

Naval Auxiliary Landing Field San Clemente Island Biosecurity Plan

FINAL

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Acronyms and Abbreviations

APP	Accident Prevention Plan
BASH	bird airstrike hazard
BMP	best management practices
Cal-IPC	California Invasive Plant Council
CDFA	California Department of Food and Agriculture
CDFW	California Department of Fish and Wildlife
EO	Executive Order
ESA	Endangered Species Act
ft	feet
FOD	foreign object damage
FR	Federal Register
GPS	Global Positioning System
IAS	invasive alien species
INRMP	Integrated Natural Resource Plan
IPM	Integrated Pest Management
ISPM	International Standards for Phytosanitary Measures
KD	kiln-dried
Km	kilometers
LCAC	Landing Craft Air Cushion
m	meter
MarOps	Maritime Operations
MIS	marine invasive species
MOD	marine-origin debris
NALF SCI	Naval Auxiliary Landing Field San Clemente Island
NASNI	Naval Air Station North Island
NBSD	Naval Base San Diego
nm	nautical mile
NRO	Natural Resource Office
OSPR	Office of Spill Prevention and Response
TAR	Training Areas and Ranges
UXO	unexploded ordnance
SCB	Southern California Bight
SCI	San Clemente Island
SERG	Soil and Ecology Restoration Group
WPM	wood packaging materials
°C	degrees Celsius

1.0 Introduction

1.1 Background

Invasive species pose a perpetual and costly threat to islands' native ecosystems, ecosystem functions, biodiversity, watersheds, military missions, economies, public health, and the quality of life for island users. Islands throughout the world boast a unique assemblage of life and are notoriously vulnerable to biological invasions. Because of isolation from mainland species, island species are able to evolve without mainland pressures. The combination of isolation and time tends to result in the development of distinct genotypes and the emergence of highly specialized species or subspecies with new characteristics and unusual adaptations, such as gigantism, dwarfism, and loss of dispersibility and defense mechanisms. Population sizes and genetic diversity tend to be limited and species often become concentrated in small confined areas. These factors in combination with human impacts make island species more susceptible to extirpation, extinction, and displacement by invasive species than their mainland counterparts (Loope and Mueller-Dombois 1989).

For the reasons listed above, many island species are endemic—found nowhere else on Earth. Islands harbor higher concentrations of endemic species than do continents and the number and proportion of endemics rises with increasing isolation, island size, and topographic variety (Kier et al. 2009).

Biosecurity strategies and plans have been formulated for various archipelagos and specific islands around the world, including many island countries (e.g., New Zealand) to protect against biological invasion. According to the Food and Agriculture Organization of the United Nations, an appropriate definition for biosecurity would be a “strategic and integrated approach that encompasses policy and regulatory framework for analyzing and managing invasive species’ relevant risks to human, animal and plant life and health, and associated risks to the environment” (2010). Executive Order (EO) 13112 defines an invasive species as “an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health”.

While biosecurity can include post-incursion response as well as management of established invasive species (e.g. eradication, containment, and control) emphasis is usually focused on preventative measures. Minimizing the probability and the number of new invasions is usually viewed as the most cost-effective and desirable strategy to pursue, because it can be extremely difficult to eradicate or control species once they have become established (Wittenberg and Cock 2001). Even though prevention may be the best approach to minimizing impacts from potential invasive species, other strategies such as early detection/monitoring and rapid response to incursions should be incorporated into a thorough biosecurity plan.

Efforts to prevent the transport of potentially harmful species are usually directed at specific vectors and aim to reduce the magnitude and frequency of species transfers to particular areas. Such measures may also be directed at specific species; however, vectors are a more comprehensive and explicit focal point for management action in most cases. Thus, vector management is a central aspect of most efforts to prevent invasions, whether on land or in water.

1.2 Purpose and Scope

The purpose of this document is to outline a Biosecurity Plan for Naval Auxiliary Landing Field San Clemente Island (NALF SCI; SCI). The EO on Invasive Species (EO 13112) requires federal agencies whose actions may affect the status of invasive species to “identify such actions and use programs to prevent the introduction of invasive species, detect and respond rapidly to and control populations of such species, monitor, conduct research, and develop technologies to prevent the introduction of invasive species.”

Additionally, SCI’s Integrated Natural Resources Management Plan (INRMP) recognizes the need for a Biosecurity Plan recommending that SCI “develop and implement a Biosecurity Plan containing specific measures to identify and reduce threats to listed species, reduce the arrival of non-native species, and promote early detection of new arrivals” (Navy 2013).

Non-native species can and do result in physical encumbrances to military ranges. Invasive species can directly affect SCI’s military mission by increasing the risk of fire or indirectly affect military missions by invasive species’ ability to outcompete native species thereby limiting suitable native habitat. This can result in additional Endangered Species Act (ESA) listings of various SCI taxa. The establishment of a Plan supports the EO’s requirement to identify actions and programs that prevent the introduction of invasive species as well as supports SCI INRMP’s recommendation to reduce threats to listed species by providing actions that reduce the arrival of non-native species. The Biosecurity Plan thereby supports continued military operations on SCI by presenting incremental guidelines that either partially or comprehensively work to limit the introduction and spread of invasive species. For the purposes of this plan, all non-native species introductions will be treated as the potential to become invasive until proven otherwise.

The focus of this plan is on implementable prevention and response measures for the unique bio-invasion vectors for San Clemente Island. While the transport of cargo from the mainland to the island is a primary vector of concern, other vectors such as on-island sourcing of materials, construction and restoration activities, food and waste operations, personnel, and natural processes are also thoroughly considered. While the bio-invasion vectors and activities associated with these vectors are specific to SCI, the principles outlined herein can be used to make sound biosecurity decisions in addressing any potential introduction pathway, both current and future. And though this plan is meant to be comprehensive, there are limitations to its scope discussed in Section 2.1.

1.3 San Clemente Island

The southern-most island of California’s eight Channel Islands, San Clemente is located in the Southern California Bight (SCB) approximately 68 nautical miles (nm) (126 kilometers [km]) west of San Diego. The SCB is a recessed curve in the southwestern California coastline from Point Conception in Santa Barbara County to just south of the Mexican border and is a transitional area between many different water masses creating an area rich in biodiversity (Figure 1-1).

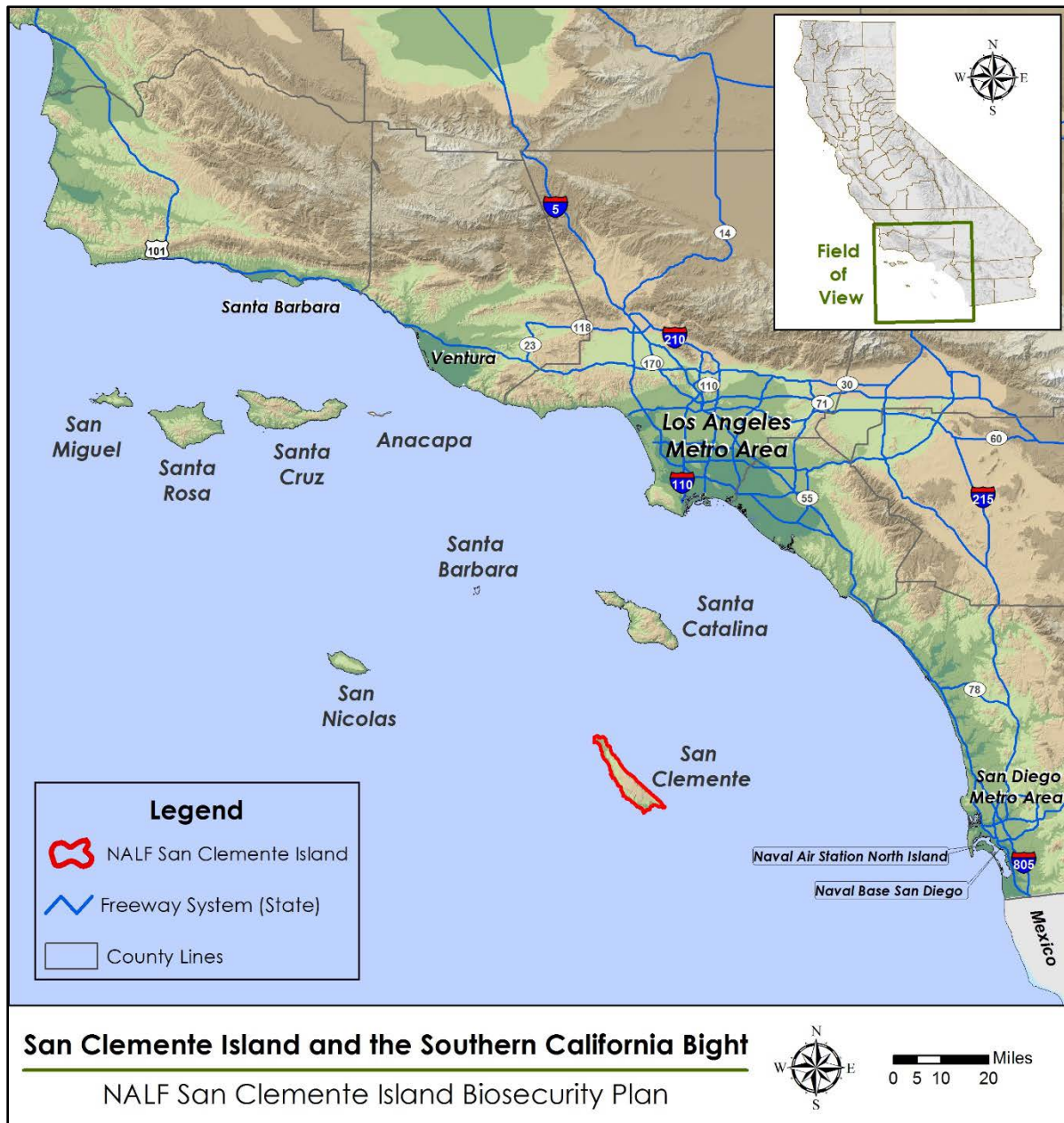


Figure 1-1. San Clemente Island's location relative to other Channel Islands within the Southern California Bight.

SCI harbors more endemic species than any other island in the Channel Islands archipelago. Unlike most other Channel Islands, SCI has not been completely covered by the ocean during times of high sea level due to its relatively high relief, the highest point of 1965 feet (ft) (599 meters [m]) being at Mount Thirst (Navy 2013). Consequently, many species currently inhabiting the island have been present for millions of years. SCI is an oceanic island originating from volcanic activity at the sea floor three million years ago and all taxa that populate the island originated from the mainland by flying, floating in ocean currents, rafting, and/or hitchhiking (Olmsted 1958).

The island is home to a variety of sensitive flora and fauna found only on or in the surrounding waters of the Channel Islands or SCI itself. Endemic federally listed species include the San Clemente Island lotus (*Acmispon dendroideus* var. *traskiae*), San Clemente Island Indian paintbrush (*Castilleja grisea*), San Clemente Island larkspur (*Delphinium variegatum* ssp. *kinkiense*), San Clemente Island woodland-star (*Lithophragma maximum*), San Clemente Island bush-mallow (*Malacothamnus clementinus*), San Clemente loggerhead shrike (*Lanius ludovicianus mearnsi*), San Clemente Bell's sparrow (*Artemisiospiza belli clementeae*). Other regionally occurring and federally listed species may occur on or near SCI include Santa Cruz Island rockcress (*Sibara filifolia*), western snowy plover (*Charadrius alexandrinus nivosus*), white abalone (*Haliotis sorenseni*), black abalone (*Haliotis cracherodii*), loggerhead sea turtle (*Caretta caretta*), olive ridley turtle (*Lepidochelys olivacea*), leatherback turtle (*Dermochelys coriacea*), eastern Pacific green sea turtle (*Chelonia mydas*), Guadalupe fur seal (*Arctocephalus townsendi*), Steller sea lion (*Eumetopias jubatus*), blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), north Pacific right whale (*Eubalaena japonica*), sei whale (*Balaenoptera borealis*), and sperm whale (*Physeter microcephalus*; Schoenherr et al. 1999). Guadalupe murrelet (*Synthliboramphus hypoleucus*) and Scripps's murrelet (*Synthliboramphus scrippsi*) are currently candidate species and are being considered for listing under the ESA indicating that they are species of conservation concern (80 FR 80583).

SCI is also home to several introduced non-native and invasive species. Feral cats (*Felis catus*), non-native rodents, Argentine ants (*Linepithema humile*), and invasive plants may threaten native species on island. Documented, recent introductions include the arrival of a gopher snake (*Pituophis catenifer*) in 2006 (Navy 2013), a domestic cat transported in the hood of a work truck (Institute for Wildlife Studies, personal communication, 8 March 2016), and a domestic dog (*Canis lupus familiaris*) that swam from a fishing boat in February 2016 and survived on the island for close to five weeks (Wagner 2016). Invasive plant introductions are harder to pinpoint, but many arrive via equipment and materials shipped from the mainland, fire activities, personal effects and wind dispersal. While the above accidental animal introductions did not result in established populations, introduction of non-native and potentially invasive alien species (IAS) present threats to SCI's ecosystem as well as military mission through the potential for disease introduction, ecological damage, and regulatory restrictions on military operations. Impacts to native fauna and flora from past introductions of non-native species may have resulted in multiple listings of plants and animals under the federal ESA. Because military operational use has the potential to result in many pathways for the introduction of invasive species and eradication/control programs come at a tremendous cost, prevention in the form of an effective plan for biosecurity is imperative.

2.0 Implementation Strategy

2.1 Challenges and Needs

For SCI, biosecurity risks are high for both marine and terrestrial habitats, but lesser so for ephemeral freshwater environments. The interface of public and military interests in waters surrounding SCI specifically confound marine invasive species (MIS) management options since

marine species tend to have high dispersal rates and the ability to rapidly colonize and outcompete other marine taxa. Many pathways for invasive species transit through the marine environment by barge, boat, or equipment contained therein and enter into SCI's management footprint where they could eventually end up in terrestrial habitat.

Freshwater habitats may be less affected mainly due to their limited extent and ephemeral nature on the island (Navy 2013). On the other hand, the limited existence of freshwater habitats also makes them extremely vulnerable and easily impacted by various invasives if incursions occur. While the likelihood of additional freshwater introductions are relatively low when compared to marine and terrestrial systems, basic biosecurity strategies applicable to all SCI ecosystems will outline comprehensive preventative measures. Additionally, the federally listed San Diego fairy shrimp (*Branchinecta sandiegoensis*), native to Southern California, will be considered as a biosecurity risk to freshwater ecosystems for SCI's management purposes because of the added regulatory constraint that may impact the military mission if it were introduced.

The effects of non-native species are largely dependent on the characteristics of the organism and invasive impacts are difficult to predict. However, all systems are at risk and any introduced non-native organisms have the potential to become established, create viable populations, and cause impacts. This is evident globally and locally on SCI. Non-native species established on SCI that may cause harm in the form of ecological damage, restrictions to the military mission, and/or disease introduction include black rat (*Rattus rattus*), house mouse (*Mus musculus*), and feral cat. Species that are likely to cause further serious effects if their current distributions expand include brown garden snail (*Cornu aspersum*), garden slug (*Lehmannia valentiana*), Argentine ant, and various invasive plant species. These are stand-out organisms due to the impacts they have already caused, although the island is not limited to threats caused by these species. New introductions of additional rodents, such as Norwegian rat (*Rattus norvegicus*), lagomorphs (hares and rabbits), reptiles, and mesopredators (e.g. raccoons [*Procyon lotor*], opossums [*Didelphis virginiana*]) could create new disease vectors for the island. Because certain zoonotic infections (leptospirosis, West Nile, Hantavirus, etc.) occur naturally within the environment, prevention of incursion and monitoring of invasive species are critical to prevent and contain zoonotic diseases.

Biosecurity plans are designed to provide the framework for future action and their execution must consider installation range plans, training plans, INRMPs, Integrated Cultural Resource Management Plans, Integrated Pest Management Plans, Installation Restoration Plans, and other appropriate plans. The development of intricate protocols should stem from the structure that a comprehensive Biosecurity Plan provides while at the same time ensuring that management recommendations are outlined and cross referenced with other plans. Other major topics in biosecurity that need to be addressed include: improved outreach and education enabling military, staff and other island users to actively participate in supporting biosecurity efforts; enhanced regulations (in the form of contracting language, naval instructions, and military protocols); better development, implementation, and enforcement of barge operations; and developing rapid response efforts.

One of the largest vectors for the introduction of IAS to SCI is the ocean-going barge and the materials carried therein. Currently, no inspections take place and no oversight other than minimal contracting requirements exists. Most SCI materials and commodities arrive via ocean-going vectors. The lack of oversight on materials movement is perhaps one of the most serious risks identified. Resolving this gap in barge operations and materials transport should be a high priority for NALF SCI. This challenge points to the need for a biosecurity manager that can conduct inspections or coordinate the effort to do so.

2.2 Biosecurity Oversight

Enforcement of the policies outlined in this plan presents an additional challenge. Many archipelagos throughout the world create departments within their government structure to enforce biosecurity policies. For example, New Zealand has designated biosecurity managers governed by the Ministry of Primary Industries, a governmental organization of six different branches with missions to protect New Zealand against the incursion of invasive species. Micronesia also conducts inspections through local agricultural quarantine officers. Creating specific biosecurity positions with roles such as enforcement, inspection, and coordination ensure that biosecurity plans are implemented. While the Navy may not need a specific department to regulate policies and ensure their enforcement, SCI would benefit from the designation of a small program and at least one multi-disciplinary biosecurity manager who implements biosecurity strategies, conducts inspections, and coordinates response to incursions.

This position would require experience in biology, wildlife surveys, animal tracking and signs, plant identification and surveys, management, biosecurity vectors, federal regulations and executive orders, agricultural inspection policies, pertinent regulatory drivers, etc. Collaborative efforts would include working with the NALF SCI Commander to write Naval Instructions and to thoroughly train personnel on topics in biosecurity. Additionally, one of the first tasks of the biosecurity manager would be to conduct a thorough analysis of job descriptions on NALF SCI and assign tasks based off recommendations made within this plan to encourage the culture of biosecurity on island. Without improved biosecurity and a position dedicated to coordinating these efforts, additional invasive species are likely to become established and established species will likely expand their current distributions. Currently, biosecurity efforts are the responsibility of multiple entities that may not have the time or resources to dedicate to the full-time need.

Additionally, committing permanent funding to support the position will be key to effectively addressing IAS issues on SCI. Though many IAS activities and planning efforts are currently underway throughout the Channel Islands archipelago, only one official position has existed for biosecurity coordination for the Northern Channel Islands (John Knapp, The Nature Conservancy, pers. comm.). Locally, most topics in island biosecurity, including inspections of cargo, become the responsibility of natural resource offices and/or positions that do not have full-time funding. Dedicating a full-time position that is permanently funded can eliminate gaps that could develop with a non-full time or permanently funded position.

Expanding job descriptions of various managers across NALF SCI to incorporate biosecurity into their program is also a potential option, though would not be effective. Biosecurity involves vigilant oversight, implementation, enforcement, and most importantly—authorization. The

biosecurity manager must have authority to stop shipments to SCI; otherwise a biosecurity manager would merely be making suggestions that could be overridden. Any lapses in inspections or coordination efforts can allow incursions that affect the military mission and compromise long-term program operations. There is a clear need for dedicated permanent funding for a biosecurity position to address invasive species issues on SCI.

In addition to a permanently funded biosecurity position, secondary points of contact need to be identified and trained in identification, animal handling and capture to assist the biosecurity manager. A new position does not necessarily need to be created, but these IAS trained positions should be present in the event an IAS is detected on-island at barge and aircraft unloading, and on the mainland for barge and aircraft loading.

2.3 Recommendations' Organization Scheme

The SCI biosecurity recommendations are at the core of the implementation strategy and are organized in a vector-based approach. The biggest challenge communicating these recommendations and the subsequent distribution to staff is that the structure and organization needs to be of value to a diverse group of stake-holders; including land managers, facilities managers, military personnel, and contractors. Therefore, the vector-based recommendations are organized into three sections and are delineated in order to draw attention to the differences between biosecurity threats that originate off-island, originate on-island, and natural processes in which management has little control or prevention strategies. The organization scheme is intended to eliminate redundancy and cross-referencing throughout the document. Additionally, the document can be deconstructed into relevant parts that can then be disseminated to targeted or interested audiences.

Each section is organized based off vectors' point of origin. Section 3 discusses the preparation and transport of cargo originating from off-island sources. Section 4 discusses on-island source materials, infrastructure operations and maintenance, and natural resource management once cargo is already on SCI. Cargo is defined herein as any materials or equipment arriving on the island such as vehicles, heavy machinery, personal gear, personnel, construction equipment, aggregate and road base, soil, food, refuse, water, fuel, natural resource management supplies, etc. Finally, Section 5 discusses natural processes that pose biosecurity risks to NALF SCI, but that may be difficult to manage from a preventative objective.

Different vectors are discussed thoroughly within their respective subsection, providing scenarios and examples observed on NALF SCI and associated biosecurity risks. Each vector has multiple biosecurity objectives that are categorized as: the prevention of incursions, early detection and monitoring, post detection response, and educational opportunities. Each of these objectives has one or more strategies associated with the topic. For example, prevention strategies may include packaging sourcing or trapping efforts on barges. For each strategy, multiple recommendations are made as implementable "actions". While many other invasion biology topics overlap with biosecurity, issues such as the containment and control of existing invasive plant populations or the eradication of current rodent populations are better suited to existing or future management plans and cross-referenced with the NALF SCI Biosecurity Plan. This Biosecurity Plan focuses on prevention and detection strategies designed to limit IAS from reaching SCI in the first place.

Some action items could easily fit into more than one objective and where this is the case, an attempt has been made to place the action item under the most appropriate objective. Many of the actions are vector specific; however, one theme common to all recommendations is the need for inspections and enforcement.

2.3.1. Biosecurity Effort Score Priority Index and Action Value Tables

The quantity of recommended actions is intended to be exhaustive, but also adaptable and justifiable to the needs of NALF SCI's command structure. However, not all recommendations may be implemented for reasons beyond the current command structure's control. Therefore, for each vector subsection, a biosecurity effort priority index and action value table is provided that ranks all actions recommended in this plan. A total "biosecurity effort" score is made up of three ranked categories; Implementation, Personnel, and Cost and the action value ranks the strategic level of each action.

The Implementation category within the effort score is ranked one to three; an index of one indicates that implementation of the associated action will result in a minor alteration to an existing action or program, an index of two indicates that the action can be implemented within existing programs but will moderately expand the program, and an index of three indicates that an additional program may be necessary or it will significantly alter and add substantial tasks to existing programs.

The Personnel category within the effort score is ranked one to three; an index of one indicates that the action can be executed under an existing position; however, the job description may need to expand slightly to incorporate the implementation or execution of the biosecurity action. An index of two indicates that a job description must expand significantly to incorporate the implementation or execution of the associated action, and an index of three indicates that a new position must be created to incorporate the recommended action, i.e. a biosecurity manager.

Finally, the Cost category within the effort score is ranked one to three; an index of one indicates that the action is essentially cost-neutral. An index of two indicates that a moderate increase to cost will result while a score of three would require a significant program-wide cost increase.

