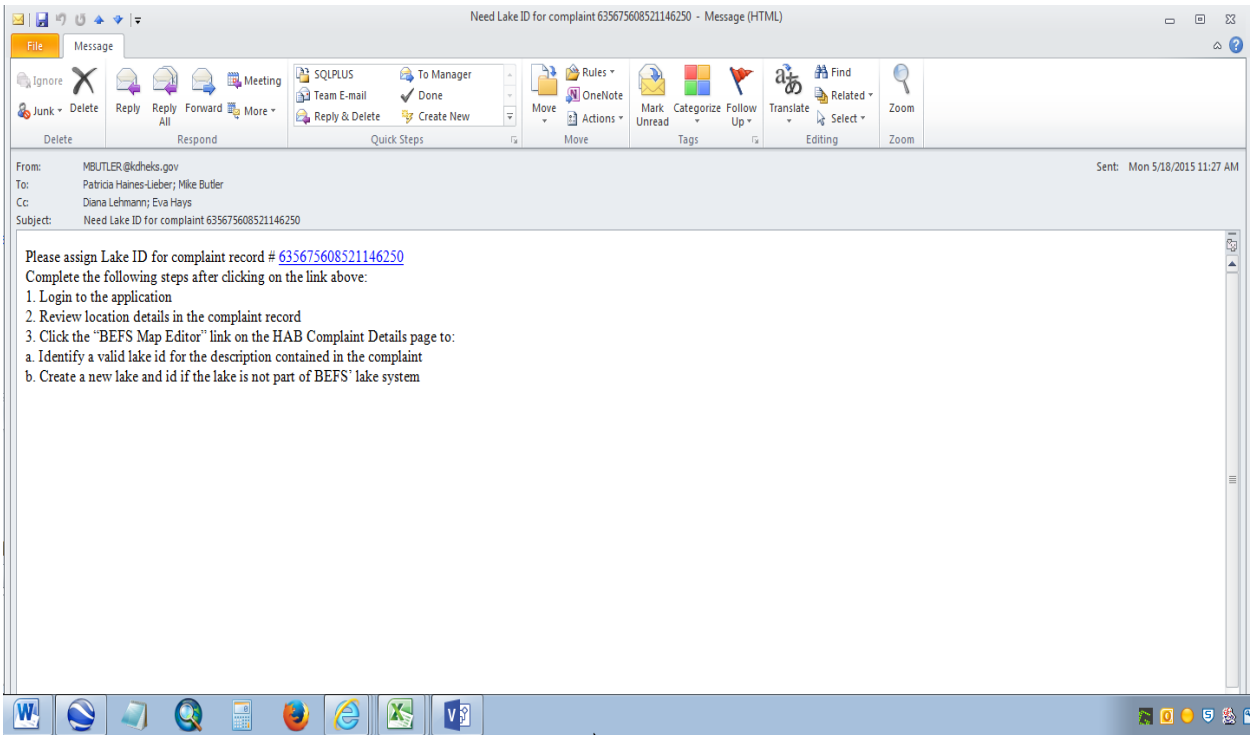
G. Select lake if available.



H. <u>If the lake is not avaialble</u>, a site ID needs to be created. If the lake name does not appear on the drop down "Waterbody ID" list, then click on the "Submit Request for Lake Id" button.



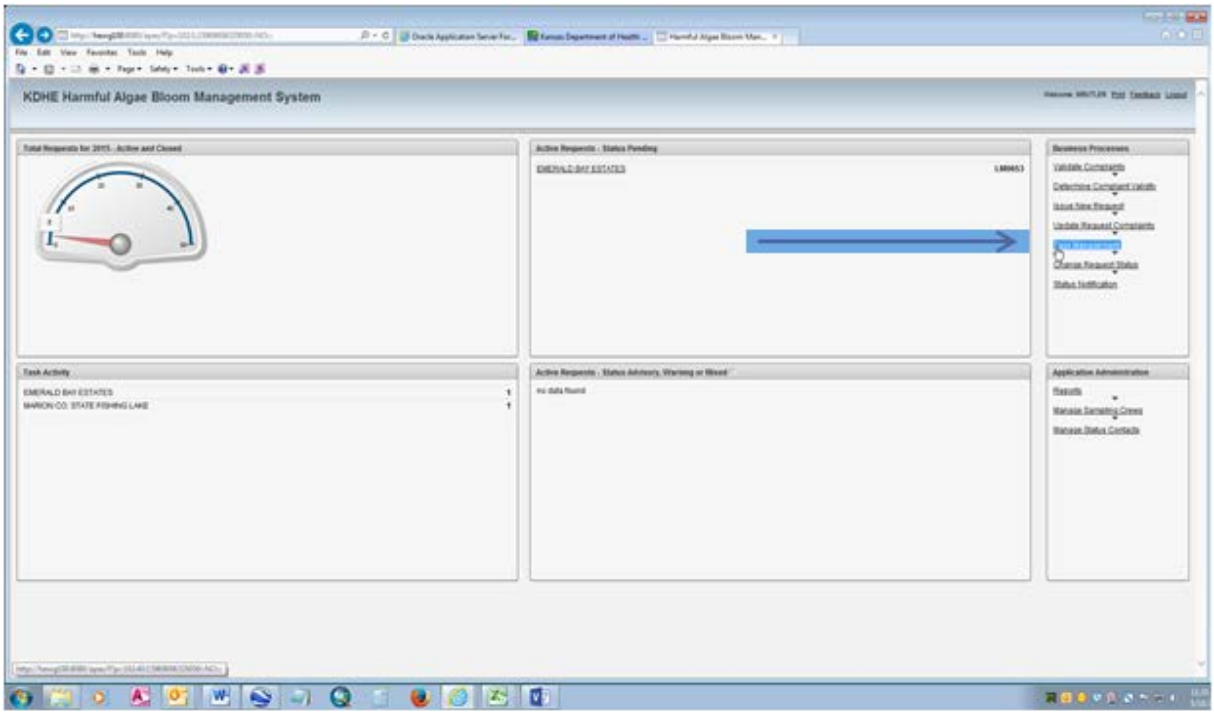
Example of the Request



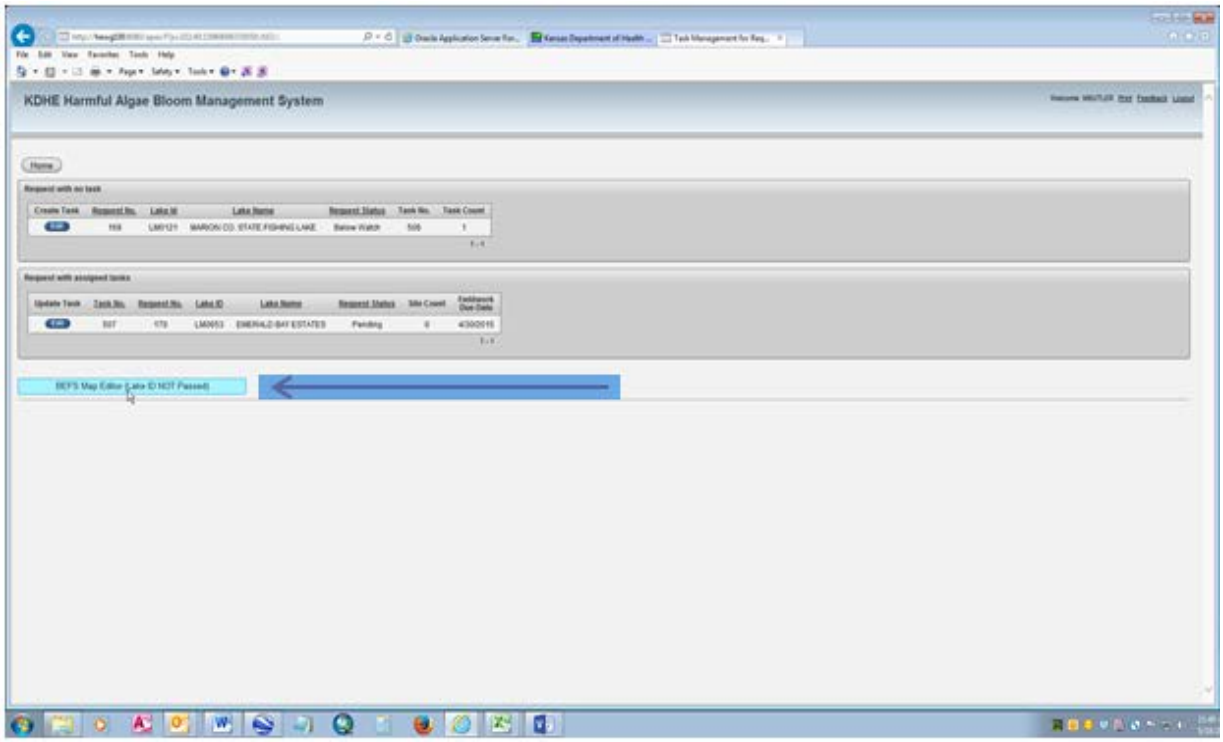
I. A site ID must be created in ORACLE. See the "HAB Oracle" instructions.

J. A polygon (lake) must be created with the associated site ID from ORACLE and at least one sampling site (point) plotted. A lake center point must also be established at this time.

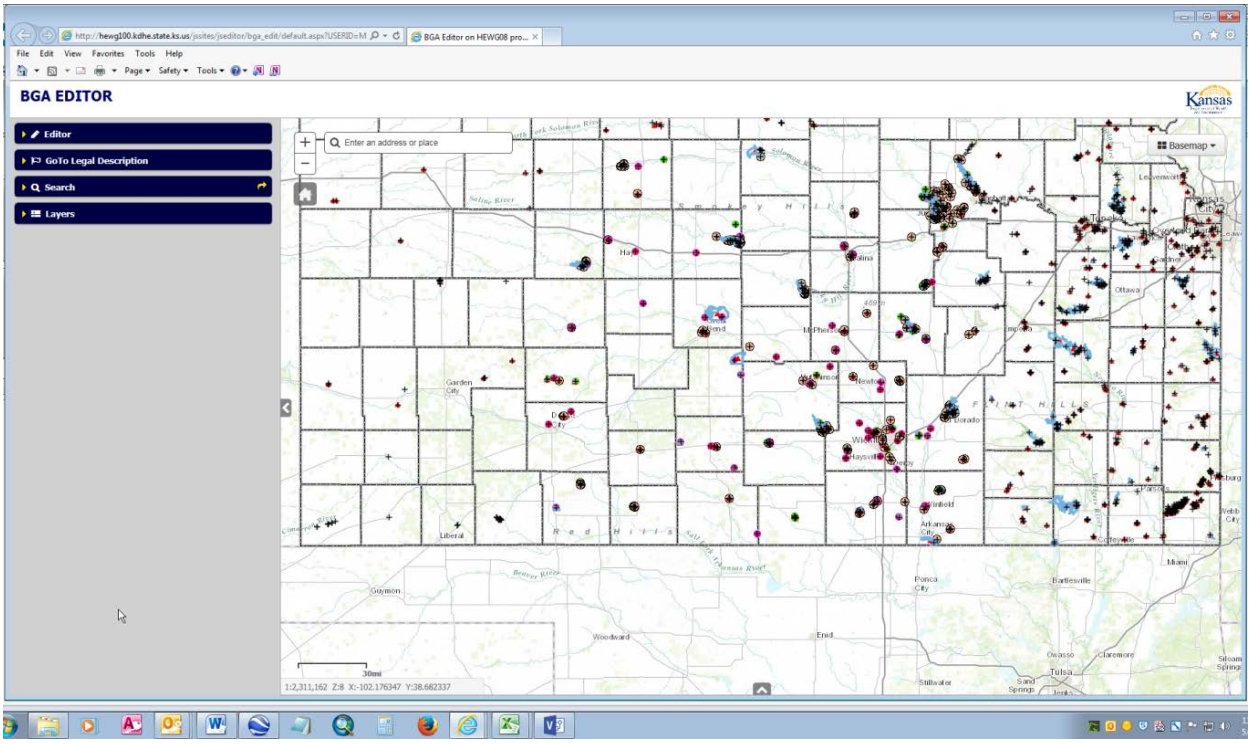
1. Go to "Home" and click on "Task Management".



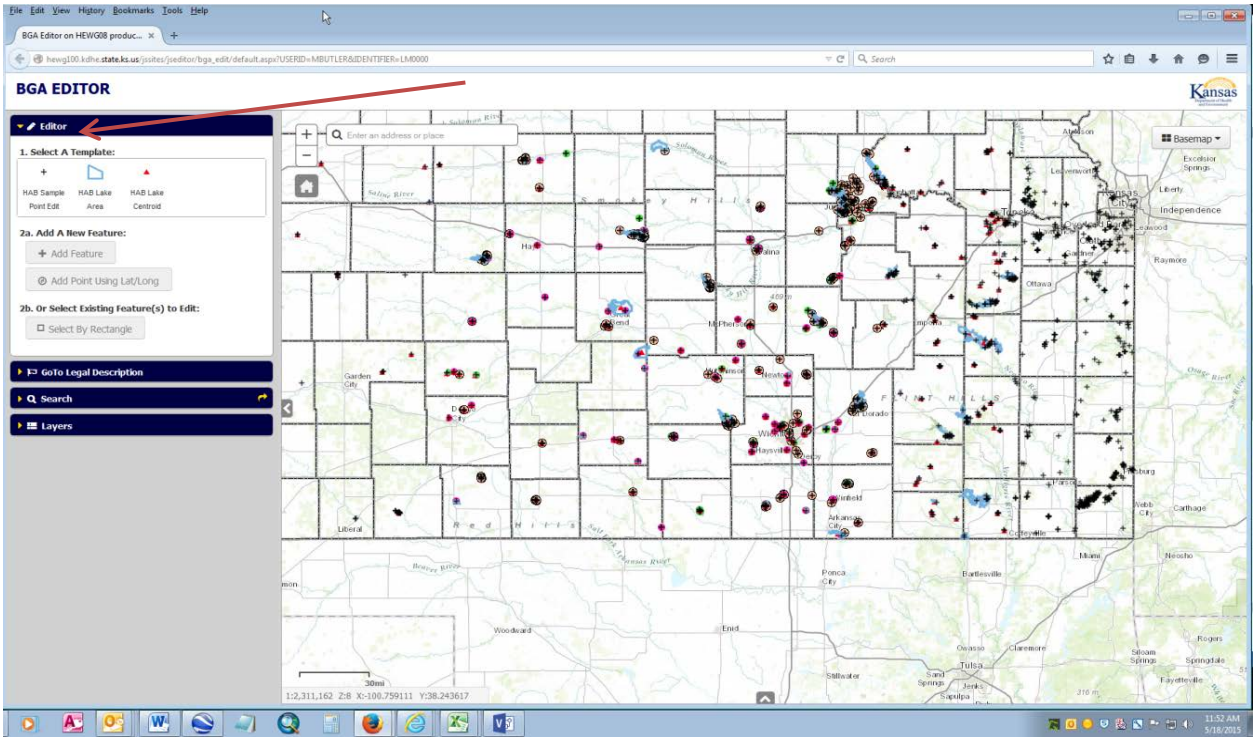
2. Select "BEFS Map Editor".



