Aquatic Pesticide Application Plan

Vandenberg Air Force Base, California

16 January 2020

Prepared for

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Acronyms and Abbreviations

%R	percent recovery
ac	acre(s)
ATV	all-terrain vehicles
cm	centimeter
COC	chain of custody
DPR	California Department of Pesticide Regulation
EO	Executive Order
EPA	Environmental Protection Agency
FB	Field Blank
FD	Field Duplicate
ha	hectare(s)
INRMP	Integrated Natural Resources Management Plan
km	kilometer(s)
km^2	square kilometers
L	liter
MD	method blank
mg	milligram
mi	mile(s)
mi^2	square miles
ml	milliliter
mm	millimeter
MS	matrix spike
NTU	nephelometric unit
QA/QC	quality assurance and quality control
RPD	relative percent difference
SU	Standard Units
ULV	ultra low volume
USDA-ARS	United States Department of Agriculture – Agricultural Research Service
VAFB	Vandenberg Air Force Base
VOA	Volatile Organic Analyte
µg/L	microgram per liter
µS/cm	microSiemens per cm

1 Introduction

Vandenberg Air Force Base (VAFB or Base) is located in western Santa Barbara County along the south-central coast of California north of Point Conception, approximately halfway between San Diego and San Francisco (Figure 1-1). The Base covers approximately 99,571 acres (ac; 40,295 hectares [ha], VAFB 2019) and is headquarters for the 30th Space Wing of the United States Air Force. The primary mission of VAFB is to launch and track satellites, test and evaluate America's intercontinental ballistic missile systems, and support aircraft operations in the Western Range.

The Santa Ynez River physically divides VAFB into northern and southern sections. Much of VAFB is open space used as security or safety buffer zones for space and missile launch activities. The topography of VAFB is varied, including hills, mountains, terraces, floodplains, mesas, canyons, and rocky headlands. VAFB occurs in a transitional ecological region that includes the northern and southern distributional limits for many plant and animal species.

Much of the open space on VAFB is allowed to persist in a natural state with relatively little disturbance. This has resulted in the conservation of natural plant and animal communities over much of the Base. Outside VAFB, many similar areas have been developed, fragmented or subjected to more intensive disturbance, especially in coastal areas. These large areas of relatively natural habitat support many rare species, which include 18 species listed as threatened or endangered under the Endangered Species Act of 1973 (16 United States Code § 1536).

Invasive plant species currently pose the primary constraint to recovery and pose the greatest existential threat to most of the threatened and endangered species occurring on VAFB. Nationally, an estimated 42 percent of federally endangered or threatened species were listed because of invasive species driven population declines (Pimentel et al. 2005). Invasive species also have tremendous economic impacts. Costs to the national economy are estimated at 120 billion dollars per year due to decreased agricultural yields and expenditures on chemical or mechanical control.

Executive Order (EO) 13112 issued on 3 February 1999 called upon federal agencies to take steps to prevent the introduction and spread of invasive species as well as to support efforts to eradicate and control existing invasive species. VAFB also maintains an Integrated Natural Resources Management Plan (INRMP). VAFB's INRMP sets forth "Goals" which are subdivided into "Objectives" and then specific "Projects." Goal D.3 of the Endangered and Threatened Species Management Plan is to protect and enhance existing populations and habitats of threatened and endangered species. Goal K.1 of the Invasive Species Management Plan is to maintain and enhance the ecological integrity of sensitive habitats and species affected by invasive species.

To comply with EO 13112 and fulfill goals set forth in the VAFB INRMP, VAFB conducts invasive plant management across Base through a series of efforts designed to improve habitat for federally listed species and restore native ecosystem functions. Several of the target invasive species occur in Waters of the United States (U.S.) and need to be treated with herbicides in order to gain broad control of these species. As a result, this Aquatic Pesticide Application Plan

(APAP) was developed to comply with the requirements of the State of California's Water Quality Order 2013-0002-DWQ, the Statewide General National Pollutant Discharge Elimination System Permit for Residual Aquatic Pesticide Discharges to Waters of the U.S. from Algae and Aquatic Weed Control Applications Permit CAG990005 (General Permit), adopted by the State Water Resource Control Board on 5 March 2013. The General Permit regulates the point-source discharges of residues resulting from pesticide applications using products containing 2,4-D, acrolein, calcium hypochlorite, copper, diquat, endothall, flumioxazin, fluridone, glyphosate, hydrogen peroxide, imazamox, imazapyr, penoxsulam, sodium carbonate peroxyhydrate, sodium hypchlorite, and triclopyr -based algaecides and aquatic herbicides, and adjuvants containing ingredients represented by the surrogate nonylphenol. The General Permit covers only discharges of algaecides and aquatic herbicides that are currently registered for use by the California Department of Pesticide Regulation (DPR) or that become registered for use and contain the active ingredients listed above and ingredients represented by the surrogate of nonylphenol.

Figure 1-1. Regional location of Project Area.

2 Water System Description

VAFB supports some of the most extensive riverine riparian habitat along the central California coast. Perennial riverine systems on VAFB include, from north to south, San Antonio Creek, the Santa Ynez River, Cañada Honda, and Jalama Creek (Figure 2-1), described below:

San Antonio Creek is a 28 miles (mi) (45 kilometers [km]) long, east-west trending creek, entering north VAFB at Barka Slough, on its eastern boundary, and extending approximately 11 mi (18 km) across VAFB before emptying into the Pacific Ocean north of Purisima Point. The San Antonio Creek watershed has a drainage area of 154 square miles (mi^2) (399 square kilometers [km^2]) that includes Los Alamos Valley in the upstream portion and San Antonio Valley in the downstream portion. Although intermittent through much of its course, the creek is perennial west of Barka Slough, where it flows through the bottom of the San Antonio Valley with a meandering channel lined with riparian vegetation, but often deeply incised 15 ft (4.5 m) or more, east of Lompoc-Casmalia Road.

The Santa Ynez River flows west along the northern base of the Santa Ynez Mountains. The river watershed has a total drainage area of about 900 mi^2 (2,331 km^2), reaching more than 50 mi (80 km) inland, with less than five percent of this area, or approximately 3.5 mi (5.6 km) of river course, within VAFB. Flow in the Santa Ynez River is seasonal and largely controlled by dams upstream of VAFB, as well as irrigation withdrawals. As a result, higher flow events generally only occur during the rainy season, from November to May. The portion of the Santa Ynez River that flows through VAFB is generally hydrated throughout the year due to the discharge of treated effluent from the Lompoc Regional Wastewater Treatment Plant, located about 5 mi (8 km) upstream of the 13th Street Bridge, which discharges a maximum of 3.5 million gallons per day. A large estuary is present at the river mouth through most of each year, only receding when high flow and/or high tide events breach the sand berm at its terminus.

Cañada Honda is located 6 mi (10 km) south of the Santa Ynez River and 2.5 mi (4.0 km) north of Point Arguello (Figure 2-1). Cañada Honda is a perennial stream about 9 mi (14 km) long with a drainage basin of about 12 mi^2 (32 km^2). The majority stream (7.8 mi [12.6 km]) occurs on VAFB and has experienced very little development or impact from other activities, such as agriculture. Although the area is relatively intact, in September 2016 the Canyon Fire burned almost the entire basin, resulting in significant erosion and sedimentation throughout the drainage.

Jalama Creek is approximately 8 mi (13 km) in length and drains 24 mi^2 (62 km^2) of the Santa Ynez Mountains, with only a small portion (0.8 mi [1.3 km]) occurring on VAFB at its southern boundary, approximately 5 mi (8 km) north of Point Conception. The Jalama Creek drainage basin is largely intact, with minimal agriculture and grazing and very little development.

In addition to these perennial features, a number of intermittent drainages are also found on VAFB. Bear Creek is the largest of these streams, at approximately 3.5 mi (5.6 km) long and located entirely within VAFB, but additional intermittent flow systems exist along Sudden Ranch and the region north of Lions Head (Figure 2-1).