The total biosecurity effort is achieved by adding the Implementation, Personnel, and Cost indices for the final score. This score allows management to discern what level of effort must be undertaken to effectively implement each recommended action.

However, an additional component that must be considered when deciding what biosecurity recommendations to implement is the inherent value of the action. Because resources are usually limited, the paired element of including a value score from one to three allows managers to evaluate the strategic worth of each action. A rank of one indicates that the action is a standard biosecurity strategy, a rank of two indicates that the action increases in strategic value, and a rank of three indicates that the strategy is an advanced and highly valuable action. The recommended actions are not meant to be selected solely based on their value score; some actions are only applicable to specific resources or are made to prevent specific incursions.

The biosecurity effort score and the action value score when paired together are comprehensive, and are provided in tables tailored for each vector subsection. The biosecurity effort index and

action value tables include all biosecurity actions recommended in the prevention of incursions, early detection and monitoring, post detection response, and biosecurity education sections. These tables are intended to prioritize biosecurity strategies on a scale from easily implementable to a more intensive effort. NALF SCI can easily select the best strategies based on the current command structure and available resources while adapting this plan and its recommended strategies to remain relevant in the future.

3.0 Off-Island Cargo and Personnel

The development of a remote island, in this case SCI, presents an inherent biosecurity risk because of the necessity to introduce commodities, supplies and services to support mission operations. For example, maintenance of island facilities may require importation of construction supplies such as wood, metal, gravel, prefabricated structures, earth-moving equipment and vehicles. Cargo originates from “abroad,” whether internationally or nationally to eventually be dispersed around the island after transport via barge or aircraft. While there are biosecurity risks with the transport mechanism (barge, aircraft), there are significant and inherent biosecurity risks with the cargo itself and these differences between the transport mechanism and the cargo contained within the transport mechanism will be handled separately for the purposes of this Biosecurity Plan.

Certain preventative strategies can be employed to reduce and in some cases eliminate biosecurity risks in the preparation of vehicles, personnel, equipment and supplies to be shipped. Following established protocols and enforcing the policies described will be key to preventing IAS introductions through imported cargo.

3.1 Preparation for Transport of Cargo and Personnel

There are a myriad of potential cargo items; however, there are three general groups that most cargo can be attributed to. Recommendations for the preparation of cargo for transport to NALF SCI will fall under the following three subcategories: Vehicles and Heavy Equipment, Equipment and Materials, and Personnel. Preparation for transport of vehicles, cargo and personnel for military operations is addressed in Section 4.1.4.

3.1.1. Vehicles and Heavy Equipment

Vehicles of all types are loaded onto the barge at the 32nd Street Pier on Naval Base San Diego (NBSD) and transported to SCI for all purposes, including construction, maintenance, and general transportation. Heavy equipment, more specifically, is defined as any earth-working, heavy-duty vehicles that are usually used for construction tasks. It is widely recognized that vehicles and heavy equipment easily harbor invasive species because vehicles are mobile and originate from across a large region. A single piece of equipment that hasn’t been cleaned, transported from an area with a highly aggressive weed species can cause an island-wide infestation.

SCI’s INRMP and Biological Opinion FWS- LA-09B0027-09F0040 Conservation Measure AVMC-M-7 requires the following measures to reduce the potential for transport of invasive plants to the island: “Prior to coming to SCI, military and non-military personnel will be asked to conduct a

brief check for visible plant material, dirt, or mud on equipment and shoes. Any visible plant material, dirt or mud should be removed before leaving for SCI" (Navy 2013 and USFWS 2008).

The recommendations below seek to incorporate and expand upon this policy.

Table 3-1. Vehicles and heavy equipment biosecurity effort priority index and action value table.

Action Number	Potentially Prevented Taxa	Action	Implementation Index	Personnel Index	Cost Index	Additive Effort Score	Action Value Score
Prevention of Incursions							
A1.	invertebrates, invasive plant propagules, small mammals, reptiles	Implement the vehicle cleaning standards included as a checklist in Appendix A.	1	1	1	3	1
A2.	invertebrates, invasive plant propagules, small mammals, reptiles	Require signed agreements that vehicles will be in compliance with Action A1 prior to shipping.	1	1	1	3	1
A3.	invasive plant propagules	Require all vehicles (including heavy equipment) to drive over "shaker plates" prior to loading.	1	1	2	4	2
A4.	invertebrates, invasive plant propagules, small mammals, reptiles	Institute monthly cleaning/inspection schedules and complete cleaning upon arrival at NALF SCI.	1	2	1	4	2
A5.	invertebrates, invasive plant propagules, small mammals, reptiles	Inspect all vehicles and heavy equipment before transport to NALF SCI.	2	2	2	6	3
A6.	all species	Implement a tagging system and flag vehicles if they do not meet inspection standards.	3	3	2	8	3
A7.	invertebrates, invasive plant propagules	Install pressure washers, vacuums, and air compressors at barge loading facilities.	3	2	3	8	3
A8.	invertebrates, invasive plant propagules	Contain and dispose of propagule-containing water at a waste management facility.	3	3	3	9	3
Early Detection and Monitoring							
B1.	invertebrates, invasive plant propagules	Monitor shaker plates at barge loading facilities for the presence of dirt or seeds. Initiate cleaning protocols if not cleaned.	1	1	2	4	1
B2.	invasive plants	Monitor roadsides for new species.	1	2	2	5	2
B3.	invertebrates, invasive plant propagules, small mammals, reptiles	Examine all vehicles and heavy equipment prior to transport.	2	3	2	7	1
Post Detection Response							
C1.	invertebrates, invasive plant propagules, small mammals, reptiles	Hold the shipping party responsible for cleaning tagged vehicles.	1	2	1	4	2
C2.		Identify and notify the appropriate point of contact.	2	2	1	5	1
C3.		Deliver a formal warning.	2	2	1	5	1
C4.		Within an implemented "red-tag program" (Action A6), tag vehicles when they do not meet cleaning protocols and/or IAS have been detected to prevent transport on the barge.	2	3	1	6	3
C5.		Contain the detected organism.	2	2	2	6	1

Table 3-1 continued. Vehicles and heavy equipment biosecurity effort priority index and action value table.

Biosecurity Education							
D1.	invertebrates, invasive plant propagules, small mammals, reptiles	Distribute NALF SCI Commander's Naval Instructions on Biosecurity.	1	1	1	3	● 1
D2.		Include reference to NALF SCI Commander's Naval Instruction in all interpretive paneling on biosecurity.	1	1	1	3	● 1
D3.		Distribute a SCI "Most Wanted" poster of watch-list species and worst invaders to anyone shipping vehicles or driving on-island.	1	1	1	3	● 1
D4.		Distribute information on how to report suspected incursions.	2	2	1	5	● 1
D5.		Create and post instructional signage for vehicle cleanliness standards at washing stations at barge loading facilities (if implemented).	2	2	2	6	● 1
D6.		Conduct regular training on IAS prevention and distribute Command Instructions to all personnel.	2	3	2	7	● 2

Prevention of Incursions – Vehicles and Heavy Equipment

Strategy A: Vehicle Shipping Standards and Accountability

Adhere to the standards set by NALF SCI for the transport of clean vehicles and ensure shipping parties' accountability.

ACTIONS

- A1. **Implement the vehicle cleaning standards included as a checklist in Appendix A.**
Vehicles should be free of dirt and debris. Paint should be clean and free of dust. Tires should be free of dirt and debris in treads. Undercarriages should be pressure washed to ensure dirt and debris is completely dislodged. Vehicle appendages should be free of cobwebs. Hoods of vehicles and truck beds should be confirmed as free of IAS. Toolboxes, front loader buckets should all be thoroughly cleaned. Cabs should be opened and floorboards should be swept. When parked and stored, front loaders should have blades resting on the blade edge in full contact with the ground to prevent non-native animals from hiding underneath.
- A2. **Require signed agreements that vehicles will be in compliance with Action A1 prior to shipping.**
Shipping parties should certify that they have read and understood the vehicle and heavy equipment cleaning protocols well in advance of attempting to ship. It should be made clear that vehicles not in compliance with cleaning protocols (i.e. are unclean or are harboring IAS) will be given a first warning to remedy the vehicle cleanliness. Shipping parties will be liable for the costs incurred with having to transport vehicles a second time. If shipping parties are repeat offenders, loss of access should be considered if shipping parties do not abide by protocols.
- A3. **Require all vehicles (including heavy equipment) to drive over "shaker plates" prior to loading.**
Shaker plates are metal plates fabricated to dislodge seeds and other IAS (Figure 3-1). These should be utilized at the entrance to the barge loading facilities and could potentially reduce weed seeds and other IAS transported in mud, dirt, and dust contaminating the loading area and conveyed to NALF SCI. Regular maintenance will be required to clean the plates and prevent re-contamination.

- A4. **Institute monthly cleaning/inspection schedules and complete cleaning upon arrival at NALF SCI.**
If vehicles and heavy equipment are to remain on island for long periods of time, regular scheduled cleaning and inspections should be instituted to prevent the spread of IAS between project sites on SCI.
- A5 **Inspect all vehicles and heavy equipment before transport to NALF SCI.**
Ensure that the minimum standards are met for vehicle and heavy equipment (Appendix A).
- A6. **Implement a tagging system and flag vehicles if they do not meet inspection standards.**
San Nicolas Island (SNI) developed a “red-tag” system in which the Environmental Division is responsible for inspecting vehicles, cargo and shipping containers and initiate warnings if these do not pass inspection. They work with the shipping party to remedy the situation but if it is not, the SNI Environmental Division places a red tag to distinguish items that are not eligible for transport (NAVFAC 2012). NALF SCI could develop a similar system to SNI’s red-tag program to eliminate confusion on vehicles and other cargo that should not be transported to the island because of IAS incursion risks. However, NALF SCI should work with shipping parties in advance of transportation to notify of cleaning inspection protocols. Most importantly for SCI, if the biosecurity manager or the inspection officer tags a vehicle, they should have express authorization to stop the shipment if it does not meet cleaning standards.
- A7. **Install pressure washers, vacuums, and air compressors at barge loading facilities.**
If vehicles are not found not in compliance with cleaning protocols, shipping parties can quickly meet minimum standards at the dock prior to loading by using the tools available to clean vehicles and heavy equipment. If shipping parties must use these supplies, this should serve as the initial warning and more drastic measures should be enacted for repeat offenders not prepared to ship vehicles.
- A8. **Contain and dispose of propagule-containing water at a waste management facility.**
Shipping parties may be transporting vehicles from all over the region and equipment could potentially be harboring many noxious weeds or other IAS. All water produced during cleaning activities should be properly contained and disposed of to reduce the risk of recontamination or contamination of other vehicles.



Figure 3-1. Two examples of shaker plates, designed to "shake" mud and dirt from tires and undercarriages and could prove to be effective at dislodging IAS.

Early Detection and Monitoring – Vehicles and Heavy Equipment

Strategy B: Early Detection

Develop a standardized monitoring system focused on early detection for high priority IAS on vehicles and heavy equipment.

ACTIONS

- B1. Monitor shaker plates at barge loading facilities for the presence of dirt or seeds. Initiate cleaning protocols if not cleaned.**
If shaker plates are dirty, identify IAS present. Maintain cleanliness on a regularly established basis, ideally before and after every loading event once weekly.
- B2. Monitor roadsides for new species.**
Coordinate with existing weed management plans to survey ruderal and disturbed roadsides to detect new invasive weed species brought by vehicles.
- B3. Examine all vehicles and heavy equipment prior to transport.**
Thoroughly inspect all vehicles following the checklist in Appendix A. Retain the vehicle if IAS are detected.

Post Detection Response – Vehicles and Heavy Equipment

Strategy C: Rapid Response

Implement a coordinated system for rapid response efforts to contain newly detected IAS from vehicles.

ACTIONS

- C1. Hold the shipping party responsible for cleaning tagged vehicles.**
If vehicles are found in violation of established cleanliness standards, are unable to be used on island or cannot be cleaned to be shipped in time, the shipping party is responsible for any incurred costs for reshipments. This may incentivize compliance with biosecurity standards.
- C2. Identify and notify the appropriate point of contact.**

Depending on the organism detected, potential points of contact may include Naval Base San Diego pest management, natural resources, animal services, and/or weed managers. The appropriate entity should be notified that an IAS was detected upon inspection.

- C3. **Deliver a formal warning.**
The Navy should issue formal warnings and maintain an official record. If shipping parties are repeatedly in non-compliance by not cleaning vehicles or heavy equipment prior to delivery to the barge, shipping parties should be warned, and then prohibited from sending vehicles and equipment to NALF SCI.
- C4. **Within an implemented “red-tag program” (Action A6), tag vehicles when they do not meet cleaning protocols and/or IAS have been detected to prevent transport on the barge.**
If vehicles do not meet the shipping standards for cleanliness, they should be treated as if they harbor IAS.
- C5. **Contain the detected organism.**
Develop procedures to contain various organisms. For example, nets, traps, or cages should be used for invasive vertebrates. Sealed plastic bags should be used for invasive plant species.

Biosecurity Education - Vehicles and Heavy Equipment

Strategy D: Outreach

Increase education of, and outreach to, those who may be potential sources for IAS introductions through the transport of vehicles and heavy equipment.

ACTIONS

- D1. **Write and distribute NALF SCI Commander’s Naval Instructions on Biosecurity.**
The first task of a biosecurity manager should be to assemble recommendations made herein for the Commanding Officer to authorize and sign. The Naval Instructions should have a section on the preparation and cleanliness expectations of vehicles prior to transport.
- D2. **Include reference to NALF SCI Commander’s Naval Instruction in all interpretive paneling on biosecurity.**
It should be reinforced that NALF SCI’s expectation is that vehicles and heavy equipment should be carefully and frequently cleaned to prevent introductions and to limit the spread of IAS.
- D3. **Distribute a SCI “Most Wanted” poster of watch-list species and worst invaders to anyone shipping vehicles or driving on-island.**
Colorful and photo-heavy pamphlets should be distributed to all personnel driving vehicles and heavy equipment.
- D4. **Distribute information on how to report suspected incursions.**

Shipping parties should have the proper contacts if it is suspected that an IAS was transported to the island through a vehicle.

D5. Create and post instructional signage for vehicle cleanliness standards at washing stations at barge loading facilities (if implemented).

Instructional materials should detail the importance of keeping vehicles clean, how to prevent spread of IAS to the island, and the expectations on what should be thoroughly cleaned (Appendix A).

D6. Conduct regular training on IAS prevention and distribute Command Instructions to all personnel.

All in-briefs should include a significant component on biosecurity and include vehicle and heavy equipment washing standards.

3.1.2. Equipment and Materials

In order to service an inhabited island, equipment and materials are imported to SCI to sustain a functioning military. However, equipment and materials are imported with inherent risks such as arthropod pests embedded in wood packaging materials (WPM) and cardboard, invasive plant species from aggregates, IAS on hand and power tools, and organisms on or contained within shipping containers.

Although some materials are produced on the island for road maintenance, a significant amount are sourced from the mainland and brought to NALF SCI. Importation of such materials such as gravel and road base were likely responsible for several non-native earthworm species recorded along Ridge Road in 2013/2014 (Shishir Paudel, pers. comm.).

Cargo such as soil and erosion control material (straw wattles or straw bales) may also contain IAS unless certified weed and pest-free (Figure 3-5). Tools used for construction or restoration projects, road maintenance or transportation may introduce IAS, especially weed seeds.

The Natural Resource Office (NRO) restoration program imports potting soil and soil amendments for use in the native plant nursery. Potting soil is imported in two cubic-foot plastic bags or bales and may be composed of SuperSoil® or similar, peat moss, perlite and vermiculite (Emma Havstad, pers. comm.). Coarse sand may also occasionally be imported or collected in small quantities from the island. Materials originating from the mainland may introduce soil pathogens including fungus, bacteria, invertebrates, non-native mycorrhizal inoculants, exotic worms, arthropods, nematodes, etc. that may harm native plants and disrupt natural soil cycles. Improperly composted materials may also contain viable seeds. Composted soils and peat moss present the greatest threat, while perlite and vermiculite are generally sterile. Invertebrates such as earthworms, slugs and ants may occur within or on packaging, and large shipments may conceal small mammals such as rats or mice. Media contaminated with insects, disease organisms, or weed seeds will quickly cause problems.

Additionally, restoration or erosion control materials such as straw bales and wattles can harbor noxious plant species and transport other non-native taxa. To prevent the spread of invasive plants, County Agricultural Commissioners and the California Department of Food and Agriculture (CDFA) offer inspection services to certify materials as weed free. Weed Free Forage

is defined as hay, feed, straw or straw mulch that has been inspected, and certified not to contain seeds or propagules found on the California noxious weed list. The term “weed free” is a misnomer in that the CDFA inspection process cannot reduce the risk to zero nor are these materials inspected for invasive weeds not listed on the CDFA noxious weed list.

Ideally, in the process of construction or restoration, soils can be re-used, or manufactured, on-site; however, some projects may require more soils than are available on-site, or on-site manufacture of construction soils may be too expensive, impractical or not allowed, thereby, requiring the import of mainland soils and amendments.

Lastly, containers such as roll-offs, dumpsters, Conex boxes, or prefabricated construction materials are attractive to various IAS such as raccoons, and have the potential to easily transport organisms to the island, especially if containers are not inspected.

Table 3-2. Equipment and materials biosecurity effort priority index and action value table.

Action Number	Potentially Prevented Taxa	Action	Implementation Index	Personnel Index	Cost Index	Additive Effort Score	Action Value Score
Prevention of Incursions							
A1.	invertebrates, invasive plant propagules, small mammals	Dispose of cardboard properly.	1	1	1	3	2
A2.	invertebrates, invasive plant propagules	Require lumber that is heat treated, kiln dried and/or chemically impregnated.	2	2	2	6	2
A3.	invertebrates, invasive plant propagules	If obtaining wood internationally, require lumber in compliance with ISPM 15.	2	2	2	6	2
A4.	invertebrates, invasive plant propagules	If obtaining wood from the Western United States, require wood be certified with a KD-HT stamp.	2	2	2	6	2
A5.	invertebrates, invasive plant propagules, small mammals	Forbid the arrival of shipments in cardboard boxes.	3	1	3	7	3
A6.	invertebrates	Require that pallets arriving on island be certified as treated and/or fumigated with methyl bromide.	3	2	2	7	2
A7.	invertebrates, invasive plant propagules, small mammals	Require shipments arrive on plastic pallets.	2	2	3	7	2
A8.	invertebrates, invasive plant propagules, small mammals	Use plastic crates for food shipment.	3	1	3	7	2
A9.	invertebrates, invasive plant propagules, small mammals	Ensure shipments made on/in WPM prevent the transport of IAS.	3	2	3	8	3
A10.	small mammals, reptiles	Maintain on-island plastic pallets that are cleaned and reused as needed.	3	2	3	8	2
A11.	small mammals	If shipments are made on wooden pallets, require the transfer of shipments from wooden to plastic pallets.	3	3	3	9	2
B1.	invasive plant propagules	Require that personnel source aggregates from approved mainland quarries that meet approved standards.	1	1	1	3	3
B2.	invasive plant propagules	Require that aggregates are sourced from pit quarries; forbid river-bottom sourced aggregates.	2	1	2	5	3
B3.	invasive plant propagules	Require weed-free aggregate.	2	2	3	7	3
C1.	invertebrates, invasive plant propagules	Do not stock pile soil.	1	1	1	3	1
C2.		Require contractors source certified weed free erosion control and restoration materials (straw bales, wattles).	1	1	1	3	3
C3.		Alternatively, if soil must be imported, shipping parties should visually inspect the outside of the package.	1	2	1	4	1
C4.		Forbid transport of foreign soil and develop a "make-your-own" soil program.	3	3	2	8	3
C5.		Consider sterilization measures such as solarization.	3	3	2	8	2
C6.		Consider sterilization measures such as chemical treatment.	2	3	3	8	2

Table 3-2 continued. Equipment and materials biosecurity effort priority index and action value table.

Prevention of Incursions continued							
D1.	invasive plant propagules, small mammals	Require that food and perishable items be stored in pest-proof containers.	1	2	1	4	● 3
D2.	all taxa	Require that shipping parties bear the burden of unshipped containers.	1	2	1	4	● 1
D3.		Tag shipping containers that harbor IAS or are unclean.	1	3	1	5	● 3
D4.		Thoroughly inspect all shipping containers destined for SCI.	3	2	2	7	● 3
D5.		Investigate the feasibility of phasing out current storage containers and dumpsters that travel from the mainland to NALF SCI and phasing in storage containers with lids.	2	3	3	8	● 3
D6.		Require that the integrity of all storage containers, Conex boxes, roll-offs, dumpsters, etc. be intact and pressure-washed.	3	3	3	9	● 1
D7.		Investigate the feasibility of island-designated shipping containers that are not used anywhere else in the region.	3	3	3	9	● 3
D8.		Create a quarantined and pest-free storage facility near barge operations to store shipping containers destined for the island.	3	3	3	9	● 3
E1.	all taxa	Thoroughly inspect all cargo destined for NALF SCI, check for the presence of IAS and ensure cleanliness of equipment.	3	3	2	8	● 1
E2.		Implement inspections by trained scent dogs.	3	3	3	9	● 3
F1.	Cargo specific	Forbid the transport of specific cargo items.	1	1	1	3	● 1
F2.	all taxa	Do not allow stockpiling or storage of equipment and materials prior to transport.	1	1	1	3	● 1
F3.		Provide contracting language.	1	1	1	3	● 1
F4.		Tag cargo not in compliance or harboring IAS.	1	3	2	6	● 3
Early Detection and Monitoring							
G1.	all taxa	Set up regular monitoring schedules anywhere equipment and materials are stored or unpackaged on island.	2	2	2	6	● 1
Post Detection Response							
H1.	equipment specific	Hold the shipping party responsible for meeting cleanliness expectations.	1	1	1	3	● 1
H2.	all taxa	Identify and notify the appropriate point of contact.	2	2	1	5	● 1
H3.		Deliver a formal warning.	2	2	1	5	● 1
H4.		Contain the detected organism.	2	2	2	6	● 1
H5.		Tag equipment and materials when IAS have been detected to prevent accidental inclusion on the barge.	3	3	2	8	● 3
H6.		When detections are confirmed, set up regular monitoring schedules anywhere equipment and materials are stored or unpackaged on island.	3	3	2	8	● 3
Biosecurity Education							
I1.	all taxa	Distribute NALF SCI Commander's Naval Instructions on Biosecurity.	1	1	1	3	● 1
I2.		Include reference to NALF SCI Commander's Naval Instruction in all interpretive paneling on biosecurity.	1	1	1	3	● 1
I3.		Develop and widely distribute a concise and regularly updated list of most wanted species likely to be attached to equipment and materials.	1	1	1	3	● 1
I4.		Ensure that contracting language includes cleaning expectations for equipment and the expectation that certain sourced materials will have to be approved.	1	1	1	3	● 1
I5.		Distribute information on how to report suspected incursions.	2	2	1	5	● 1
I6.		Implement regular training on IAS and Command Instructions to all personnel.	2	2	2	6	● 1
I7.		Develop interpretive signage at all shipping locations (barge and airport) emphasizing importance of source materials and equipment cleanliness.	2	2	2	6	● 1

Prevention of Incursions – Equipment and Materials

Strategy A: Examine Protocols On WPM

Require shipping parties to examine the media involved in the transport of supplies to NALF SCI.