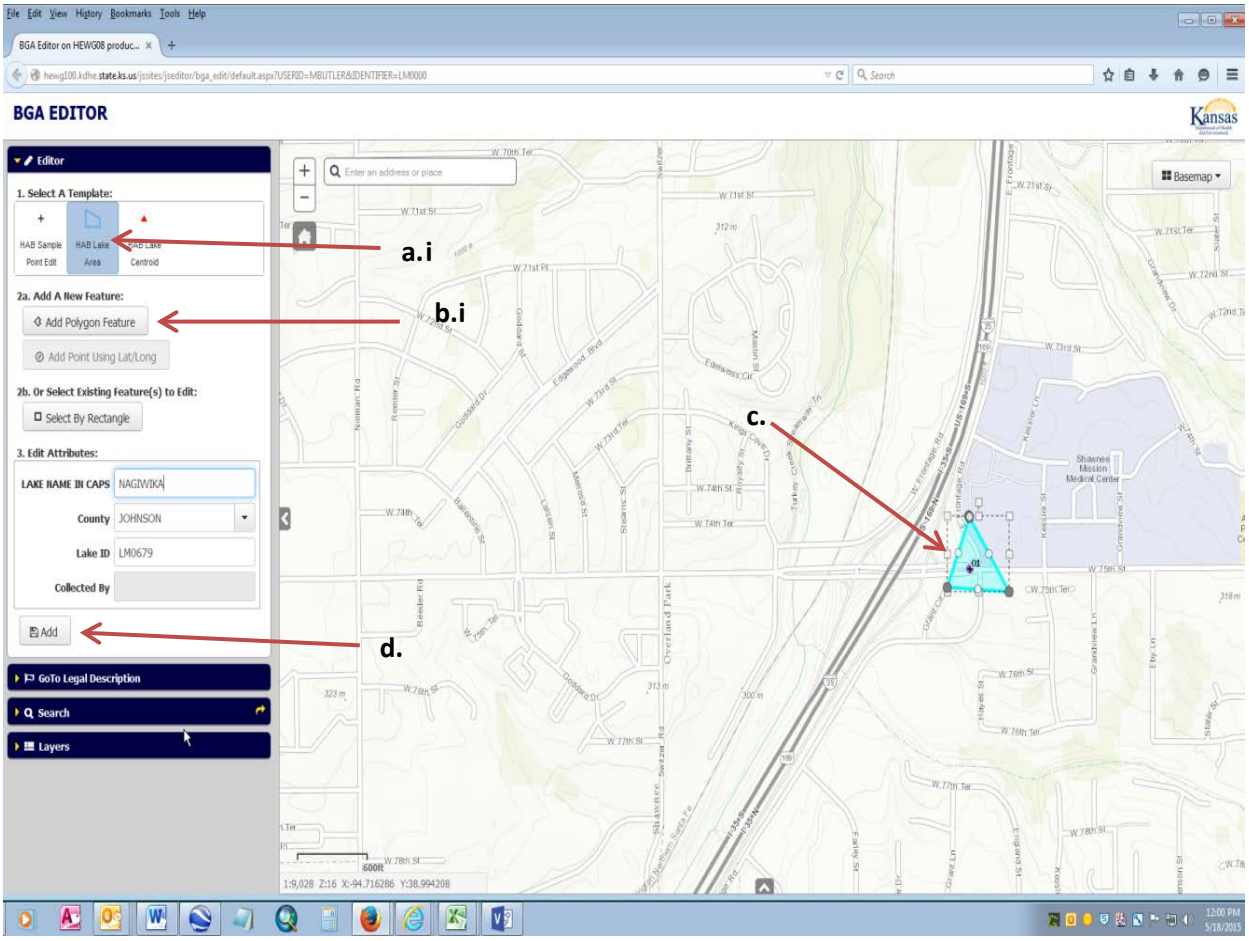
View of Map Editor page



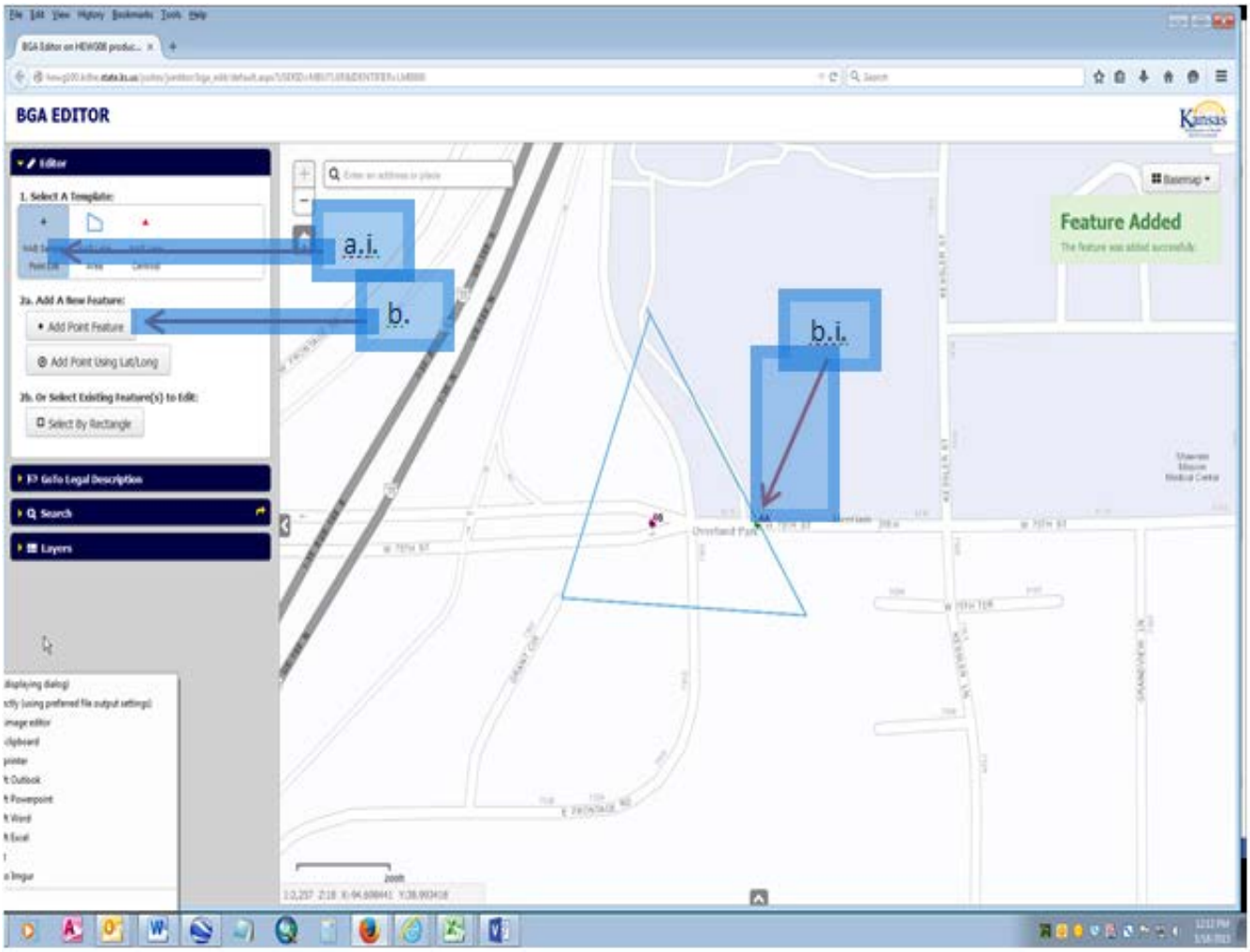
3. Zoom to area where lake exists on map. (NOTE: Looking up the waterbody on Google Earth first helps to locate the site on the Map Editor more easily.) Click on "Editor" button.



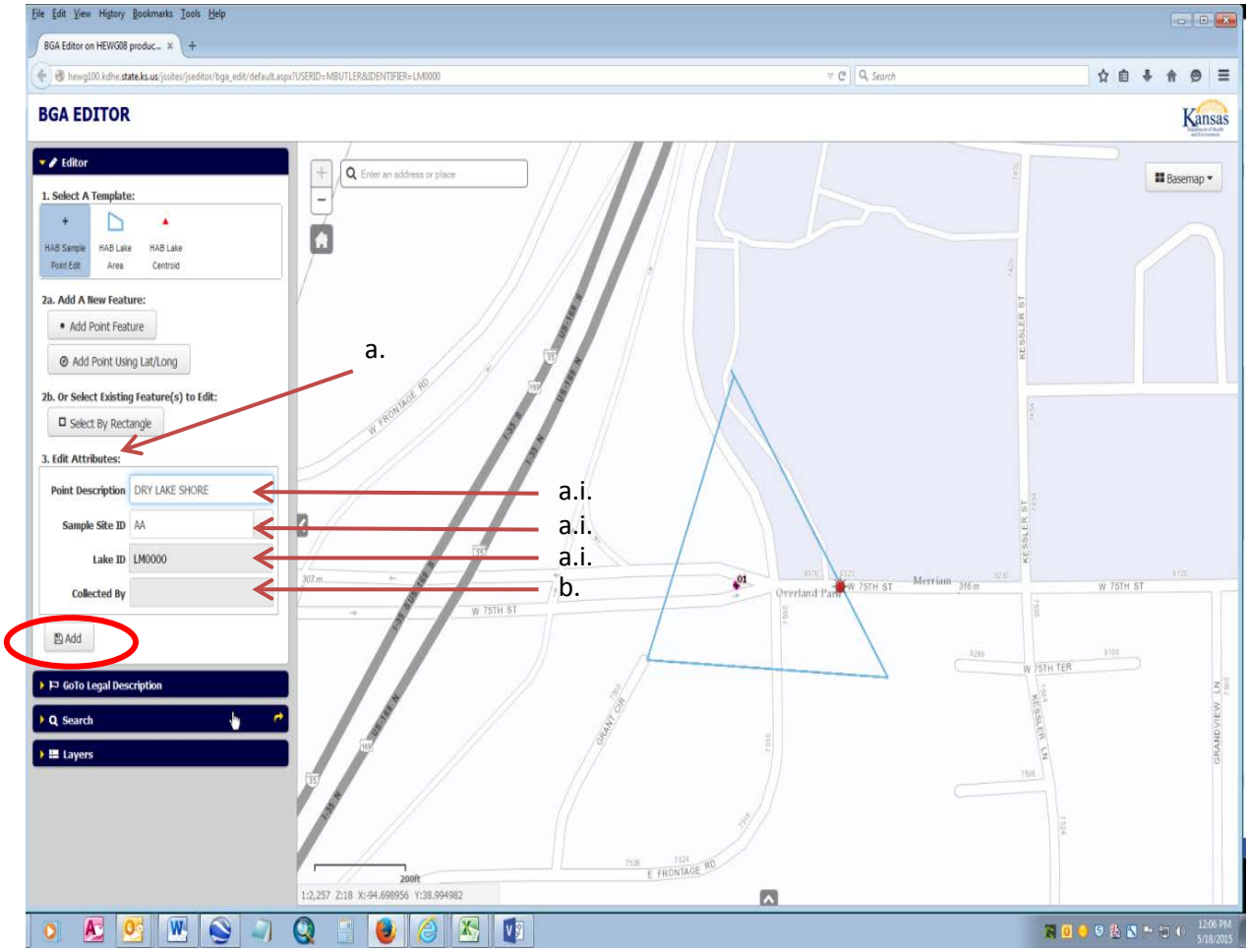
4. Go to:
   a. "1. Select a Templete"
      i. Click on "HAB Lake Area"
   b. Go to "2a. "Add A New Feature:"
      i. Click on "Add Polygon Feature".
   c. Go to map area and draw lake outline.
   d. If the polygon area is acceptable, then click on the "Add" button and the lake will now be in the HAB system.



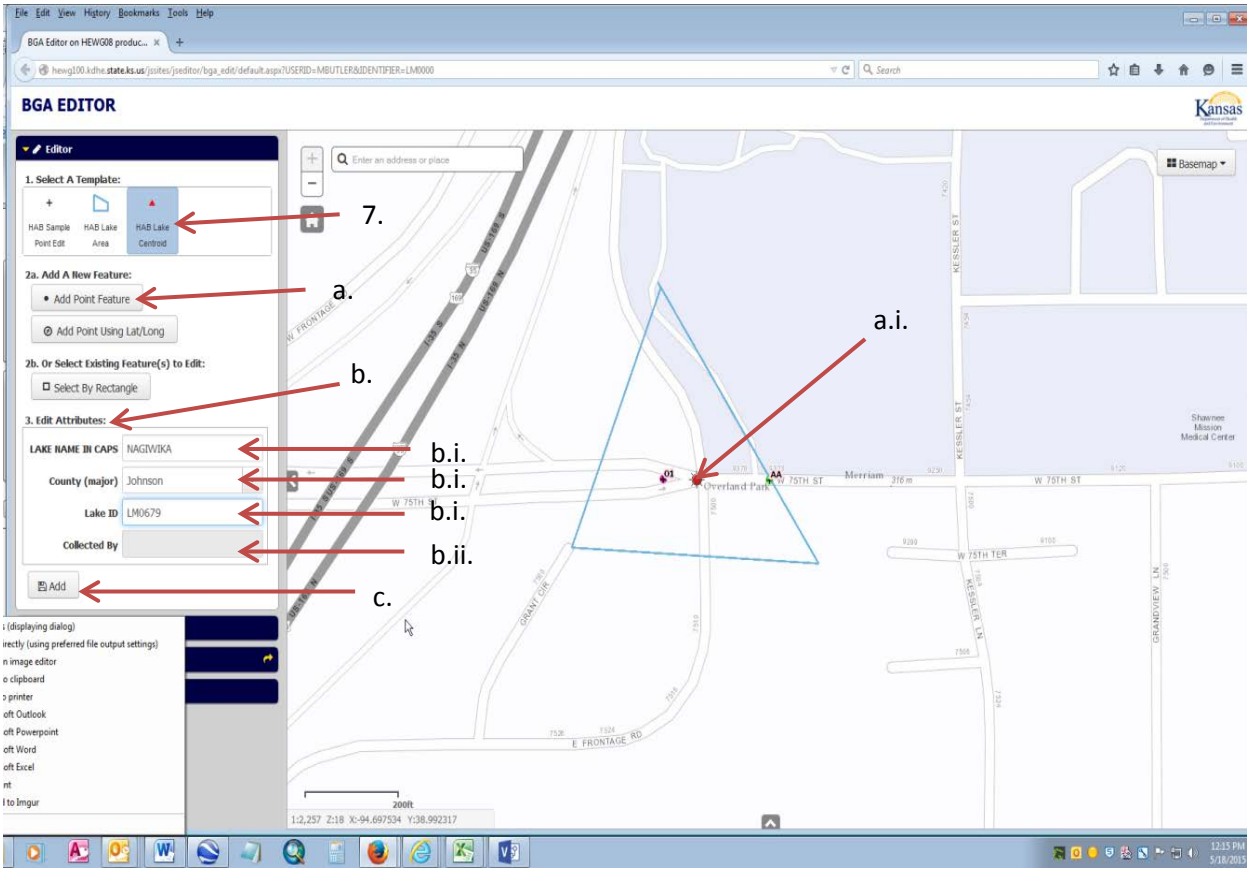
5. Go to:
   a. "1. Select a Templete".
      i. Click on "HAB Sampling Point Edit"
   b. Under 2A. select "Add Point Feature".
      i. Double click on map at desired location for sampling location.



