Draft Study Plan
Bird Injury of the Lower Passaic River

Diamond Alkali Superfund Site Natural Resource Damage Assessment

DIAMOND ALKALI SUPERFUND SITE NATURAL RESOURCE FEDERAL TRUSTEES

U.S. Department of the Interior
U.S. Department of Commerce

DRAFT FOR PUBLIC REVIEW AND COMMENT

March 6, 2020

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Executive Summary

The 17.4 mile lower Passaic River (LPR) has been contaminated through past and ongoing discharge of hazardous substances, including 2,3,7,8-tetrachlorodibenzo-*para*-dioxin (TCDD), polychlorinated biphenyls (PCBs), mercury, and others. The U.S. Department of the Interior (DOI), acting by and through the U.S. Fish and Wildlife Service, and the U.S. Department of Commerce (DOC), acting by and through the National Oceanic and Atmospheric Administration, (the "Federal Trustees") have prepared this draft study plan to assess and restore the natural resources injured by those hazardous substances.

The LPR, part of the Diamond Alkali Superfund Site (DASS), provides fragmented, yet important, habitat for a variety of bird species. Birds utilizing the LPR for nesting habitat are exposed to hazardous substances primarily through their diet. This dietary exposure may result in the accumulation of hazardous substances in their tissues, resulting in injury, such as potential adverse effects on reproductive success or altered breeding behavior. To support evaluation of DASS-related injury to bird species, the Federal Trustees intend to undertake a study in 2020 and 2021 to measure concentrations of hazardous substances in eggs of breeding birds nesting along the LPR. In addition, the Federal Trustees intend to conduct breeding bird surveys to gather information on the presence and density of bird species nesting along the LPR for potential use in injury assessment and restoration planning.

In accordance with the Final Natural Resource Damage Assessment Plan for the Diamond Alkali Superfund Site, dated January 2020, the Federal Trustees have developed this Draft Study Plan to evaluate injury to breeding birds. This Draft Study Plan describes field studies and laboratory chemical analyses the Federal Trustees intend to undertake to meet the following objectives:

1. assess the concentrations of certain hazardous substances in eggs of birds breeding along the Lower Passaic River; and
2. determine breeding bird species presence and density.

In the future the Federal Trustees may propose additional work to supplement this effort.

The Federal Trustees are issuing this Draft Study Plan for a 30-day public review and comment period. Comments should be submitted in writing (email is preferred) by April 6, 2020 to:

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Please include "DANRD Bird Study" in the email subject line.

Written comments may also be mailed to:

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1.0 Background

As the result of past and continuing discharges of hazardous substances, including 2,3,7,8-tetrachlorodibenzo-*para*-dioxin (TCDD) and other polychlorinated-dibenzodioxins (PCDDs), dibenzofurans (PCDFs), and biphenyls (PCBs); polycyclic aromatic hydrocarbons (PAHs); and mercury, the U.S. Department of the Interior (DOI), acting by and through the U.S. Fish and Wildlife Service; and the U.S. Department of Commerce (DOC), acting by and through the National Oceanic and Atmospheric Administration, (the "Federal Trustees") are conducting a natural resource damage assessment (NRDA) to assess and restore the natural resources injured by hazardous substances released at or from the Diamond Alkali Superfund Site (DASS) (DOI and DOC 2020).

The lower Passaic River (LPR) provides important habitat for a variety of bird species. Although this habitat is fragmented and compromised in quality, birds have been observed year-round (Kerlinger 1997; USFWS 1997; Walsh *et al.,* 1999, as cited by Ludwig *et al.,* 2010; Antonucci *et al.,* 2008; Boyle 2011). Surveys conducted along the river in multiple seasons during 2010 and 2011 detected a total of 49 aquatic or semi-aquatic bird species along the LPR (Windward 2019).

Birds are an integral part of the river ecosystem, and provide a number of important ecosystem services such as seed distribution, plant pollination, and insect control. Birds (particularly bird eggs) are also an important source of prey to other species. Birds may be exposed to hazardous substances through direct ingestion of contaminated water, sediment, and soil; and/or through consumption of food items that contain hazardous substances derived from the LPR and its floodplain. Contaminated food items linked to the river may include fish, amphibians, benthic invertebrates, adult insects that develop from aquatic larvae, spiders that prey on those insects, plants growing in or near the river, and vertebrates that forage in the floodplain. The dietary exposure of birds to these food items may result in the accumulation and biomagnification of hazardous substances in their tissues, resulting in injury, such as potential adverse effects on reproductive success or altered breeding behavior.