ACTIONS

- A1. **Dispose of cardboard properly.**
Cardboard must not be disposed of in the NALF SCI landfill. It should be stockpiled in a designated dumpster near barge operations and transported off island once weekly.
- A2. **Require lumber that is heat treated, kiln dried and/or chemically impregnated.**
For the purposes of WPM and the requirement to eradicate pest infestations, heat treated (HT) lumber is heated to reach a core temperature of 56 degrees centigrade (°C) for 30 minutes. Strength or durability is not compromised in any way by the HT process.
- A3. **If obtaining wood internationally, require lumber in compliance with International Standards for Phytosanitary Measures No. 15 (ISPM 15).**
ISPM 15 affects all wood packaging material (pallets, crates, dunnage, etc.) and requires that they be debarked and then heat treated or fumigated with methyl bromide and stamped with a mark of compliance (Figure 3-2). This is mostly available for wood that is sourced internationally and imported into the United States. In international shipping, fumigation certificates can also be requested when importing cargo and WPM from abroad, but are not mandated. Locally sourced lumber will not have an ISPM 15 stamp but a kiln-dried heat-treated stamp (KD-HT).
- A4. **If obtaining wood from the Western United States, require wood be certified with a KD-HT stamp.**
Western Wood Products Association lists mills offering KD-HT grade marked lumber; Sierra Forrest Products, Sierra Pacific Industries, Unity Forest Products, and Collins Pine Co. Require that shipping parties either sources from these recommendations, or provide sources that the biosecurity manager approves.
- A5. **Forbid the arrival of shipments in cardboard boxes.**
Cardboard boxes can harbor various pests and should be banned from use on NALF SCI. If not feasible, limit the use of cardboard on NALF SCI to only allow shipments in cardboard if materials were directly packed into a clean and inspected cardboard box. Do not allow cardboard to be repurposed. Repurposed cardboard, especially used in the galley, can attract invasives such as Argentine ants to new locations on the island (Figure 3-4).
- A6. **Require that pallets arriving on island be certified as treated and/or fumigated with methyl bromide.**
WPM (boxes, pallets, crates, dunnage, ammo containers, etc.) are typically made from the lowest grade of lumber and have not been debarked—an important standard in sourcing wood materials. Therefore, the instances of pests and risk of introduction are often higher in WPM, including pallets, due to the presence of bark. Therefore, require that all pallets are in compliance with ISPM 15.

- A7. **Require shipments arrive on plastic pallets.**
Alternatively, if wooden pallets are not in compliance with ISPM 15, mandate that all shipments utilize plastic pallets; many types and affordable options exist (Figure 3-3).
- A8. **Use plastic crates for food shipment.**
Food should be shipped in plastic agricultural boxes to limit the spread of pests and promote cleanliness.
- A9. **Ensure shipments made on/in WPM prevent the transport of IAS.**
WPM (boxes, pallets, crates, dunnage, ammo containers, etc.) are typically made from the lowest grade of lumber and have not been debarked—an important standard in sourcing wood materials. Therefore, the instances of pests and risk of introduction are often higher in WPM due to the presence of bark. Untreated lumber poses a risk of carrying harmful pests, including wood-boring beetles that could negatively affect the limited oak, ironwood, and cherry woodlands on SCI. Every region that lumber is sourced from likely has some pest(s) which could be extremely harmful to local flora and fauna on NALF SCI.
- A10. **Maintain on-island plastic pallets that are cleaned and reused as needed.**
Using plastic pallets will prevent the spread of pests and other IAS harbored in WPM. However, they must be regularly cleaned and stored in pest-free environments.
- A11. **If shipments are made on wooden pallets, require the transfer from wooden to plastic pallets.**
Once palletized shipments arrive on NALF SCI, shipments should be transferred to plastic pallets in a quarantine facility near barge operations or areas of highest use. These plastic palletized shipments can then be distributed throughout the island.



Figure 3-2. Examples of pallets and crates with the ISPM 15 logo certifying these containers are in compliance with international standards. Source: en.wikipedia.org/wiki/ISPM_15



Figure 3-3. Many types of plastic pallets exist including crates and storage options. Source: www.packagewarehouse.com



Figure 3-4. Cardboard should never be repurposed on the island. The use of cardboard in the galley to soak up oil and water make an attractive food source for Argentine ants.

Strategy B: Require Weed Free Aggregates

Require contractors and military personnel to source certified weed free aggregates before transport to NALF SCI.

ACTIONS

- B1. Require that personnel sourcing aggregates source materials from approved mainland quarries that meet standards.**

Management should develop a list of approved aggregates sourced from the mainland incorporating the California Invasive Plant Council's (Cal-IPC) best management practices (BMP; Weed Free Aggregates for Land Managers, N.D.; Appendix E). Contractors should notify biosecurity managers within two weeks after the contract award date the source company, location, and type of aggregate material they plan to use for the project.

B2. Require that aggregates are sourced from pit quarries; forbid river-bottom sourced aggregates.

Highly disturbed sites such as river-bottom quarries have the potential to include a higher diversity of invasive weed species because of alluvial sediment movement. Pit quarries source aggregates deeper from surface soil layers and have less of a potential for cross-contamination and seed movement as compared to river-sourced aggregates.

B3. Require weed-free aggregate.

Aggregates sourced from quarries and gravel pits are from perennially disturbed areas. Because of this disturbance regime, quarries become high quality habitat for many invasive species and the materials sourced from them become a mechanism to transport IAS elsewhere. Invasive plant seeds and propagules land on and contaminate recently mined sand and gravel. When the contaminated aggregate is transferred to a project site, these seeds are distributed and can easily establish.

Strategy C: Examine Restoration and Erosion Control Materials

Require contractors and military personnel to source certified weed-free erosion control materials and pest-free soil.

ACTIONS

C1. Do not stock pile soil.

Store mixed soils and ingredients in a manner that will not encourage growth of pathogens or IAS. Keep the area clean and dry to not attract pests.

C2. Require contractors source certified weed free erosion control and restoration materials (straw bales, wattles).

Shipping parties should provide a proof of certification that erosion control materials are weed-free before transport to SCI. CDFA Form 66-079 "Certificate of Quarantine Compliance (Origin or Treatment)" is the legal document verifying that the materials have been inspected and certified. This is associated with the inspection of forage/straw materials.

- C3. **Alternatively, if soil must be imported, shipping parties should visually inspect the outside of the package.**

Packages should be free of dirt and dust and imported in a pest-proof cleaned container as an extra precautionary measure.

- C4. **Forbid transport of foreign soil and develop a “make-your-own” soil program.**

Soil could be mixed on the island from materials of known origin. Sources of material could include properly composted food waste from the installation’s various kitchens in pest-free containers, inorganic material and sand from island quarries. Santa Barbara Island, one of the California Channel Islands, is successfully making soil on-site for its restoration efforts (D. Mazurkiewicz, pers. comm.).

- C5. **Consider sterilization measures such as solarization.**

Large quantities of soil can be reliably solarized using plastic tarps, and pathogens should be killed after 30 minutes at 82°C. Soil sterilization should occur as soon as possible after arrival to prevent escape of any potential IAS (Callaway et al. 2004).

- C6. **Consider sterilization measures such as chemical treatment.**

This would require considerably more infrastructure, permitting and storage of chemicals but would be effective at preventing the introduction of new weed species. This is not effective for invertebrate pests. A broad spectrum, non-selective herbicide such as imazapyr is active in soils for up to six months and can be used as a pre-emergent in addition to a post-emergent herbicide. However, this will likely have a negative effect on restoration output because of the amount of time that imazapyr remains active in the soil and therefore the soil would require a resting period to allow the herbicide to deactivate.



Figure 3-5. Yellow star-thistle growing out of a straw bale. Source: Cal-IPC.

Strategy D: Examine Storage Containers

Ensure that storage containers, roll-offs, dumpsters, etc. prevent refuge for IAS and that all perishables are stored in pest-proof containers.

ACTIONS

- D1. **Require that food and perishable items be stored in pest-proof containers.**

Food should not only be transported in ISPM 15 certified crates or plastic agricultural boxes but in sealed containers that do not allow pests such as invertebrates and rodents.

- D2. **Require that shipping parties bear the burden of unshipped containers.**

Provide the shipping party with reasons why cargo did not pass inspection and require that cleanliness standards are met before shipment to SCI.

D3. **Tag shipping containers that harbor IAS or are unclean.**

Prevent the transport of shipping containers that do not pass inspection prior to barge loading.

D4. **Thoroughly inspect all shipping containers destined for SCI.**

Open doors of Conex boxes, open lids to dumpsters, and thoroughly examine all potential animal harborage points and presence of mesopredators, reptiles, and rodents. Prior to departure, a flashlight should be used to inspect fork lift holes which may serve as rodent refuge in shipping containers (Figure 3-8).

D5. **Investigate the feasibility of phasing out current storage containers, dumpsters and roll-offs that travel from the mainland to NALF SCI and phasing in storage containers with lids.**

Dumpsters without lids are attractive to all animals and could not only transport mesopredators to NALF SCI, but once on island, could potentially spread disease to island foxes. (Figure 3-7).

D6. **Require that the integrity of all storage containers, Conex boxes, roll-offs, dumpsters, etc. be intact and pressure-washed.**

Storage containers must be free of dust, cobwebs, dirt clods, mud, attached organisms, and contraband such as firewood. They must be cleaned and swept prior to loading any materials inside. Inspections must confirm that shipping containers do not harbor any organisms. No holes should be permitted to prevent reinfestation after the inspection (Figure 3-8). Developing rust spots should be painted to prevent further corrosion and development of holes.

D7. **Investigate the feasibility of island-designated shipping containers that are not used anywhere else in the region.**

If feasible, shipping containers that are NALF SCI designated could reduce the risk of IAS. Cleanliness standards would be easier to ensure and pest-free storage conditions could be achievable.

D8. **Create a quarantined and pest-free storage facility near barge operations to store shipping containers destined for the island.**

Shipping parties could access all island designated shipping containers from a pest-proof mainland facility in which to load equipment. A concerted trapping effort with integrated pest management (IPM) is recommended.



Figure 3-6. Holes in dumpsters or shipping containers offer attractive points of entry for IAS.



Figure 3-7. Dumpsters without lids are attractive to invasive mesopredators and rodents, but also pose the potential to spread disease to island foxes once on island.



Figure 3-8. Fork lift holes should be inspected with flashlights to ensure no animal harborage prior to departure.

Strategy E: Ensure Cleanliness of Equipment And Materials

Require that personnel ensure the cleanliness of their equipment and materials before transport to NALF SCI.

ACTIONS

E1. Thoroughly inspect all cargo destined for NALF SCI, check for the presence of IAS and ensure cleanliness of equipment.

Ensure that equipment and materials free of dust, cobwebs, dirt clods, mud, attached organisms and that cargo does not harbor any organisms whatsoever. Items such as chainsaw chains, hand saw blades, mower decks and blades, weed-eater blades, and crevices on other tools should be carefully inspected to prevent the introduction of IAS, including IAS harbored in dirt or mud. General inspections should include visual survey of the outside of packages, palletized shipments, or equipment for the presence of dirt (Figure 3-9).

E2. Implement inspections by trained scent dogs.

Detection dogs or military working dogs should conduct weekly cargo inspections for items transported by the barge. Trained dogs are effective detection tools for tracking animals and their sign, contraband, and forbidden materials (Smith et al. 2001).



Figure 3-9. Collections of dirt on equipment loaded on the barge. Equipment with piles of dirt should be treated as if harboring an IAS and properly cleaned or removed from the barge shipment.

Strategy F: Accountability

Ensure shipping parties are held accountable for the preparation of equipment and materials being transported to NALF SCI.

ACTIONS

F1. **Forbid the transport of specific cargo items.**

Managers on NALF SCI should prioritize high risk items that should be forbidden from importation to the island, suggested items include: firewood, wood packaging materials, personal pets, landscaping and house plants.

F2. **Do not allow stockpiling or storage of equipment and materials prior to transport.**

Equipment and materials should not be stored in unsecured facilities, or facilities with no Integrated Pest Management (IPM). Cargo should not be staged at the barge loading facilities or at the airport overnight. Cargo should be directly transported from points of origination to the barge and aircraft loading facilities.

F3. **Provide contracting language.**

An abbreviated example of contracting language that could be adapted for use by NALF SCI follows: “All *imported material* from contractor-located sources must be certified to be free from noxious weeds or invasive plant materials and other deleterious material before entering the project site at the start of any contract with ground disturbing activities and/or construction season. The site and/or quarry must be available for review between the months of May and August, as that is the primary time when invasive plants are presentable and recognizable.” (Cal-IPC, N.D.).

F4. **Tag cargo not in compliance or harboring IAS.**

If any shipping containers, equipment, tools, etc. are not up to cleanliness protocols or harbor IAS, they must be tagged and forbidden transport to NALF SCI.

Early Detection and Monitoring – Equipment and Materials

Strategy G: Early Detection

Develop a standardized monitoring system focused on early detection for IAS on equipment and materials or at un-packaging locations.

ACTIONS

G1. **Set up regular monitoring schedules anywhere equipment and materials are stored or unpackaged on island.**

This should be accomplished using track plates, camera traps, and active traps. Though most expensive, camera traps have the ability to identify a larger swath of species occurring within a site; from small mammals to mesopredators and snakes. Camera traps can be set passively without using an attractant bait—beneficial when facilities do not want to attract pests to their equipment.

Post Detection Response – Equipment and Materials

Strategy K: Rapid Response

Implement a coordinated system for rapid response efforts to contain newly detected IAS from equipment and materials.

ACTIONS

- H1. **Hold the shipping party responsible for meeting cleanliness expectations.**
If equipment is found in violation of established cleanliness standards and is unable to be included for shipment on the barge, the shipping party is responsible for any incurred costs for reshipments. This may incentivize compliance with biosecurity standards.
- H2. **Identify and notify the appropriate point of contact.**
Depending on the organism, potential points of contact may include Naval Base San Diego pest management, natural resources, animal services, and/or weed managers that an IAS was detected upon inspection.
- H3. **Deliver a formal warning.**
The Navy should issue formal warnings and maintain an official record. If shipping parties become repeat offenders by not cleaning equipment or materials, or harboring invasives prior to inclusion on the barge, shipping parties should be prohibited from shipping cargo to NALF SCI.
- H4. **Contain the detected organism.**
Develop procedures to contain various organisms. For example, nets, traps, or cages should be used for invasive vertebrates.
- H5. **Tag equipment and materials when IAS have been detected to prevent accidental inclusion on the barge.**
If equipment and materials do not meet the shipping standards for cleanliness, they should be treated as if they harbor IAS.
- H6. **When detections are confirmed, set up regular monitoring schedules anywhere equipment and materials are stored or unpackaged on island.**
Develop set transects, grids, or routes in concentric rings outward from storage areas, facilities, yards, nursery, restoration and erosion control sites or anywhere equipment and materials arrive targeting invasive plants species. Buffer zones and fence edges should also be surveyed with set transects, grids. Ensure that the IPM plan has a robust trapping program in these locations to prevent Norway rat or other IAS. See Section 4.1.1 for more information on buffer zones.

Biosecurity Education - Equipment and Materials

Strategy L: Outreach

Increase education of, and outreach to, those who may be potential sources for IAS introductions through the transport of equipment and materials.

ACTIONS

- I1. **Write and distribute NALF SCI Commander's Naval Instructions on Biosecurity.**
The first task of a biosecurity manager should be to assemble recommendations made herein for the Commanding Officer to authorize and sign. This should also be given as

part of the mandatory in-brief and included in all contracts. It should outline the expectations for the preparation and cleanliness of all equipment and materials.

12. **Include reference to NALF SCI Commander's Naval Instruction in all interpretive paneling on biosecurity.**
Including a reference that there are Naval Instructions may persuade personnel to actively engage in biosecurity topics.
13. **Develop and widely distribute a concise and regularly updated list of most wanted species likely to be attached to equipment and materials.**
Photographs can help personnel positively identify and report IAS.
14. **Ensure that contracting language includes cleaning expectations for equipment and the expectation that certain sourced materials will have to be approved.**
Section 3.1 Vehicles and Section 3.1 Equipment and Materials can both be included as appendices to contracts or other materials given to contractors.
15. **Distribute information on how to report suspected incursions.**
After a point of contact is identified, all reports should coordinate and collaborate with other departments.
16. **Implement regular training on IAS and Command Instructions to all personnel.**
All in-briefs should include a thorough biosecurity section.
17. **Develop interpretive signage at all shipping locations (barge and airport) emphasizing importance of source materials and equipment cleanliness.**
Educate personnel and all shipping parties that the first strategy for prevention is how cargo is prepared for transport.

3.1.3. Live Forage in Support of NRO's Shrike Program

Live forage materials include crickets (*Gryllus* sp.), mealworms (*Tenebrio* sp. larvae), waxworms (*Galleria mellonella* larvae), frozen lizards (*Anolis* sp.) and mice (*Mus musculus*). These are used by the San Diego Zoo as forage for the San Clemente loggerhead shrike captive breeding program. The insects, mainly crickets but also occasionally bee larvae, may escape from the boxes they are transported in, their storage facility or shrike cages. Escapees have the potential to become pests themselves, introduce non-native genotypes to native arthropod populations, or introduce disease to vertebrates and invertebrates, such as the native deer mouse (*Peromyscus maniculatus clementis*) or SCI's endemic and sensitive silk-spinning cricket (*Cnemidettix pulvillifer*). Though the forage used for the program are not likely to thrive in a natural context, their contact with native or feral mice should be kept to a minimum to prevent the spread of zoonotic disease.

Additionally, cryptic invasions (or the introduction of non-native genotypes to native populations) are a largely unrecognized type of biological invasion that leads to underestimation of the total numbers and impacts of invaders because of the difficulty in detecting them. Introducing any species not native to the island has potential complications to native populations.

Table 3-3. Live forage biosecurity effort priority index and action value table.

Action Number	Potentially Prevented Pathogens/Taxa	Action	Implementation Index	Personnel Index	Cost Index	Additive Effort Score	Action Value Score
Prevention of Incursions							
A1.	zoonoses, hybridization	Invertebrates should be visually inspected.	1	1	1	3	1
A2.		Feed shrikes from containers that mice cannot escape from.	1	1	2	4	2
A3.		Ensure anoles are frozen in subzero freezers.	1	1	2	4	1
A4.		Set ESA and Migratory Bird Treaty Act compliant sticky traps around zoo storage facilities and aviary.	1	1	2	4	2
A5.		Ensure use of escape-proof containers.	1	2	2	5	1
A6.		Maintain a barrier material around the bottom 12 inches of the perimeter of the aviary to prevent fallen forage from escaping.	2	1	2	5	1
A7.		Investigate feasibility of captive breeding of the feral house mouse and endemic deer mouse population as forage.	3	2	2	7	1
Early Detection and Monitoring							
B1.	zoonoses, hybridization	Monitor shrike cages, release sites, and mealworm dispensers for escaped crickets and mice.	1	1	1	3	1
B2.	zoonoses	Request certificates of health from live forage sources.	1	1	1	3	1
B3.	zoonoses, hybridization	Research disease-free and less-likely-to-escape sources of shrike forage.	1	2	1	4	1
Post Detection Response							
C1.	zoonoses	If a problem is observed, change sourcing materials.	3	1	2	6	1
Biosecurity Education							
D1.	zoonoses, hybridization	Educate shrike personnel about dangers of escaped forage and develop control measures.	1	2	1	4	1

Prevention of Incursions – Live Forage

Strategy A: Prevention

Prevent zoonotic disease introductions by limiting contact of live forage with feral populations.

ACTIONS

- A1. Invertebrates should be visually inspected.**
Invertebrates, e.g. crickets, should be free of visible parasites, such as mites that may pose risk to native populations.
- A2. Feed shrikes from containers that mice cannot escape from.**
High vertical walled, plastic containers should prevent escapees.
- A3. Ensure anoles are frozen in subzero freezers.**
In the event that anoles are harboring intestinal parasites, freeze at subzero temperatures.
- A4. Set ESA and Migratory Bird Treaty Act compliant sticky traps around zoo storage facilities and aviary.**
To prevent escapees from entering the natural environment, set sticky traps around the perimeter of the zoo storage facilities.
- A5. Ensure use of escape-proof containers.**

Continue using containers such as in Figure 3-10 and regularly make repairs.

A6. **Maintain a barrier material around the bottom 12 inches of the perimeter of the aviary to prevent fallen forage from escaping.**

To prevent escapees from entering the natural environment, maintain a physical barrier between their captive and natural environment.

A7. **Investigate feasibility of captive breeding of the feral house mouse and endemic deer mouse population as forage.**

Introducing unknown populations of *Mus musculus* can introduce zoonoses such as Hantavirus strains that are unknown to the island deer mouse. The source population of forage should be regularly tested for zoonoses.



Figure 3-10. Live forage containers shipped via airplane to NALF SCI.

Early Detection and Monitoring – Live Forage

Strategy B: Early Detection

Develop a standardized monitoring system focused on early detection for unknown pathogens.

ACTIONS

B1. **Monitor shrike cages, release sites, and mealworm dispensers for escaped crickets and mice.**

ESA and Migratory Bird Treaty Act compliant sticky traps should be installed to determine if the forage is escaping.

B2. **Request certificates of health from live forage sources.**

Because of the complexities involved with monitoring live forage populations, the goal would be to minimize the contact of live forage and native fauna. Request that the sources certify forage as healthy; the live forage source should investigate the feasibility of detecting disease in their population.

- B3. **Research disease-free and less-likely-to-escape sources of shrike forage.**
If live forage is observed escaping or observed with parasites and disease, other live forage sources should be immediately implemented.

Post Detection Response – Live Forage

Strategy C: Rapid Response

Implement a coordinated system for rapid response efforts to contain disease around zoo facilities and the aviary.

ACTIONS

- C1. **If a problem is observed, change sourcing materials.**
If issues arise, such as infections, intestinal parasites in forage, etc., change sourcing materials immediately or implement on-island breeding programs.

Biosecurity Education – Live Forage

Strategy D: Outreach

Increase education of, and outreach to, zoo personnel and shrike technicians.

ACTIONS

- D1. **Educate shrike personnel about dangers of escaped forage and develop control measures.**
Discuss the concerns of live forage and the prevention strategies in all in-briefs and trainings.

3.1.4. Personnel

Personnel have the potential to be an inadvertent vector of IAS dispersal through clothing and footwear and personal effects such as luggage carried onto the island. Personnel bringing authorized and unauthorized gear as part of their personal effects may become problematic if IAS disperse from their personal effects. Generally, few occupants bring houseplants or decorative landscaping but introductions have occurred in the past even though NALF SCI policy does prohibit these items.

Additionally, unsanctioned personnel activities, such as hobby gardening, may introduce garden species that have the potential to become pest species. For example, gardens at the Federal Fire installation and elsewhere contain non-native white sage (*Salvia apiana*) and tomatoes (*Solanum lycopersicum* varietals). White sage has the potential to escape, spread, and/or hybridize with SCI species of *Salvia* and cherry tomatoes have proven invasive on Anacapa, one of the Northern Channel Islands.

The preparation of personnel and personal effects before arrival on NALF SCI involves adherence to cleaning protocols in addition to understanding about unsanctioned items.

Table 3-4. Personnel biosecurity effort priority index and action value table.