Shuman Creek, an intermittent stream, is located approximately 5 mi (8 km) south of Point Sal and approximately 3 mi (5 km south of the northern VAFB boundary. It is 9 mi (14 km) long and

has a drainage area of about 21 mi^2 (54 km^2). The water course extends for 4.4 mi (7.1 km) within VAFB and for approximately 5 mi (8 km) beyond the base boundary. In addition to riverine systems, VAFB supports several natural and artificial ponds and ephemeral pools. Many of these water bodies could be classified as vernal lakes, which are typically larger than vernal pools. Artificial ponds were created through purposeful modification of habitats and through unintentional modification as a result of construction of roads, embankments, and others features. Natural and artificial ponds include, the Lake Canyon Lakes, Punchbowl Pond and MOD III Pond (Figure 2-1). Ephemeral pools are found throughout VAFB, including substantial vernal pool complexes found in the cantonment area and upper La Salle Canyon at Arguello Ridge (Figure 2-1).

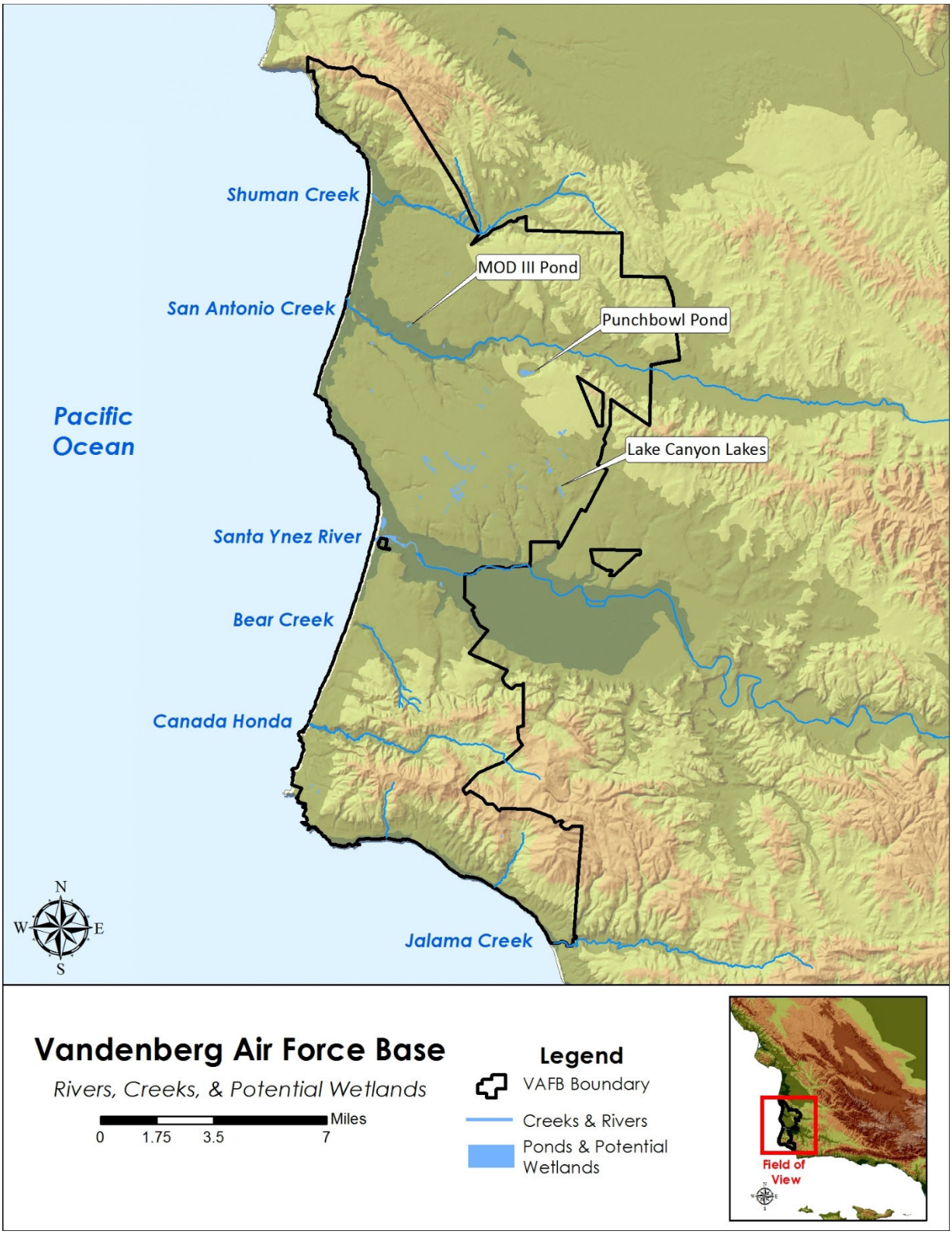

Figure 2-1. Rivers, creeks, and potential wetlands on VAFB (note: not all potential wetlands are depicted).

3 Treatment Area Description

Many of the drainages, ponds, and pools on VAFB have also undergone many years of physical alterations and land use practices (eg. grazing, agricultural, etc.) that have left portions of each drainage in different states of health. Extensive incursions by invasive plant species have disrupted natural ecological processes by impacting flow, water table, fire regime, etc. Federally-listed species, such as the California red-legged frog (*Rana draytonii*), unarmored threespine stickleback (UTS; *Gasterosteus aculeatus williamsoni*), tidewater goby (*Eucyclogobius newberryi*), southern California steelhead distinct population segment (steelhead; *Oncorhynchus mykiss*), southwestern willow flycatcher (*Empidonax traillii extimus*; though not observed since 2004), vernal pool fairy shrimp (*Branchinecta lynchi*), and Gambel's watercress (*Nasturtium gambellii*) are found in these habitats and have been impacted by their degredation. These species would greatly benefit by decreasing the extent of various invasive plants and the subsequent improvement in native habitat functionality. To accomplish this aim, all areas on VAFB where aquatic vegetation meets treatment thresholds will potentially be treated. This will include drainages and wetland features on VAFB that may qualify as Waters of the U.S.

4 Description of Weeds

Below is a description of the six invasive plant species found in aquatic areas that currently pose the greatest threat to federally-listed species on VAFB.. These species vary in their potential for ecological harm, dispersal mechanisms, and rates of spread, but all have been identified as either High or Moderate state-wide threats by the California Invasive Plant Council (Cal-IPC, Table 1, MSRS 2018a). This organization utilizes publicly available information and expert opinion to determine a rank of High, Moderate, or Limited invasiveness for non-native species in California. The Cal-IPC standardized ranking system classifies the degree of threat posed by each species. The degree of threat is based on the potential ecological impacts of each invasive species (Cal-IPC 2006):

- **High** ranked species have severe ecological impacts on ecosystems, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. These species are usually widely distributed ecologically, both among and within ecosystems.
- **Moderate** ranked species have substantial and apparent but generally not severe ecological impacts on ecosystems, plant and animal communities, and vegetation structure. Their reproductive biology is conducive to moderate to high rates of dispersal, though establishment is generally dependent on ecological disturbance. Ecological amplitude (the combination of ecological impact and invasive potential) and distribution may range from limited to widespread.

Table 4-1. Invasive species found in VAFB's aquatic areas addressed in this Plan. Table sorted by Cal-IPC Ranking.