The Final Natural Resource Damage Assessment Plan for the Diamond Alkali Superfund Site (DOI and DOC 2020) identified avian health as an area of biological injury investigation. To assess possible injury due to exposure to hazardous substances, including but not limited to dioxin and/or dioxin-like contaminants at or from the DASS, the Federal Trustees intend to conduct multiple field studies on breeding birds along the LPR in 2020 and 2021.

Recent peer-reviewed literature has shown that the relative sensitivity of various avian species to dioxin-like compounds is in part a result of different genotypic isoforms of the aryl hydrocarbon receptor (AHR), a transcription factor that regulates a variety of gene expressions, including the toxic responses to TCDD and/or dioxin-like compound exposure (Karchner *et al.,* 2006; Head *et al.,* 2008; Manning *et al.,* 2012; Farmahin *et al.,* 2013). Based upon these studies, birds can be

classified into three main sensitivity groups for risk assessment purposes (defined as Type 1, 2, and 3). Of the more than 80 bird species that have been genotyped for the AHR, five have been identified as highly-sensitive Type 1 species, including the gray catbird (*Dumetella carolinensis*; Eng *et al.,* 2017).

The Comprehensive Environmental Response Compensation and Liability Act's implementing regulations stipulate that injury quantification should consider "species, habitats, or ecosystems that are especially sensitive to the oil or hazardous substance and the recovery of which will provide a useful indicator of successful restoration" (43 C.F.R. § 11.71(l)(2)(ii)). Therefore, AHR Type 1 and Type 2 species have been targeted for the 2020-2021 field studies.
The Federal Trustees intend to conduct assessment studies in 2020 and 2021 to accomplish:

1. the collection of eggs from nests of birds breeding along the LPR for analysis of egg contents; and
2. a survey to determine breeding bird species presence and density along the LPR.

Concentrations of hazardous substances measured in eggs of breeding birds nesting along the LPR will be compared to concentrations found in existing literature that are known to cause adverse effects. If ranges of concentrations measured in eggs are at or above existing thresholds known to cause mortality and/or reproductive effects, and injury is deemed probable for the breeding bird species, future controlled egg exposure studies may be performed to assess the level of adverse effects at given concentrations of hazardous substances (unless appropriate studies have already been conducted). Levels of adverse effects, in connection with concentrations of hazardous substances measured in eggs collected along the LPR, will be used to assess DASS-related breeding bird injury. In addition, the results of the breeding bird survey can and may be used in injury assessment and restoration planning.

2.0 Introduction

Previous bird surveys have indicated a large number of bird species are found along the LPR. Considering factors such as the life history of aquatic and semi-aquatic bird species and goals of the NRDA, the Federal Trustees have determined that it is appropriate to conduct further investigations focused on avian injury assessment to be initiated in the year 2020.
As outlined in the Final Natural Resource Damage Assessment Plan for the Diamond Alkali Superfund Site (DOI and DOC 2020), the Federal Trustees have developed this Draft Study Plan as part of an avian injury assessment effort. This Draft Study Plan describes an effort to estimate the concentrations of hazardous substances in eggs of bird breeding along the LPR, and a survey to determine the species presence and density of birds breeding along the LPR.

The Federal Trustees are issuing this Draft Study Plan for a 30-day public review and comment period. Comments should be submitted in writing (email is preferred) by April 6, 2020 to:

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3.0 Purpose and Objective

The purpose of this work is to inform the Federal Trustees' assessment of injury to birds, and to guide future efforts assessing pathways and injuries to birds from hazardous substances, as stipulated by the NRDA regulations (43 C.F.R. Part 11). This work may also be used to help determine whether additional studies are warranted, and if so, to inform their design.
The objectives of the field studies are:

1. assess the concentrations of hazardous substances in eggs of breeding birds; and
2. determine breeding bird species presence and density, and document habitat characteristics.

4.0 Methods

4.1 Egg Collection and Analysis

The Federal Trustees intend to collect eggs from bird species that are likely consuming, among other prey items, invertebrates emerging from the LPR during the spring breeding season. These species include the gray catbird (*Dumetella carolinensis*), a high-sensitivity Type 1 bird species, and the song sparrow (*Melospiza melodia*), American robin (*Turdus migratorius*), barn swallow (*Hirundo rustica*), and common grackle (*Quiscalus quiscula*), four moderate-sensitivity Type 2 species (Farmahin *et al.,* 2013).

Field technicians will implement surveys to identify and record nest locations at the start of nesting season for each species. Nest surveys will begin shortly after sunrise to minimize disturbance to birds, especially during the peak heat of the day. For each species, once a nest is identified, field technicians will opportunistically sample eggs for laboratory chemical analyses.