Action Number	Potentially Prevented Taxa	Action	Implementation Index	Personnel Index	Cost Index	Additive Effort Score	Action Value Score
Prevention of Incursions							
A1.	invertebrates, invasive plant propagules	Require personnel sign "Statements of Awareness" certifying they have inspected themselves and their personal effects.	1	1	1	3	● 1
A2.	invertebrates, invasive plant propagules	Initiate discussion on restricting island resident's personal gardens.	1	1	1	3	● 1
A3.	all taxa	Require an additional biosecurity subsection as part of required Navy Work Plans and Environmental Compliance Plans.	1	1	1	3	● 1
A4.	invertebrates, invasive plant propagules	Update contracting language and refer contractors to Conservation Measure AVMC-M-7.	1	1	1	3	● 1
B1.	invertebrates, invasive plant propagules	Remove any deleterious material from clothing, boots and gear (including backpacks, gaiters) before leaving the mainland and travelling to NALF SCI.	1	1	1	3	● 1
B2.	invertebrates, invasive plant propagules	Clean clothing, boots and gear at designated cleaning areas or locations on the mainland limited in exposure to invasive plant seeds or material.	1	1	1	3	● 1
B3.	invertebrates, invasive plant propagules	Maintain the cleanliness of boot scrubbers and other cleaning implements such as wall vacuums	1	1	1	3	● 1
B4.	all taxa	Disseminate the personnel biosecurity protocol checklist (Appendix B).	1	1	1	3	● 1
B5.	invertebrates, invasive plant propagules	Require designated officials to perform quick visual inspections of personnel departing on aircraft and barges destined for NALF SCI.	2	1	1	4	● 1
B6.	invertebrates, invasive plant propagules	Require field personnel to carry appropriate equipment on both the mainland and SCI to help remove soil, seed, and plant parts.	2	1	1	4	● 2
B7.	invertebrates, invasive plant propagules	Examine camping gear.	1	2	1	4	● 1
B8.	invertebrates, invasive plant propagules	If inspections are implemented, camping gear should be produced upon request for thorough inspections by trained officials.	1	2	1	4	● 1
B9.	invertebrates, invasive plant propagules	Mandate on-island designated shoes/hiking boots, gaiters and field backpacks.	1	1	2	4	● 2
B10.	all taxa	Ensure pest-proof trash cans distributed island-wide and encourage the proper disposal of trash.	2	1	3	6	● 2
B11.	all taxa	Implement inspections by trained scent dogs.	3	3	3	9	● 3

Table 3-4 continued. Personnel biosecurity effort priority index and action value table.

Early Detection and Monitoring								
C1.	invertebrates, invasive plant propagules	Encourage personnel to self-report species they have removed from clothing.	1	1	1	3	●	1
C2.	invertebrates, invasive plant propagules	Monitor for sign of invasive species in resident's personal gardens.	1	1	1	3	●	2
C3.	invertebrates, invasive plants	Schedule monitoring for entry points and common areas.	1	2	1	4	●	2
Post Detection Response								
D1.	all taxa	Notify the appropriate point of contact.	2	2	1	5	●	1
D2.		Deliver a formal warning and repercussions if protocols are not followed.	2	2	1	5	●	1
D3.		Contain any detected organism found on personnel's clothing, shoes, or personal luggage.	2	2	2	6	●	1
D4.	invertebrates, invasive plant propagules	If personnel do not meet cleanliness standards, do not allow transport to NALF SCI until they have remedied the issue(s).	3	2	2	7	●	2
Biosecurity Education								
E1.	all taxa	Routinely distribute NALF SCI Commander's Naval Instructions on Biosecurity and regularly include in briefings.	1	1	1	3	●	1
E2.		Include reference to NALF SCI Commander's Naval Instruction in all interpretive paneling on biosecurity.	1	1	1	3	●	1
E3.		Develop and widely distribute a concise and regularly updated list of most wanted species likely to be attached to personnel.	1	1	1	3	●	1
E4.		Include general biosecurity recommendations in the document "How to Do Business Onboard San Clemente Island".	1	1	1	3	●	1
E5.		Implement regular training on IAS and Command Instructions to all personnel.	2	2	1	5	●	1
E6.		Develop a general PowerPoint or other media that is applicable to all island personnel and include in the mandatory in brief of all NALF SCI visitors.	2	2	2	6	●	1

Prevention of Incursions – Personnel

Strategy A: Accountability

Ensure personnel are held accountable for the preparation of cargo (themselves and their personal gear) being transported to NALF SCI as well as items considered contraband.

ACTIONS

- A1. **Require personnel sign "Statements of Awareness" certifying they have inspected themselves and their personal effects.**
Biosecurity managers should draft a template statement of awareness that is included in all island debriefings and is signed by island visitors. Personnel must ensure clothing and boots are free of dust, cobwebs, dirt clods, mud, seeds and flower heads, attached organisms, etc. and that their personal effects do not harbor any organisms whatsoever.
- A2. **Initiate discussion on restricting island resident's personal gardens.**
The risks in hobby gardens include the spread of escapee plants as well as hybridization between native and non-native plants. In order to increase personnel awareness of endemic species, encourage residents to plant only native gardens in place of hobby gardens especially around resident housing. Wilson Cove Fire Station's native garden may serve as a good public model.
- A3. **Require an additional biosecurity subsection as part of required Navy Work Plans and Environmental Compliance Plans.**

The Navy (or NALF SCI in the least) should require the contractor to prepare a biosecurity subsection as part of the contract deliverable Work Plans and Environmental Compliance Plans for construction projects. This subsection should detail understanding of the risk of invasive species potentially introduced as a result of the project. Contractors should describe their activities on NALF SCI, the equipment they intend to import (i.e. the potential vectors) and how they could create the accidental introduction of invasive species. This subsection should detail their understanding on the topic and how the contractor expects to prevent the transport of IAS from the mainland to SCI as well as any mitigation actions should they introduce a non-native species.

A4. Update contracting language and refer contractors to Conservation Measure AVMC-M-7.

Ensure that contracting languages details items expressly forbidden and the cleaning standards they should adhere to prior to arrival on NALF SCI. “Prior to coming to SCI, military and non-military personnel will be asked to conduct a brief check for visible plant material, dirt, or mud on equipment and shoes. Any visible plant material, dirt or mud should be removed before leaving for SCI (Navy 2013).”

Strategy B: Ensure Personnel Cleanliness and Proper Disposal

Require that personnel ensure the cleanliness of themselves and their personal effects before transport to NALF SCI and the proper disposal of IAS found within their own effects.

ACTIONS

- B1. Remove any deleterious material from clothing, boots and gear (including backpacks, gaiters) before leaving the mainland and travelling to NALF SCI.**
Soil, mud, seeds, any propagules should be carefully removed and placed in sealed plastic bags for disposal. Cleaning stations should be developed at the airport with wall vacuums and outside boot brushes (Section 3.2.2) where personnel can safely clean footwear.
- B2. Clean clothing, boots and gear at designated cleaning areas or locations on the mainland limited in exposure to invasive plant seeds or material.**
It is important that gear is cleaned prior to arrival on NALF SCI, not post arrival. Locations where wall and hose vacuums have been installed as part of the biosecurity educational kiosk are appropriate boot cleaning facilities.
- B3. Maintain the cleanliness of boot scrubbers and other cleaning implements such as wall vacuums**
Boot brushes that are routinely dirty can re-contaminate footwear and defeat the purpose of cleaning (Figure 3-11). Cleaning stations with boot brushes and/or wall vacuums should be regularly maintained to ensure cleanliness and lack of deleterious debris.
- B4. Disseminate the personnel biosecurity protocol checklist (Appendix B).**
All personnel destined for NALF SCI should follow the checklist to ensure all personal clothing and gear has been thoroughly cleaned and inspected.

- B5. **Require designated officials to perform quick visual inspections of personnel departing on aircraft and barges destined for NALF SCI.**
Identify a point of contact that can provide visual inspections to ensure that footwear is clean.
- B6. **Require field personnel to carry appropriate equipment on both the mainland and SCI to help remove soil, seed, and plant parts.**
In particular, restoration, military, and fire field personnel will benefit by carrying wire brushes, horse-pick type brushes, small screwdrivers, and boot brushes to help clean gear in between sensitive areas on SCI and before departure from the mainland to SCI.
- B7. **Examine camping gear.**
Tents should be shaken out and thoroughly dried before transport to NALF SCI. Velcro should not harbor any seeds or debris. No dirt, mud, or other deleterious debris.
- B8. **If inspections are implemented, camping gear should be produced upon request for thorough inspections by trained officials.**
Enforcement of protocols will prevent incursions from overlooked items.
- B9. **Mandate on-island designated shoes/hiking boots, gaiters and field backpacks.**
Personnel not entering field-type settings, or occupying office-type situations, may not need abide by this action. This is at the discretion of the biosecurity program and this may be most effective for military performing training exercises, natural resource, fire, utilities, and restoration personnel.
- B10. **Ensure pest-proof trash cans distributed island-wide and encourage the proper disposal of trash.**
Personnel will dispose of trash that poses biosecurity risks if pest-proof trash cans are widely available. NALF SCI should discourage personnel and residents from littering or stashing refuse in inappropriate places such as unsecured trash cans. All trash cans should be impenetrable to animals such as rodents. Ask personnel to dispose of weed seeds in sealed plastic bags.
- B11. **Implement inspections by trained scent dogs.**
Detection dogs can be trained to detect IAS and contraband. Dogs can quickly and discreetly walk through a waiting room of personnel waiting to depart to perform inspections of personnel and their personal effects.



Figure 3-11. Boot brushes should be regularly cleaned and debris should be disposed of in sealed plastic bags. The trafficked area around the boot cleaning station should also be swept and maintained.

Early Detection and Monitoring - Personnel

Strategy C: Early Detection

Develop a standardized monitoring system focused on early detection for high priority IAS around areas heavily trafficked by personnel.

ACTIONS

- C1. **Encourage personnel to self-report species they have removed from clothing.**
This may encourage other personnel to inspect clothing.
- C2. **Monitor for sign of invasive species in resident's personal gardens.**
Although hobby gardens should be discouraged, any existing gardens should be monitored for known noxious and invasive weeds and any rodent activity.
- C3. **Schedule monitoring for entry points and common areas.**
The galley, Salty Crab, resident housing and training areas should be on a regular monitoring schedule.

Post Detection Response - Personnel

Strategy D: Rapid Response

Post-detection responses should be tailored to whether a biosecurity risk was likely or not likely introduced to NALF SCI from personnel.

ACTIONS

- D1. **Notify the appropriate point of contact.**

Coordinate and collaborate with appropriate agencies; pest management, natural resource, and/or weed managers that an IAS was detected upon inspection.

- D2. **Deliver a formal warning and repercussions if protocols are not followed.**
If authority is granted, personnel with repeat offenses should be denied transport to NALF SCI and do not follow protocols outlined in Appendix B for cleanliness standards.
- D3. **Contain any detected organism found on personnel's clothing, shoes, or personal luggage.**
Dispose of dirt and seeds in sealed plastic bag. If personnel are bringing expressly forbidden personal pets or other animals, contain the animal.
- D4. **If personnel do not meet cleanliness standards, do not allow transport to NALF SCI until they have remedied the issue(s).**
Sites of embarkation should have boot cleaning materials and brushes so that personnel can quickly clean footwear to meet protocols and pass inspections.

Biosecurity Education - Personnel

Strategy E: Ensure Personnel Cleanliness

Increase education of, and outreach to, those who may be potential sources for IAS introductions through the transport of vehicles and heavy equipment.

ACTIONS

- E1. **Routinely distribute NALF SCI Commander's Naval Instructions on Biosecurity and regularly include in briefings.**
The first task of a biosecurity manager should be to assemble recommendations made herein for the Commanding Officer to authorize and sign. The Naval Instructions should have a section on the preparation and cleanliness expectations of personnel prior to transport.
- E2. **Include reference to NALF SCI Commander's Naval Instruction in all interpretive paneling on biosecurity.**
It should be reinforced that this is a NALF SCI expectation that personnel are responsible to prevention their own introductions and to limit the spread of IAS, including landscaping and gardening supplies.
- E3. **Develop and widely distribute a concise and regularly updated list of most wanted species likely to be attached to personnel.**
Colorful and photo-heavy pamphlets should be distributed to all personnel. These should also be in areas such as resident housing.
- E4. **Include general biosecurity recommendations in the document "How to Do Business Onboard San Clemente Island".**
Refer personnel to the NALF SCI Biosecurity Plan for applicable and specific vector activities.
- E5. **Implement regular training on IAS and Command Instructions to all personnel.**

All in-briefs should include a significant component on biosecurity and incorporate the cleaning standards checklist (Appendix B).

E6. Develop a general PowerPoint or other media that is applicable to all island personnel and include in the mandatory in brief of all NALF SCI visitors.

Primarily cover SCI topics that affect personnel and the specific vectors that will affect the military mission. Topics should instruct personnel how to:

- Prepare cargo for transport to NALF SCI
- Prepare vehicles and heavy equipment for transport
- Source on-island materials to reduce spread of invasives
- Properly store food items
- Properly clean clothing, shoes and personal effects
- Identify particular IAS species of concern
- Report sightings and identify points of contact
- And most importantly, demonstrate the impacts IAS have on the NALF SCI military mission and ecosystem

3.2 Modes of Transport

Globally, international and national shipping is the primary pathway for the introduction of invasive species through the transport of foreign cargo and materials. Locally, for SCI this is no different; however, the conveyance itself (whether by barge, aircraft, commercial or recreational boats) is a significant vector. Barges discharge ballast water, suffer from biofouling complications, and also provide a platform for the transport of larger IAS, especially rodents. Aircraft are capable of rapid transit resulting in higher species survival during short travel times and the risk of repeated introductions because of the regularity of flight schedules.

Although cargo is a substantial biosecurity risk and detailed in Section 3.1, thorough plans must also incorporate the risks incurred by the mode of transport (in this case, ocean-going vessels and commercial aircraft) itself. Military aircraft and amphibious vehicles will be discussed separately in Section 4.1.4.

Ocean-going traffic in waters around SCI include NALF SCI's weekly barge operations, commercial and recreational fishing operations, and recreational boats. Round-trip civilian flights service NALF SCI multiple times daily.

Well defined protocols need to be implemented for the transportation agent itself—the *Eel Point* Barge and various airplanes that arrive on NALF SCI, in addition to the preparation of cargo for transport

3.2.1. Barge



Figure 3-12. The *Eel Point* and Crowley marine tug returning from NALF SCI.

The barge *Eel Point* services SCI once a week and is towed by Crowley tugboats (Figure 3-12). Materials, vehicles, roll-off dumpsters, equipment and general supplies arrive to the loading area on 32nd Street at NBSD. When not in use, the barge is tied alongside the dock at NBSD and is rarely used for tasks unrelated to SCI operations. No rat barriers are used along mooring cables at NBSD.

Cargo and shipping loads are not stored prior to transport to NALF SCI, they are quickly loaded the morning of departure.

Crowley has two tugboats that tow the barge in the Port of San Diego that are available to any customer; they are not used for solely Navy purposes. When not in use, they are tied to Crowley docks in the Port of San Diego. It is unknown if Crowley maintains rat barriers along mooring cables.

Although the *Eel Point* is dedicated to service SCI, other barges may be contracted for special requests and could come from various locations around Southern California, including the ports of Los Angeles and Long Beach where aquatic invasive species including but not limited to *Undaria pinnatifida* and *Sargassum horneri* have invaded harbor waters (Silva et al. 2002).

Prevention is the most cost effective and environmentally sensitive method of managing invasive species and involves the interception of invasives at the point of entry or release. The movement of MIS is usually the primary focus with ocean-going vessels but terrestrial invasive species are of high concern as well. Regulating and enforcing ocean-going vessels is notoriously challenging and limited reasonable options exist to prevent the introduction of organisms (excluding organisms contained in cargo) such as rodents, reptiles and mesopredators that have sought refuge in hiding locations, invasive algae, fish and fouling organisms attached on hulls, rudders, propellers, anchors etc.

Additionally, the barge's storage location and sheer proximity to such an urbanized environment with persistent pests invites many opportunities for organisms to seek refuge and eventual transport to SCI.

Table 3-5. Barge biosecurity effort priority index and action value table.

Action Number	Potentially Prevented Taxa	Action	Implementation Index	Personnel Index	Cost Index	Additive Effort Score	Action Value Score
Prevention of Incursions							
A1.	all species	Modify contract language.	1	1	1	3	1
A2.	invertebrates, invasive plant propagules, small mammals	Eliminate debris piles, including coiled line piles, dirt collection, or gravel piles.	1	1	1	3	1
A3.	all species	Inspect barge to ensure that it is free of dirt, plant or animal species prior to loading.	1	1	1	3	1
A4.	small mammals	Dispose of trash and refuse appropriately.	1	1	1	3	1
A5.	all species	Require that marine tugs are "pest-free".	1	1	1	3	3
A6.	invasive fish, algae, biofouling organisms	Require tug and barge contractors produce documentation that they are adhering to biofouling management and reporting requirements.	1	1	1	3	3
A7.	invasive fish, algae, biofouling organisms	Require tug and barge contractors produce documentation that they are adhering to ballast water discharge requirements (if applicable).	1	1	1	3	3
A8.	invasive plant propagules, small mammals, invertebrates	Require that barges are pressure washed with water before any loading occurs.	1	2	1	4	1
A9.	all species	Write NBSD and NALF SCI Instruction for barge operations biosecurity requirements.	1	2	2	5	1
A10.	small mammals, reptiles	Continually maintain traps to capture rodent, snake, and mesopredators on and around the barge.	2	1	2	5	2
A11.	small mammals	Install rat guards on mooring lines for both the barge and tugs.	2	1	2	5	2
A12.	small mammals	Require that marine tugs maintain rodent traps.	2	1	2	5	2
A13.	small mammals	Provide rodenticide bait on the barge for the control of rodents.	2	1	2	5	3
A14.	small mammals	Moor the barge greater than ten feet from a dock to discourage IAS from seeking refuge.	3	1	3	7	3
A15.	invasive plants, small mammals, reptiles	Develop a robust IPM plan around barge areas.	3	2	3	8	2
A16.	invasive fish, algae, biofouling organisms	Determine an interval for in-water and dry dock hull cleaning of the marine tug and barge. Maintain the hull cleaning schedule.	3	2	3	8	3
A17.	all taxa	Implement detection dog surveys at barge landings.	3	3	3	9	3

Table 3-5 continued. Barge biosecurity effort priority index and action value table.

Early Detection and Monitoring							
B1.	all species	Require a pre-departure survey of traps, visual inspections of the barge and its cargo, and ensure cleanliness.	2	2	2	6	● 1
B2.	all species	When the barge is not in use, maintain animal traps and passive camera traps onboard prior to loading.	2	2	2	6	● 2
B3.	invasive plants	Perform regular invasive plant surveys around the immediate loading facilities.	2	2	2	6	● 2
B4.	invasive fish, algae, biofouling organisms	Negotiate with the contractor to conduct regular underwater surveys of both the barge and the tugs' hulls to detect the presence of invasive marine algae, fish or egg masses, mollusks, or other biofouling organisms.	3	3	3	9	● 3
Post Detection Response							
C1.	all species	Identify the party responsible for IAS containment and animal capture.	1	1	1	3	● 1
C2.	invertebrates, small mammals, reptiles	Determine most effective trap for each target species group.	1	1	1	3	● 1
C3.	all species	Identify lapses in biosecurity protocols that allowed introduction to occur.	1	2	1	4	● 1
C4.	small mammals, reptiles	Maintain an animal capture and containment kit aboard the barge at all times to assist in animal capture.	1	2	2	5	● 2
C5.	small mammals, reptiles	Stage IAS "spill kits" in an easily accessible location near barge docking activities.	1	2	2	5	● 2
C6.	small mammals, reptiles	If discovered at the on-island barge dock or if an IAS is discovered escaping from the barge, implement grid trapping around detection sites no more than 150 feet apart (Roberts 2003) across five acres or the complete area where the animal was detected, whichever is greater.	3	2	3	8	● 3
C7.	small mammals, reptiles	If an invasive animal is found and contained on the barge: determine sex, quarantine, euthanize and perform necropsy.	3	3	3	9	● 1
C8.	invasive fish, algae, biofouling organisms	If invasive algae are discovered on the hull, pull the barge or tug immediately.	3	3	3	9	● 1
C9.	all species	Post removal, perform local sampling to confirm that all individuals have been removed and a population has not been established.	3	3	3	9	● 2
Biosecurity Education							
D1.	all species	Distribute NALF SCI Commander's Naval Instructions on Biosecurity.	1	1	1	3	● 1
D2.	all species	Require barge contractor and all personnel associated with barge operations to participate in biosecurity course.	2	2	2	6	● 1

Prevention of Incursion - Barge

Strategy A: Develop Inspection and Operations Standards

Identify all standards for barge cleanliness and operations.

ACTIONS

A1. **Modify contract language.**

Contracts should ensure that barge operators are aware of cleanliness standards and all additional requirements that follow.

A2. **Eliminate debris piles, including coiled line piles, dirt collection, or gravel piles.**

Coil line on hooks that do not come into contact with the deck; do not coil lines on deck. This will reduce the potential for IAS refuge such as rodents, snakes, mesopredators and windblown seed (Figure 3-16).

A3. **Inspect barge to ensure that it is free of dirt, plant or animal species prior to loading.**

At the minimum inspect: rodent traps, presence of mesopredators in areas of likely harborage, animal spoor, cleanliness of barge platform. Barges should not be permitted to

cross the channel with collections of dirt on the deck or the presence of any animal sign (Figure 3-15). Consider the use of detection dogs in inspection surveys (see Action A17).

A4. **Dispose of trash and refuse appropriately.**

Any trash on the vessel should be disposed of properly on the mainland prior to departure. No trash should be stored on the barge while in dock.

A5. **Require that marine tugs are “pest-free”.**

Develop contracting language that encourages the use of pest control by the marine tug company and that the marine tug will ensure pest-free tugs. Contracting language should also indicate that the contractor will assume liability should it be discovered that a pest from a tug was subsequently introduced to the barge or NALF SCI.

A6. **Require tug and barge contractors produce documentation that they are adhering to biofouling management and reporting requirements.**

Refer to California’s Marine Invasive Species Program reporting standards (California State Lands Commission 2015) to discourage the spread of MIS species.



Figure 3-13. Example of a rat guard that should be installed on all vessels at dock travelling to NALF SCI. Source: US Navy.



Figure 3-14. Past the U.S. Navy restricted area fence are offshore mooring buoys that would be an ideal location to store the barge to discourage IAS from seeking refuge.

- A7. **Require tug and barge contractors produce documentation that they are adhering to ballast water discharge requirements (if applicable).**
Not all barges may be ballasted by seawater. Refer to California's Marine Invasive Species Program reporting standards (California State Lands Commission 2015) to discourage spread of MIS species.
- A8. **Require that barges are pressure washed with water before any loading occurs.**
This will reduce the potential for IAS refuge to ensure no collection of dirt that may be harboring IAS (Figure 3-15).



Figure 3-15. Dirt collection places on barge deck should be pressure washed prior to loading.



Figure 3-16. Dock line piles encourage animal refuge. Ropes should be hung from hooks on the barge.