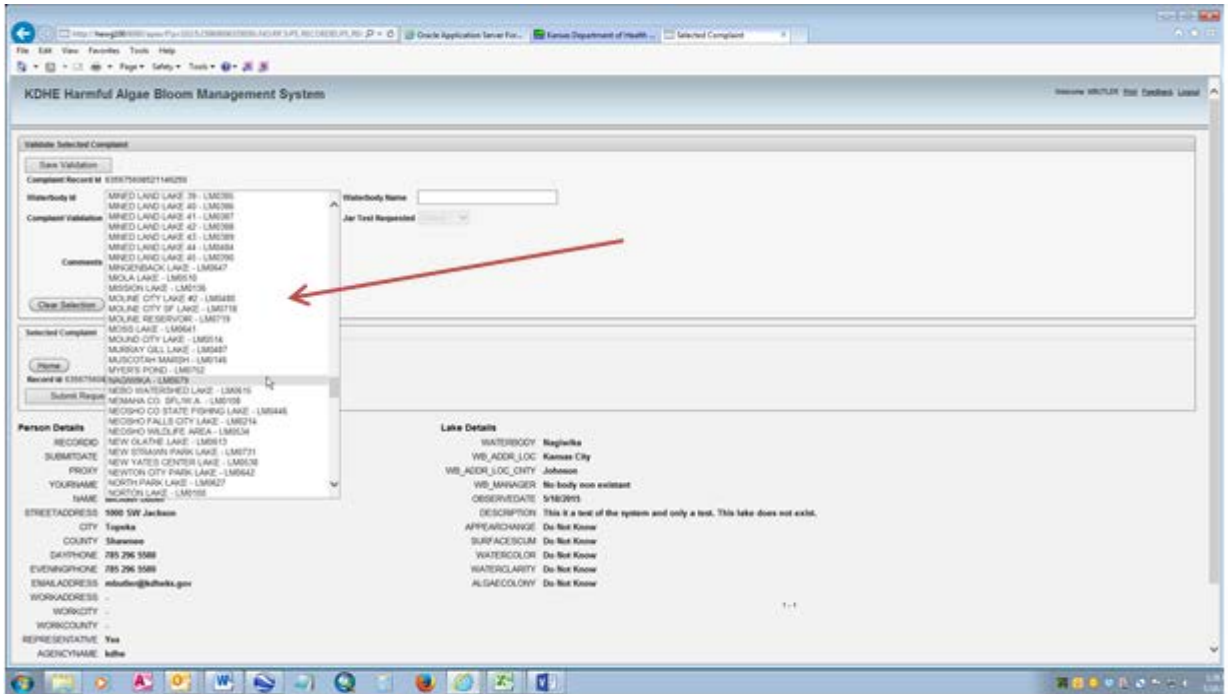
6. After point is completed, go to:
   a. "3. Edit Attributes"
      i. Enter lake name, sample site I.D. and lake ID.
   b. "Collected By" will be autogenerated.
   c. Then click "Add" to save.



7. Go to “1. HAB Lake Centroid”.
   a. Click on “2a. Add Point Feature”
      i. Double click on map at desired location for centroid location.
   b. Click on “ 3. Edit Attribute Features”
      i. Enter lake name in caps, county, and lake ID.
      ii. “Collected By” will be autogenerated.
   c. Click Add to save Center Point Centroid.
   d. Return to “Validate Complaints”.

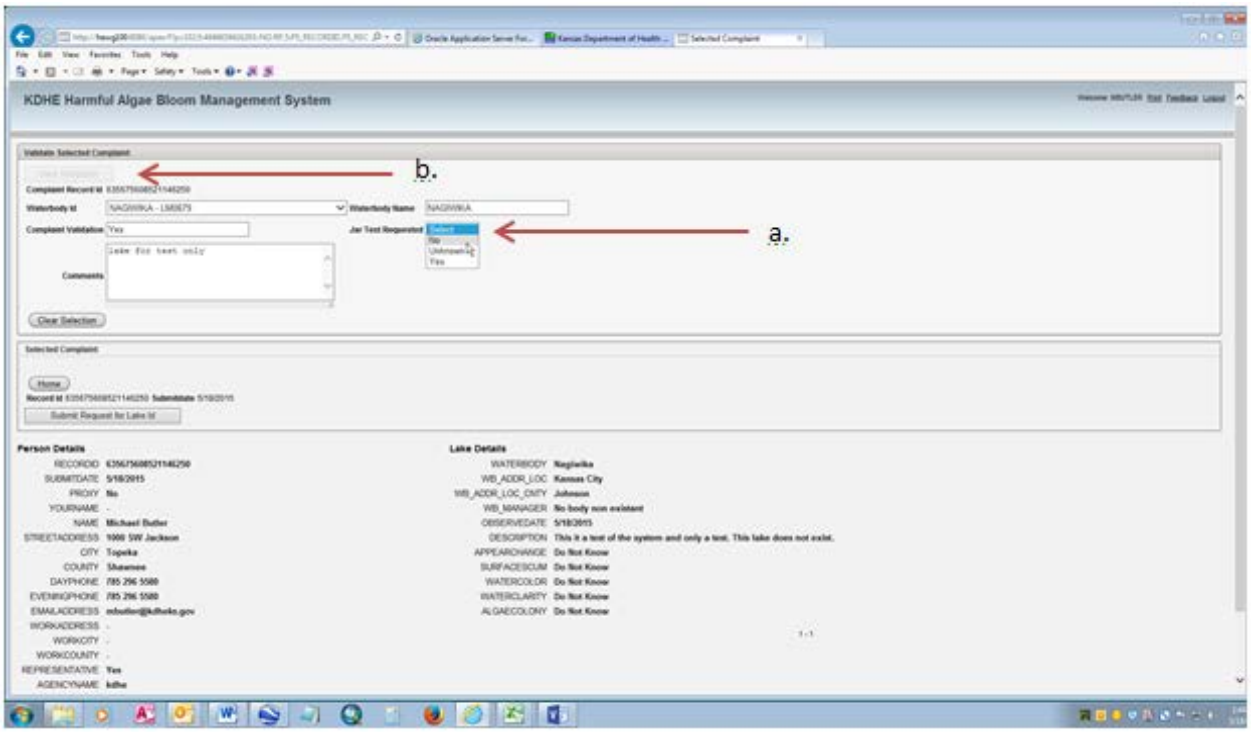


K. If lake is already in system or has just been added, select lake from “Waterbody Id” pull down list.



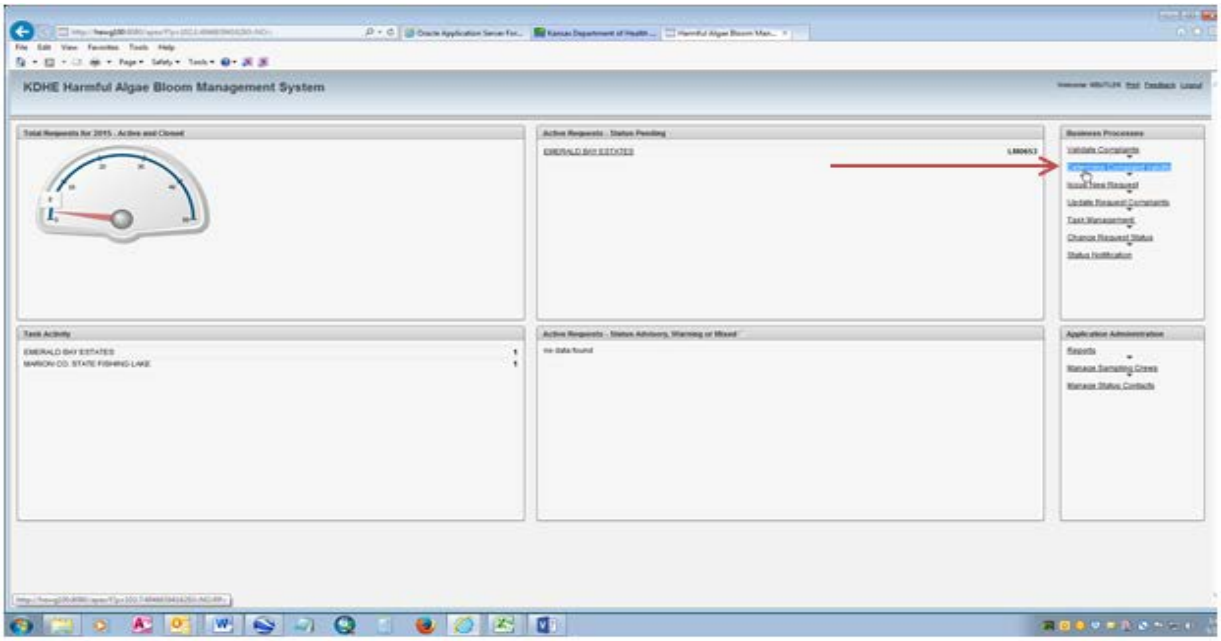
L. Before it can be saved as validated,

1. a jar test request must have an entry.
2. Click on “Save Validation”. An email will be sent to designated personnel.



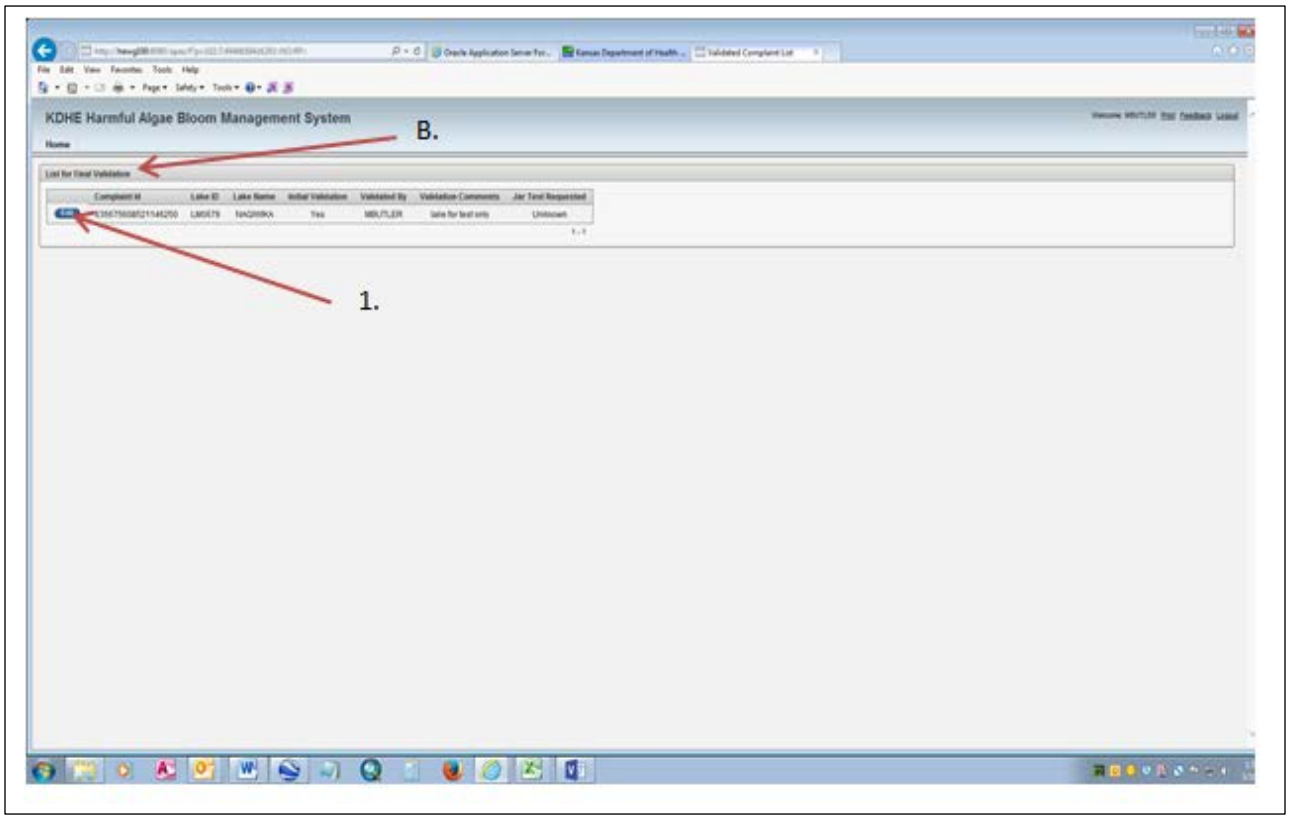
II. Determine Complaints Validity

A. Click on “Determine Compalints Validity”



B. Brings up “List for final Validation.

a. Click on “Edit”.



C. Brings up “Current Requests”.

1. Go to “Final Complaint Validation”.

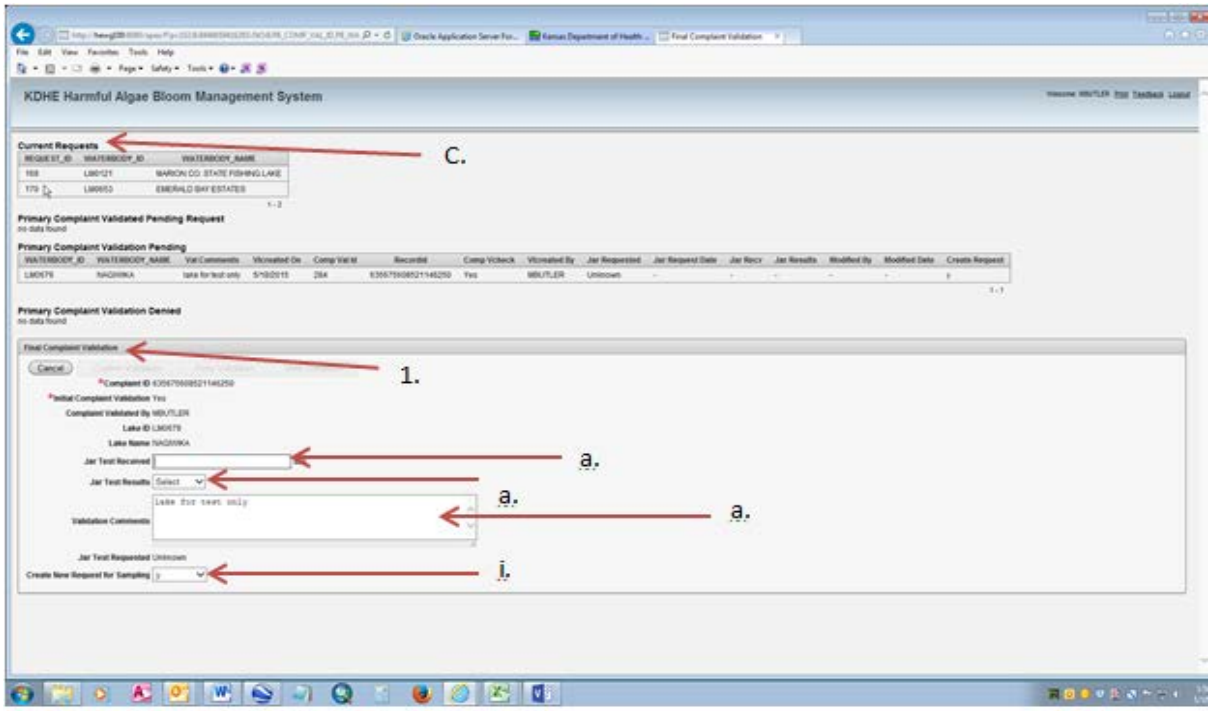
a. Complete blanks as required, including: “Jar Test Received”; “Jar Test Results”; “Validation Comments”, if any; and “Create New Request for Sampling”.

i. If new sample request is:

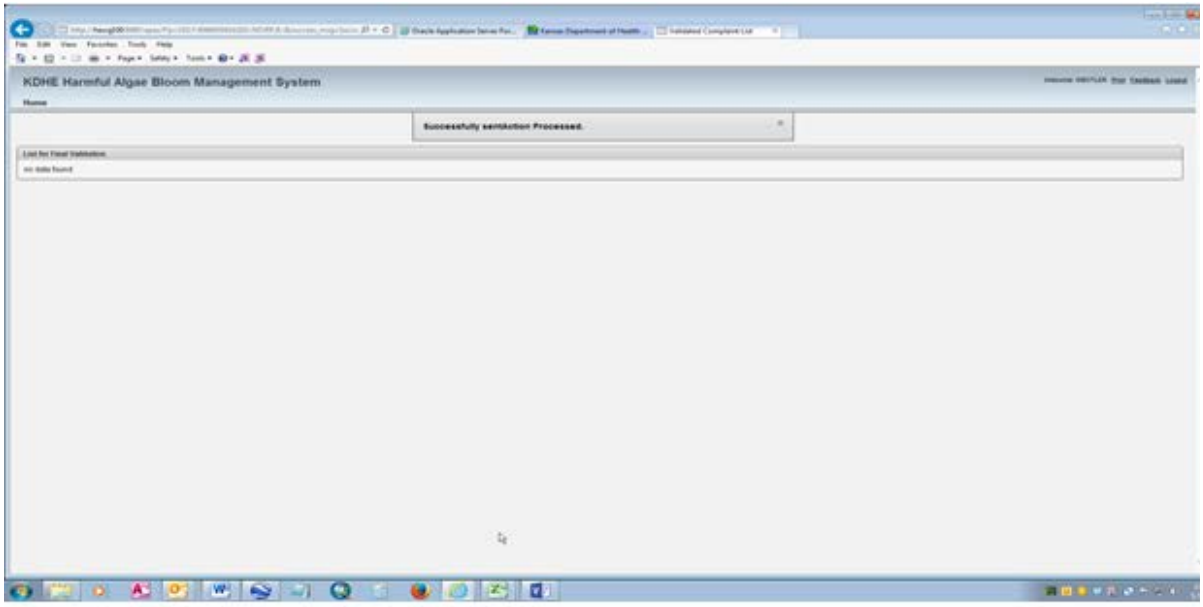
a) Yes, then “Confirm Validation”.

b) No, then “Deny Validation”.

c) Additional, then “Save Complaints”.