Scientific Name	Common Name	Family	Cal-IPC Rank	Dispersal Method	Fecundity/Rate of Spread
Arundo donax	Giant Reed	Poaceae	High	Primarily vegetative	Moderate
Cortaderia jubata	Jubata Grass	Poaceae		Copious seed production	High
Delairea odorata	Cape Ivy	Asteraceae		Aggressive vegetative spread	High
Tamarix spp.	Tamarisk	Tamaricaceae		Seed production	High
Carpobrotus spp.	Iceplant spp.	Aizoaceae	High/ Moderate	Seed production and vegetative spread	Moderate
Eucalyptus spp.	Eucalyptus	Myrtaceae	Limited	Seed production, basal resprouting	Moderate

4.1 Giant Reed (*Arundo donax*)

Giant reed, or arundo, is native to tropical Asia and the Mediterranean region. It is a bamboo-like perennial grass that can grow up to 25 ft (7.6 m) tall, with semi-woody, erect canes, that are 1-2 inches (in) (2.5-5.1 centimeters [cm]) thick. Younger canes have the same diameter as older canes, but are not branched and are more pliable. Blades under 3 ft (0.9 m) long and 1-3 in (2.5-7.6 cm) wide can occur on older canes. Ligules (strap-like membrane on the inside surface of the leaf sheath and between the blade) consist of a short, even, and finely-fringed membrane, 0.04-0.08 in (1-2 millimeter [mm]) long. The auricles and collar region (the junction between the blade and outer sheath) are distinctly pale-yellowish-green. Rhizomes form dense root networks that are thick, scaly, and knotty at the stem base. Inflorescences consist of large terminal plume-like panicles, 1-2 ft (0.3-0.6 m) long, which are silvery cream-colored to purplish or brown.

Arundo is perennial with a blooming period in late spring and early summer. It occurs primarily in riparian areas, floodplains, ditches, and gentle slopes. This species grows best in well-drained, moist soils and can tolerate some salinity and prolonged drought conditions. It does not survive for extended periods of freezing temperatures. On VAFB, it primarily occurs in riparian habitats with arroyo willow (*Salix lasiolepis*) and central coastal scrub species near the Santa Ynez River and San Antonio Creek (MSRS 2018b). A single rhizome displaced through flooding can root and establish in uninfested streamside sites. From the initial colonization, the stand can expand and develop an impenetrable monoculture that displaces native vegetation (DiTomaso et al. 2013, MSRS 2018b). Arundo increases fire risk in riparian corridors as well as flood hazards, siltation, and the rate of water loss from underground aquifers.

4.2 Jubata Grass (*Cortaderia jubata*)

Jubata grass is native to South America, where it occurs in mid-elevation habitats of Andes regions in Ecuador, Peru, Bolivia, and northern Argentina. It is a tall perennial grass with large,

densely tufted, plume-like inflorescences that are about 1-3 ft (0.3-0.91 m) long. Basal leaves are long, with serrated edges that will easily cut the skin. Short, shallow lateral rhizomes produce dense and fibrous roots. Ligules consist of a thick ring of hairs approximately 0.10 in (2.5 mm) long.

Jubata grass is a perennial species that blooms during the fall and winter. Each plant can produce approximately 100,000 seeds per plume. Jubata grass reproduces via apomixis, meaning that it can reproduce exclusively from female plants without requiring fertilization. Seeds are very light and can travel up to 20 mi (32.2 km) on wind patterns (DiTomaso et al. 2013). The copious seed production results in rapid down-wind spread into uninfested sites. Because seeds are so minuscule, seed banks are non-persistent (short-lived) and individual seeds do not survive past six months under field conditions. Seeds begin germinating after the first fall rains and continue through the spring.

Jubata grass occurs primarily along coastal habitats associated with disturbed areas, dunes, bluffs, roadsides, road-cuts, logged forests, coastal shrubs, grasslands, and adjacent inland areas with maritime influences. It is highly competitive with native plants, often overtaking natives and forming dense monocultures. Jubata grass occurs across VAFB, where it reduces the quality and quantity ofmaritime chaparral and swale habitats (MSRS 2018b). Disturbed areas contain the highest concentration of infestations. Jubata grass infestations can alter the hydrology of wetland habitats through water uptake, often times limiting surface water availability and can also cause anoxic conditions in pools due to the deposition of organic material.

4.3 Cape Ivy (*Delairea odorata*)

Cape ivy is native to South Africa. It is a green, glabrous, fleshy perennial vine with broad deltate (triangular-shaped) leaves that are 1-4 in (2.5-10.2 cm) long and comprised of 5-9 lobes. Foliage is evergreen in mild climates and deciduous in more temperate regions. Stems can spread up to 30 ft (9.1 m), creating thick creeping mats that can grow up trees and shrubs. This species produces clusters of yellow disk flowers about 0.20 in (5 mm) long. The achenes (dry fruits) are 0.08-0.12 in (2 to 3 mm) long and contain a pappus which can distribute seeds by wind (DiTomaso et al. 2013). Most seeds are not viable due to a lack of effective pollinators, but Cape ivy dispersal and colonization via seeds has been confirmed in California (Balciunas 2001).

Cape ivy occurs along the coasts of California, Oregon, and Hawaii. It requires year-round moisture and does not tolerate full sun. It is commonly found in riparian corridors, seasonal wetlands, coastal habitats, moist canyons, and disturbed sites, such as roadsides and waste places, and can tolerate serpentine soils and drought conditions.

On VAFB, infestations occur Base-wide within non-native grassland, central coastal scrub, maritime chaparral, and central coast arroyo willow riparian forest. It is extensive throughout the Santa Ynez River corridor and the Bear Creek watershed (MSRS 2018b). Where infestations have established via aggressive vegetative spread, cape ivy forms a dense smothering cover over other vegetation, reducing native species richness and seedling recruitment. Cape ivy can also contains pyrrolizidine alkaloids (liver toxins), which are harmful when ingested and can kill fish if plant materials soak in waterways.

4.4 Tamarisk (*Tamarix* spp.)

Tamarisk species are difficult to separate outside of their native range and likely hybridize extensively, so are commonly lumped. The plants are small deciduous trees or shrubs with small, alternate, scale- or awl-like leaves. Leaves clearly overlap each other and have acute tips. Smallflower tamarisk (*Tamarix parviflora*) is the shortest of the species and grows to about 15 ft (4.6 m) tall. Saltcedar (*T. ramosissima*), French tamarisk (*T. gallica*), and Chinese tamarisk (T. chinensis) grow to about 20 ft (6.1 m) tall. Foliage is usually more blue-green than smallflower tamarisk. Inflorescences are comprised of racemes, 0.12-0.20 in (3-5 mm) wide and occasionally panicle-like. Flowers are white or pale to dark pink, with five sepals, petals, and stamens. Smallflower tamarisk flowers are usually pale to dark pink and develop four sepals, petals, and stamens. Saltcedar and Chinese tamarisk hybridize extensively in the United States - this particular hybrid has high seed viability and is the most common invasive tamarisk species of the west. Other hybrids between saltcedar, Chinese tamarisk, smallflower tamarisk, Canary Island tamarisk (*T. canariensis*), and French tamarisk exist to a lesser extent than the saltcedar and Chinese tamarisk variant, adding further confusion in identifying Tamarix species. Seeds are very small and contained within a capsule less than 0.20 in (5 mm) long (DiTomaso 2013 et al., MSRS 2018b).

Infestations occur Base-wide in a variety of habitats, such as: coastal brackish marsh, non-native grasslands, disturbed/developed areas, coastal bluffs, coastal sage scrub, and central coast arroyo willow riparian forest. Tamarisk species can infest an entire watershed with dense stands that can seriously reduce surface and ground water resources through high rates of transpiration. Rapid water uptake to support transpiration concentrates salts in leaf tissues, and when leaves drop to the ground, they deposit salt onto the soil surface, resulting in limited growth, survival, and recruitment of desirable vegetation. Tamarisk trees can also increase flood and fire hazards in habitats that are not accustomed to these threats. Some animals will utilize tamarisk thickets for nesting and cover but will generally not consume any part of the plant (MSRS 2018b).

4.5 Iceplant (*Carpobrotus* spp.)

Two species of iceplant, *Carpobrotus edulis* and *C. chinensis*, hybridize and intergrade, making differentiation of the species problematic. However, impacts and treatments for the two are similar, so they are frequently referred to as *Carpobrotus* spp. or iceplant. Originally imported as a landscaping plant and soil stabilizer from South Africa, this plant is primarily invasive in coastal areas of California. It will invade sandy areas and increase organic material in the soil, allowing invasion by other non-native species that otherwise would not tolerate sandy conditions. It is spread by animals ingesting fruits, and as such has the ability to constantly re-invade treated sites (DiTomaso et al. 2013). Although the species is still occasionally planted for slope stabilization, it has generally fallen out of favor for that purpose. The shallow roots combined with heavy biomass can actually contribute to slope destabilization. In fact, the mulch left over from controlling iceplant is likely to be a better protector of the slope, while still encouraging recruitment of natives within the mulch layer.