A9. **Write and distribute NBSD and NALF SCI Instruction for barge operations biosecurity requirements.**

The first task of a biosecurity manager should be to assemble recommendations made herein for the Commanding Officer to authorize and sign. The recommendations that are employed by NBSD and NALF SCI should be reflected in Naval Instructions signed by the commander as well as contracting language. This will clearly define the expectations

of military personnel and contractors for the prevention of invasive species introductions to NALF SCI via barge transport.

A10. **Continually maintain traps to capture rodent, snake, and mesopredators on and around the barge.**

Traps should be durable and not quickly degrade in the maritime environment. These traps should be maintained on the barge as well as in addition to a robust integrated pest management program trapping effort at barge loading facilities. Check occupancy before departure from NBSD. See Appendix C for trap recommendations.

A11. **Install rat guards on mooring lines for both the barge and tugs.**

Although not always 100-percent preventative, they are a good barrier to prevent the introduction of mesopredators in addition to rodents depending on the size of the cone (Figure 3-13). Also require the tug contractor to install rat guards if not already in place.

A12. **Require that marine tugs maintain rodent traps.**

Because marine tugs tie up to barges in order to direct barge movement, lines between tug and barge can become a route for rodents (Figure 3-17). An example of a small and inconspicuous trap (TOMCAT) that is recommended for tugboats is shown in Appendix C.

A13. **Provide rodenticide bait on the barge for the control of rodents.**

This is necessary for free-ranging animals that resist traps. DoD, Federal, State and local regulations for pesticide applications will apply.

A14. **Moor the barge greater than ten feet from a dock to discourage IAS from seeking refuge.**

Eel Point's proximity to the dock, the height of the dock, and the available sources of animal harborage in the area (warehouses, storage facilities) may make it impossible to fully prevent rodents and other pests from attempting to seek refuge on the barge. Repositioning the barge to an offshore mooring buoy would fully discourage IAS from easy access (Figure 3-14). The barge could then be moved to the dock once loading is initiated and all cargo has been prepared for transit.

A15. **Develop a robust IPM plan around barge areas.**

Integrated pest management plans should also coordinate with weed management plans to develop trapping and treatment schedules for barge loading facilities. Aggressively trapping for pests at the barge loading facilities will reduce the number of IAS in the area and therefore reduce the risk of pests seeking refuge on the barge itself. Additionally, it is highly recommended to keep a plant-free margin around the immediate barge loading facilities and all structures. Cover all dirt and non-asphalt services with pea-gravel to further reduce the growth of invasive plants.

A16. **Determine an interval for in-water and dry dock hull cleaning of the marine tug and barge. Maintain the hull cleaning schedule.**

Marine tugs should have complete hull cleanings at agreed upon and scheduled intervals. The decks of tugs should be pressure washed prior to tugging the *Eel Point* across the channel.

A17. **Implement detection dog surveys at barge landings.**

Detection dogs quickly and thoroughly inspect barges and/or associated marine tugs that may be otherwise difficult for visual inspection prior to departure or on arrival.



Figure 3-17. A small possibility exists for rodents to move between tug and barge. This possibility can be reduced by maintaining rodent traps on both the tug and barge.

Early Detection and Monitoring – Barge

Strategy B: Early Detection

Develop a standardized monitoring system focused on early detection for high priority IAS on the barge.

ACTIONS

B1. **Require a pre-departure survey of traps, visual inspections of the barge and its cargo, and ensure cleanliness.**

Forbid the barge from crossing the channel if an IAS is detected and not removed during pre-departure surveys of traps or if the barge is not adhering to cleanliness standards.

B2. **When the barge is not in use, maintain animal traps and passive camera traps onboard prior to loading.**

If the barge is side-tied to the dock, maintain passive animal traps and un-baited camera traps so as not to attract any pests to the barge. However, if the barge is moved to an off-shore mooring buoy, bait all traps. If an animal is captured or detected on camera traps, further inspect the boat. Camera traps set correctly can detect the presence of small mammals and mesopredators (Figures 3-18 and 3-26). These photos should be reviewed at least once weekly and set to catch any animal movement on the barge.

- B3. **Perform regular invasive plant surveys around the immediate loading facilities.**
Develop set transects for invasive plant species at barge loading facilities and NALF SCI barge dock. Coordinate with weed management to treat any invasive plant species to limit seed dispersal through wind and equipment travelling through the area to the barge.
- B4. **Negotiate with the contractor to conduct regular underwater surveys of both the barge and the tug's hulls to detect the presence of invasive marine algae, fish or egg masses, mollusks, or other biofouling organisms.**
If invasive species are detected in the underwater survey, the tug or barge must be immediately cleaned. The California Coastal Commission recommends cleaning hulls as frequently as every six weeks (California Coastal Commission 2012). Hulls may need to be more frequently cleaned because of concerns with invasive algae contamination.



Figure 3-18. Reconyx Hyperfire cameras are motion and infrared sensitive and should be used to detect organisms while the barge is moored. Source: Reconyx.

Post Detection Response – Barge

Strategy C: Rapid Response

Post-detection responses should be tailored to detected biosecurity risks involving the barge.

ACTIONS

- C1. **Identify the party responsible for IAS containment and animal capture.**
The responsible person should be a natural resource position experienced in animal capture. This position should be present at the weekly barge docking on NALF SCI with the designated responsibility of looking for, identifying and responding to IAS.
- C2. **Determine most effective trap for each target species group.**
Traps should be considered and deployed for the target species.

- C3. **Identify lapses in biosecurity protocols that allowed introduction to occur.**
Adapt the NALF SCI Biosecurity Plan as needed to incorporate any lapses in strategies that allowed the barge to transport an invasive species.
- C4. **Maintain an animal capture and containment kit aboard the barge at all times to assist in animal capture.**
If an animal is discovered prior to departure, attempt containment and removal. If an animal is discovered during docking procedures, the barge should not make contact with the island or safely detach from the NALF SCI dock until the animal is contained. If they cannot be contained, the barge should return to port for assistance from animal services. However, under no circumstances should the barge make landfall. Once captured, IAS should be disposed of properly.
- C5. **Stage IAS “spill kits” in an easily accessible location near barge docking activities.**
Multi-target kits should not possess any toxic baits due to regulatory constraints and the potential for off-target consumption (island fox). The following serves as an example of contents in a multi-target spill kit:
- Gnaw sticks or other indicator baits such as peanut butter, molasses, oat loaves, cat food
 - Rapid response camera traps
 - Snake, mesopredator, rat, and small mammal traps (Sherman traps)
 - Rat tunnels, papers, and paint (Black Trakka; Appendix C)
 - Nets
- C6. **If discovered at the on-island barge dock or if an IAS is discovered escaping from the barge, implement grid trapping around detection sites no more than 150 feet apart (Roberts 2003) across five acres or the complete area where the animal was detected, whichever is greater.**
Usually grid searches and accompanying traps are an effective survey method for the initial introduction of rodents in particular. The trapping method would be determined based off the taxa of the species identified and the IAS spill kit available.
- C7. **If an invasive animal is found and contained on the barge: determine sex, quarantine, euthanize and perform necropsy.**
Time is of the utmost importance when containing newly introduced IAS. Performing necropsies will be important to delineate stomach contents and to identify if the animal has reproduced recently.
- C8. **If invasive algae are discovered on the hull, pull the barge or tug immediately.**
Clean the hull using BMPs (California Coastal Commission 2012) to eliminate the algae infestation.
- C9. **Post removal, perform local sampling to confirm that all individuals have been removed and a population has not been established.**
Determine appropriate lengths of time to monitor post-extirpation. The interval and location would be defined based off the particular IAS fall event.

Strategy D: Outreach

Improve the awareness of invasive species and topics in biosecurity concerning supply barges to barge operators, contractors, and associated personnel through targeted outreach efforts.

ACTIONS

D1. Write and distribute NALF SCI Commander’s Naval Instructions on Biosecurity.

The first task of a biosecurity manager should be to assemble recommendations made herein for the Commanding Officer to authorize and sign. The Naval Instructions should be readily available and detail barge cleanliness expectations and other barge transport protocols detailed in the Prevention section (Actions A1 – A 16) of barge operations.

D2. Require barge contractor and all personnel associated with barge operations to participate in biosecurity course.

An in-brief and PowerPoint presentation on the topic of biosecurity should be developed specifically for all barge personnel.

3.2.2. Aircraft

Regularly scheduled commuter flights to NALF SCI are run by Berry Aviation. Between eight and 12 roundtrip flights from NASNI arrive Monday through Friday on NALF SCI. The aircraft used as of this writing is a Metro Air with a capacity of 20 passengers. In addition, contractors working on the island with greater than ten personnel are instructed to charter private aircraft for transportation.

It may be challenging to prevent IAS introductions from aircraft originating from across the region, such as chartered private aircraft. However, recommendations emphasize early detection and outreach at the point of origin for introductions; the airport at NASNI, and secondarily for NALF SCI’s airfield as well.

Table 3-6. Aircraft biosecurity effort priority index and action value table.

Action Number	Potentially Prevented Taxa	Action	Implementation Index	Personnel Index	Cost Index	Additive Effort Score	Action Value Score
Prevention of Incursions							
A1.	rodents	Coordinate with installation pest management service providers to conduct rodent prevention and control at all airport storage facilities and hangars.	1	1	1	3	2
A2.	invertebrates, invasive plant propagules	Regularly clean luggage carts.	1	1	1	3	1
A3.	invasive plant propagules, small mammals, reptiles	Conduct routine inspections targeting landing gear.	1	1	1	3	1
A4.	rodents	Paint 12 inch white "rat runs" at the bottom of walls in airport storage facilities and hangars.	1	1	1	3	1
A5.	all species	Assemble, inspect and approve a list of charter aircrafts for contractors.	1	1	1	3	2
A6.	all species	Utilize X-Ray machines to scan luggage.	3	3	3	9	3
A7.	all species	Implement detection dog surveys at NASNI airfield.	3	3	3	9	3
Early Detection and Monitoring							
B1.	all species	Include IAS and cleanliness inspections as part of routine aircraft maintenance.	1	1	1	3	1
B2.	invertebrates, invasive plant propagules	Regularly inspect flight line equipment such as baggage carts.	1	1	1	3	1
B3.	all species	Regularly clean and monitor cargo spaces for IAS.	1	1	1	3	1
B4.	invasive plant propagules	Check aircraft moorings/hangars for IAS propagules.	1	1	1	3	1
B5.	all species	Conduct airfield monitoring for presence of IAS as part of "foreign object damage (FOD) walk-downs".	1	1	1	3	1
B6.	rodents	Investigate feasibility of baited rodent traps onboard aircraft.	1	2	2	5	3
B7.	all species	Implement detection dog surveys at NASNI airfield to monitor for IAS.	3	3	3	9	3
Post Detection Response							
C1.	all species	Identify the party responsible for IAS containment and animal capture.	1	1	1	3	1
C2.	invertebrates, small mammals, reptiles	Determine most effective trap for target species group.	1	1	1	3	1
C3.	all species	Identify lapses in biosecurity protocols that allowed introduction to occur.	1	2	1	4	1
C4.	small mammals, reptiles	Stage IAS "spill kits" in an easily accessible location near airport facilities.	1	2	2	5	2
C5.	small mammals, reptiles	Maintain an animal capture and containment kit in airport facilities at all times to assist in animal capture.	2	2	2	6	2
C6.	small mammals, reptiles	If an invasive animal is found and contained on the aircraft: determine sex, quarantine, dispatch and perform necropsy.	3	3	3	9	1
C7.	small mammals, reptiles	If discovered at the NALF SCI airfield or if an IAS is discovered escaping from the aircraft, implement grid trapping around detection sites no more than 150 feet apart (Roberts 2003) across five acres or the complete area where the animal was detected, whichever is greater.	3	3	3	9	3
C8.	invasive fish, algae, biofouling organisms	Post removal, perform local sampling to confirm that all individuals have been removed and a population has not been established.	3	3	3	9	3
Biosecurity Education							
D1.	all species	Develop an "educational kiosk" at the NASNI airport waiting room.	2	2	2	6	1
D2.		Develop a cleaning station as part of the educational kiosk.	2	2	2	6	2

Prevention of Incursion – Aircraft

Strategy A: Minimize Risk Of Introduction

Identify all standards for aircraft cleanliness and operations.

ACTIONS

- A1. **Coordinate with installation pest management service providers to conduct rodent prevention and control at all airport storage facilities and hangars.**
The number one preventative strategy will be to prevent the incursion of rodents, which are well established at NASNI and can easily access aircraft through wheel wells.
- A2. **Regularly clean luggage carts.**
If not maintained, luggage carts may inadvertently transfer invasive seeds to luggage. They should be regularly washed and vacuumed ideally at the beginning and end of every day.
- A3. **Conduct routine inspections targeting landing gear.**
Aircrafts' landing gear can be a potential source of entry for IAS (Figure 3-19). Inspection emphasis should focus on materials caught in wheels and tire treads as well as any organism that may have breached the aircraft through the wheel well. Landing gear breaches do occur as in the case of an Australian scrub python (*Morelia amethistina*) in 2013 that was discovered nestled in the wing of the plane (Daily Mail 2013, Figure 3-21).
- A4. **Paint 12 inch white “rat runs” at the bottom of walls in airport storage facilities and hangars.**
Painted white rat runs can enable management to determine if integrated pest management efforts need to be implemented or expanded (Figure 3-19). If rub marks (dark, greasy stains) appear on the white run, then trapping efforts and other IPM strategies should be employed. Rats like linear spaces, particularly if they offer some concealment, therefore additional white rat runs could be painted along the floor at the bottom of walls, in gutters, on ledges, between walls and units of equipment like coolers and stoves, or on pipes and wires.
- A5. **Assemble, inspect and approve a list of charter aircrafts for contractors.**
Biosecurity personnel and pest management personnel should work closely with various chartered aircraft companies in the region to ensure that the company's pest management activities will prevent the introduction of IAS from aircraft. First, a list of chartered aircrafts that have been approved by the biosecurity manager should be assembled. NALF SCI should ensure that all chartered aircraft companies have adequate pest management activities in place, such as robust trapping efforts in facilities and hangars.
- A6. **Utilize X-Ray machines to scan luggage.**
This is not the most effective preventative action; if compliance with personnel becomes a problem then this could be an added recommendation. X-ray machines can be used to detect contraband and restricted items.

A7. **Implement detection dog surveys at NASNI airfield.**

Detection dogs can quickly and thoroughly inspect aircraft prior to departure that may be otherwise difficult for visual inspection prior to departure or on arrival.



Figure 3-19. Rats leave rubbings (dark greasy stains) along linear locations, usually between a nest and food source. Painted white rat runs will enable management to determine if integrated pest management trapping efforts are successful.



Figure 3-20. Landing gear is easily accessible and may provide refuge for rodents and mesopredators. They should be regularly inspected.



Figure 3-21. Scrub python that breached an airplane's landing gear and travelled over 500 miles from Australia to Papua New Guinea in 2013. Source: dailymail.co.uk.

Early Detection and Monitoring – Aircraft

Strategy B: Early Detection

Develop a standardized monitoring system focused on early detection for high priority IAS around aircraft and associated facilities.

ACTIONS

- B1. Include IAS and cleanliness inspections as part of routine aircraft maintenance.**
Work with airport personnel to conduct biosecurity surveys (looking for IAS) while conducting routine maintenance and inspections on aircraft.
- B2. Regularly inspect flight line equipment such as baggage carts.**
Baggage carts should be thoroughly cleaned at the minimum once a day five days a week to limit the spread of IAS through dirt, seeds, and debris.
- B3. Regularly clean and monitor cargo spaces for IAS.**
Cargo spaces should be monitored and cleaned as part of routine aircraft maintenance.
- B4. Check aircraft moorings/hangars for IAS propagules.**
Any areas on the tarmac or in hangars that harbor debris should be regularly pressure washed and disposed of.
- B5. Conduct airfield monitoring for presence of IAS as part of “foreign object damage (FOD) walk-downs”.**
Inspections should include the landing gear and any foreign items on the tarmac.
- B6. Investigate feasibility of baited rodent traps onboard aircraft.**
Cargo holds and other stowaway locations may be feasible to use small, plastic traps for rodents and should be discussed with the contractor (TOMCAT, Appendix C).
- B7. Implement detection dog surveys at NASNI airfield to monitor for IAS.**
Detection dogs can quickly and effectively survey for IAS.

Post Detection Response - Aircraft

Strategy C: Rapid Response

Post-detection responses should be tailored to detected biosecurity risks involving the aircraft.

ACTIONS

- C1. Identify the party responsible for IAS containment and animal capture.**
The responsible person should be trained personnel experienced in animal capture present at both the NASNI and NALF SCI airport. This position should be present at the daily loading of the aircraft with the designated responsibility of looking for, identifying and responding to IAS.
- C2. Determine most effective trap for target species group.**
Traps should be considered and deployed for the target species.
- C3. Identify lapses in biosecurity protocols that allowed introduction to occur.**
Adapt the NALF SCI Biosecurity Plan as needed to incorporate any lapses in strategies that allowed the aircraft to transport an invasive species.

- C4. **Stage IAS “spill kits” in an easily accessible location near airport facilities.**
Multi-target kits should not possess any anti-coagulants or toxic baits due to regulatory constraints and the potential for off-target consumption (island fox). The following serves as an example of contents in a multi-target spill kit:
- Gnaw sticks or other indicator baits such as peanut butter, molasses, oat loaves, cat food
 - Rapid response camera traps
 - Snake, mesopredator, rat, and small mammal traps (Sherman traps)
 - Rat tunnels, papers, and paint (Black Trakka; Appendix C)
 - Nets
- C5. **Maintain an animal capture and containment kit in airport facilities at all times to assist in animal capture.**
If an animal is discovered prior to departure, attempt containment and removal. If an animal is discovered while en route, the aircraft should not open any holds or begin offloading procedures until the animal is contained. If the animal cannot be contained, the plane should return to the mainland for assistance from pest management. Once captured, IAS should be disposed of properly.
- C6. **If an invasive animal is found and contained on the aircraft: determine sex, quarantine, dispatch and perform necropsy.**
Time is of the utmost importance when containing newly introduced IAS. Performing necropsies will be important to delineate stomach contents and to identify if the animal has reproduced recently.
- C7. **If discovered at the NALF SCI airfield or if an IAS is discovered escaping from the aircraft, implement grid trapping around detection sites no more than 150 feet apart (Roberts 2003) across five acres or the complete area where the animal was detected, whichever is greater.**
Usually grid searches and accompanying traps are an effective survey method for the initial introduction of rodents in particular. The trapping method would be determined based off the taxa of the species identified and the spill kit available.
- C8. **Post removal, perform local sampling to confirm that all individuals have been removed and a population has not been established.**
Determine appropriate lengths of time to monitor post-extirpation. The interval and location would be defined based off the particular IAS fall event.

Biosecurity Education - Aircraft

Strategy D: Outreach

Increase education of, and outreach to, personnel travelling by aircraft who may be potential sources for IAS introductions.

ACTIONS

- D1. **Develop an “educational kiosk” at the NASNI airport waiting room.**

Educational signage should be included at debarkation sites for personnel such as the NASNI Airport. Currently, there are educational panels detailing the sensitive resources of NASNI and NALF SCI. An adjacent location, currently approved by the Airfield Manager (March 2016), could incorporate an approximately three feet wide by five feet tall interpretative panel hung near the exit of the waiting room. This location should also direct personnel to the cleaning station—wall vacuum, hose attachment, and boot brush (Action HH2). The panel should include biosecurity topics such as: NALF SCI Commander’s Naval Instruction and biosecurity importance to the military mission, ecosystem preservation, endemic species, personnel awareness, cleaning and clothing checks, and watch-list species. The NASNI Airport educational panel should also suggest that personnel visit the educational panel at the NALF SCI airfield.

D2. Develop a cleaning station as part of the educational kiosk.

Various seed capture supplies should be installed as a component of the educational kiosk. Wall vacuums with hose attachments are relatively easy and inexpensive to install in addition to boot brushes, horse picks, and other brush-type implements (Figures 3-23 and 3-24). Wall vacuums are dual-purpose and can clean personnel’s footwear as well as maintain passive boot cleaning brushes. All seed-capture devices can be installed outside and have almost no noise impact. A 5-gallon tank that captures all debris can be installed inside the storage facilities and emptied as part of a maintenance schedule.

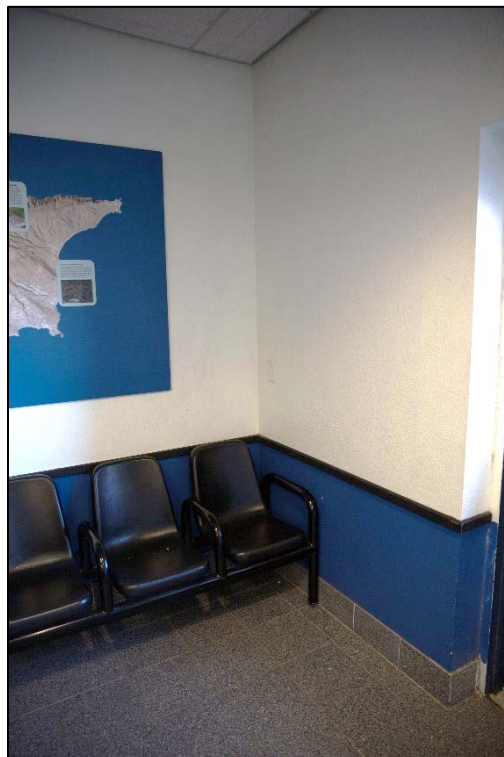


Figure 3-22. Approved location for educational and interpretative signage directing personnel to clean their footwear and personal effects. The sign should also point to an outside cleaning station and direct people to pass through educational signage at the NALF SCI airfield.



Figure 3-23. Example of a port wall vacuum where refuse (invasive plant seeds) can be disposed.



Figure 3-24. Example of a wall vacuum with a hose attachment that can be used to maintain cleanliness at the biosecurity station as well as to vacuum footwear and personal effects.

3.2.3. Commercial Fishing and Recreational Boats

Many ocean areas around SCI are accessible to the public for recreational and commercial purposes. The waters around SCI are popular for commercial and sport fishing, recreational diving and other recreational activities, which are important social and economic activities. These industries support large numbers of fishermen, boat operators and recreational boaters.

The commercial fishing industry around SCI can be productive for fish, squid, crab, lobster and sea urchins. Commercial fisheries within the area account for a significant proportion of California's tuna catch, including skipjack, yellowfin, bluefin tuna and albacore. Salt-water sport fishing and charter boats can also target waters around San Clemente to pursue fish species such as yellowfin and bluefin tuna, yellowtail, rockfish, kelp bass, California sheephead, whitefish, dorado, marlin, barracuda and lingcod (Commercial Fishing Interests, ND).

The greatest biosecurity concern with the interface of commercial fisheries and the public boating community in NALF SCI's management footprint is the introduction of MIS through the transference of fishing gear from waters elsewhere and terrestrial vertebrate species through

swim-to-shore vessel and scupper escapes or vessel groundings. Unfortunately for the Navy's biosecurity concerns, this is pervasive problem and California State is responsible for regulating the spread of MIS by developing policies that ensure the cleanliness of fishing gear and boats in general.