Nest and Egg Identification

Nest are likely to be found by observing adult birds entering the nest, in which case species identification will be based on known adult characteristics. If adult birds are not present, nest characteristics will be used to identify species.

Gray Catbird

Gray catbird nests are built typically 2 meters from the ground (roughly eye level), but nests can be difficult to find because they are often built in dense bushes (Budliger and Kennedy 2005). The study team will search from the ground while looking up through shrub riparian areas with dense understory, concentrating on areas with honeysuckle (*Lonicera spp.)* and multiflora rose (*Rosa multiflora*).

When a nest is located, the study team will identify whether or not the nest belongs to a gray catbird based upon dimensions, nest materials, and egg characteristics. Gray catbird nests are approximately 15 cm across and constructed of loosely woven twigs with a 5-7 cm cup constructed of tendrils from grape vines (*Vitis spp.*) and Virginia creeper (*Parthenocissus quinquefolia*) (Smith *et al.,* 2011). Gray catbirds commonly lay 4 teal-colored, 23 x 17 mm eggs (Baicich and Harrison 2005; Budliger and Kennedy 2005). Additionally, the field crew will attempt to confirm the presence of gray catbird adults visually or by detecting nearby territorial vocalizations.

Song Sparrow

Song sparrow nests are typically low, between 0 to 1m from the ground, exceptionally up to 4 m in trees. They are mostly under grass tufts or shrubs, but also in sedges (*Carex* spp.), cattail (*Typha* spp.), or some small trees. Locations adjacent to water are common, but nests are sometimes found in tree cavities, hollow logs, rails, woodsheds, or nest boxes (Bent 1968). The female will usually create a foundation with strips of grapevine bark and loosely arranged course grass stems (Nice 1943). Nests are usually constructed as compact open bowls of twigs, herbs, shrub parts, grass and weed stems, and dry leaves; some unlined, others lined with fine grass (Kern *et al.,* 1993). Song sparrow typically lay 3-5 blue to blue-green, 22 x 17 mm eggs, with red-brown small speckles or large irregular splotches with pigment usually oriented around the large end (Nice 1937; Baicich and Harrison 2005).

American Robin

Robins nest in a wide variety of locations, including those associated with human-made structures, such as rafters and sills. In nearby New York state, the first robin nests of the season are likely to be low in a protected evergreen tree, later ones higher in a deciduous tree. Of 244 nests in Ithaca, New York, half were < 3 m high (Howell 1942). The female constructs the outer wall with dead grass and twigs (Tyler 1949). The female may also add white paper, feathers, rootlets, or moss to outside. She will then carry mud from worm castings in her bill and knead it into the hollow of the cup. Lastly, the female lines the nest with fine pieces of dead grass

(Howell 1942). American Robins lay typically 3-4 unmarked, sky blue, 28 x 20 mm eggs. (Howell 1942; Baicich and Harrison 2005).

Barn Swallow

Barn swallow nests are easy to identify since they are usually constructed from mud, and are either fastened to a vertical wall or built on top of a horizontal ledge underneath a horizontal overhang, often near the juncture of the wall and the overhang ceiling of a bridge or abandoned trailer. Eggs are slightly glossy, creamy or pinkish white with and small reddish brown spots, and measure 20 x 14 mm. The mean first clutch size for barn swallows in West Virginia was 4.6 eggs and for second clutches 4.1 eggs (Brown and Brown 2019).

Common Grackle

Common grackles' nests are often constructed in conifers due to their propensity to nest early in the spring season (Maxwell II *et al.,* 1976). Nests are commonly large bulky cups consisting primarily of stems, leaves, and fine grasses (Maxwell II 1970). After the cup is lined with mud and, it is lined again with fine grasses or other material such as of paper, string, fishing line, cloth, corn husks, bark, moss, feathers, manure, tape, or wire (Bent 1958, Peck and James 1987). Eggs commonly have a background color of light blue to pearl gray (Maxwell II 1970), but can range from almost white to dark brown (Rothstein 1974). Blackish brown scrawls or spots are at the large end of eggs. Eggs measure 28 x 21 mm, and are usually laid in clutch sizes of 4-5, or up to 7 eggs (Baicich and Harrison 2005).

Reference Areas

The riparian corridors of the Rahway River or the Mullica River, or other similar, less degraded estuarine river(s), will be used as reference areas for collecting eggs of each species of interest for comparison to concentrations of hazardous substances measured in eggs from the LPR. Eggs collected from the chosen reference river(s) will be sent for laboratory chemical analysis. Because barn swallows opportunistically nest under bridges, field technicians may need to collect from accessible bridges in multiple reference areas to achieve the desired sample size.