On VAFB, iceplant hampers proper functioning of sand dunes and invades sandy habitats uncluding chaparral (MSRS 2018c). It also impacts ephemeral wetlands, such as vernal pools,

where the biomass contributes to anoxic conditions in the pools when they fill. The combination of vegetative spread and seed dispersal makes iceplant a particularly virulent invader. After initial colonization, dense infestations can develop and smother native vegetation, preventing recolonization of native species.

4.6 Eucalyptus (*Eucalyptus* spp.)

A variety of eucalyptus species have been introduced to California from Australia and the surrounding region. The most problematic of these species is Tasmanian blue gum (*Eucalyptus globulus*). These are fast growing, tall trees that can reach heights up to 180 ft (54.9 m) tall and 7 ft (2.1 m) wide. The trunks are usually straight, with fissured and rough to smooth, dark to light bark. Leaves can be large (up to 8 in [20 cm] long), dark green to gray, glossy, narrowly lanceolate to ovate, slightly curved, and vertically hanging. Flowers can be yellow, white, pink, or red. Fruits are usually hard, woody capsules up to 1 in (2.5 cm), with broad to round tops and multi-sided or globular in shape (MSRS 2018b).

Eucalyptus are perennial and blooming periods range from winter to summer. Large eucalyptus species can disperse seeds hundreds of feet from parent trees, leading to rapid spread outside of initial planting or colonization areas. Seeds can also be spread greater distances by water and soil movements. Animal and human activities also distribute seeds very long distances. They can germinate a few weeks after being released from capsules, but can also persist for several years under dry conditions. This persistent seed bank necessitates many years of follow-up monitoring to ensure full control.

Eucalyptus are found primarily in the coastal regions of Hawaii and California, where they tend to favor disturbed areas in riparian and coastal habitats. Intentionally planted groves can expand into scrub, woodland, or grassland. They grow best in well-drained soils.

On VAFB, eucalyptus infestations occur Base-wide in a variety of riparian and upland habitats. Tasmanian blue gum, in particular, has established dense monoculture stands in many areas across Base, including San Antonio Creek, Santa Ynez River, Bear Creek, and Cañada Honda (MSRS 2018b). Eucalyptus trees are highly flammable, drop large amounts of branches and leaves, have allelopathic properties, and draw enormous amounts of water out of aquatic systems. On VAFB, most eucalyptus infestations have formed by spreading from wind rows and other landscape plantings. Infestations decrease habitat values and can have significant impacts on many threatened and endangered species. Some coastal stands, including those along Surf Road, provide wintering habitat for monarch butterflies (*Danaus plexippus*).

5 Discussion of Factors Influencing Aquatic Pesticide Use

The selection of and decision to use an aquatic herbicide is based on the recommendation of the Installation Pest Management Coordinator (IPMC) or a Pest Control Advisor (PCA). The IPMC will also consult with the Natural Resources Manager (NRM) and a PCA to consider the available control options and application methods, described in Section 6. The NRM will identify sensitive areas and resources and delineate buffers and identify applicable avoidance and minimization measures. Options may include mechanical and cultural techniques that, alone or in combination

with chemical controls, are the most efficacious and protective of the environment. Evaluating all potential control methods is part of VAFB's integrated pest management approach; therefore, a non-pesticide control method, such as mechanical removal, may be selected. Non-pesticide control options are described in detail in Section 11; however, they are generally not cost effective on large scales, are very time consuming, and often result in greater detrimental impacts to habitats than the use of herbicides.

Aquatic pesticides may be used when an infestation of weeds is impeding stream flow, negatively impacting water quality, or potentially degrading habitat of species listed under the Endangered Species Act (16 U.S.C. 1531 et seq.). Aquatic pesticides may also be used before the infestation reaches this threshold where they are reasonably predicted to cause future problems. As such, the invasvie species may be treated when younger or at relatively low densities. Treating them before they mature or reach thresholds reduces the amount of herbicide needed as well.

Appropriate aquatic herbicides and rates of application will be selected based on the target weed, growth state, product label requirements, regulatory requirements, and constraints, such as access considerations or sensitive natural resources.

6 Aquatic Pesticides and Application Methods

Table 6-1 summarizes the herbicides proposed for use, application methods, and degredation byproducts. All herbicide use will follow California DPR requirements and manufacturer label guidelines. The wetland approved surfactant Agridex®, a blend of paraffin-based petroleum oil and nonionic emulsifiers, will be used with all of the herbicides listed in Table 6-1 to increase cuticle penetration, improve coverage and canopy deposition, and reduce evaporation and volatilization.

Table 6-1. Aquatic pesticide products used by VAFB.

Herbicide	Methods	Degradation Byproducts^
Glyphosate	Backpack sprayer; handgun (Power sprayer); rope wick, paint or sponge; ULV sprayer*	- Aminomethylphosphonic acid (AMPA)
Imazapyr		- Pyridine hydroxy-dicarboxylic acid - Pyridine dicarboxylic acid (quinolinic acid) - Nicotinic acid
Triclopyr-choline		- 2-(3,5,6-trichloro-2-pyridinyl)oxy

* ULV = ultra-low volume sprayer that dispenses an atomized mist of concentrated chemical under a drift-containing hood (e.g. Mankar®).
^ Source: Aquatic Plant Management Fact Sheets (https://dnr.wi.gov/lakes/plants/factsheets/)

Targeted herbicide application will be conducted using backpack sprayer, power skid sprayer, rope wick, paint brush, sponge, or ultra-low volume (ULV) sprayer. The method employed will depend on degree of precision necessary, target species, extent of infestation, accessibility, landscape setting (terrain), and environmental constraints. A brief description of each method and their pros and cons are described in Table 6-2.

Table 6-2. Overview of application methods and pros and cons.

Application Method	Description of Technique	General Benefit	General Cons
ULV Sprayer	Dispenses an atomized mist of concentrated chemical under a drift-containing hood	Fine scale control of herbicide application	Inefficient in tall vegetation, no ability to mark treated areas
Rope Wick, Paint, or Sponge	Hand application directly dispenses liquid herbicide on contact with target plant, avoids drift problems associated with sprayed herbicides	Allows fine scale control of herbicide application	Inefficient for large areas
Backpack Sprayer	Designed for a single person to carry. Dispenses variable sized particles depending on environmental conditions to decrease drift	Moderate control of herbicide application	Inefficient for large areas, physically demanding for personnel, time consuming
Power Skid Sprayer	Truck or ATV-mounted spray rig with adjustable nozzle and up to 600-ft hose used to spot-spray areas next to established access points	Efficiently spot treats large areas	Increased likelihood of herbicide drift compared to the aforementioned treatment methods
Truck Boom Sprayer	Truck-mounted spray rig with boom to apply continuous coverage of herbicide	Efficiently treats large infestations on flat ground	Coarse control, not suitable for areas with significant slope, topography, or woody vegetation

7 Gates and Control Structures

There are no gates or control structures within the water and wetlands located on VAFB.

8 State Implementation Policy (SIP) Section 5.3 Exception

VAFB is not planning to use copper or acrolein to control aquatic vegetation; therefore, a SIP Section 5.3 Exception is unnecessary.

9 Monitoring and Reporting Program (MRP)

This MRP is designed to comply with Attachment C of the General Permit and addresses two key questions:

1) Does residual aquatic herbicide discharge cause an exceedance of receiving water limitations?
2) Does the discharge of residual aquatic herbicides, including active ingredients, inert ingredients, and degradation byproducts in any combination cause or contribute to an exceedance of the “no toxics in toxic amount” narrative toxicity objective?