The Safety Zone around SCI is divided into eight sections and extends from the high tide line out to 3 nm (5.6 km) (Figure 3-25). Two sections are permanently restricted to the public and the remaining six are periodically restricted when the military is conducting training exercises. While the public is generally allowed in the areas surrounding SCI, enforcement is low when vessels are in violation of temporarily restricted areas, and some make landfall. Prevention strategies targeted at the public are limited, thus biosecurity efforts should be directed at outreach and the development of rapid response plans for vessel groundings on shores.

Table 3-7. Commercial fishing and recreational boat biosecurity effort priority index and action value table.

Action Number	Potentially Prevented Taxa	Action	Implementation Index	Personnel Index	Cost Index	Additive Effort Score	Action Value Score
Prevention of Incursions							
A1.	invasive fish, algae, biofouling organisms	Work with CDFW to implement fishing gear policies to limit the spread of MIS.	2	2	2	6	3
A2.	invasive fish, algae, biofouling organisms	Develop species specific rapid response protocols.	2	2	2	6	2
A3.	invasive fish, algae, biofouling organisms	Enforce boats in violation of the Safety Zone.	3	2	3	8	3
Early Detection and Monitoring							
B1.	small mammals	Install at minimum 20 remote camera traps across island to be rotated biannually.	2	2	3	7	2
B2.	small mammals	Develop and implement monitoring plans if vessels run aground.	2	2	3	7	2
B3.	invasive fish, algae, biofouling organisms, small mammals	Establish MIS monitoring plan in coordination with relevant marine monitoring activities.	2	2	3	7	3
Post Detection Response							
C1.	invasive fish, algae, biofouling organisms, small mammals	Stage IAS spill kits in easily accessible places in facilities around the island.	1	2	2	5	2
C2.	all taxa	Determine the taxon of potential threat and identify professionals experienced in detection and extirpation.	2	2	2	6	2
C3.	all taxa	In the event of a grounded vessel, implement rapid response protocols.	3	3	3	9	2
C4.	all taxa	If an invasive animal is contained on NALF SCI: determine sex, quarantine, euthanize and perform necropsy.	3	3	3	9	1
Biosecurity Education							
D1.	all taxa	Create interpretative signage at military barge embarkation points, public access points, marinas, commercial fishing ports, etc. across the Southern California region.	2	2	2	6	1
D2.		Update The Southern California Offshore Range's (SCORE) website to better reflect that vessels are prohibited from landing on shore and to educate the public on biosecurity risks associated with the marine environment.	2	2	2	6	1
D3.		Require charter fishing companies fishing within three nautical miles to provide biosecurity pamphlets regarding MIS on board.	2	2	2	6	1

Prevention of Incursion – Commercial Fishing and Recreational Boats

Strategy A: Prevention

Work with SCORE, California Department of Fish and Wildlife (CDFW), and any other enforcement agencies to ensure “range-foulers” are enforced and fishing gear is kept clean.

ACTIONS

A1. Work with CDFW to implement fishing gear policies to limit the spread of MIS.

The need for policy at the state level is apparent and is largely unregulated at the marine commercial fishing level. The threat of non-native organisms is high because of the widespread movement across the region, and the pervasive distribution of invasives such as algae across Southern California harbors. The State is responsible for developing strong policies regarding hull fouling, biofouling, fishing gear, fishing traps, live wells, sea chests, rodent infestation prevention, etc. Commercial fishing activities are poised to spread MIS and threaten the diverse underwater, nearshore and terrestrial ecosystems of not only NALF SCI, but of all the Channel Islands. Navy Region Southwest is encouraged to make suggestions to the State to encourage the implementation of a statewide policy to limit the spread of MIS by commercial and charter fishing operations.

A2. Develop species specific rapid response protocols.

Rapid response protocols should be separate management plans of their own, with specific actions based off of the location and total area of the incursion, the species involved. Plans are encouraged to be developed for Norway rats, dogs, raccoons and possums. However, taxa already present on the island such as black rats, mice, and cats should also have separate rapid response protocols because of their ability to introduce zoonoses that may not already be present in the population.

A3. Enforce boats in violation of the Safety Zone.

Six sections (A, B, C, D, E, and F) are available for public use unless they are temporarily restricted for military exercises. Enforce these Safety Zones to reduce the potential for vessel groundings as well as to discourage boats from making landfall. The Navy should have a consistent history of landfall enforcement that the public will consider when violating laws.



Figure 3-25. Eight sections extend out 3nm. Wilson’s Cove and Section G are permanently closed to recreational activities. All other six sections may be temporarily restricted.

Early Detection and Monitoring – Commercial Fishing and Recreational Boats

Strategy B: Early Detection

Develop a standardized monitoring system focused on early detection for high priority IAS around shoreline, beach and dune areas.

ACTIONS

- B1. Install at minimum 20 remote camera traps across island to be rotated biannually.**
 Camera trap monitoring programs can be very successful for monitoring all invasive vertebrates, especially introduced by vectors with few prevention strategies (Boser et. al. 2014). Reconyx-type cameras should be placed in a variety of habitats depending on the species targeted but ideally in habitat near coastline and can detect a variety of species (Figure 3-26). Traps should be set between three and five feet from the bait source with a combination of musk rat scent attractant and a peanut butter and oat bait mixture (Wildlands Conservation Science, 2015). Photos should be downloaded at least twice a year to monitor for the presence of invasive vertebrates. Secure digital cards should be at least 32 gigabytes to ensure that high visitation does not exhaust the storage capacity.
- B2. Develop and implement monitoring plans if vessels run aground.**
 Rapid response and monitoring plans should take into consideration the risk of rodent incursion from vessels, especially commercial fishing vessels. NALF SCI should develop a generalized monitoring plan and separate specific target species rapid response plans. The Nature Conservancy has developed a specific rapid response protocol for rodent incursion (Appendix D).

B3. Establish MIS monitoring plan in coordination with relevant marine monitoring activities.

Regular marine sampling should survey in Wilson Cove, Horseshoe/China Cove, Pyramid Point and other areas where lobster traps are deployed. Sampling could occur concurrently with marine-related sampling activities, such as kelp forest monitoring.

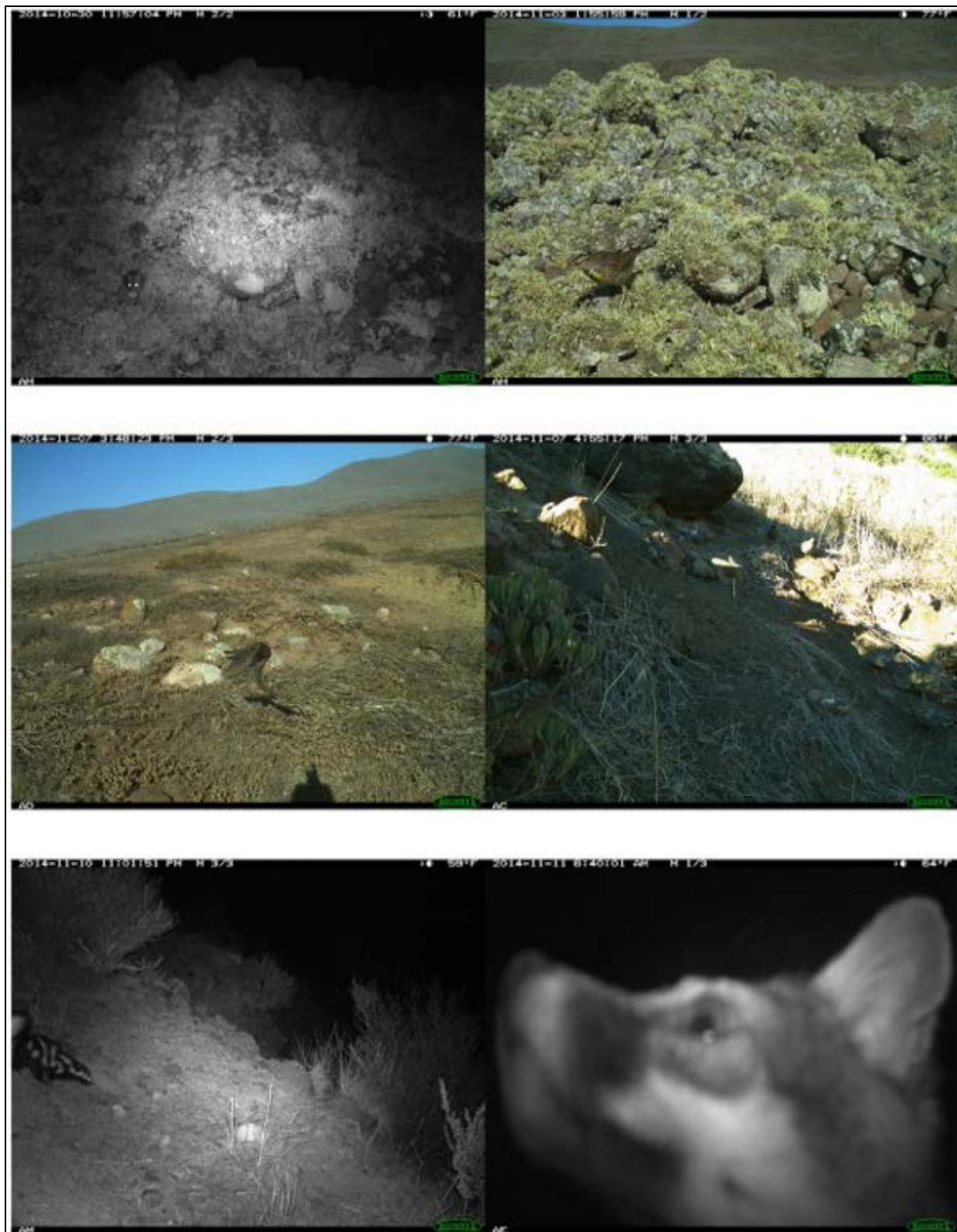


Figure 3-26. Examples of species detected on camera traps on Santa Cruz Island. Source: Wildlands Conservation Science and The Nature Conservancy.

Post Detection Response – Commercial Fishing and Recreational Boats

Strategy C: Develop Response Initiatives for Shipborne Taxa

Post-detection responses should be tailored to whether a biosecurity risk was introduced from a vessel.

ACTIONS

- C1. **Stage IAS spill kits in easily accessible places in facilities around the island.**
Multi-target kits should not possess any toxic baits due to regulatory constraints and the potential for off-target consumption (island fox). The following serves as an example of contents in a multi-target spill kit:
- Gnaw sticks or other indicator baits such as peanut butter, molasses, oat loaves, cat food
 - Rapid response camera traps
 - Snake, mesopredator, rat, and small mammal traps (Sherman traps)
 - Rat tunnels, papers, and paint (Black Trakka; Appendix C)
 - Nets
- C2. **Determine the taxon of potential threat and identify professionals experienced in detection and extirpation.**
Confirm the species detected and identify the appropriate response plan, recommended in Action A3 for rodents, cats, dogs, raccoons, and opossums. NALF SCI should develop relationships with various professionals that are experienced in detecting incursions at low densities, especially in island contexts. NALF SCI will need to determine if the threat is high enough to quickly contract eradication professionals to prevent a non-native shipborne vertebrate population from establishing.
- C3. **In the event of a grounded vessel, implement rapid response protocols.**
Response plans are most effective if established well in advance of any shipborne incursion, especially to prevent the introduction of Norwegian rat. Refer to Appendix D for The Nature Conservancy's Rodent Rapid Response Protocol, currently in development.
- C4. **If an invasive animal is contained on NALF SCI: determine sex, quarantine, euthanize and perform necropsy.**
Time is of the utmost importance when containing newly introduced IAS. Performing necropsies will be important to delineate stomach contents and to identify if the animal has reproduced recently.

Biosecurity Education – Commercial Fishing and Recreational Boats

Strategy D: Outreach

Increase education and outreach to the public boating community.

ACTIONS

- D1. **Create interpretative signage at military barge embarkation points, public access points, marinas, commercial fishing ports, etc. across the Southern California region.** Signage should detail risks of MIS (particularly *Undaria pinnatifida* and *Sargassum horneri*) to the environment, biofouling organisms, rodent infestations, and the risks incurred by transporting fishing gear from areas infesting with invasive algae and how the public can help prevent invasion.
- D2. **Update the Southern California Offshore Range's (SCORE) website to better reflect that vessels are prohibited from landing on shore and to educate the public on biosecurity risks associated with the marine environment.** SCORE created a website (www.scisland.org) that provides scheduling information to fishermen, boaters, divers and other users of areas around San Clemente Island. By accessing this website, users can better plan their routes to avoid areas temporarily restricted because of Navy activity. However, this is also a good opportunity to educate the public on biosecurity concerns, such as making landfall and the associated risks.
- D3. **Require charter fishing companies fishing within three nautical miles to provide biosecurity pamphlets regarding MIS on board.** The Navy should coordinate with local charter fishing companies to have biosecurity pamphlets on board if they are to fish in NALF SCI waters. This can increase general public awareness on a diverse array of marine-environment related topics, including rodent and rat infestations on board and biofouling concerns.

4.0 On-Island Operations and Infrastructure Management

4.1.1. Facilities Management

The construction and maintenance of facilities, as well as facilities in and of themselves, presents a biosecurity risk with the movement of construction supplies, equipment and personnel not just from the mainland to SCI, but movements throughout SCI itself. For example, Federal Fire personnel may have been involved in the spread of Sahara mustard (*Brassica tournefortii*, E. Howe pers. obs.), which spread from a small population and currently has been recorded at hydrant locations across the island. NALF SCI facilities may include buildings, construction and equipment yards, quarries, Public Utilities offices and facilities, temporary training targets, radar stations, bivouac/camping areas, utility lines (power, water, sewer, and gas pipelines), training areas used for demolition, small arms or tactical training, and the NRO compound.

Although biosecurity efforts are focused at preventing incursions, significant efforts should also be directed at protocols designed to reduce the spread of IAS in the event an organism does make it to the island.

The NRO compound includes the nursery facility, personnel offices, and general restoration activities. The nursery facility has the potential to introduce IAS to various locations on SCI through its operations to produce stock for rare plant and habitat restoration projects. An intermittently-used ground-based compost pile associated with the NRO compound harbors a population of non-native earthworms and may be the source of non-native seeds from discarded food waste. The pile is not secured from fox and rat raids, and these may vector propagules

outside the compound area. Because of these concerns, the composted material is not currently used for any propagation activities.

Argentine ants and other IAS are present at locations near the NRO, including the nursery and pose a high risk by translocation through restoration activities or to restoration sites throughout the island. Though thus far, no noxious weed, ant or earthworm introductions have been found at restoration sites (Shishir Paudal, pers. comm.). Vigilance and effective protocols could prevent the further spread of existing IAS around the island.

Table 4-1. Facilities management biosecurity effort priority index and action value table.

Action Number	Potentially Prevented Pathogens/Taxa	Action	Implementation Index	Personnel Index	Cost Index	Additive Effort Score	Action Value Score
Prevention of Incursions							
A1.	invertebrates, invasive plant propagules	Maintain a 12-foot distance between aggregate piles and any vegetation. Do not allow "stockpiling creep".	1	1	1	3	1
A2.	invertebrates, invasive plants	Treat all invasive plants growing near aggregate piles, and on the perimeter of facilities and thoroughfares.	1	1	1	3	1
A3.	invertebrates, invasive plant propagules	Install shaker plates at the entrance to all yards and facilities with a high probability of transferring IAS.	1	1	2	4	1
A4.	invertebrates, invasive plant propagules, small mammals	Implement vehicle cleaning protocols before travelling to other facilities or infested habitats.	2	1	1	4	3
A5.	invasive plants	Perform routine weed treatment activities at high-use yards and military areas at identified facilities.	2	1	3	6	2
A6.	invertebrates, invasive plant propagules	Identify additional high-use facilities and military areas that would benefit from invasive plant management and implement the suggested weed containment scheme.	2	1	3	6	2
A7.	invasive plants, small mammals	Ensure construction and utility yard cleanliness by defining boundaries with a chain link fence.	2	2	3	7	2
A8.	invertebrates, invasive plant propagules	Create a 12-foot buffer zone of pea-gravel surrounding fenced facilities.	2	2	3	7	3
A9.	invertebrates, invasive plants	Install gravel inside the perimeter of fencing, or the yard itself, when feasible.	2	2	3	7	3
B1.	rodents	Paint 12-inch white rat runs at the bottom of walls in facilities across the island.	1	1	1	3	1
B2.	small mammals	Maintain a geodatabase of trapping efforts and locations. Update frequently.	2	1	1	4	1
B3.	small mammals	Develop robust integrated pest management activities including trapping in areas of high rodent infestation.	2	2	1	5	1
B4.	taxon specific	Stage IAS "spill kits" in easily accessible locations across the island.	1	2	2	5	2
B5.	small mammals	Exclude rodents and other small mammals from buildings.	2	1	3	6	3
C1.	invasive plant propagules	Ensure functionality of car wash drain.	1	1	1	3	1
C2.	invasive plant propagules	Identify drains that collect propagule containing water and ensure proper disposal.	2	2	1	5	2
C3.	invasive plant propagules	Ensure functionality of all NALF SCI drains.	2	2	1	5	3
D1.	invertebrates, zoonoses	Re-grade yards and quarries to ensure consistent surface topography.	2	2	3	7	3
E1.	invertebrates, invasive plants, small mammals, zoonoses	Investigate the feasibility of an island food waste program.	1	1	1	3	3
E2.	invertebrates	Install nursery table legs that have been designed to eliminate invasive Argentine ants	1	1	2	4	1
E3.	invasive plants, genetic dilution	Ensure that only native plants grown in the island nursery are from seeds collected on SCI for outplanting.	1	1	2	4	2
E4.	invasive plant propagules	Treat gravel in the greenhouse and maintain a weed buffer around the perimeter.	1	1	2	4	1
E5.	invertebrates, invasive plant propagules, small mammals, zoonoses	Decommission any in-ground compost piles and replace with tumblers.	1	2	2	5	2

Table 4-1 continued. Facilities management biosecurity effort priority index and action value table.

Early Detection and Monitoring							
F1.	all taxa	Coordinate with IPM, restoration and weed managers to assess opportunities to include monitoring for IAS.	1	1	1	3	● 2
F2.	all taxa	Identify optimal budgets for monitoring around facilities in cooperation with the invasive weed manager and determine the interval of monitoring.	1	1	1	3	● 2
F3.	all taxa	Determine regular monitoring schedules for IAS at NALF SCI points of first entry.	1	1	1	3	● 2
F4.	rodents	Paint 12-inch white rat runs at the bottom of walls in facilities across the island.	1	1	1	3	● 1
F5.	small mammals, reptiles	Develop a facilities based camera trap monitoring plan.	1	2	1	4	● 1
F6.	all taxa	Monitor landfill for possible escapees or unauthorized material that may harbor IAS.	2	1	2	5	● 1
F7.	rodents	Install rodent chew cards at all points of entry.	2	2	3	7	● 3
F8.	all taxa	Require contractors and personnel to set up monitoring schedules for an agreed upon time period after initiation and post-completion of construction or ground disturbing activities.	3	3	3	9	● 3
F9.	invasive plants	Collaborate with the biosecurity manager and invasive weed manager to schedule and ensure these sites receive an annual weed survey.	3	3	3	9	● 3
Post Detection Response							
G1.	all taxa	Stage IAS spill kits in easily accessible places in facilities around the island.	1	2	2	5	● 2
G2.	taxon specific	Implement rapid response protocols.	2	2	2	6	● 1
G3.	taxon specific	Determine the taxon of potential threat and identify professionals experienced in detection and extirpation.	2	2	3	7	● 1
G4.	taxon specific	If an invasive animal is contained on NALF SCI: determine species and sex, quarantine, dispatch and perform necropsy.	3	3	3	9	● 1
Biosecurity Education							
H1.	all taxa	Create an educational station near facilities at the NALF SCI Airfield walkthrough (Figure 4-23).	2	2	2	6	● 1
H2.		Develop a "weed box" and install an accompanying educational panel and additional footwear cleaning brushes.	2	2	2	6	● 1

Prevention of Incursions – Facilities Management

Strategy A: Create Weed Entrapment and Containment Areas

Creating buffer zones and routine weed treatment activities around facilities with high potential to disperse IAS can work to control easily dispersed weed species. Control stockpiling.

ACTIONS

- A1. **Maintain a 12-foot distance between aggregate piles and any vegetation. Do not allow "stockpiling creep".**
Aggregate piles can spread seed directly by infesting nearby native habitat or indirectly by infesting the pile itself with non-native seed that is then dispersed throughout project sites (Figures 4-3 and 4-4).
- A2. **Treat all invasive plants growing on or near aggregate piles and on the perimeter of facilities and thoroughfares.**
Invasive weeds growing within or near facilities should be prioritized and aggressive treatments should occur, especially on the perimeters of facilities to discourage seed dispersal into surrounding habitats. Aggregate piles should be preemptively treated and if invasive plants are growing near or on the piles (Figures 4-3 and 4-4).

- A3. **Install shaker plates at the entrance to all yards and facilities with a high probability of transferring IAS.**
These must be maintained on a regular basis to not allow dirt or seed collection. Materials caught in the shaker plates should be properly disposed of to prevent germination of any seeds captured.
- A4. **Implement vehicle cleaning protocols before travelling to other facilities or infested habitats.**
Vehicles should reduce the risk of infesting other sites. Thoroughly clean vehicles before leaving work yards or maintain a regular cleaning schedule. Reference Appendix A for a vehicle cleanliness checklist.
- A5. **Perform routine weed treatment activities at high-use yards and military areas at identified facilities.**
After a cursory review of different yards and military use areas, ManTech identified three specific weed containment schemes to prevent further spread of invasives throughout the island: 1) Fence perimeters of facilities and cover yard and outer margin with gravel (Actions A7, A8); 2) Fence perimeter of facility and cover outer margin with gravel (Action A8); 3) perform routine weed treatments only. Preventative pre-emergent herbicide treatments, such as imazapyr, will help prevent the growth and subsequent spread of wind-dispersed weed seeds, especially in facilities with high use and therefore high potential to spread across the island. See Figure 4-5 – Figure 4-13 for recommended facilities containment schemes for weed treatment, gravel buffer zones and fencing.
- A6. **Identify additional high-use facilities and military areas that would benefit from invasive plant management and implement the suggested weed containment scheme.**
The identified weed manager and biosecurity manager should work collaboratively with the military to identify additional facilities of high potential for weed dispersal (Figure 4-2). Implement these weed containment BMPs described above (Figure 4-5 – Figure 4-13).
- A7. **Ensure construction and utility yard cleanliness by defining boundaries with a chain link fence.**
Installing fencing around the perimeter of work yards with a high porosity shade cloth can reduce wind-dispersed seeds presently onsite from being further spread across NALF SCI. Fencing will also eliminate stockpiling “creep” or the slow spreading of materials closer to native and non-native vegetation which presents infestation risks (Figures 4-3 and 4-4).
- A8. **Create a 12-foot buffer zone of pea-gravel surrounding fenced facilities.**
Pea-gravel buffer zones should encircle the fencing described in Action A7. Preventatively treating buffered gravel with a non-selective, pre-emergent herbicide, such as imazapyr, will help prevent the growth and subsequent spread of wind-dispersed weed seeds and acts as a catchment system (Figure 4-1). Figure 4-5 – Figure

4-13 show recommended facilities containment schemes for weed treatments, gravel buffer zones and fencing.