Sample Collection

After confirmation that a nest belongs to the intended species, the nest will be checked for eggs. If eggs are present, the nest will be photographed and coordinates of the nest will be recorded using a GPS device. The study team will also record current clutch size before collecting eggs while wearing nitrile gloves.

Since no bird tissue data are known to exist for the LPR, and thus concentrations of hazardous substances in birds there are unknown, a power analysis calculating the degree of variation in concentrations could not be conducted for the purposes of determining the minimum number of samples to collect for future statistical analyses. Two eggs will be randomly collected from each nest and pooled for chemical analysis. Broken or obviously damaged eggs will not be collected.

Eggs will be assigned a unique number as follows:

> GRCA001a: first is the four letter species alpha code, with "GRCA" used as a species code for gray catbird, SOSP for song sparrow, AMRO for American Robin, BARS for barn swallow, and COGR for common grackle; next is a three-digit numerical code for the nest; and then an alphabetical code indicating the order of collection of the individual egg in cases of multiple eggs being collected from the same nest with "a" for the first egg collected, "b" for the second egg collected, and so forth.

Collected eggs and accompanying documentation will be processed according to Standard Operating Procedures and under Chain of Custody. Multiple eggs collected from the same nest will be pooled into the same jar that will be labelled similar to the example below, in which two gray catbird eggs were collected from nest 001:

> GRCA001ab

Samples will be stored in a secured freezer until they are shipped to the analytical laboratory for chemical analysis.

Sample Analysis

Egg contents will be analyzed for PCDDs, PCDFs, PCBs, and percent lipids. Eggs may be analyzed for methyl mercury if sufficient mass remains after PCDDs, PCDFs, and PCB extractions.

PCDD and PCDF congeners to be measured in eggs collected along the Lower Passaic River are:

PCDDs	**PCDFs**
2,3,7,8-TCDD	2,3,7,8-TCDF
1,2,3,7,8-PeCDD	1,2,3,7,8-PeCDF
1,2,3,4,7,8-HxCDD	2,3,4,7,8-PeCDF
1,2,3,6,7,8-HxCDD	1,2,3,4,7,8-HxCDF
1,2,3,7,8,9-HxCDD	1,2,3,6,7,8-HxCDF
1,2,3,4,6,7,8-HpCDD	1,2,3,7,8,9-HxCDF
OCDD	2,3,4,6,7,8-HxCDF
	1,2,3,4,6,7,8-HpCDF
	1,2,3,4,7,8,9-HpCDF
	OCDF

All 209 PCB congeners will be measured in eggs. The specific dioxin-like PCB congeners to be quantified in eggs collected along the Lower Passaic River are:

PCB Congeners	
PCB-77	PCB-126
PCB-81	PCB-156
PCB-105	PCB-157
PCB-114	PCB-167
PCB-118	PCB-169
PCB-123	PCB-189

Quality Assurance (QA) and Quality Control (QC)

Throughout the study, both in the field and analytical laboratory, QA procedures will encompass a range of activities that enable laboratories to achieve and maintain high levels of accuracy and proficiency despite changes in test methods and the volume of specimens collected or tested. Study QC will be designed to detect, reduce, and correct deficiencies in an internal analytical processes prior to the release of results; provide a measure of precision, or how well the measurement system reproduces the same result over time and under varying operating conditions.

Contract laboratories performing services in support of this study will have the QA/QC system that, among other things:

- establishes standard operating procedures (SOPs) for each step of the laboratory testing process, ranging from specimen handling to instrument performance validation;
- defines administrative requirements, such as mandatory recordkeeping, data evaluation, and internal audits to monitor adherence to SOPs;
- specifies corrective actions, documentation, and the persons responsible for carrying out corrective actions when problems are identified; and
- sustains high-quality employee performance.

The study's QA/QC program will be documented in the final report. The Federal Trustees intend to develop procedures and schedules for sharing data, split samples, and results of analyses, when requested, with any identified potentially responsible party. Information on any such decisions and procedures will be shared with the public.

4.2 Breeding Bird Survey

Field Survey Method

Field surveys will estimate the density for each species of breeding bird commonly observed along the LPR. Field surveys on the LPR will be conducted throughout June 2020. This time period has been targeted as it is during the breeding season, after migration has ended but before breeding birds have reduced their singing behavior (and thus detectability). Survey locations will include areas with appropriate nesting habitat in riparian zones, consisting of small trees and bushes for nesting along the river. It will also encompass the range of diverse habitats along this urbanized river, including marshes, parks, neighborhoods, and industrial property. Whenever possible, survey locations will be accessed via vehicle and foot. Since some breeding birds nest in structures on the river such as bridges, or in structures along the river such as abandoned trailers, a few survey locations will be accessed by boat.