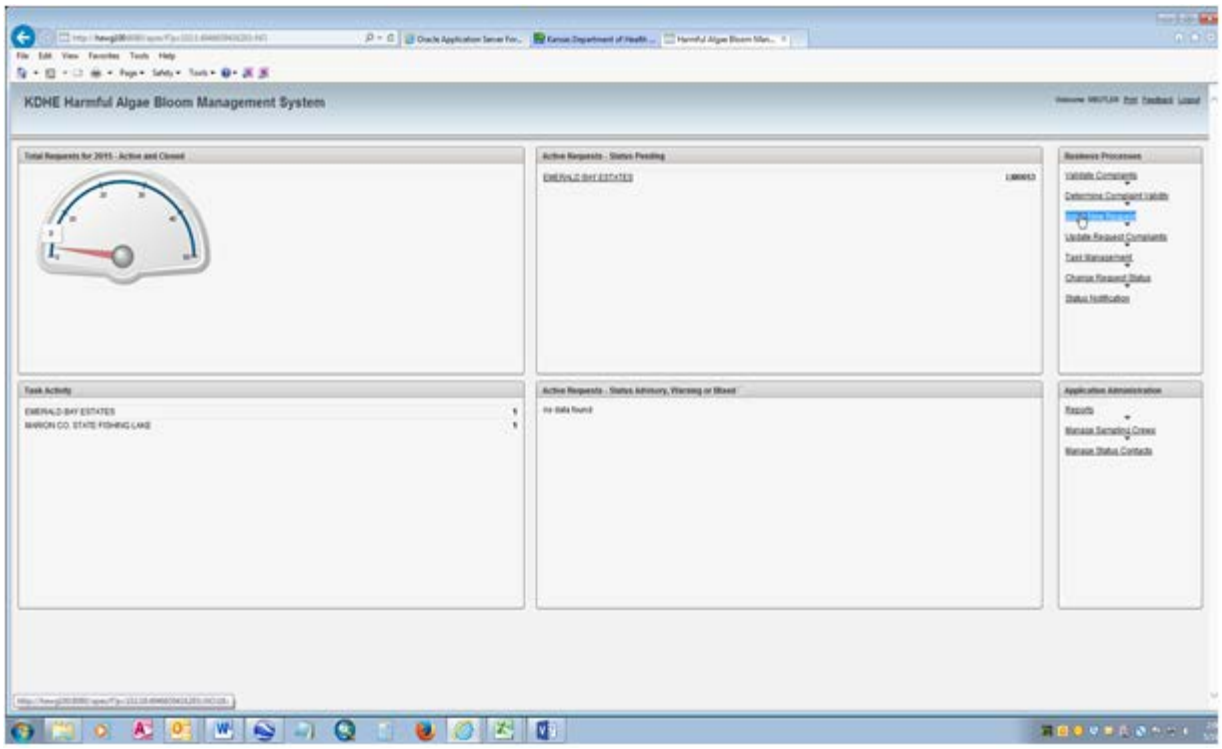


Sucessfully Completed



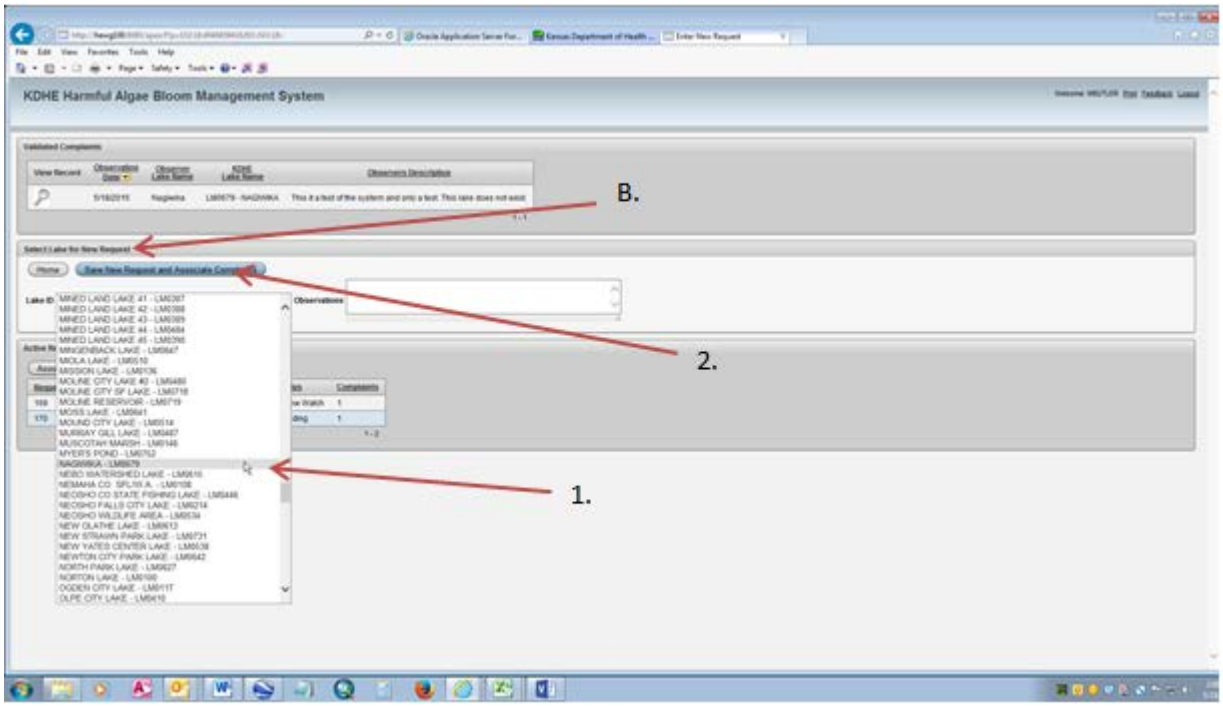
III. Issue New Request

A. Click on “Issue New Request”

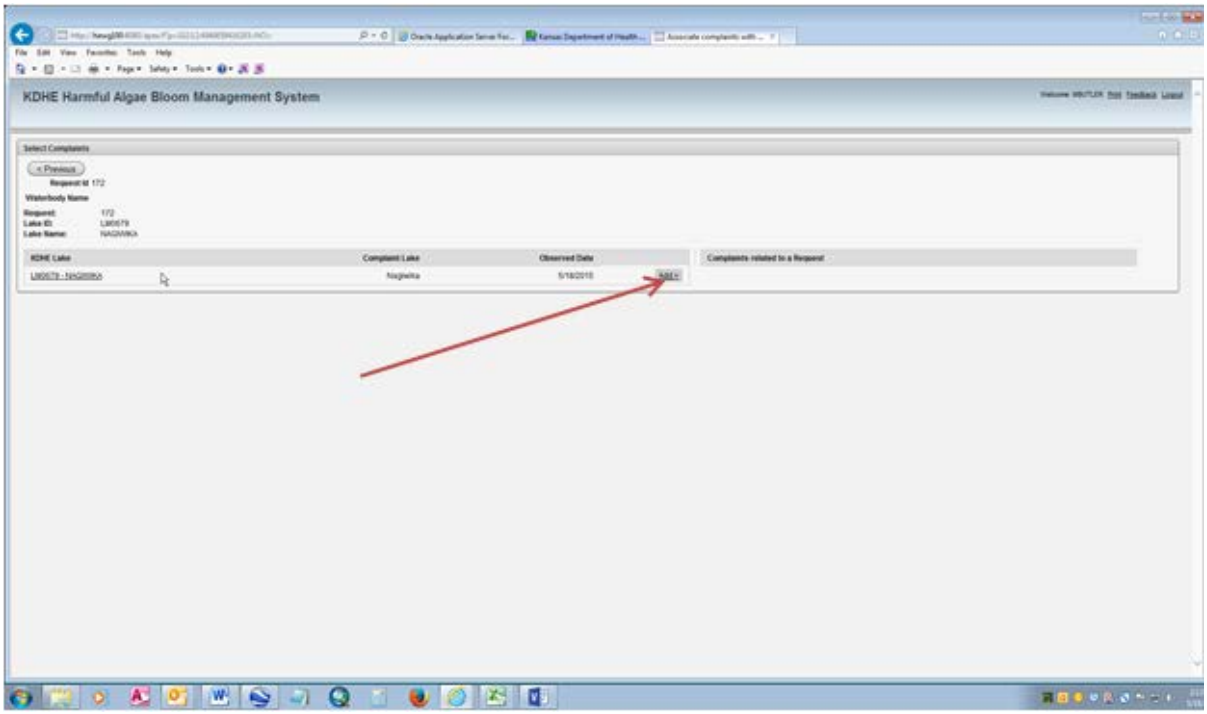


B. Go to “Select Lake for new Request” and

1. Click on “Lake Id” and scroll down and select proper lake.
2. Click on “Save New Request and Associate Complaints”.

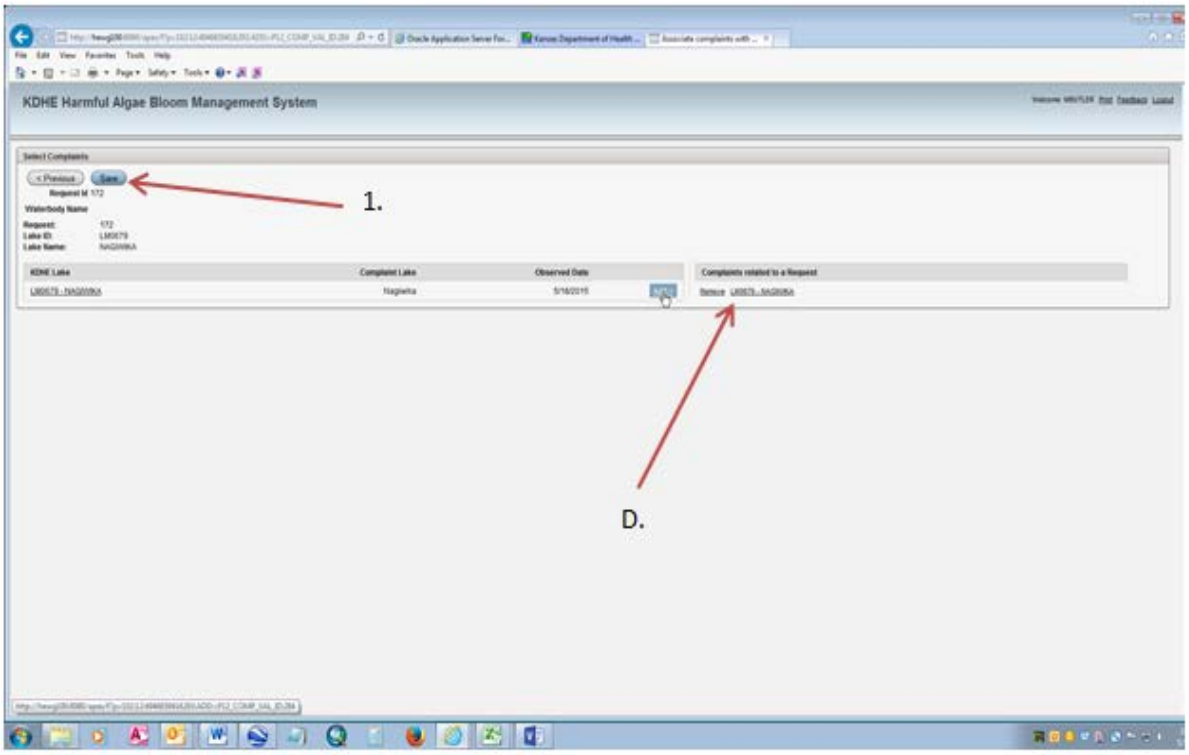


C. Click on “Add” button.

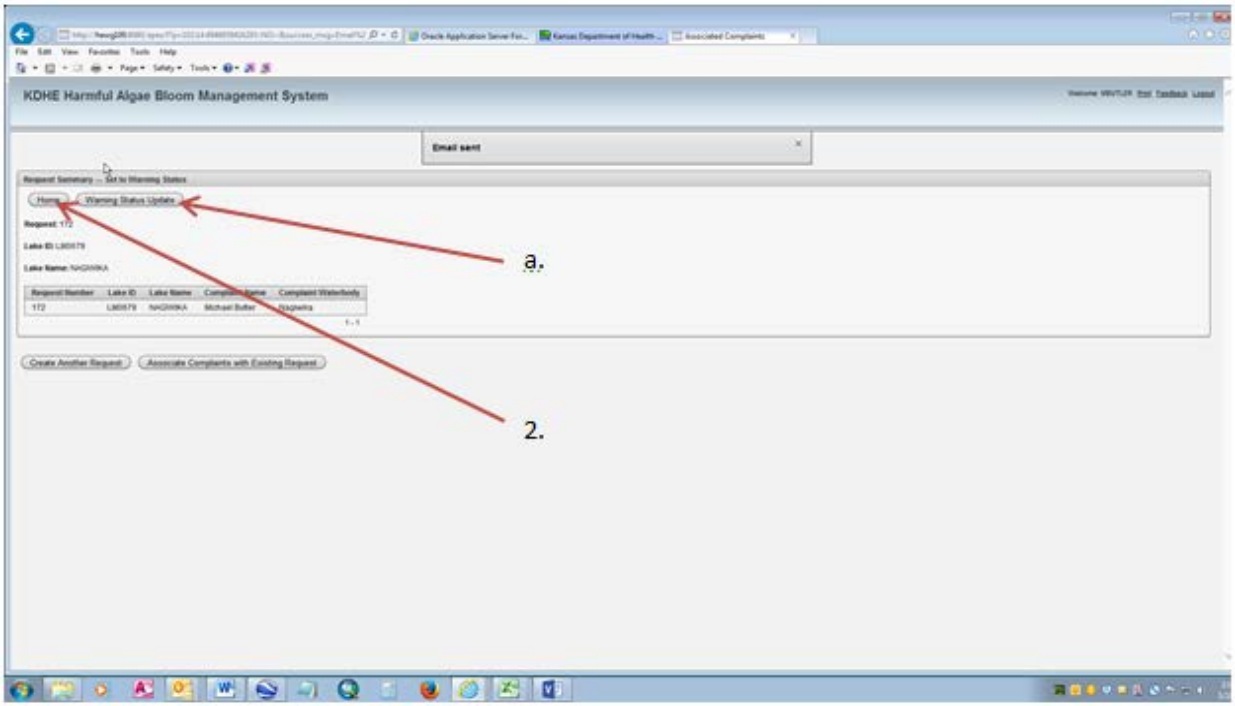


D. Lake name should appear under “Complaints related to a Request”.

1. Click “Save” button. An email is sent to designated personnel.

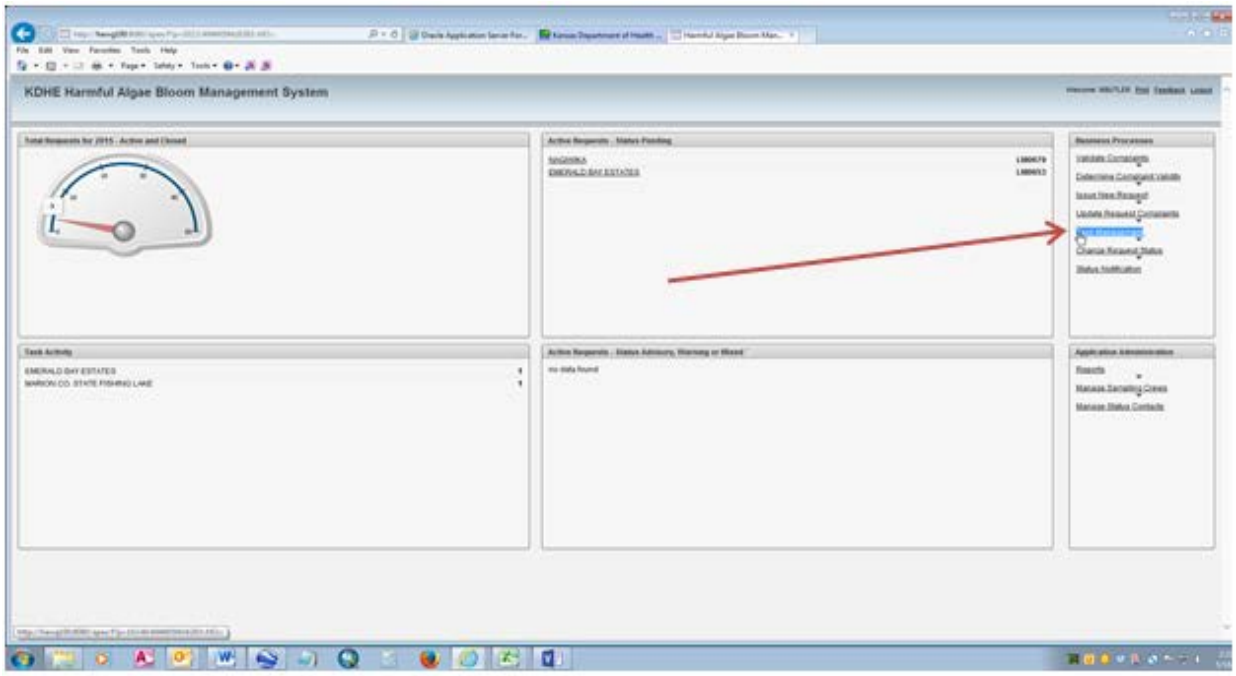