- A9. **Install gravel inside the perimeter of fencing, or the yard itself, when feasible.** Activities that will not be affected by wholly-graveled yards (i.e. no military training exercises) should additionally install gravel within the perimeter of the fencing. See Figure 4-5 – Figure 4-13 for recommended facilities containment schemes for weed treatment, gravel buffer zones and shade fencing.



Figure 4-1. First point of entry for personnel arriving at the NALF SCI. The gravel buffer is an actual catchment of IAS propagules and should be on a regular herbicide regime.



Figure 4-2. Example of a yard that would benefit from a 12-foot gravel buffer and pre-emergent herbicide treatment.



Figure 4-3. Example of stockpiling creep. Piles should maintain a 12-foot distance from all vegetation.



Figure 4-4. Stockpiling creep resulting in *Carpobrotus edulis* infestation into aggregate piles.

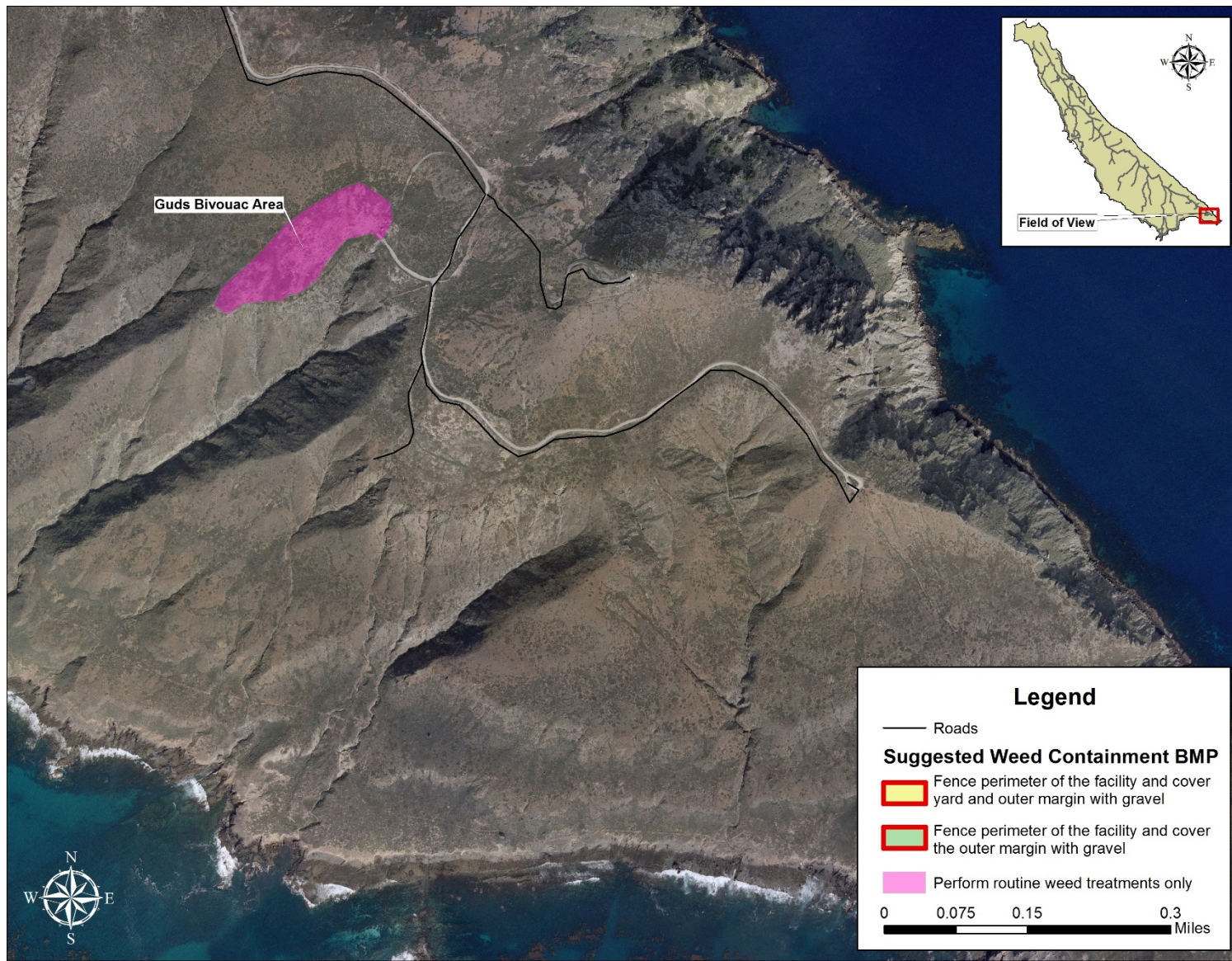


Figure 4-5. Suggested weed containment scheme for Guds Bivouac Area.

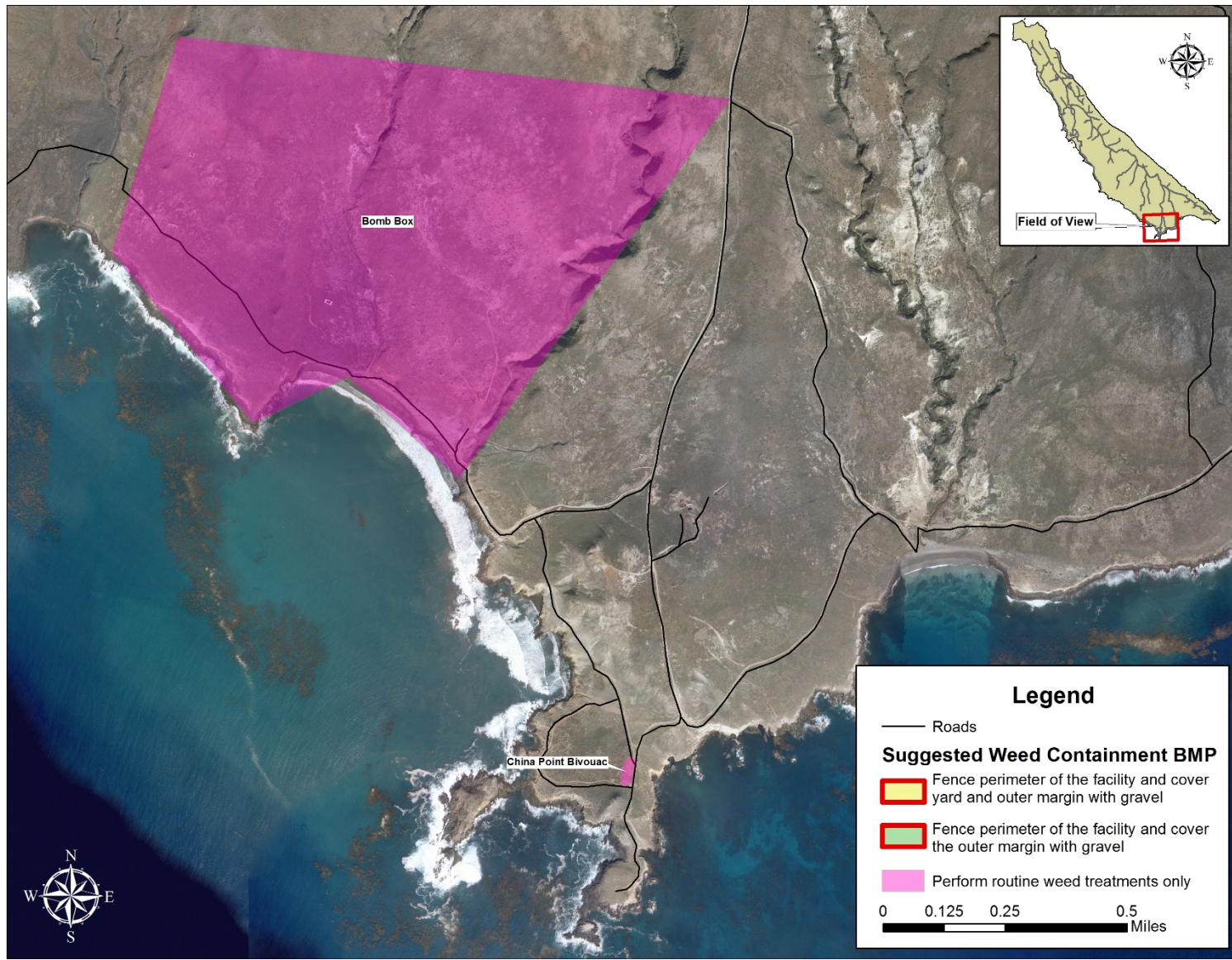


Figure 4-6. Suggested weed containment scheme for the Bomb Box and China Point Bivouac Area.

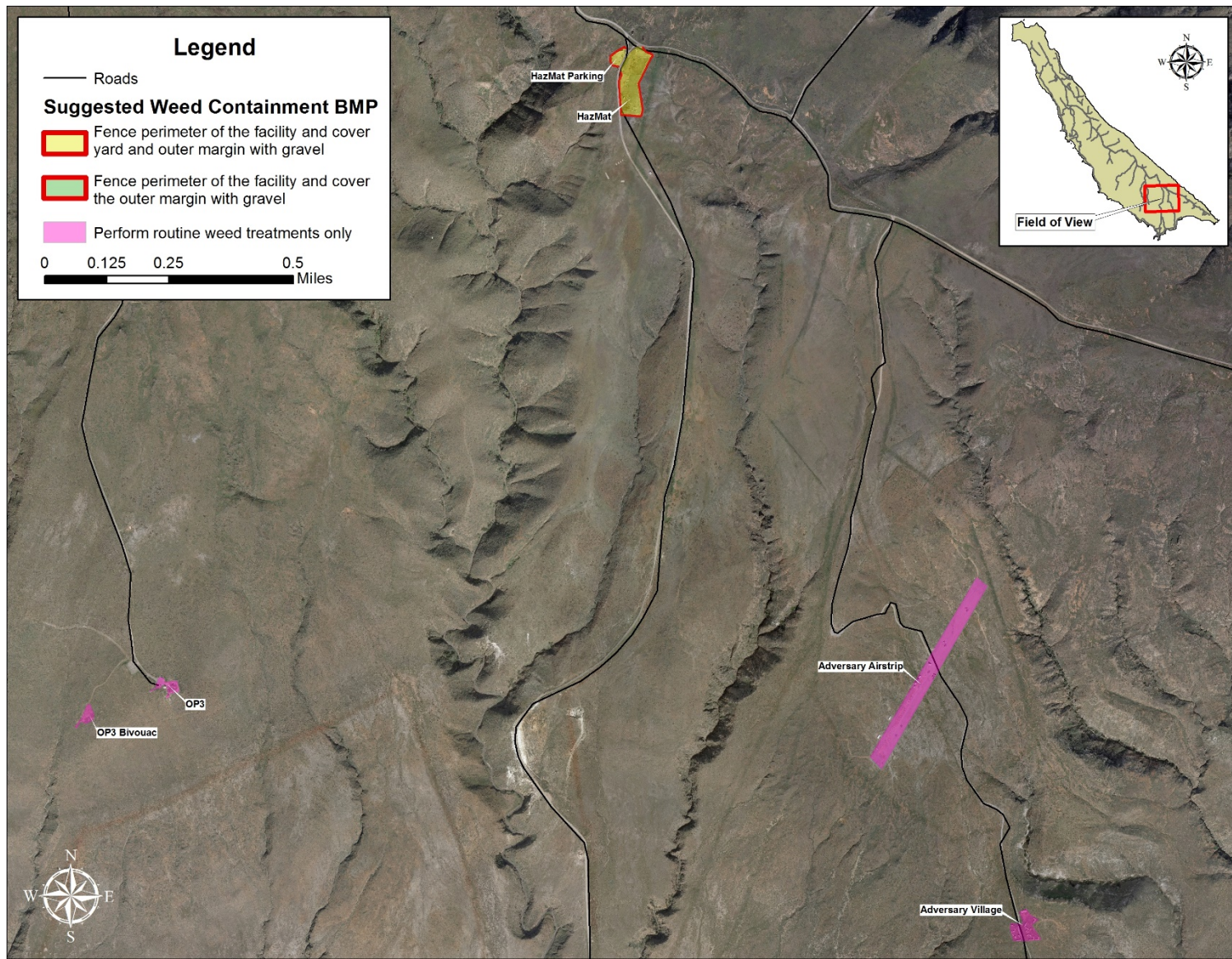


Figure 4-7. Suggested weed containment scheme for OP3 facilities, Adversary facilities, and Hazmat.

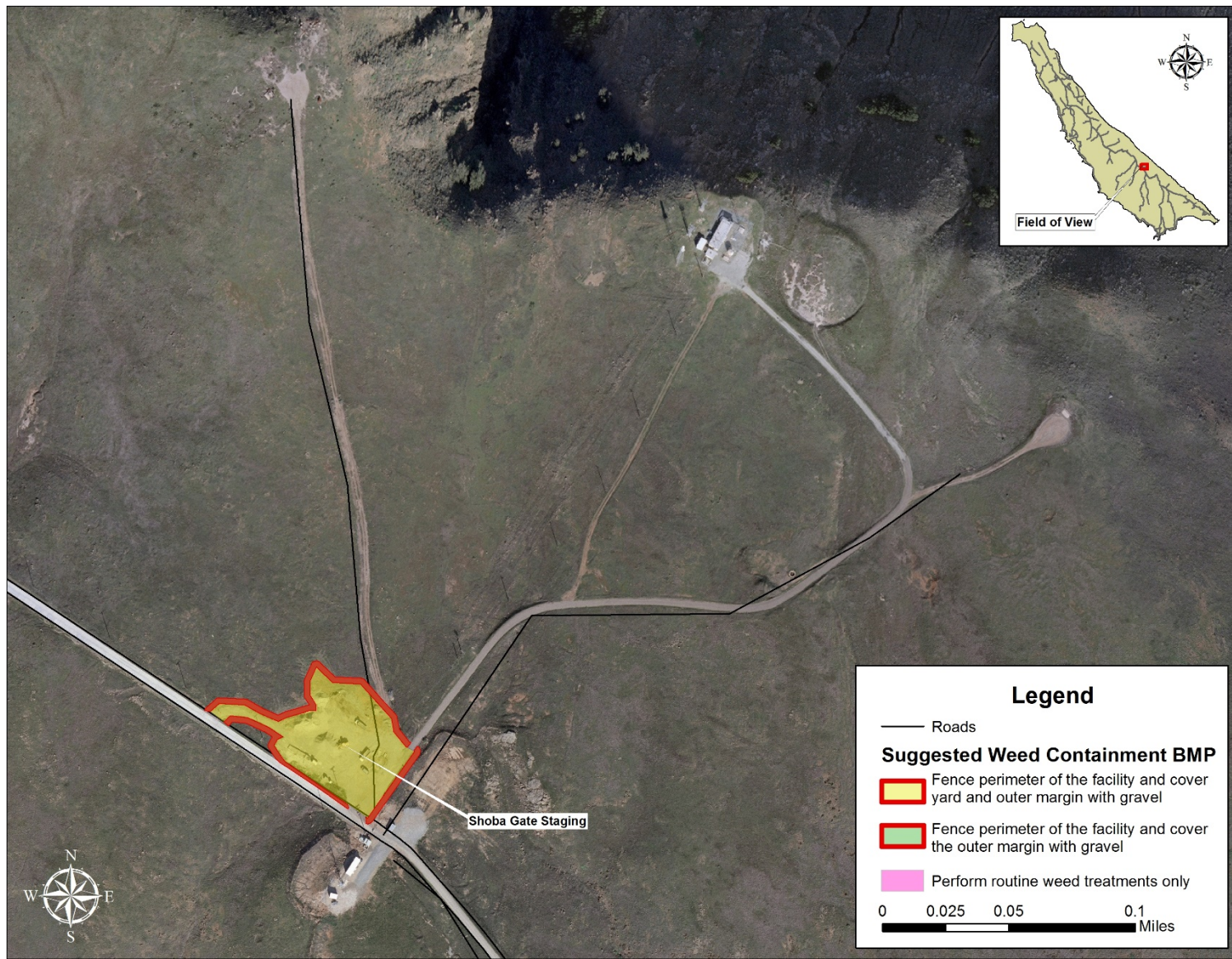


Figure 4-8. Suggested weed containment scheme for Shoba Gate staging area.

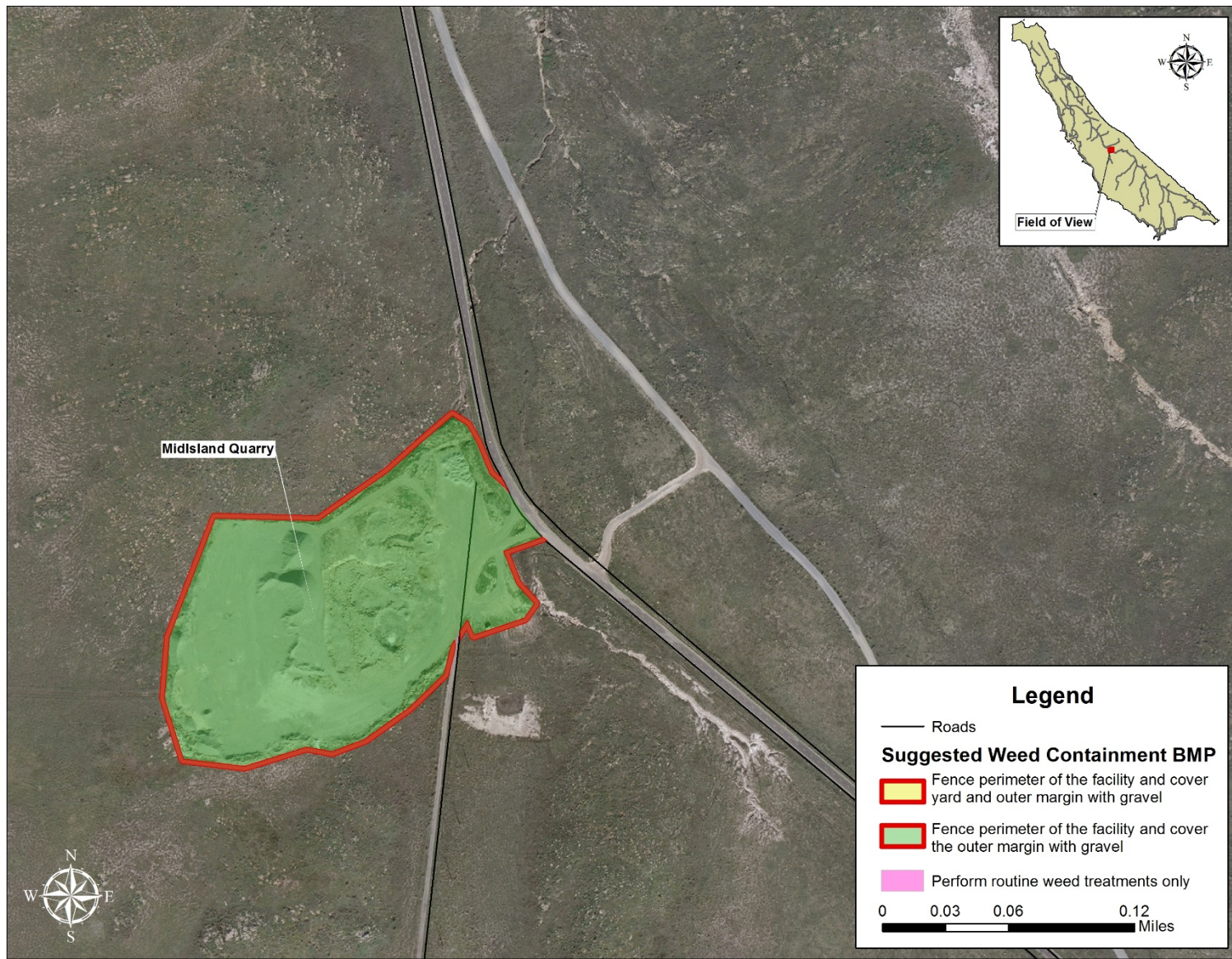


Figure 4-9. Suggested weed containment scheme for Mid-Island Quarry.

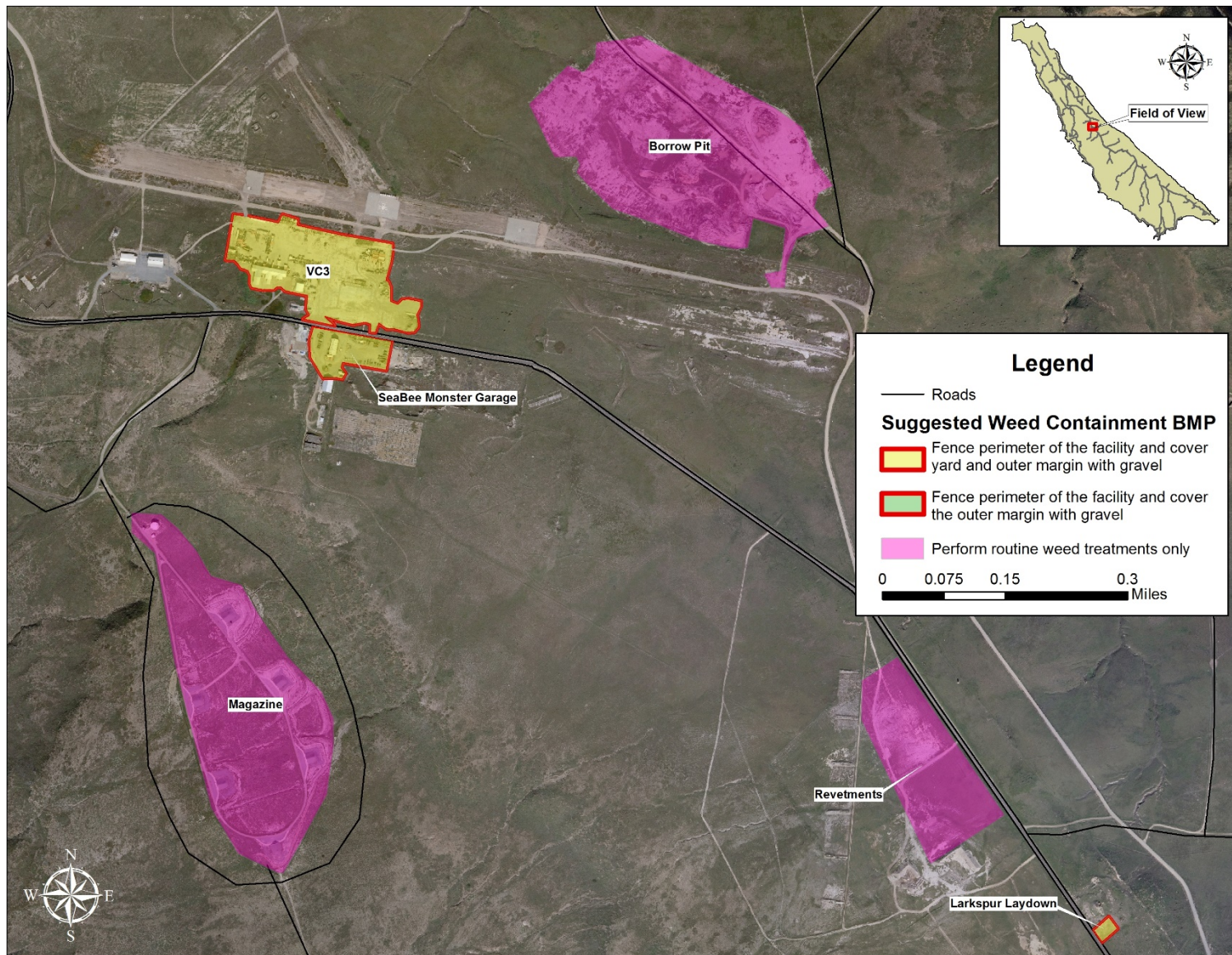


Figure 4-10. Suggested weed containment scheme for Magazine, VC-3, Borrow Pit, Larkspur Laydown and Revetments.