Efforts during the first few days will include visiting potential survey sites to determine conditions that may prohibit or impair successful surveys. For example, a highway or factory in the vicinity may impede a surveyor's ability to hear bird songs and calls. Sites will be selected based on the criteria outlined in this plan (*e.g.*, within a certain distance of the river and publicly accessible) and based on safety (*i.e.,* field surveyors can park and safely access the site). In addition, sites will be selected such that they are, to the extent possible, spread evenly across the geographic scope of the lower 17 miles of LPR.

During the site selection process, a sequential numbering system of sites will be implemented. Starting at one, each new site visited will be given the next sequential number and the latitude and longitude of each site will be recorded in a master site list. In addition, each site will be assigned a unique name that briefly describes the site for future reference (*e.g.*, intersection Route 21 and Riverside Avenue). Further, the habitat type at each site will be described on the master site list based on an estimate made at the time of first survey detailing the percent of each of the predominant land cover types (marsh, developed, forest, field, etc.), plus detailed notes on how to re-find the site and any peculiarities affecting birds (*e.g.*, recent construction activity that would not show up on an aerial photo). Habitat types will also be classified afterwards using GIS and land cover data for different sized buffers around survey points.

Individual survey sites will be positioned within 150 m from the shore of the river, while remaining on public property such as roads or parks where permits will not be required. This will allow effective surveying of a circle of >100 m diameter that includes terrestrial habit, but not the river. At this time, the Federal Trustees do not intend to conduct any surveys on private property. Surveys at each site will be repeated up to three times. By way of example, if the Federal Trustees conduct two surveys per mile of the lower 17 river miles, one on each side of the shoreline, the number of survey sites equals approximately 68 locations overall (17 miles x 2 point count surveys x 2 shorelines). If a site is visited three times, the end result will be approximately 204 point counts (68 sites x 3 visits to each).

The study Principal Investigator (PI) will ensure field survey methods are consistent across observers and observers are accurately recording observations. During the afternoon of each survey day, the PI and survey team will develop a list of target sites for the next day. Additionally, the PI will accompany surveyors on a rotating basis, ensuring they are accurately recording the birds present and to achieve study-specific data quality objectives. Observers typically count birds from approximately 5AM (sunrise) to 8AM, after which time the volume of singing decreases and detectability is greatly reduced, especially in highly urban areas such as along LPR.

Based on similar surveys in scope and scale, it is expected that for roughly ten percent of the time surveys will not be conducted as planned due to unforeseen logistical and climatic constraints. For example, a planned survey location may not be safely accessible on a particular day and the distance to the next nearest location prevents the next appropriate survey from being completed before 8AM. Further, surveys may be interrupted for temporary noises, such as waste collection vehicles or school buses. Surveys may be halted altogether when consistent landscaping noise (4 on the noise index; see below), rain, or strong winds occur. In addition, breeding bird surveys can only occur during periods of fair weather because singing is greatly reduced during inclement weather. Based on a review of relevant weather data from Newark, New Jersey, weather is fair on two-thirds of days, which means a minimum of 30 days should be budgeted to complete 20 days of actual field work. During periods of inclement weather, field surveyors will scout potential survey locations for future days and/or conduct data entry and prepare for data analysis.

The number of breeding units of all bird species (*i.e.,* one individual, one pair, or one family) detected by sight and/or sound will recorded. A laser-based rangefinder (Bushnell Yardage Pro450, Overland Park, KS or similar device) will be employed to estimate ground distance to each bird (or the base of the tree that it is in) at first detection. Birds that are either flying over or seen outside of the count period (*i.e.,* on the way back to the car) will not be included in analyses but will be recorded for an auxiliary list of species present. A fly-over is any bird not using the habitat, and thus the data are not used in the analysis (*e.g.*, a woodpecker flying high overhead). If the bird initially detected flying overhead starts aerially foraging, lands on a tree, or does a flight display, for example, that is recorded as a regular detection at the distance where this occurs, and notes will be made to explain. All observations will be recorded by hand onto data sheets.