E. Once saved, the following screen appears,
  1. Allows an immediate warning on the lake to be assigned, if conditions warrented.
    a. Click on “Warning Status Update”.
  2. Otherwise, return to home.

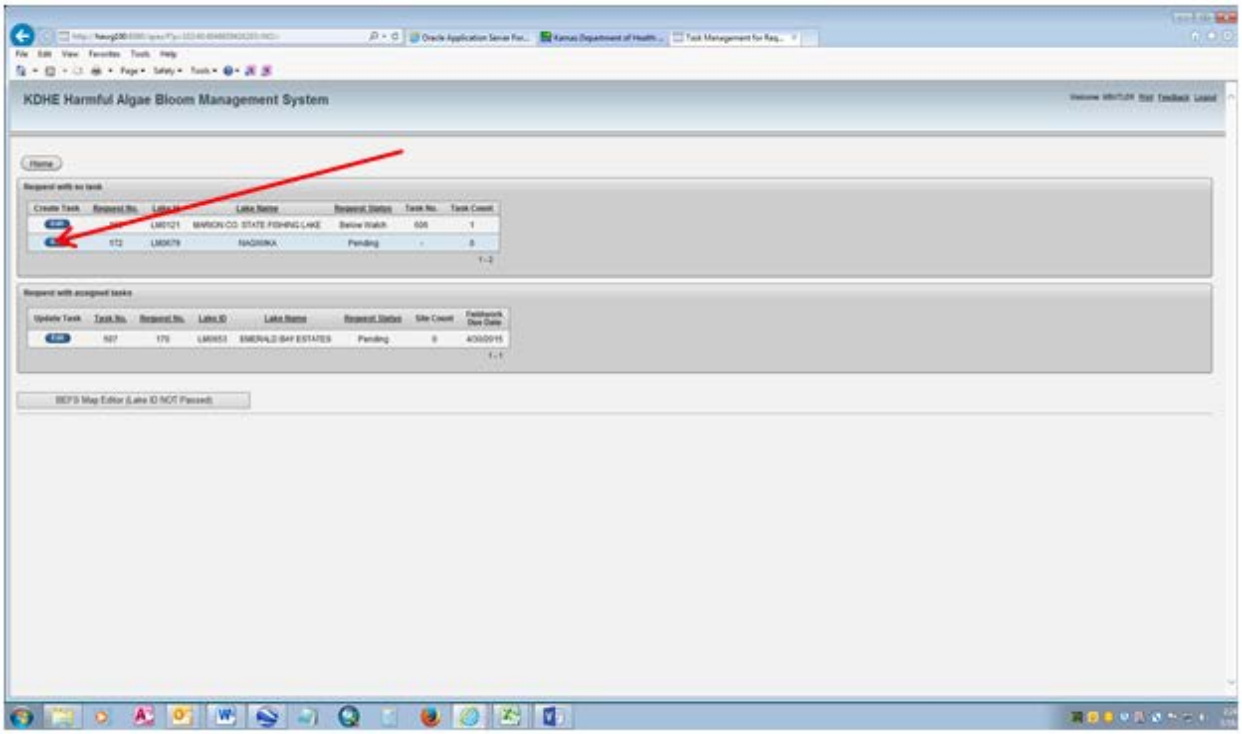


IV. Task Management

A. Click on “Task Management”

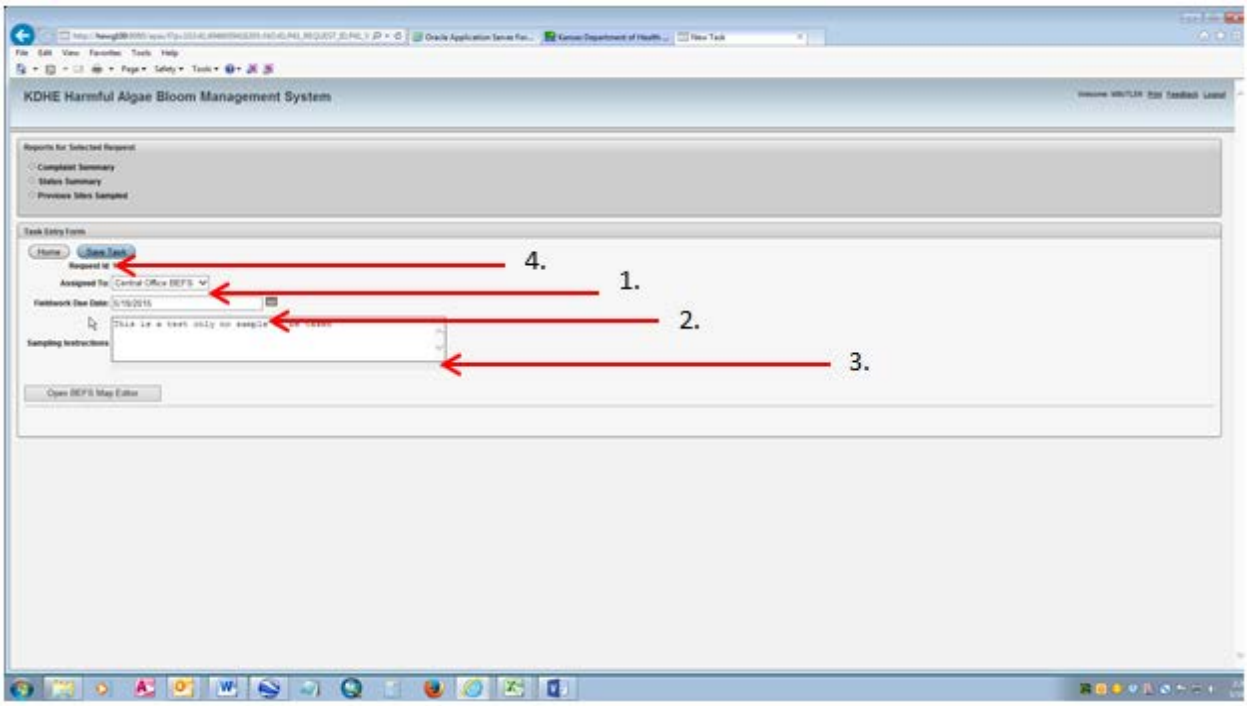


B. Click on edit button of lake you are wanting to make a sampling request on.



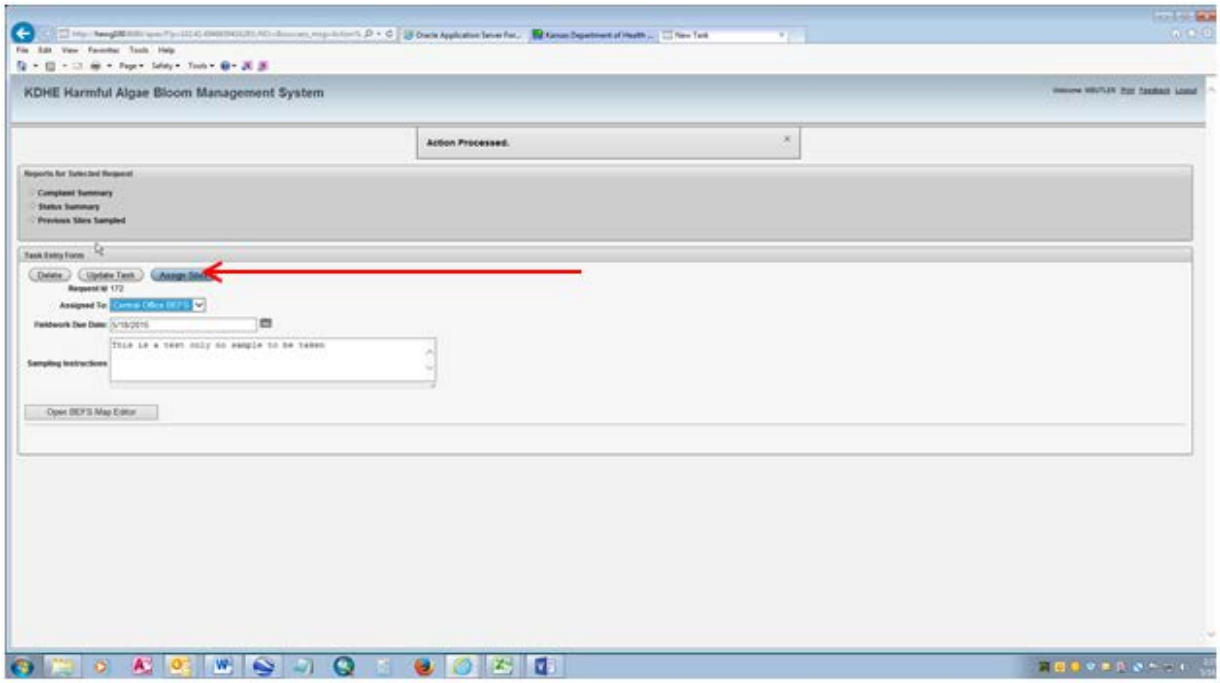
C. Complete fields accordingly, including:

1. who is to collect samples,
2. date field work is to be completed, and
3. any speical notes.
4. Click “Save Task”



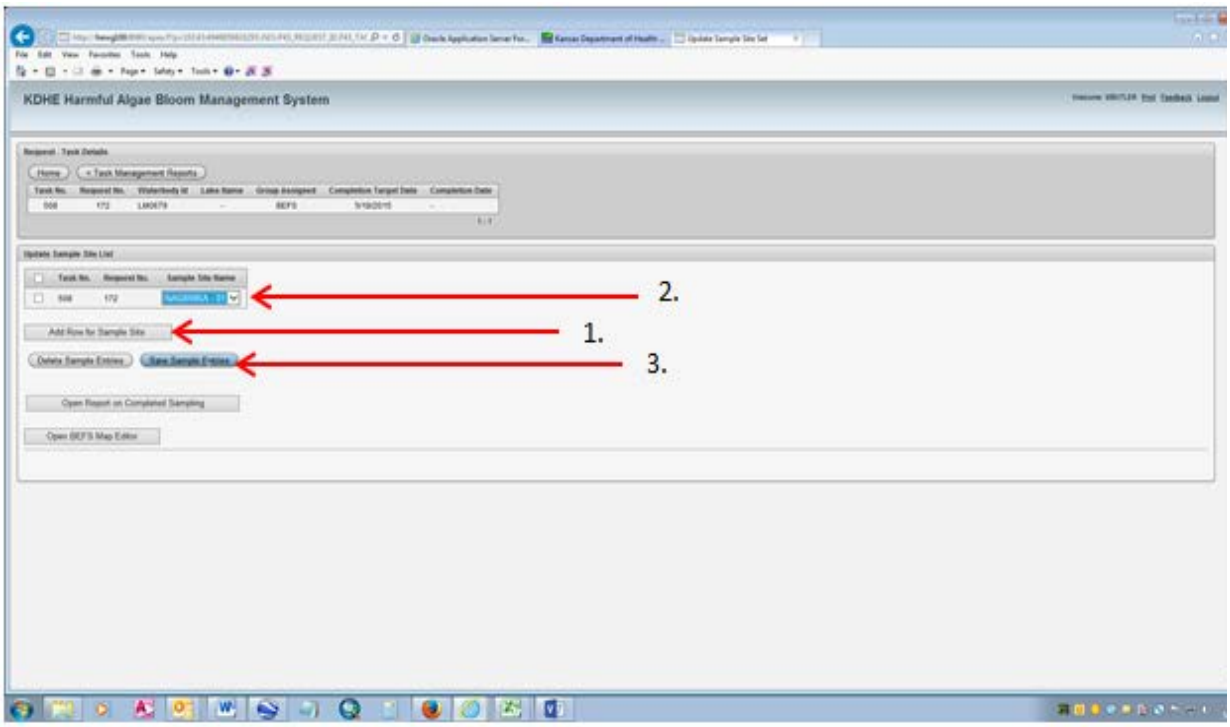
D. The “Assign Sites” button appears.