The monitoring program in this APAP must describe the tasks and time schedules in which these two key questions will be addressed. Monitoring must take place at locations that are being

planned to be applied or may be applied as described in this APAP. The goals of the MRP are as follows:

1) Identify and characterize algaecide or aquatic herbicide application projects conducted by the Discharger.
2) Determine compliance with the receiving water limitations and other requirements specified in this General Permit.
3) Measure and improve the effectiveness of the APAP.
4) Support the development, implementation, and effectiveness of BMPs.
5) Assess the chemical, physical, and biological impacts on receiving waters resulting from algaecide or aquatic herbicide applications.
6) Assess the overall health and evaluate long-term trends in receiving water quality.
7) Demonstrate that water quality of the receiving waters following completion of resource or weed management projects are equivalent to pre-application conditions.
8) Ensure projects that are monitored are representative of all algaecide or aquatic herbicide and application methods used by the Discharger.

The MRP in this APAP is designed to meet these goals.

9.1 Monitoring Procedures

Monitoring will be conducted for all active ingredients at locations that are described in Section 2 of this APAP and below. Monitoring will include visual, physical, and chemical monitoring on a pre-determined schedule that includes background monitoring, event monitoring, and post-event monitoring, as described below.

9.1.1 Monitoring Locations and Frequency

Water quality sampling for glyphosate will be conducted for one application event from each location where glyphosate application occurs. Locations include the four perennial riverine riverine systems (San Antonio Creek, Santa Ynez River, Canada Honda, Jalama Creek), Shuman Creek, Bear Creek and other intermittent streams, lakes and vernal pools. In riverine systems, water quality sampling will be conducted for each flowing water and non-flowing water setting if applications in each of these settings occur. For applications of all other herbicides listed in Table 6-1, sampling will be conducted for at least five application events for each active ingredient in each location and each flowing and non-flowing water setting in riverine locations per year. If less than five application events of an active ingredient within an environmental setting occur within a year, sampling will occur for each event. If the results from five consecutive sampling events show concentrations that are less than the applicable receiving water limitation, VAFB will reduce the sampling frequency for that active ingredient to once annually for each environmental setting. If the annual sampling shows an exceedance within the applicable receiving water, VAFB will return to a minimum of five sampling events per year.

Sites will be chosen to represent variation in treatment areas, include hydrology, conveyance, impoundment type, etc. Exact locations will be determined after site scouting and determination

that an herbicide application will be conducted. Background, event, and post-event monitoring will be conducted as described below.

Background Monitoring

In moving water, the background sample will be collected upstream of the treatment area at the time of the application event, or in the treatment area within 24 hours prior to the start of the application.

For static water, the background sample will be collected in the treatment area within 24 hours prior to the start of the application.

Event Monitoring

The event monitoring sample for flowing water will be collected immediately downstream of treatment area immediately after the application event, but after sufficient time has elapsed such that treated water would have exited the treatment area.

The event monitoring sample for non-flowing (static) water will be collected immediately outside the treatment area immediately after the application event, but after sufficient time has elapsed such that treated water would have exited the treatment area.

The location and timing for the collection of the event monitoring sample will be based on a number of factors including, algae and aquatic weed density and type, flow rates, size of the treatment area, and duration of treatment.

Post-Event Monitoring

The post-event monitoring sample will be collected within the treatment area within one week after the application.

9.1.2 Visual Monitoring

Visual monitoring will be performed for all aquatic herbicide applications at all sites. Qualified personnel will look for, record, and describe any evidence of floating materials, sheen, suspended materials, odors, water discoloration, and water clarity. These visual observations will be recorded for background monitoring, event monitoring, and post-event monitoring for all sample sites (see *Aquatic Herbicide Field Monitoring & Sampling Forms*, Appendix A).

9.1.3 Field Measurements

In conjunction with sample collection, a variety of physical parameters will be measured during sample collection. These will include temperature, turbidity, electrical conductivity/salinity, pH, and dissolved oxygen (see *Aquatic Herbicide Field Monitoring & Sampling Forms*, Appendix A).

9.1.4 Sample Collection

If the water depth is six or more feet (1.83 m), the sample will be collected at a depth of three feet. If the water depth is less than six feet, the sample will be collected at mid-depth. Samples will be collected in a manner that minimizes the amount of suspended sediment and debris in

the sample and minimizes loss of monitored constituent. Sample collection locations may be adjusted if access or other problems are encountered in the field.

One full set of three samples (i.e., background, event monitoring and post-event monitoring) will be collected during each treatment, according to the monitoring frequency and locations described above. Additionally, one field duplicate (FD) and one field blank (FB) will be collected during each sampling event and submitted for analysis for each analyte.

9.1.5 Sample Preservation and Transportation

If preservation is required for the monitored constituent, the preservative will be placed in the the container by the analytical laboratory or vendor prior to sample collection. Once a sample is collected and labeled it will immediately be placed in a dark, cold environment, which is typically an ice chest with ice. Delivery to the laboratory will typically occur on the same day of sample collection.

9.1.6 Sample Analysis

All samples requiring laboratory analyses will be collected and analyzed by a laboratory certified for such analyses by the California Department of Public Health. All analyses will be conducted in accordance with the latest edition of Guidelines Establishing Test Procedures for Analysis of Pollutants (Guidelines), promulgated by the U.S. Environmental Protection Agency (EPA) per the Code of Federal Regulations Title 40 Section 136. Field analysis for the parameters of temperature, dissolved oxygen, electrical conductivity, and pH may be performed using a portable multi-parameter meter. The meter(s), will be maintained and calibrated at regular intervals according to the manufacturer specifications. Table 3 shows the required analyses for each sampling event.

Table 9-1. Required sample analyses.

Analyte	EPA Method	Reporting Limit	Hold Time (days)	Container	Preservative
Temperature	Field Test[ł] or 170.1	N/A	N/A	N/A	N/A
Turbidity	Field Test[ł] or 180.1	0.02 NTU	2	100 mL HDPE	None
Electrical Conductivity	Field Test[ł] or 120.1	1 µS/cm at 25°C	28	100 mL HDPE	None
pH	Field Test[ł] or 150.1 or 150.2	0.1 SU	Immediately	100 mL HDPE	None
Dissolved O_2	Field Test[ł] or 360.1 or 360.2	1.0 mg/L	Immediately	250 mL Amber Glass	None
Triclopyr*	8151-modified	0.1 µg/L	7	1 L Amber Glass	None
Glyphosate*	547	0.5 µg/L	14	2 x40 mL VOA or other glass container	sodium thiosulfate

Imazapyr*	8321	1 µg/L	7	1 L Amber Glass	None

Abbreviations: °C – degrees Celsius, µg/L – microgram per liter, µS/cm – microSiemens per cm, L – liter, mg/L – milligram per liter, mL – milliliter, , HDPE- high density polyethylene (plastic) bottle, N/A - Not applicable, NTU – nephelometric unit, SU - Standard Units, VOA - Volatile Organic Analyte vial

* Active ingredient (herbicide). Chemical analysis is only required if the active ingredient(s) is used in treatment.

[ł] Field test with calibrated portable instrument.

9.2 Sampling Guidelines

The purpose of this section is to present methods and guidelines for the collection and analysis of samples necessary to meet the APAP objective of assessing adverse impacts, if any, to beneficial uses of water bodies treated with algaecides and aquatic herbicides.

This section describes the techniques, equipment, analytical methods, and quality assurance and quality control (QA/QC) procedures for sample collection and analysis. Guidance for the preparation of this section included the *National Pollutant Discharge Elimination System Storm Water Sampling Guidance Document* (EPA 1992), *Guidelines and Specifications for Preparing Quality Assurance Project Plans* (EPA 1980), and the *National Field Manual for the Collection of Water Quality Data* (United States Geological Survey 1995).

9.2.1 Sample Containers

Clean, empty sample containers with caps will be supplied in protective cardboard cartons or ice chests by the analytical laboratory. The containers will be certified clean by either the laboratory or the container supplier. To ensure data quality control, the sampler will use the appropriate sample container as specified by the laboratory for each sample type (see Table 3). A label will be affixed to each container indicating a discrete sample number, as well as the location, date and time of sampling, and the sampler's name and type of sample.