When arriving at a site identified the day before, the field surveyor(s) will find a safe place to legally park their car on non-private property. The field surveyor will then orient themselves to their surroundings and collect their observation equipment from their car, including, as needed:

- Binoculars
- GPS unit
- Thermometer

- Stopwatch
- Rangefinder
- Decibel Meter
- Clipboard
- Data sheets

Before beginning the point count, the field surveyor(s) will record ambient information as required (*i.e.,* site ID, point, survey, temperature, Beaufort wind score, noise index, and first of three decibel readings). At least 3 minutes after movement or disturbance by the observer has ceased, the field surveyor will then begin the stopwatch, recording the start time. During the point count, the field surveyor will remain as still and quiet as possible, recording each bird detected on the data sheet. The data sheet includes the following:

- **Point:** The unique numeric code assigned to each point identified within the geographic scope of the study area.
- **Survey Repetition ("Rep"):** Because individual points will be surveyed multiple times, it is necessary to distinguish between each survey, which will be accomplished using this field.
- **Start Time:** The time the survey starts, in 24-hour clock convention.
- **Temp:** The outside air temperature, in Celsius, and wind chill. This recording will be taken once per survey, at the start of the survey.
- **Beaufort Wind Score:** The Beaufort Wind Score ranges from 0 to 5 during fair weather based on the qualitative observations described. This recording will be taken once per survey, at the start of the survey. The categories are as follows:
  - 0 = Calm, smoke rises vertically
  - 1 = smoke drifts, sporadic leaf rustling
  - 2 = leaves rustling, can feel wind on face
  - 3 = leaves and twigs move around, small flags extend
  - 4 = moves thin branches, raises loose papers
  - >4 = small trees swaying

  The full list of Beaufort Wind Scores (0 to 12) will be provided to each surveyor during training, but birds will not be surveyed when wind is >4 on this scale.

- **Noise Index:** As included at the top of the data sheet, the Noise Index ranges from 0 to 4 based on the qualitative observations described. This recording will be taken once per survey, at the start of the survey. The categories are as follows:
  - 0 = No appreciable effect (*e.g.* owl calling)
  - 1 = Slightly affecting sampling (*e.g.* distant traffic or dog barking, occasional car passing)
  - 2 = Moderately affecting sampling (e.*g.* nearby traffic, several cars passing/minute)

  - 3 = Seriously affecting sampling (*e.g*. continuous traffic nearby, cicadas)
  - 4 = Profoundly affecting sampling (mowing, construction, garbage collection)
- **Decibel:** Using a Decibel Meter, the field surveyor will record at least three readings. These recordings will be made: just before the start of the survey, 5 minutes into the survey, and after the survey. The field surveyor will use the "Max-Hold" feature, which provides the maximum decibels for a period of time (for this survey, 30 seconds). The middle reading will be used to represent the noise level.
- **Species:** For each bird detected, the field surveyor will record the species using the four letter ornithological species code. Each field surveyor will be provided a laminated list of species codes found within the region based on recent eBird data.
- **Distance:** Distance is an estimate of ground distance to bird in meters upon first detection, not accounting for height off of ground. It is based on rangefinder and practice, but typically the bird is unseen so it is an estimate based on range-finding something near where the field surveyor believes it to be.
- **Time of Detection:** Each time the field surveyor detects a new bird, they will record the time of detection since starting the survey as recorded on a stop watch.
- **Means of Detection:** Detection method will be recorded. For example:
  - V = Visual
  - S = Song
  - C = Call
  - FO = Fly-over

When the point count is concluded, the field surveyor will sequentially number all sheets used for that point count as "page 1 of X." For fields that are repetitive (*i.e.,* entered once at the beginning), the field survey will indicate the previous entry applies by drawing an arrow down through the next entry (*i.e.,* no field will be left blank).

On a daily basis all field forms, data sheets, and field note books, will be scanned and transmitted electronically to the United States Fish and Wildlife Service (USFWS) Project Officer. Further, on a daily basis, any electronically captured information (*e.g.,* photographs, recordings, *etc*.) will be identified, labeled, compiled and preserved in its native format, including metadata, and electronically transmitted to the USFWS Project Officer.

Data Analysis

The Federal Trustees intend to analyze survey data using the DISTANCE program (Thomas *et al.,* 2010). The DISTANCE program is based on the statistical methods of *distance sampling* that are widely used and accepted techniques for estimating the size or density of biological population and for which there is a creditable and extensive body of peer-reviewed literature (Diefenbach *et al.,* 2003; Alldredge *et al.,* 2007; McWethy *et al.,* 2010; Reidy *et al.,* 2011; Marques *et al.,* 2019).

Survey Quality Assurance

To ensure quality of observational data, two forms of QA will occur.