1. Click on “Assign Sites” button.

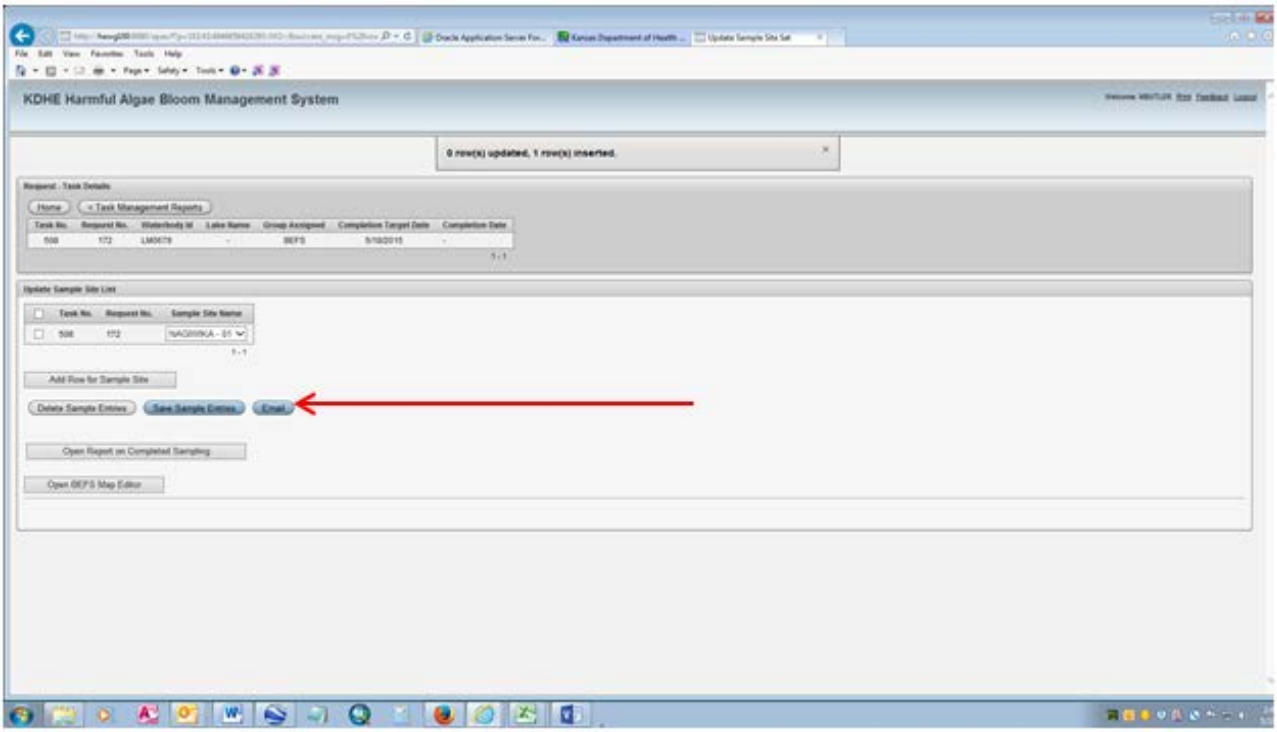


E. Click on:

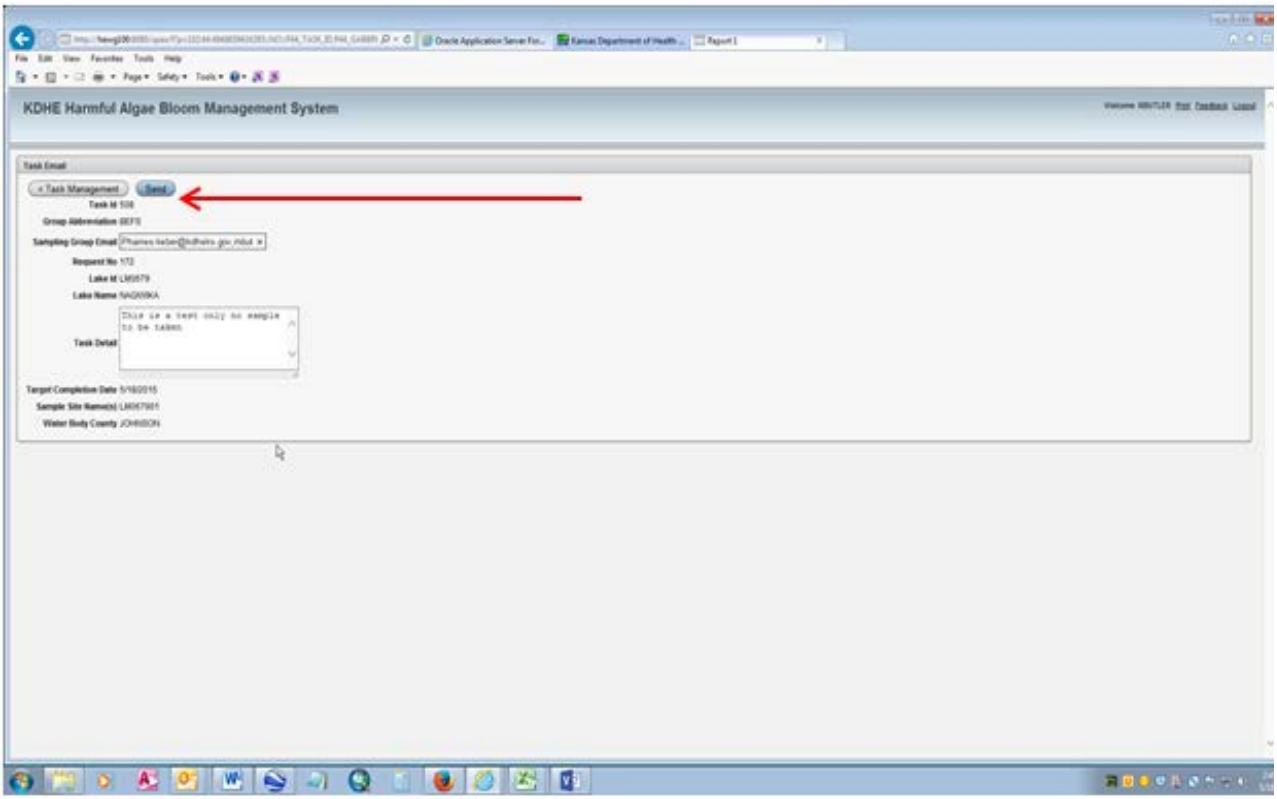
1. “Add Row for sample Site” and all avaialble sample sites will appear.
2. Sample site name, i.e. AA, AB, and continue to add as many rows as needed. Then
3. “Save sample Entries”.



F. Click on “Email”.

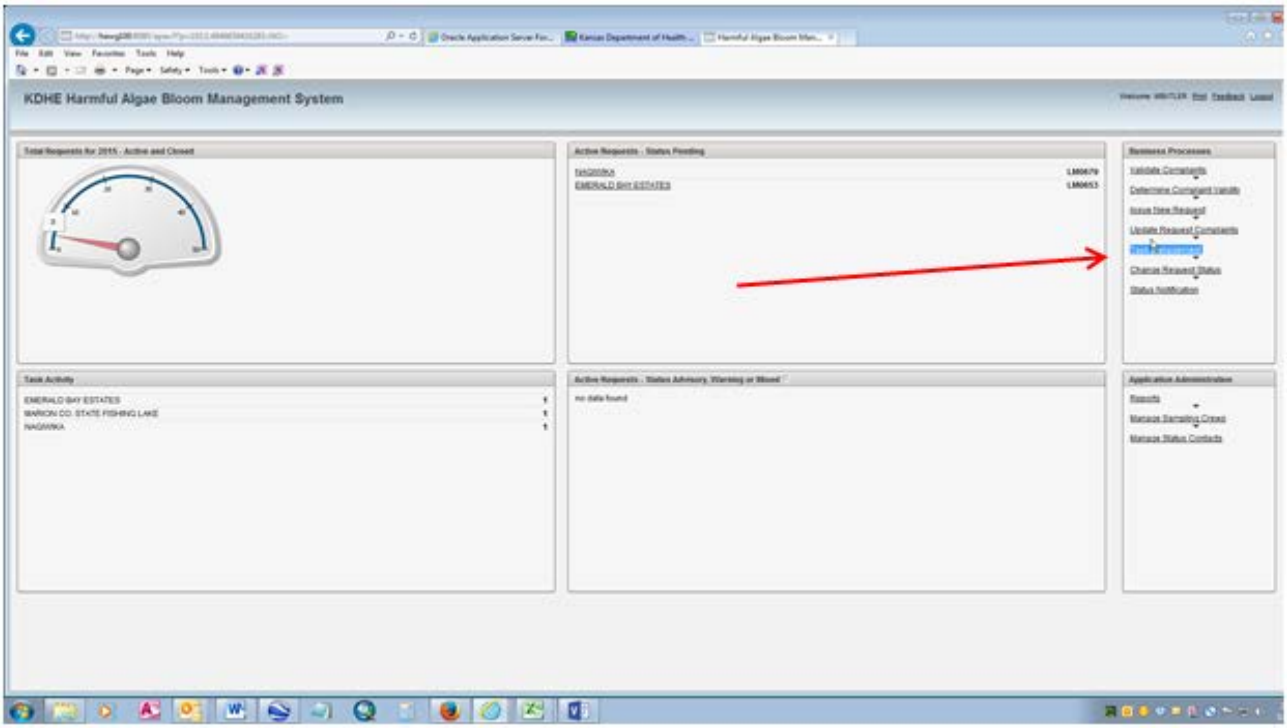


G. An email appears that allows additional comments before sending. Click “Send”. Return “Home”

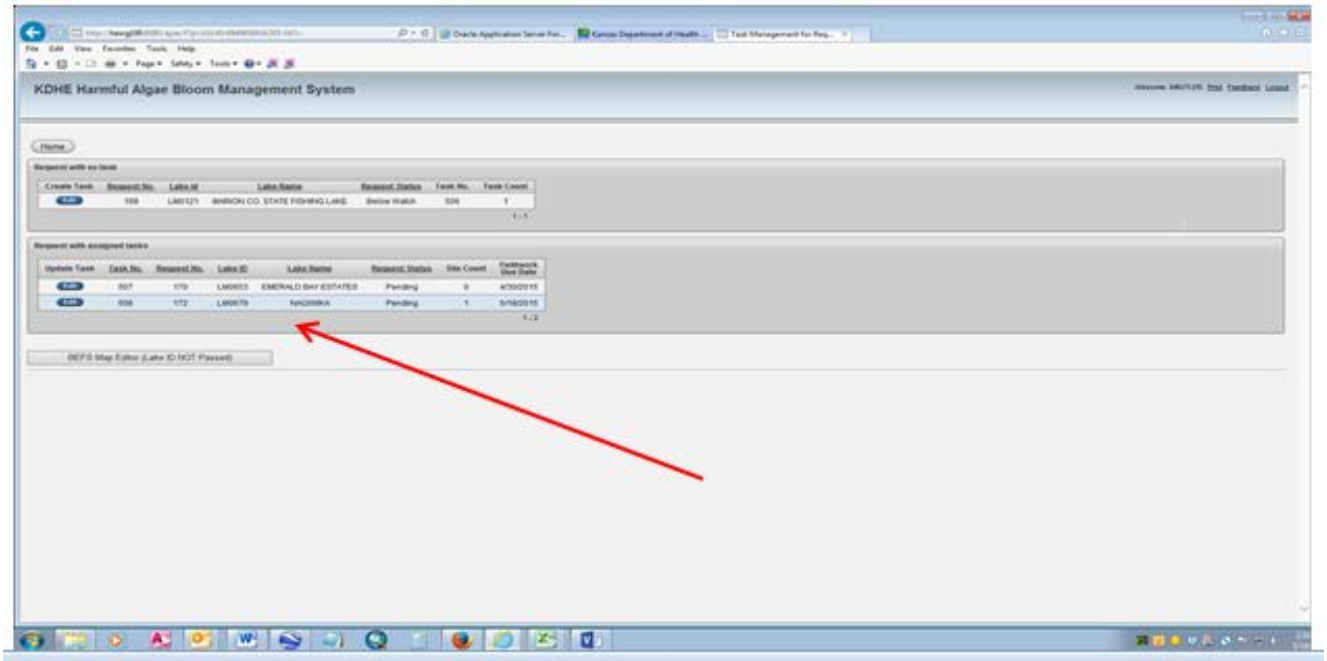


Samples must be collected and received so that correct station, date and sample collection time are known.

H. Click on “Task Management”.

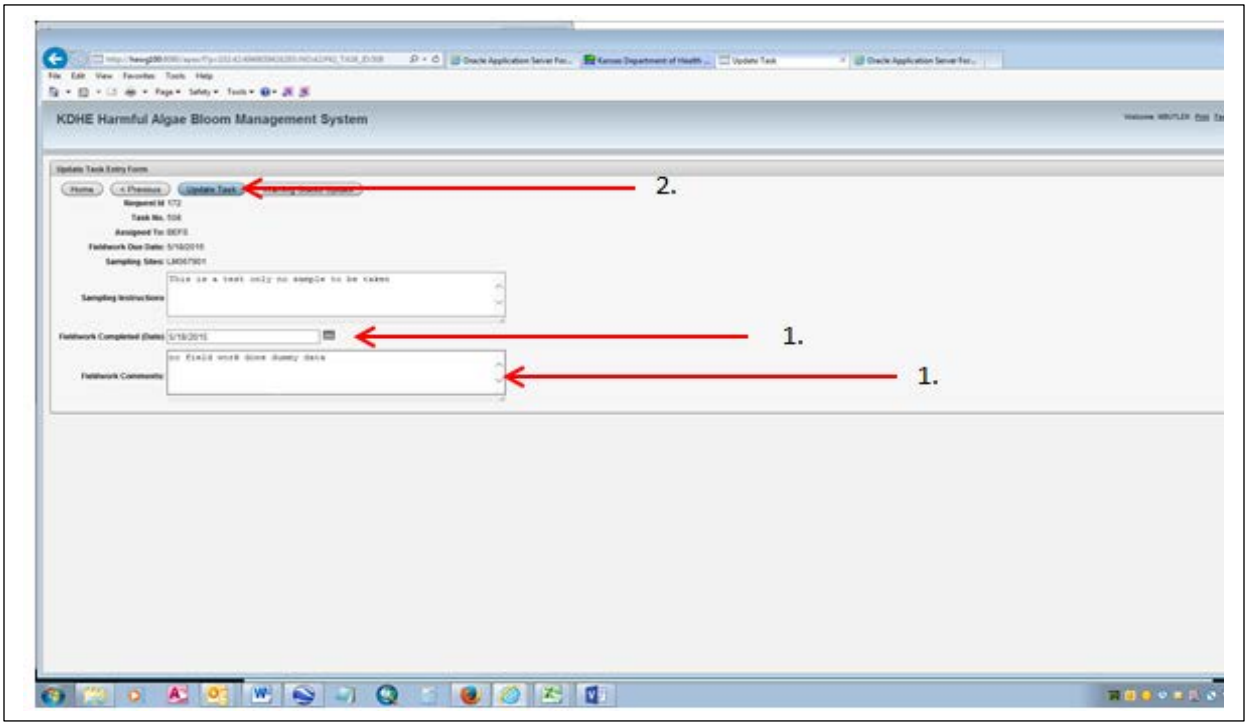


I. Now lake will appear under “Requests with Assigned Tasks”. Click selected lake on “Edit” under “Lake with Assigned Tasks”.