9.2.2 Sampling Equipment Cleaning

If sampling equipment will be used in more than one location, the equipment will be thoroughly cleaned with a non-phosphate cleaner, triple-rinsed with distilled water, and then rinsed once with the water being sampled prior to its first use at a new sample collection location.

9.2.3 Sample Packing and Shipping

All samples are to be packed and transported the day the samples are collected to provide ample time for samples to be analyzed within the required holding time. Ice packs will be included in ice chests containing samples that require temperature control. A chain of custody (COC) will be placed inside a plastic bag and placed inside the ice chest (see following section).

9.2.4 Chain of Custody

The COC record will be employed as physical evidence of sample custody. The sampler will complete a COC record to accompany each sample shipment from the field to the laboratory. The COC will specify: time, date, location of sample collection, specific and unique sample

number, requested analysis, sampler name, required turnaround time, time and date of sample transaction between field and laboratory staff, preservative, if any, and name of receiving party at the laboratory.

Corrections to the COC will be made by drawing a line through, initialing, and dating the error, and entering the correct information. Erasures are not permitted. Upon receipt of the samples, laboratory personnel will check to ensure that the contents of the ice chest(s) are accurately described by the COC. Upon verification of the number and type of samples and the requested analysis, a laboratory representative will sign the COC, indicating receipt of the samples.

The COC record form will be completed in duplicate. Upon sample delivery, the original copy will be left with the laboratory and a copy will be kept by the sampler, either electronically (as a scan) or three-hole punched, and placed in the field logbook.

9.2.5 Field Logbook

A logbook will be maintained by members of the sampling team to provide a record of sample location, significant events, observations, and measurements taken during sampling. Entries will be signed and dated. Field data will be recorded with permanent ink. Field logbooks are intended to provide sufficient data and observations to enable project team members to reconstruct events that occurred during the sampling. The field logbook entries will be legible, factual, detailed, and objective.

9.2.6 Alteration of Sampling Techniques

Actual field conditions may require a modification of the procedures outlined in this APAP. Specifically, water levels, weather, other environmental parameters and hazards including stream flow, rainfall, and stormwater may pose access and/or sampling problems. In such instances, variations from standard procedures and planned sampling locations and frequencies will be documented by means of appropriate entry into the field logbook.

9.2.7 Flow Estimation

A flow meter calibrated according to the manufacturer's directions will be placed as close to the center of the stream or creek as possible and a reading taken in feet per second. Alternatively, the time a common floating object (branch, leaf, etc.) travels a known distance will be estimated and represented in feet per second. If feasible, a minimum distance of approximately 25 feet will be used. Flow estimation measurements will be made for all moving water sampling locations.

9.2.8 Corrections to Documentation

Documents will not be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement or correction. If an error is made on a document used by an individual, that individual will make corrections by making a line through the error and entering the correct information. Corrections will be initialed and dated.

9.2.9 Document Control

A central file location will be established and used to store documentation such as the field logbook and laboratory data. These documents will be stored by the individual or contractor collecting the water samples in compliance with this APAP.

9.2.10 Sample Kit

Prior to departing to the field to collect samples, the following equipment will be prepared for use:

- Laboratory-supplied sampling bottles (one set for each sample to be collected plus spares, plus QA/QC samples)
- Sample labels (one for each sample container to be collected plus spares)
- Permanent, water-proof ink marker or pencil
- COC forms
- Field data logbook
- Flow meter (optional for moving water applications)
- Ziploc-type bags for paperwork
- Non-phosphate cleaner (e.g., Liqui-Nox®)
- Deionized or distilled water
- Ice or blue ice packs
- Clear mailing tape
- Plastic ice chest(s)
- Grab pole
- Gloves
- Rubber boots
- Stop or wrist watch

9.3 Quality Assurance/Quality Control

The purpose of QA/QC is to assure and control the quality of data generated during sample collection and analysis as described earlier in this document. Quality assurance and quality control are measured in a variety of ways, as described below.

9.3.1 Precision

Precision is a measure of the reproducibility of measurements under a given set of conditions. It is a quantitative measure of the variability of a group of measurements compared to the average value of the group and is expressed as the relative percent difference (RPD). Sources of error in precision (imprecision) can be related to both laboratory and field techniques. Specifically, lack of precision is caused by inconsistencies in instrument setting, measurement and sampling techniques and record keeping. Laboratory precision is estimated by generating analytical laboratory matrix spike (MS) and matrix spike duplicate (MSD) sample results and calculating RPD. In general, laboratory RPD values of less than 25 percent will be considered acceptable.

Field precision is estimated by collecting FD's in the field and calculating RPD. In general, field RPD values of less than 35 percent will be considered acceptable.

9.3.2 Accuracy

Accuracy is a measure of how close data are to their true values and is expressed as percent recovery (%R), which is the difference between the mean and the true value expressed as a percentage of the true value. Sources of error (inaccuracy) are the sampling process, field contamination, preservation, handling, sample matrix effects, sample preparation, analytical techniques and instrument error.

Laboratory accuracy is estimated using reference standards and MS and MSD samples. Acceptable accuracy is between 75 and 125 percent. Field accuracy cannot be measured as true field values are not known.

9.3.3 Completeness

Completeness is defined as the percentage of measurements made which are judged to be valid measurements. The completeness objective is that sufficiently valid data is generated to allow for submittal to the Water Board. Completeness will be assessed by comparing the number of valid sample results to the number of samples collected. The objective for completeness is 80 percent.

9.3.4 Representativeness

Representativeness refers to a sample or group of samples that reflects the predominant characteristics of the media at the sampling point. The objective in addressing representativeness is to assess whether the information obtained during the sampling and analysis represents the actual site conditions.

9.3.5 Field Duplicate (FD)

The purpose of an FD is to quantify the precision, or reproducibility, of the field sampling technique. It involves the duplication of the technique used for a particular field sample collection method and the subsequent comparison of the initial and duplicate values. This comparison is measured as the relative percent difference (RPD). RPD is calculated as follows:

RPD = [(Sample 1 – Sample 2) / (Average of Samples 1 and 2)] X 100

An acceptable field RPD value is 35 percent. The FD is collected at the same time as the actual field sample and one FD per year will be collected.

9.3.6 Field Blank (FB)

The purpose of the FB is to assure that the field sampling technique, equipment, or equipment cleaning technique or materials do not impart a false positive or negative result during the collection of the sample. A FB will be prepared with distilled water or equivalent and allowed to come into contact with the sampling device in a manner identical to the actual sample. The only

acceptable values for analytes in the FB are less than the reporting limits for the compounds of interest, or an expected, previously determined, background value. A FB will be collected at the same time as the actual field sample.

9.3.7 Laboratory Quality Assurance and Quality Control

Laboratory precision and accuracy will be monitored by a series of laboratory-generated quality control samples. As long as sufficient sample volume is collected and submitted to the laboratory, no additional effort is required by field activities to generate laboratory quality control samples. Each set of field samples will have associated with it the following set of laboratory quality control samples.

Method Blank (MB)

The purpose of an MB is to assure that the analytical technique does not impart a false positive result during the preparation or analysis of the sample. An MB will be prepared by the laboratory from high purity distilled or deionized water. The only acceptable values for analytes in the MB are half the reporting limit or an expected, previously determined, background value.

Matrix Spike (MS)

The purpose of an MS is to quantify accuracy and to assure that the analytical technique does not impart a false negative or positive result during the preparation or analysis of the sample. It involves the introduction of the analyte (or an analyte surrogate) of interest into the actual sample matrix and then quantitating it.