- Manual transcription verification which will ensure that all information from the field data sheets was accurately recorded in the electronic file.
    - Initially, USFWS staff will manually check five randomly-selected data sheets to ensure the field team has accurately transcribed data, such as latitude and longitude from GPS units. If any minor errors are identified, USFWS will fix them (if possible) and notify the field surveyor. If unacceptable rate of errors are identified, USFWS will request that the field surveyor review and resubmit the transcribed data. If no errors are identified, or once any errors have been remedied, USFWS will then randomly select and manually check at least an additional five percent of data sheets entered by each field surveyor.
- Automated screening to identify entries that fall outside the range of likely possibilities, including:
    - The prime contractor will map all GPS coordinates reported by the field teams to ensure data were entered correctly;
    - The prime contractor will identify numeric entries at the extreme ends of potential ranges, possibly indicating the entry was in the wrong units;
    - USFWS biologists will cross reference species recorded against possible species known to frequent the area; and,
    - USFWS biologists will review all species names to ensure consistent coding of data.

In addition, the Federal Trustees will conduct a qualitative evaluation of the operational details at a date to be determined, without notifying the contracted field surveyors in advance. This evaluation will include, but not be limited to, a review of the field equipment being used, the consistency with which the methods are followed, and the storage of paper data sheets. In addition, the PI of the survey will accompany field staff on a regular basis, performing simultaneous surveys, to ensure staff are accurately identifying species and judging distances.

To evaluate the outcome of the survey, the PI will compare the observed densities to those reported for the same species elsewhere. Such a comparison will allow for the identification of estimates greater than or less than a species reported density in the literature for similar habitat. If such a case is identified, each individual entry will be reviewed and, based on their expertise in the field, the PI will determine if an aberration in the data requires additional review or if the data are flawed and if the data are not usable. Should additional review be required, study PI will discuss the results with a consultant of similar expertise to determine if the data are usable.

Adjustments may be necessary during egg collection and breeding bird survey efforts to best accomplish the objectives of the studies. The Federal Trustees and contracted field sampling team may make *in-situ* decisions regarding sample and survey numbers and locations based on

unforeseen circumstances in the field. Any such decisions, and explanation for necessary changes, will be described in the report of assessment.

5.0 Literature Cited

Alldredge M, Simons T, Pollock K. 2007. Factors Affecting Aural Detections of Songbirds. Ecological Applications, 17:948-955.

Antonucci C, Higgins R, Yuhas C. 2008. Harbor herons: great egret (*Ardea alba*), snowy egret (*Egretta thula*), black-crowned night heron (*Nycticorax nycticorax*), glossy ibis (*Plegadis falcinellus*). New Jersey Sea Grant Consortium, Fort Hancock, New Jersey. Available at: http://www.njmsc.org/education/Lesson_Plans/Key/Herons.pdf.

Baicich PJ and Harrison CJ. 2005. Nests, Eggs, and Nestlings of North American Birds. 2nd ed. Princeton University Press, Princeton, New Jersey.

Bent AC. 1958. Life histories of North American blackbirds, orioles, tanagers, and their allies. United States National Museum Bulletin 211.

Bent AC. 1968. Life histories of North American cardinals, grosbeaks, buntings, towhees, finches, sparrows, and their allies, Pt. 3. (O. L. Austin, Jr., ed.). U.S. National Museum Bulletin 237.

Boyle WJ Jr. 2011. The Birds of New Jersey: Status and Distribution. Princeton: Princeton University Press.

Brown MB and Brown CR. 2019. Barn Swallow. The Birds of North America (A. Poole, Ed.) Ithaca: Cornell Laboratory of Ornithology; Retrieved from The Birds of North America: https://birdsna.org

Budliger RE and Kennedy G. 2005.The Birds of New York State. Lone Pine Publishing, Toronto, Canada.

Department of the Interior (DOI) and Department of Commerce (DOC). 2020. Final Natural Resource Damage Assessment Plan for the Diamond Alkali Superfund Site, prepared by the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration.

Diefenbach D, Brauning D, and Mattice J. 2003. Variability in Grassland Bird Counts Related to Observer Differences and Species Detection Rates. The Auk, 120:1168-1179.

Eng M, Bishop CA, Crump D, Jones SP, Williams TD, Drouillard KG, Elliott JE. 2017. Catbirds are the new chickens: high sensitivity to a dioxin-like compound in a wildlife species. Environmental Science and Technology 51(9):5252-5258.

Farmahin R, Manning G, Crump D, Wu D, Mundy L, Jones S, Hahn ME, Karchner SI, Giesy JP, Bursian SJ, Zwiernik MJ, Fredericks TB, Kennedy SW. 2013. Amino acid sequence of the ligand-binding domain of the aryl hydrocarbon receptor 1 predicts sensitivity of wild birds to effects of dioxin-like compounds. Toxicological Sciences 131(1):139-152.