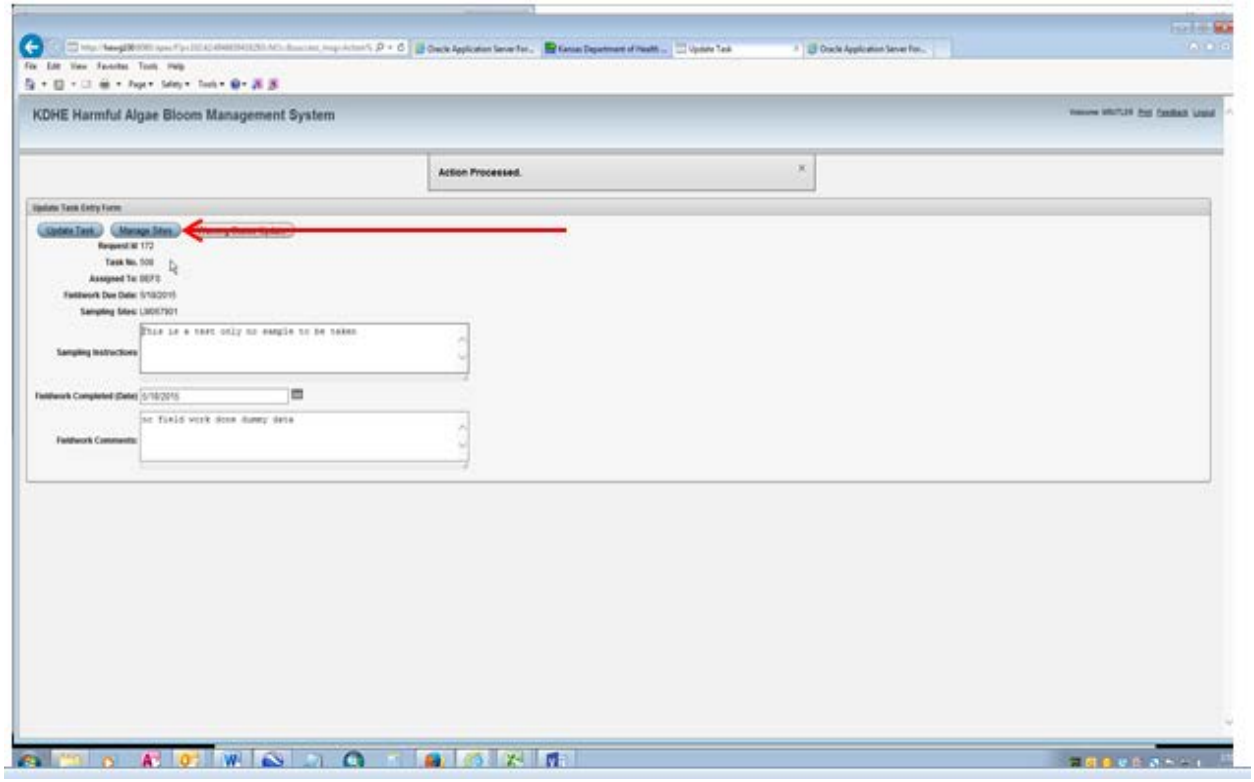


J. Go to and:

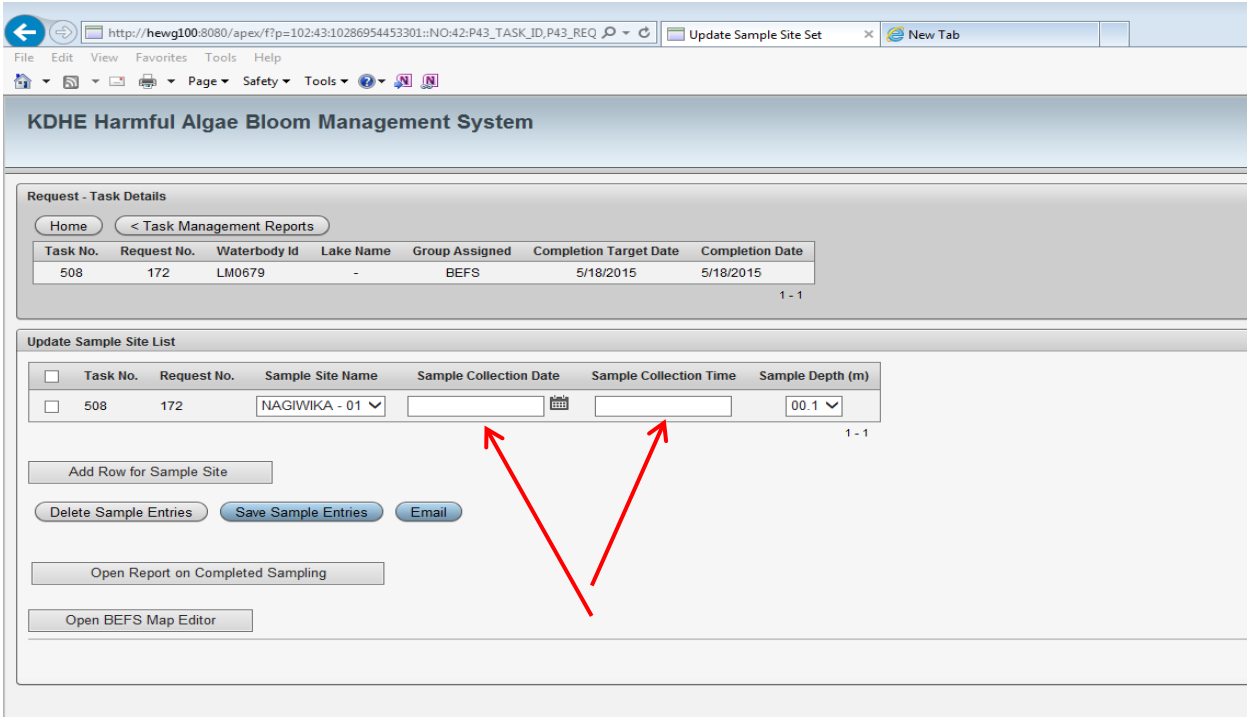
1. Complete date and fieldwork comments.
2. Click on “Update Tasks” button.

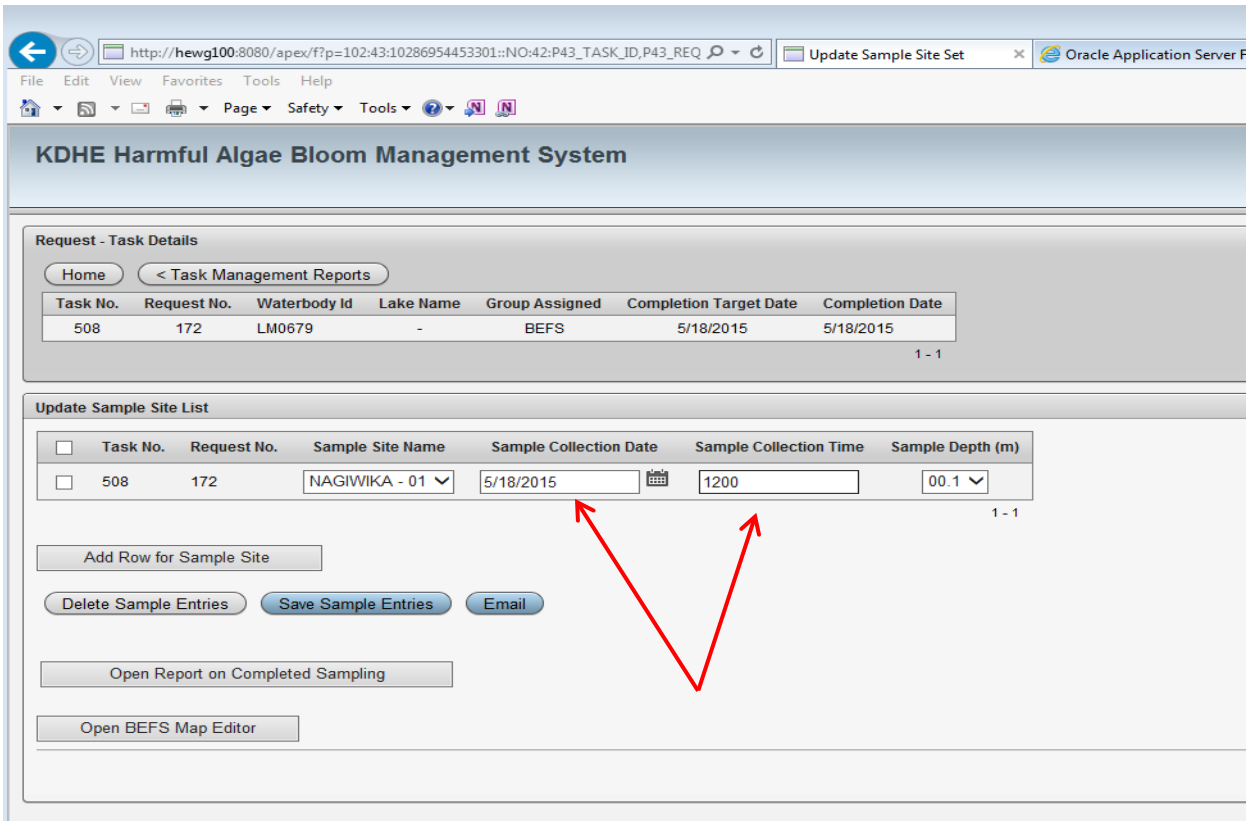


K. Then click on “Manage Sites” button.



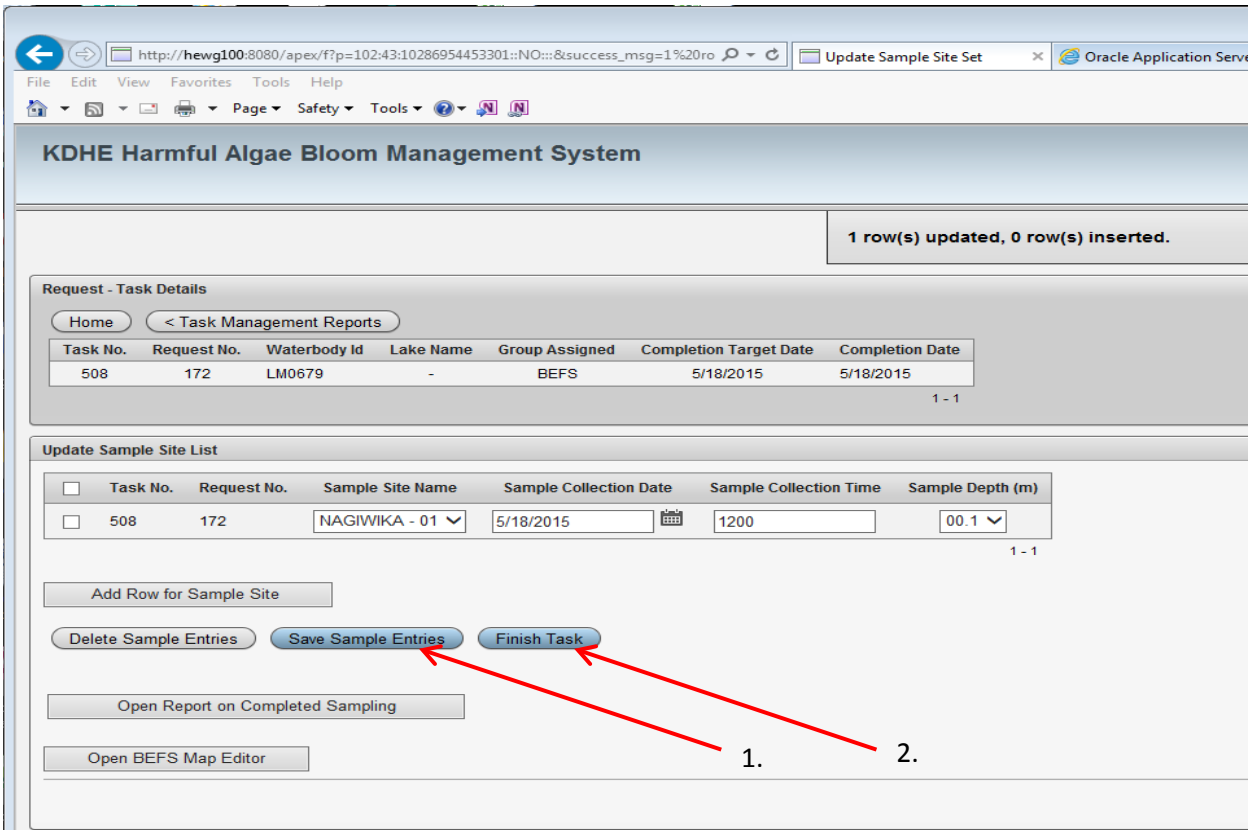
L. Put in sampling date and collection time that matches field sheet/ORACLE Algal data entry.



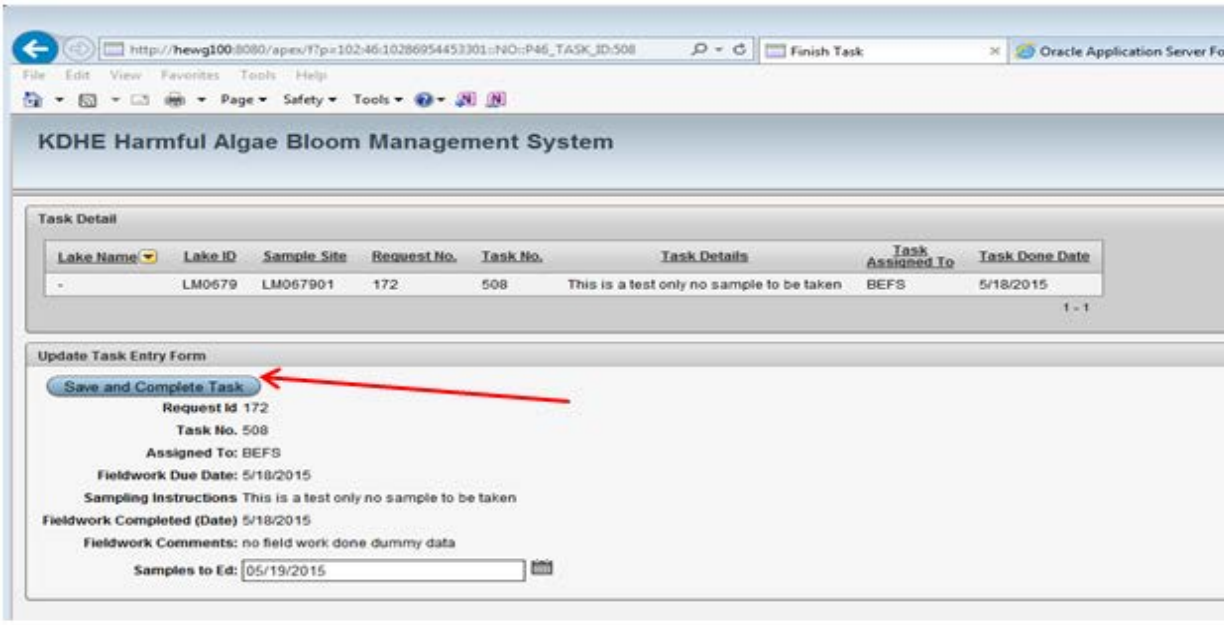


M. After entering date and time:

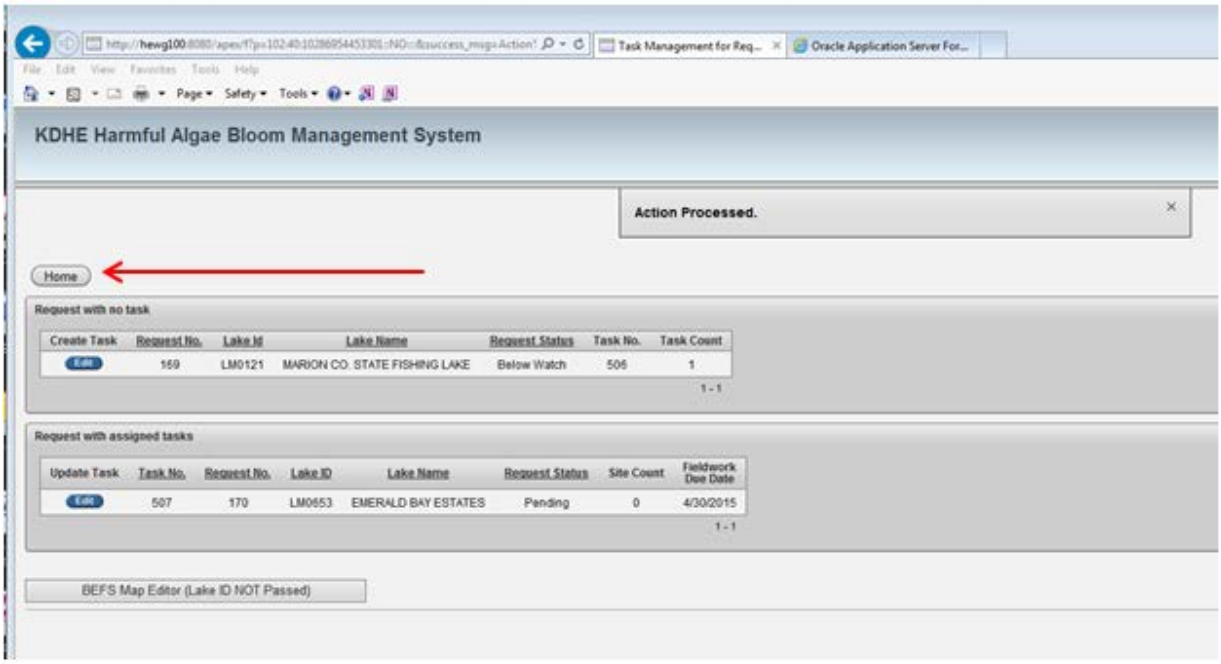
1. click on “Save sample Entries”, then
2. click on “Finish Task”.