The amount detected divided by the amount added to the matrix is expressed as %R. Acceptable values of %R range from 75 to 125 percent. Percent recovery is calculated as follows:

%R = [(Spike Amount Detected- Sample Value) I Amount Spiked] x 100

Matrix Spike Duplicate (MSD)

The purpose of an MSD is to quantify laboratory precision. An acceptable RPD is less than or equal to 25 percent. The MSD involves duplication of the MS resulting in two data points from which RPD is calculated as follows:

RPD = [(MS - MSD) I (Average of MS and MSD)] X 100

9.3.8 Data Validation

Data validation will use data generated from the analytical laboratory and the field. The criteria for evaluating data are summarized in Table 9-2. References that can be used to assist in data validation include *Contract Laboratory Program National Functional Guidelines for Superfund Inorganic Data Review* (EPA 2010) and *Contract Laboratory Program National Functional Guidelines for Superfund Organic Data Review* (EPA 2008).

The purpose of data validation is to ensure that data collected are of sufficient quality for inclusion in reports to the Water Board. In order to serve this purpose, the following information must be available in order to evaluate data validity:

1) Date of sample collection, required to identify sample holding time.
2) Location of samples, required to identify sample.
3) Laboratory QA/QC procedures, required to assess analytical accuracy, precision, and sample integrity. A laboratory QA/QC sample set consists of a MS, a MSD, and a MB. A laboratory QA/QC sample set will be analyzed by the laboratory for each field sample batch. Sufficient sample volume and number will be supplied to the laboratory in order to prepare and evaluate the laboratory QA/QC sample set.
4) Analytical methods, required to assess appropriateness and acceptability of analytical method used.
5) Detection limits, required to assess lower limit of parameter identification.
6) Holding times, preservation, and dates of extraction and analysis, required to assess if a sample was extracted and analyzed within the specified time limits and if a sample was stored at the appropriate temperature.
7) Field QA/QC procedures, required to assess field precision and sample integrity. A field QA/QC sample set consists of FB and FD samples. A field QA/QC sample set will be analyzed by the laboratory for one sampling event per year. Sufficient sample volume and number will be collected in the field and supplied to each laboratory in order to prepare and evaluate the field QA/QC sample set.

Table 9-2. Summary of QA/QC sample analysis actions, and validation criteria.

QA/QC Sample	Action Required	QA/QC Parameter Estimated	Value Required for Validation
FB	Collect in Field	False Negative/Positive	0 or no more than 20% of known background
FD	Collect in Field	Precision	RPD ≤ 35%
MS	Prepared in Lab	Accuracy	75 < %R < 125%
MSD	Prepared in Lab	Precision	RPD < 25%
MB	Prepared in Lab	False Negative/Positive	0 or no more than 20% of known background

9.3.9 Data Qualification

Data collected for compliance with the Permit will be qualified through the analytical laboratory data validation process described in above. This process will ensure all data has been thoroughly reviewed and qualified as valid. During the data validation process, data qualifiers will be used to classify sample data. The following qualifiers will be used:

- A:Acceptable. The data have satisfied each of the sampling and analysis requirements and are quantitatively acceptable (i.e., valid) and will be used for compliance purposes.
- R: Reject. Data not valid. This qualifier will be used for samples that cannot be uniquely identified by date of collection or sample location or that fail holding time, detection limit

requirements, or criteria established in Table 9-2. Invalid data will not be presented in reports submitted to the Water Board.

9.3.10 Corrective Action

Field or Laboratory QA/QC Exceedance

If previously described criteria for valid data are not met, then corrective action as follows will be taken:

1) The laboratory will be asked to check their QA/QC data and calculations associated with the sample in question. If the error is not found and resolved, then:
    a. The extracts or the actual samples, which will be saved until the data are validated, will be reanalyzed by the laboratory if they are within holding time limitations. These new results will be compared with the previous results. If the error is not found and resolved, then:
    b. If field analytical equipment is used, then calibration records will be reviewed. If the error is not found, then:
    c. The sampling procedure and sample preparation will be re-checked and verified. If the procedures appear to be in order and the error is not resolved, then:
    d. The data will be deemed invalid and not used.
2) Upon discovery of the source of an error, all reasonable attempts will be made to address the cause of the error and remedy the problem.

9.4 Procedures to Prevent Sample Contamination

Measures will be taken to prevent sample collection contamination from persons, equipment and vehicles associated with algaecide and aquatic herbicides application, as follows:

- Background monitoring sample collection will be carried out prior to application equipment or algaecides/aquatic herbicides being handled.
- Background monitoring sampling, as well as post event monitoring sampling (within one week), if appropriate, may be carried out from shore within the sampling areas to eliminate the potential for contamination.
- Sampling equipment, with particular emphasis on ice chest and sample bottles, will be transported separately from aquatic herbicides and application equipment on the day of the application event.
- Background monitoring will take place prior to the application event.
- For event monitoring, sampling will be carried out after application equipment and all application related equipment and devices including personal protection equipment used during the application has been removed from the sampling location or boat (if used), if no other boats are available to support sampling efforts.
- If possible, sample collection will be done no closer than 50 feet from application equipment and preferably upwind. If there are multiple personnel supporting applications, one will be designated the sample collector while the other will be responsible for boat operation.

- During sample bottle handling and sample collection, disposable rubber gloves will be used when collecting a water sample. Gloves will be changed between sampling locations.
- The pre-labeled sample bottle will be completed with time and date of sample collection immediately after removing from the sample ice chest and replaced in the ice chest immediately after sample collection.
- In the event that sampling equipment will be used in more than one location, the equipment will be thoroughly cleaned with a non-phosphate cleaner, triple-rinsed uncontaminated water, and then rinsed once with the water being sampled prior to its first use at a new sample collection location.
- Once sampling has been completed, water samples will be delivered immediately to the laboratory, if possible.
- If background and event samples cannot be delivered on the same day, sample bottles will be stored in a clean refrigerator or ice chest with adequate ice until samples can be delivered the next business day.

9.5 Reporting Procedures

9.5.1 24-Hour and 5-Day Reporting

The discharger and or applicator will orally report any non-compliance. This will include any unexpected or unintended effect of the use of an algaecide or aquatic herbicide that may danger health or the environment. This information will be provided orally within 24 hours from the time the discharger or applicator becomes aware of the circumstances. A written report of the noncompliance will be provided within 5 days of the time the discharger and or applicator becomes aware of the noncompliance.

9.5.2 Annual Report

An annual report for each reporting period, from 1 January to 31 December will be prepared and submitted by 1 March of the following year. In years when no aquatic herbicides are used, a letter stating that no applications were applied will be submitted in lieu of an annual report. The Annual report will be submitted to the appropriate Deputy Director and Regional Board Executive Officer. All reports submitted in response to the Water Quality Order will comply with the provisions stated in the Standard Provisions and Monitoring and Reporting Program of the General Permit. The Annual Reports will contain the following information:

1) An executive summary discussing compliance or violation of the General Permit and the effectiveness of the APAP to reduce or prevent the discharge of pollutants associated with the aquatic herbicide applications.
2) A summary of monitoring data, including the identification of water quality improvements, or degradation as a result of the aquatic herbicide application, if appropriate, and recommendations for improvements to the APAP, including proposed BMPs and monitoring program based on the monitoring results. All receiving water

monitoring data will be compared to receiving water limitations and receiving water monitoring triggers.

3) Identification of BMPs and a discussion of their effectiveness in meeting the Permit requirements.
4) A discussion of BMP modifications addressing violations of the Permit, if applicable.
5) A map showing the location of each treatment area.
6) Types and amounts of aquatic herbicides used at each application event during each application.
7) Information on surface area and/or volume of treatment area and any other information used to calculate application rates, concentration, and quantity of each aquatic herbicide used.
8) Sampling results shall indicate the name of the sampling agency or organization, detailed sampling location information (including latitude and longitude), detailed map or description of each sampling area, collection date, name of constituent/parameter and its concentration detected, minimum levels, method detection limits for each constituent analysis, name or description of water body sampled, and a comparison with applicable water quality standards, description of analytical quality assurance/quality control (QA/QC) plan. Sampling results shall be tabulated so that they are readily discernible.
9) Summary of Aquatic Pesticide Application Logs.