Head JA, Hahn ME, Kennedy SW. 2008. Key amino acids in the aryl hydrocarbon receptor predict dioxin sensitivity in avian species. Environmental Science and Technology 42, 7535–7541.

Howell JC. 1942. Notes on the nesting habits of the American Robin (*Turdus migratorius L.*). American Midland Naturalist 28:529-603.

Karchner SI, Franks DG, Kennedy S, Hahn ME. 2006. The molecular basis for differential dioxin sensitivity in birds: role of the aryl hydrocarbon receptor. Proceedings of the National Academy of Sciences USA 103, 6252–6257.

Kerlinger P. 1997. New York City Audubon Society harbor ecosystem study: nesting population of aquatic birds of the New York Harbor, 1997. New York City Audubon Society, New York, NY.

Kern MD, Sogge MK, Kern RB, Van Riper III C. 1993. Nests and nest sites of the San Miguel Island Song Sparrow. Journal of Field Ornithology 64:367-381.

Ludwig DF, Iannuzzi J, Iannuzzi TJ, Shisler JK. 2010. Spatial and temporal habitat use patterns by water birds in an urban estuarine ecosystem: implications for ecosystem management and restoration. Human Ecological Risk Assessment 16:163-184.

Manning GE, Farmahin R, Crum D, Jones SP, Klein J, Konstantinov A, Potter D, Kennedy SW. 2012. A luciferase reporter gene assay and aryl hydrocarbon receptor 1 genotype predict the LD50 of polychlorinated biphenyls in avian species. Toxicology and Applied Pharmacology 263:390-401.

Marques T and Schenk M. 2019. Distance Sampling References. Created by JabRef on 14-08-2019. Retrieved from The Distance Project website: http//distancesampling.org

Maxwell II GR. 1970. Pair formation, nest building, and egg laying of the Common Grackle in northern Ohio. Ohio Journal of Science 70:284-291.

Maxwell II GR, Nocilly JM, Shearer RI. 1976. Observations at a cavity nest of the Common Grackle and an analysis of grackle nesting sites. Wilson Bulletin 88:505-507.

McWethy DB, Hansen AJ, Verschuyl JP. 2010. Bird response to disturbance varies with forest productivity in the northwestern United States. Landscape Ecol 25:533-549.

Nice MM. 1937. Studies in the life history of the Song Sparrow I. A population study of the Song Sparrow. Transactions of the Linnean Society N.Y. 4:1-246.

Nice MM. 1943. Studies in the life history of the Song Sparrow, pt. 2. Transactions of the Linnean Society N.Y. 6:1-328.

Peck GK, and James RD. 1987. Breeding Birds of Ontario: Nidiology and Distribution. Volume 2: Passerines. Miscellaneous Publications of the Royal Ontario Museum, Toronto, ON, Canada.

Reidy JL, Thompson III FR, Bailey JW. 2011. Comparison of methods for estimating density of forest songbirds from point counts. Journal of Wildlife Management. 75(3): 558-568.

Smith RJ, Hatch MI, Cimprich DA, Moore FR. 2011. Gray Catbird. The Birds of North America (A. Poole, Ed.) Ithaca: Cornell Laboratory of Ornithology; Retrieved from The Birds of North America: https://birdsna.org

Rothstein SI. 1974. Variation in breeding parameters of a social bird. American Zoology 14:564.

Thomas L, Buckland ST, Rexstad EA, Laake JL, Strindberg S, Hedley SL, Bishop JR, Marques, TA, Burnham KP. 2010. Distance software: design and analysis of distance sampling surveys for estimating population size. Journal of Applied Ecology, 47:5-14.

Tyler WM. 1949. "Eastern Robin." In Life histories of North American thrushes, kinglets, and their allies. Edited by A. C. Bent, 14-45. U.S. National Musem Bulletin no. 196.

U.S. Fish and Wildlife Service (USFWS). 1997. Significant habitats and habitat complexes of the New York Bight watershed [online]. Southern New England-New York Bight Coastal Ecosystems Program, US Fish and Wildlife Service, Charlestown, RI. [Cited 2/18/11.] Available from: http://library.fws.gov/pubs5/web_link/text/toc.htm

Walsh J, Elia V, Kane R, Halliwell T. 1999. Birds of New Jersey. Bernardsville, New Jersey; New Jersey Audubon Society.

Windward Environmental, L.L.C. (Windward). 2019. Lower Passaic River Study Area Baseline Ecological Risk Assessment. Final. Prepared for USEPA Region 2 as part of the 17-mile LPRSA Remedial Investigation/Feasibility Study.