N. Check “Samples to Ed” date. If correct, then click “Save and Complete Task”.

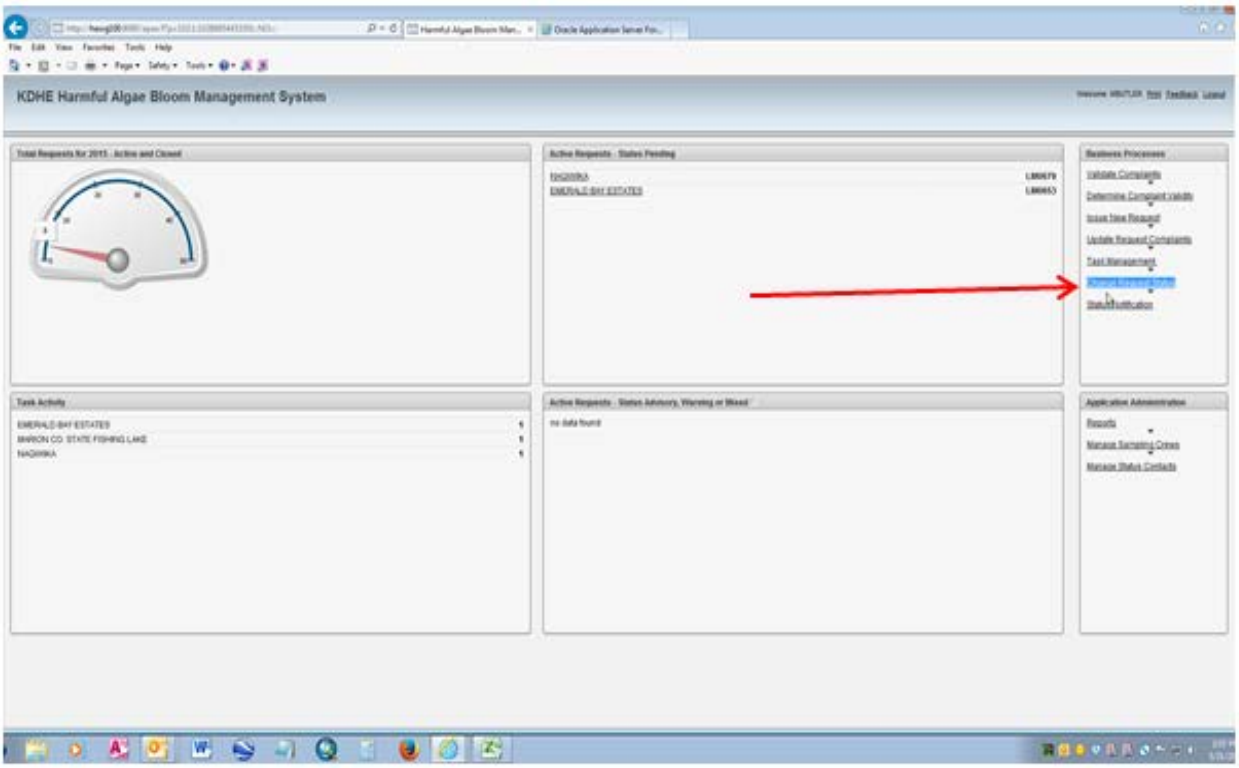


O. The lake disappears from this listing because the task has been completed. Go to “Home”.

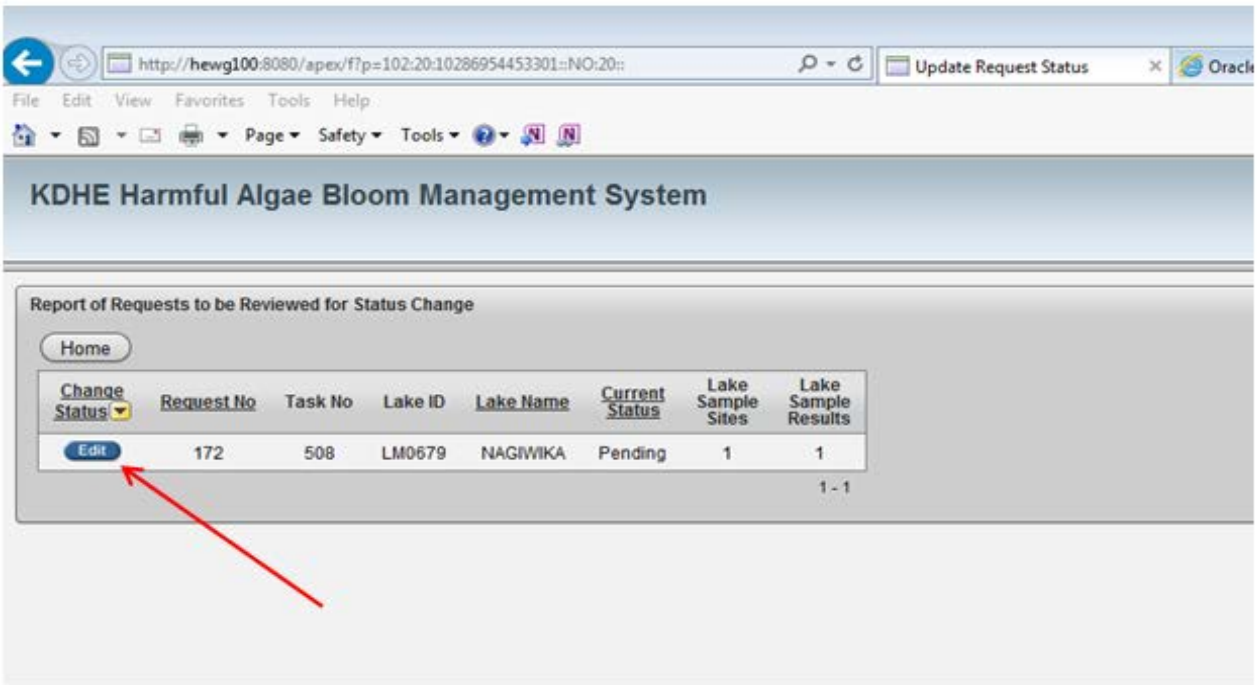


V. Change Request Status

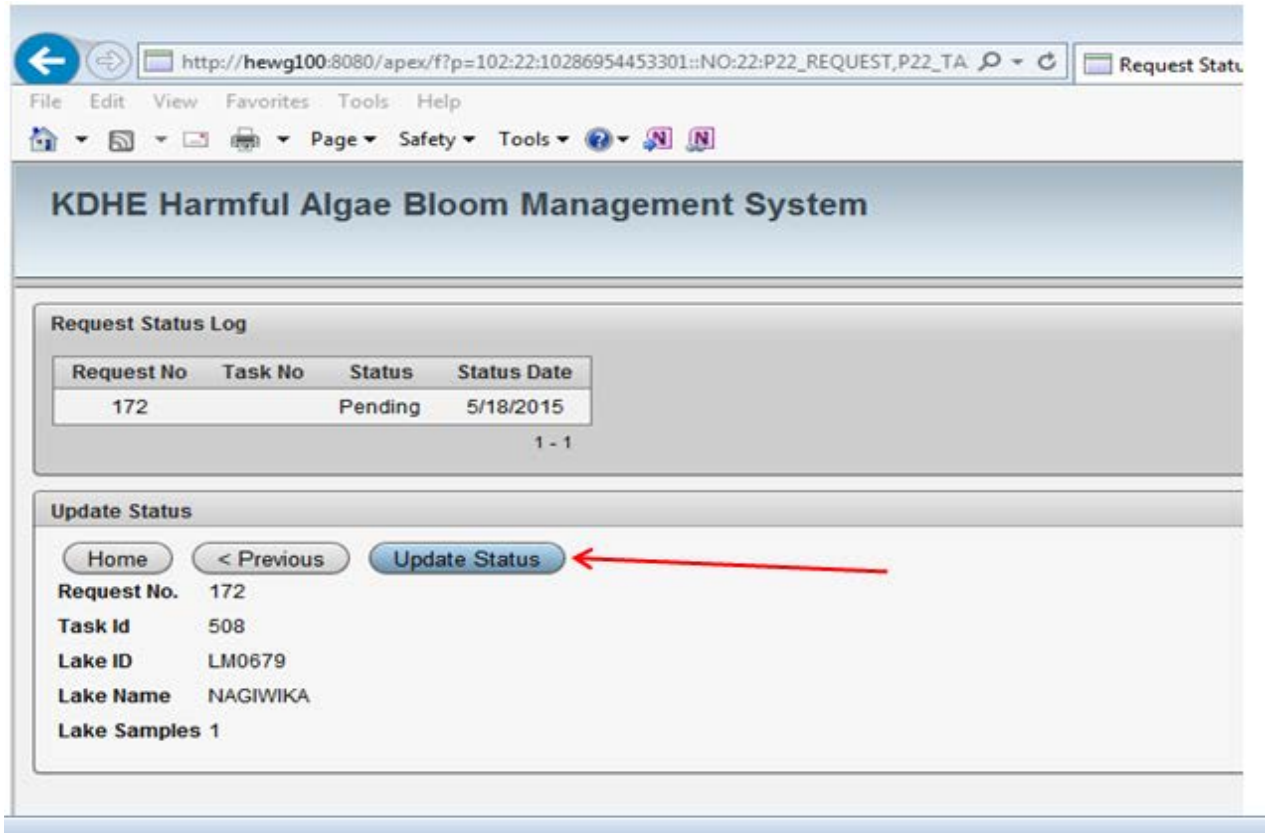
A. Click on “Change Request Status”



B. All lakes requiring status review will appear. Click on "Edit" of desired lake.

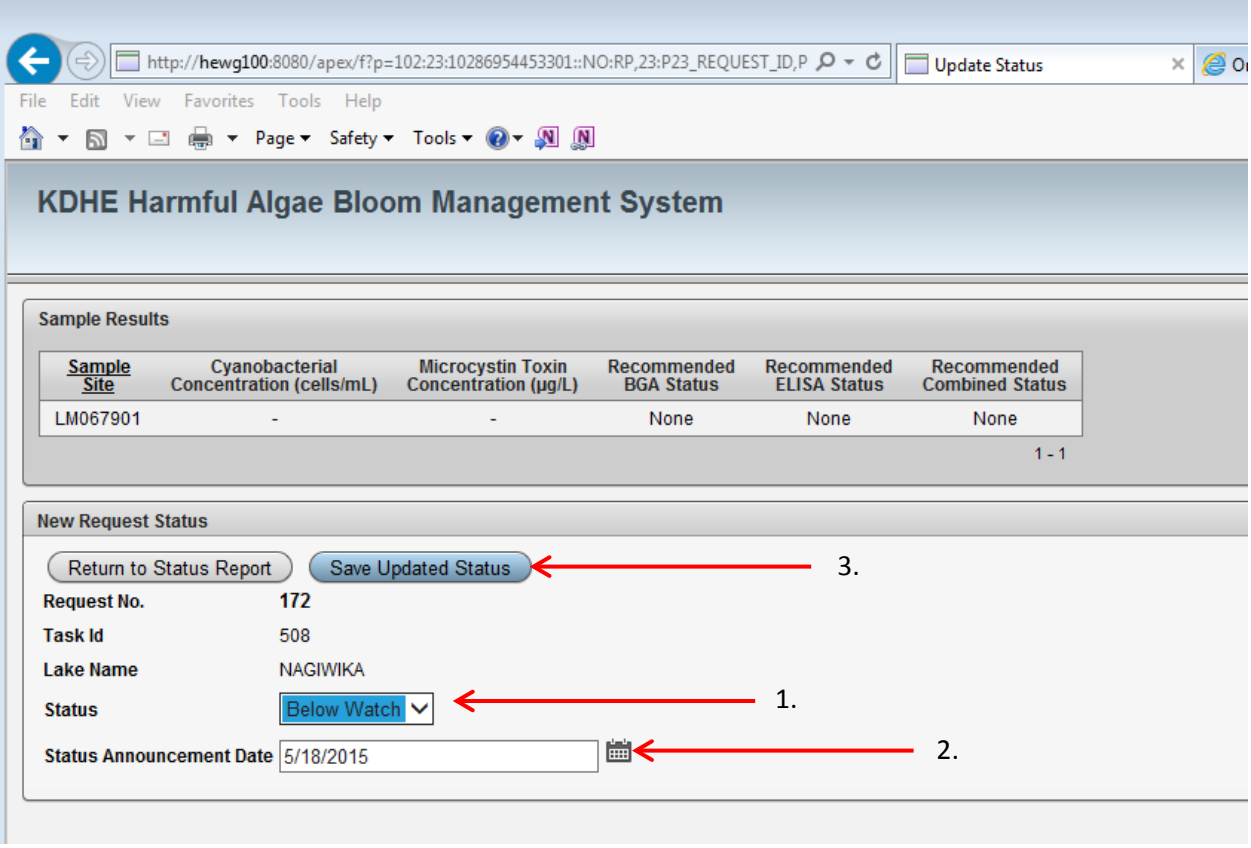


C. Click on "Update Status" button.



D. The lake status is determined at the weekly meeting.

1. That value is put in at the "Status" field.
2. "Status Announcement Date" field is also completed.
3. Click on "Save Updated Status" button. Click on "Home". Emails are sent those people who have been previously designated.



Attachment 11

Acronyms

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Acronyms

BEFS	Bureau of Environmental Field Services
BEPHI	Bureau of Epidemiology and Public Health Informatics
BGA	Blue Green Algae
BOR	U.S. Department of Interior, Bureau of Reclamation
BOW	Bureau of Water
EPI	Epidemiology
HAB	Harmful Algal Bloom
KDAH	Kansas Department of Agriculture, Division of Animal Health
KDHE	Kansas Department of Health and Environment
KDWP&T	Kansas Department of Wildlife, Parks and Tourism
KHEL	Kansas Health and Environmental Laboratories
KSVDL	Kansas State Veterinary Diagnostic Laboratory
LCMS	Liquid Chromatography Mass Spectrometry
LTP	Long Term Problem
OC	KDHE, Secretary's Office
PIO	Public Information Officer
PWSS	Public Water Supply System
USACE	U.S. Army Corps of Engineers
WPMAS	Watershed Planning, Monitoring and Assessment Section
WRAPS	Watershed Restoration and Protection Strategy