10 Description of Best Management Practices (BMPs)

10.1 Spill Prevention and Containment

Applicators mix and load aquatic herbicides and adjuvants carefully. All label guidelines are followed to ensure safe handling and loading of aquatic herbicides. All equipment is regularly checked and maintained to identify and minimize the likelihood of leaks developing or failure that would lead to a spill. Aquatic herbicides will be mixed and loaded prior to going to the application site, away from any jurisdictional waters or wetlands.

VAFB applicators are trained to properly respond to spills and use spill containment absorbant materials suitable for herbicides, which are readily available at work sites. If aquatic herbicides are spilled, they will be prevented from entering any waterbodies to the fullest extent practicable. Spills will be cleaned up according to label instructions, and all equipment used to remove spills will be properly contained and disposed of or decontaminated, as appropriate. Applicators will report spills as required by VAFB policy and in a manner consistent with local, state, and federal requirements.

10.2 Site Survey

During Base-wide invasive species surveys, qualified staff identified many invasive species stands and evaluated the extent to which acceptable aquatic weed thresholds had been exceeded. Many of these, including stands of giant reed, jubata grass, and eucalyptus, are currently exceeding these thresholds and are recommended for herbicide treatment. Others will be evaluated during additional site surveys. If a location is deemed to have exceeded a threshold or a weed

population is anticipated to exceed a threshold, an aquatic herbicide application will be considered. If the application can be made without negatively impacting the water quality, then the appropriate herbicide will be applied.

10.3 PCA and Qualified Applicator License (QAL) Review & Recommendations

Prior to performing treatments in aquatic environments, a biologist with a QAL and a PCA will review each weed infestation to be treated, review applicable product label(s) for control efficacy, determine the rates of application and any warnings or conditions that limit the application so that non-target flora and fauna are not adversely impacted, and notify the VAFB invasive species manager to receive concurrence on the recommended approach to treat each population. The PCA and/or QAL may place restrictions or prohibitions on aquatic herbicide applications based on site conditions to prevent impact to nontarget sensitive species that may be downwind or downstream of the application area. Other factors considered by the PCA and QAL include day length, existing or anticipated precipitation, wind conditions, current and anticipated water exchange and water depth and movement. If treating a target weed stand within a body of water, applicators will possess a QAC or QAL with Category F "Aquatic".

10.4 Applications per Regulatory and Label Requirements

Aquatic herbicide applications will be made according to the product label in accordance with regulations of the EPA, DPR, and the local Agricultural Commissioner. VAFB regularly monitors for any updates and amendments to labels so that applications are always in accordance with label directions.

10.5 Applications Performed by Qualified Staff

Only QAC or QAL holders licensed by DPR will perform hebicide applications. Licensed applicators have knowledge of proper equipment loading, nozzle selection, calibration and operation so that spills are minimized, precise application rates are made according to the label, and only target plants are treated. QAC and QAL holders complete continuing education to stay licensed and are therefore up-to-date on the latest techniques for pest control.

10.6 Water Users Coordination

As required by the aquatic herbicide label, water users potentially affected by any water use restrictions will be notified prior to an application being made. There are currently no public agencies or downstream water users that need notification prior to treatments. If that changes, every calendar year at least 15 days prior to the first application of aquatic herbicide, VAFB will notify the potentially affected water users.

10.7 Evaluation of BMP Effectiveness

The effectiveness of BMPs will be continuously evaluated throughout each year, as well as through a detailed evaluation performed annually. If the results of the MRP indicated the detection of an aquatic herbicide, the BMPs used in that area will be reevaluated and modified as needed to address potential cause(s) for the presence of the aquatic herbicide detection. In

addition, feedback from field staff, including pest control efficacy, staff safety, and efficiency, will be solicited and reviewed as well.

11 Alternative Methods

11.1 No Action

No action will be taken on infestations that have not reached thresholds discussed in Section 6.0, above. In most cases, however, no action to control the invasive species identified within this APAP will result in their continued spread and degradation of sensitive habitats, water resources, and natural hydrology. In addition, no action will generally result in the necessity for larger, more impactful efforts to be conducted later if the populations are allowed to establish, become larger and more entrenched, and spread.

11.2 Early Detection & Prevention

VAFB employs strict guidelines and management practices to reduce the risk of new introductions or the spread of existing invasive species on Base. These include washing equipment before bringing them onto Base or moving them between sites, conducting spot checks of construction vehicles to ensure their cleanliness, weed free erosion materials when available, proactive surveys and monitoring to detect new invasives and a rapid response program to eliminate new invasives soon after they are identified and before they can spread.

11.3 Habitat Restoration

Restoration of native habitats helps prevent the introduction and spread of weed species as these habitats tend to be resistant to invasions. Establishing native vegetation in disturbed areas helps restore ecological functionality, hold niche space, and provide competition for non-desirable species, thus reducing the need for weed abatement. Restoration tends to be expensive and can take many years to establish self-sustaining sites that do not require routine maintenance. In addition to cost and time requirements, constraints include limited labor to plant native species, safe access to sites for work crews. Wherever practicable, VAFB includes the re-establishment of native vegetation where sites have been disturbed or invasive plants have been removed to reduce the need for additional weed control in the future.

11.4 Manual and Mechanical Removal

Manual and mechanized hand tool removal techniques may be used depending on the target species, access, and environmental considerations. These methods may be used independently or in concert with herbicide application (e.g. wick application after cut stump). Table 11-1 lists some examples of manual and mechanical methods that will be considered. The techniques used will be dependent on the species, amount of biomass, likelihood of destabilizing soils and causing erosion concerns, impacts to water quality, and potential impacts to sensitive species and habitats.

In general, manual and mechanical control methods are often expensive, labor intensive, less effective, cause disturbance and erosion issues, can spread plant propagules, and may impact water quality.

Table 11-1. Example manual and mechanical control methods.

Tool/Method	Description of Technique	General Benefit	General Cons
Cut Stump	Used to kill tree or shrub species that are unlikely to resprout	No herbicides, species-specific	Limited to few a species, generates biomass that may need to be removed
Cut Stump / Herbicide	Used to kill tree or shrub species that are likely to resprout	Minimal herbicide applied in a precise manner	Generates biomass that may need to be removed
Pull by Hand or Hand Tool	Used to remove small tree/shrubs or small infestations of herbaceous species	No herbicides, species-specific	Limited to a few species, generates biomass that may need to be removed, destabilizes soil, very labor and time intensive
Mulch	Organic material used to stunt growth and starve plants of light	No herbicides	Non-selective, only useful against seedlings, physically disruptive, may impact water quality

11.5 Grazing

Grazing is most effective for emergent and terrestrial weeds and is typically not suitable for weeds growing in or near an aquatic environment. Grazing may impact water quality from animal feces and trampling, increasing turbidity, nutrients, and bank erosion, and cause damage to desirable native species. Many weed species, such as eucalyptus and giant reed, are unpalatable for grazers. As a result, this option in unfeasible in most cases; however, grazing is being considered as a viable and desirable weed control option for reducing some invasives in vernal pool restoration and may be employed where suitable.

11.6 Cultural Methods

Cultural methods used to reduce the amount of aquatic herbicides applied include modifying the timing of aquatic herbicide and non-herbicide controls to prevent plants from reaching reproductive growth stages. Another cultural method is making applications before the density of the target species is great enough to require higher aquatic herbicide rates or additional applications to maintain weed populations below threshold levels.

11.7 Biological Control Agents

VAFB natural resources managers routinely search for new options to better control invasive species, including biological control agents. Recently, a gall-forming fly (*Parafreutreta regalis*) has been identified and undergone extensive testing as a potentially effective control method for Cape ivy by the United States Department of Agriculture – Agricultural Research Service (USDA-ARS). This gall-forming fly is native to eastern South Africa and has been subjected to extensive testing against 93 different species of plants most closely related to Cape ivy and determined to

be essentially monospecific; Cape ivy is its only host plant (Balciunas et al. 2010). Testing and release of this biological control agents is currently being considered to control Cape ivy on VAFB.

Biological control agents are well known to have potentially negative and unintended consequences on native habitats and must be carefully researched and validated before employing. Any of these options will undergo careful scrutiny before use in the future.

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