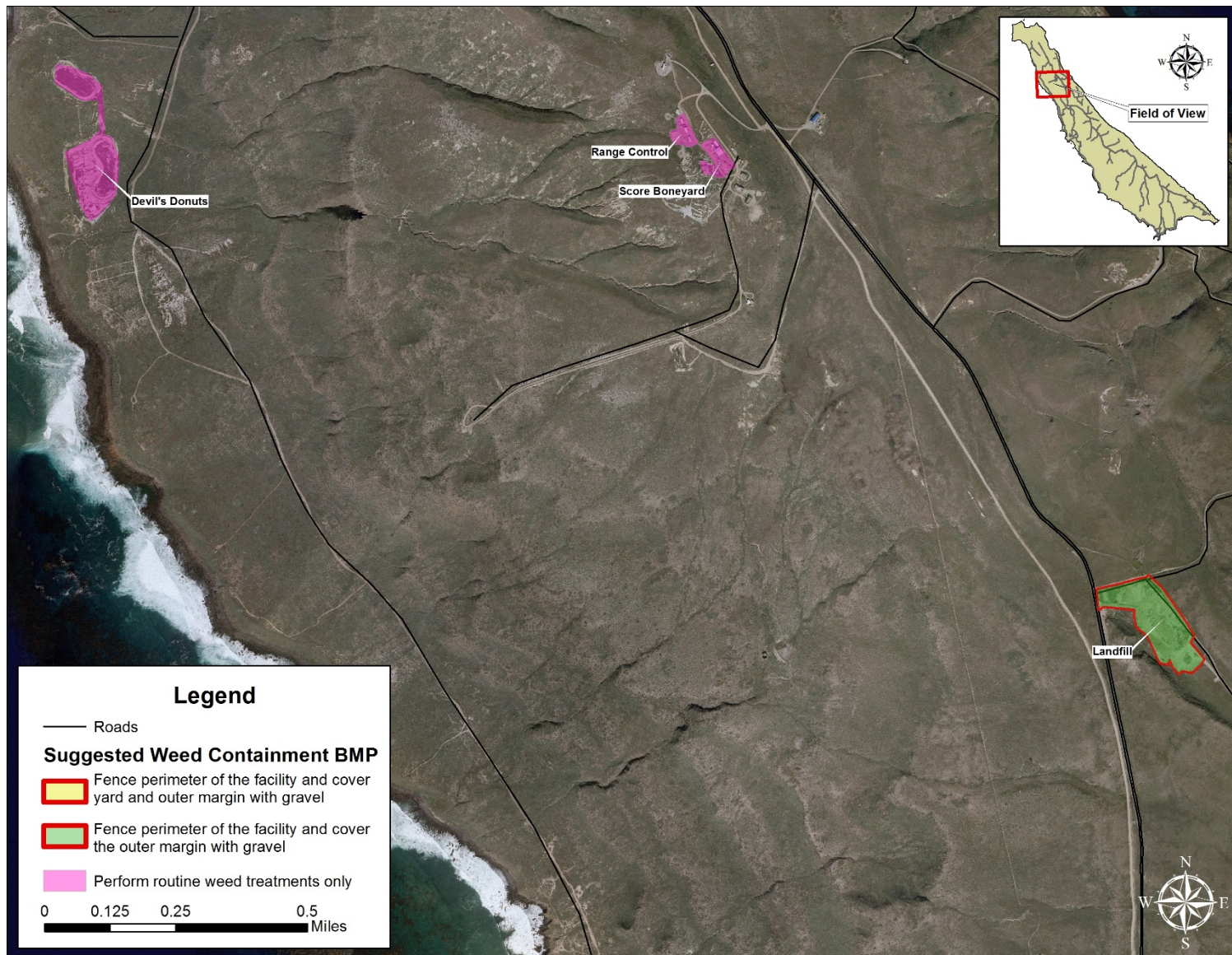


Figure 4-11. Suggested weed containment scheme for the Landfill, Range Control, SCORE Boneyard, and Devil's Donuts.

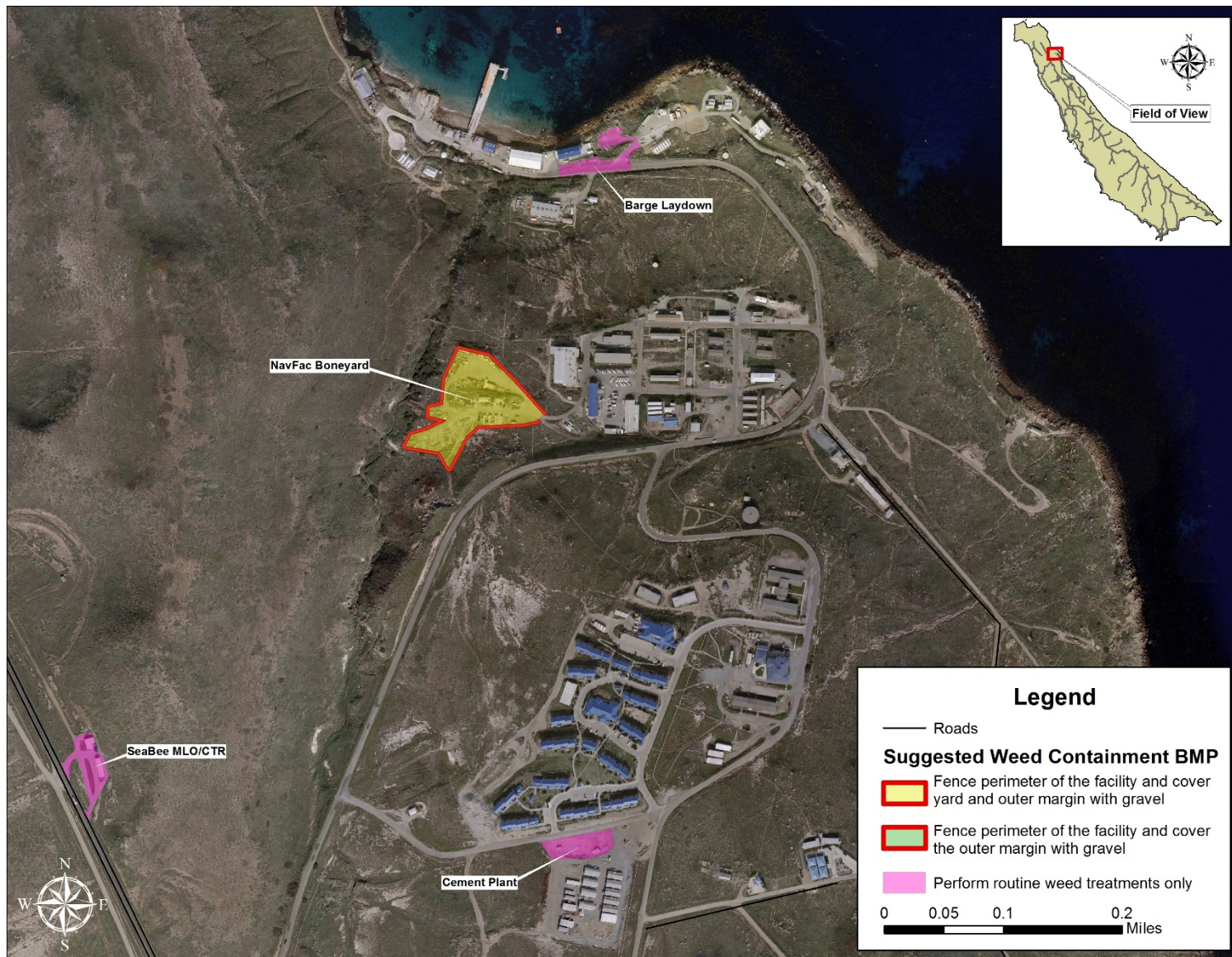


Figure 4-12. Suggested weed containment scheme for NAVFAC Boneyard, Barge laydown, SeaBee MLO/CTR, and Cement Plant.

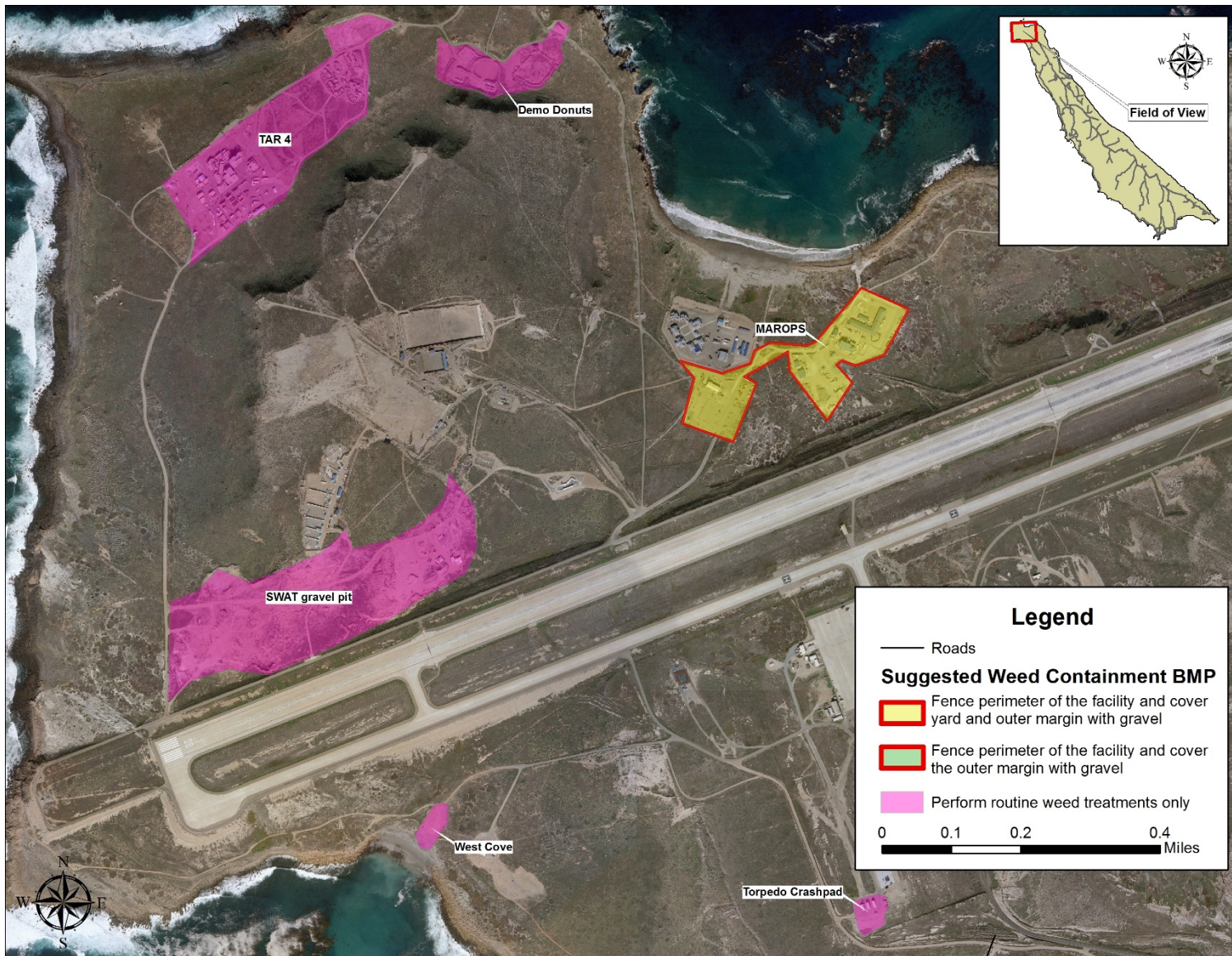


Figure 4-13. Suggested weed containment scheme for TAR 4, Demo Donuts, SWAT gravel pit, West Cove, MarOps, and Torpedo Crashpad.

Strategy B: IPM and Weed Management Efforts

Collaboration between integrated pest management, restoration, and weed management will be imperative to effectively enacting biosecurity recommendations.

ACTIONS

- B1. **Paint 12-inch white rat runs at the bottom of walls in facilities across the island.**
Painted white rat runs can enable management to determine if integrated pest management efforts need to be implemented or expanded (Figure 3-19).
- B2. **Maintain a geodatabase of trapping efforts and locations. Update frequently.**
Developing a geodatabase of pest management activities within a Geographic Information System (GIS) can allow management to quickly visualize data in order to identify gaps, track effort and trends, and identify target areas.
- B3. **Develop robust integrated pest management activities including trapping in areas of high rodent infestation.**
Coordination between biosecurity, IPM, and weed control managers will be key to ensuring that biosecurity efforts are implemented in their respective activities. Consistent and concerted trapping should occur in areas with the potential to infest restoration and military training areas.
- B4. **Stage IAS “spill kits” in easily accessible locations across the island.**
Multi-target kits should not possess any toxic baits due to regulatory constraints and the potential for off-target consumption (island fox). The following serves as an example of contents in a multi-target spill kit:
- Gnaw sticks or other indicator baits such as peanut butter, molasses, oat loaves, cat food
 - Rapid response camera traps
 - Snake, mesopredator, rat, and small mammal traps (Sherman traps)
 - Rat tunnels, papers, and paint (Black Trakka; Appendix C)
 - Nets
- B5. **Exclude rodents and other small mammals from buildings.**
Holes or degrading wood allow entry points into facilities with no previously known infestations. Biosecurity managers should coordinate with the pest management service provider to ensure that points of entry are eliminated and buildings are maintained (Figure 4-14).



Figure 4-14. Maintain facilities infrastructure and make building repairs quickly to prevent rodent entry.

Strategy C: Maintain Drains and Control the Output Location

Drains should be regularly inspected and cleared of debris in order to ensure proper drainage to prevent propagule accumulation and mosquito breeding.

ACTIONS

- C1. Ensure functionality of car wash drain.**
The car wash on NALF SCI is frequently used and has a high likelihood of containing propagule containing water in addition to providing mosquito habitat. The drain should be periodically cleared or a better design should be implemented to ensure output to a waste treatment facility (Figure 4-15).
- C2. Identify drains that collect propagule containing water and ensure proper disposal.**
The biosecurity manager should identify all facilities' drains and their outfall locations. They should ensure in areas of vehicle washings and work yards where vehicles are being pressure-washed that propagule containing water is routed to a waste management facility.
- C3. Ensure functionality of all NALF SCI drains.**
Other drains should be cleared of dirt and debris to not allow invasive plants to grow through the drain (Figure 4-16).



Figure 4-15. Water collection areas pose risk for re-contaminating tire treads.



Figure 4-16. Debris-clogged drains prevent proper flow and can trap invasive seeds.

Strategy D: Standing Pools Of Water

Reduce pooling water near infrastructure. Pools pose a biosecurity risk because of mosquito breeding and the potential to provide habitat for listed branchiopods.

ACTIONS

D1. Re-grade yards and quarries to ensure consistent surface topography.

Pools of water collect in ditches and culverts and should be discouraged to reduce the risk of waterfowl attraction (Figure 4-17). Surfaces should be level but allow proper water drainage. This will reduce the risk of introduced federally-listed branchiopods transported by waterfowl to NALF SCI and breeding of mosquitoes that transmit diseases (e.g. West Nile virus).



Figure 4-17. Pools of waters around infrastructure should be discouraged and surfaces should be regraded. This pool could encourage waterfowl to frequent the pond and subsequently introduce San Diego fairy shrimp (*Branchinecta sandiegoensis*).

Strategy E: Examine Nursery Activities

Require that the restoration program examines its practices regarding nursery operations and composting.

ACTIONS

E1. Investigate the feasibility of an island food waste program.

Utilizing galley food waste into a compost program decreases food waste at the landfill, reduces the potential for disease to spread amongst island foxes scavenging at the landfill, and aids progress towards making soil on-island for restoration projects thereby reducing import of foreign source material. All food waste should use tumbler type compost barrels (Figure 4-22). In areas of Argentine ant infestations, Figure 4-20 should be adapted to the legs of tumblers. Tumblers should be strategically located in areas of food collection.

E2. Install nursery table legs that have been designed to eliminate invasive Argentine ants

SNI implemented a Channel Islands Restoration design for nursery table legs that exclude pests from crawling into native plant starts (Figures 4-19 – 4-20). A PVC tube is filled with a non-toxic mixture (water and soap) to exclude any crawling arthropods, such as Argentine ants, from infesting nursery tables (Figure 4-18, 4-19). SCI's nursery table could easily implement this design and ensure that infestations will not occur in native plant starts (Figure 4-18).

E3. Ensure that only native plants grown in the island nursery are from seeds collected on SCI for outplanting.

Continue growing native plants from seed collected on NALF SCI to ensure the native genotype of species.

E4. Treat gravel in the greenhouse and maintain a weed buffer around the perimeter.

Ensure that any non-native propagules embedded in the gravel are preventatively treated with a non-selective pre-emergent herbicide, such as imazapyr. Maintain a weed-free 100-meter buffer around the perimeter of the greenhouse.

E5. Decommission any in-ground compost piles and replace with tumblers.

Unsecure compost piles can attract various pests and have the potential to spread disease to native populations (Figure 4-21). It is recommended to use pest-proof tumbler compost bins (Figure 4-22). The nursery table legs could be adapted to the tumbler compost legs (Figure 4-20).



Figure 4-18. San Clemente Island NRO's current nursery table.



Figure 4-19. San Nicolas Island nursery table legs are adapted to prevent the infestation of Argentine ants in native plants starts. Designed by Channels Islands Restoration.

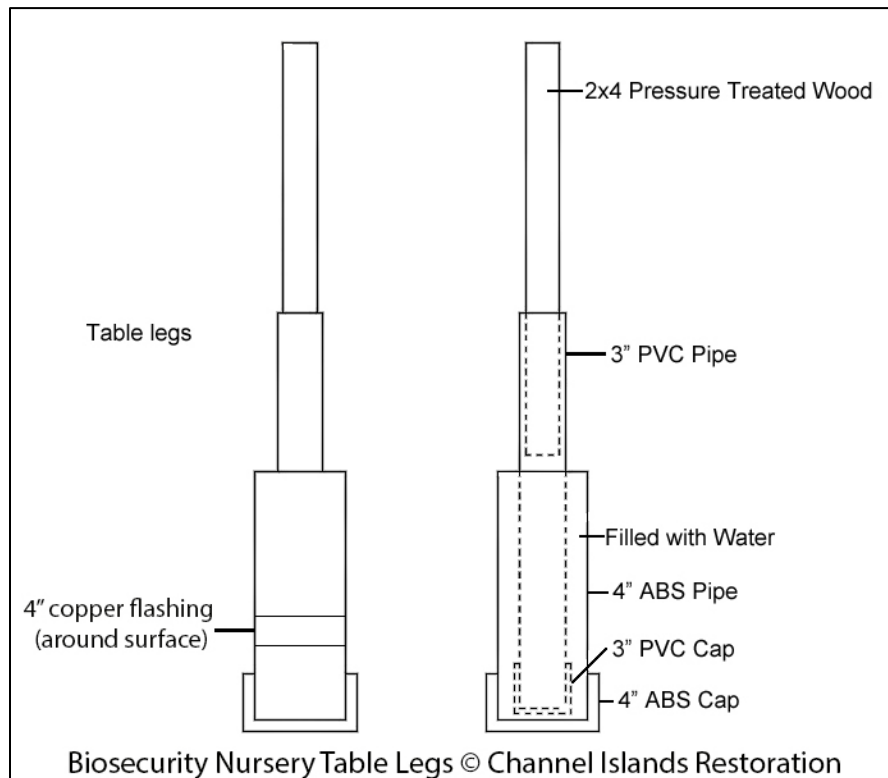


Figure 4-20. Nursery table legs designed to prevent specific pests, such as Argentine ants, from infesting native plants grown for restoration projects. Source: Ken Owen, Channel Islands Restoration.



Figure 4-21. Unsecured, in-ground compost piles are attractive to IAS and other scavengers and can become a source of unwanted pests such as earthworms.



Figure 4-22. Mostly pest-proof and high capacity tumblers aerate and compost food waste. Source: www.flipboard.com

Early Detection and Monitoring – Facilities Management

Strategy F: Early Detection

Develop a standardized monitoring system focused on early detection for high priority IAS around facilities and all points of entry.

ACTIONS

- F1. Coordinate with IPM, restoration and weed managers to assess opportunities to include monitoring for IAS.**
The biosecurity manager should work collaboratively with other managers to assess options for incorporating early detection surveys into existing management activities.
- F2. Identify optimal budgets for monitoring around facilities in cooperation with the invasive weed manager and determine the interval of monitoring.**
In order to determine the monitoring schedule, staff should first identify available resources.
- F3. Determine regular monitoring schedules for IAS at NALF SCI points of first entry.**
Develop set transects, grids, or routes in concentric rings outward from points of first entry surrounding infrastructure, such as barge loading facilities and the NALF SCI barge dock, NALF SCI airfield, roadways, facilities with high personnel usage, and military training areas.
- F4. Monitor landfill for possible escapees or unauthorized material that may harbor IAS.**
Heavy equipment and vehicles that drive to the landfill may transport weed species. The landfill should be included on a regular survey of roadsides and facilities.
- F5. Install rodent chew cards at all points of entry.**
Chew cards, or chew sticks, may assist in early detection in the event that a rodent, particularly Norway rat, is introduced. Wooden chew sticks soaked in oil or other attractants can remain attractive for two years specifically to Norway rats, an introduction concern for SCI. Additionally, differences in incisor markings on chew sticks can indicate species (McFadden 1991).
- F6. Paint 12-inch white rat runs at the bottom of walls in facilities across the island.**
Painted white rat runs can enable management to determine if IPM efforts need to be expanded and can monitor existing infestation to track efficacy.
- F7. Develop a facilities based camera trap monitoring plan.**
Facilities and infrastructure should incorporate camera trapping near buildings and yards to detect the presence of non-native vertebrates. Personnel monitoring captured photos should be well-versed in the identification of mammals, especially non-native rodents. Quantitative measurements will need to be conducted based on the nose, eyes, ears, and tails of rodents to determine species-level identification. These measurements can be made in GIS or other systems.

- F8. **Require contractors and personnel to set up monitoring schedules for an agreed upon time period after initiation and post-completion of construction or ground disturbing activities.**

For any ground disturbing projects on NALF SCI, institute best management actions that personnel and/or contractors can take to reduce the introduction of new IAS. This should include on-going selective herbicide treatments of target weed species to reduce the spread of invasive plants across the project site and follow-up biological surveys to determine any new species introduced.

- F9. **Collaborate with the biosecurity manager and invasive weed manager to schedule and ensure these sites receive an annual weed survey.**

For any ground disturbing projects on NALF SCI, institute mitigation actions that personnel and/or contractors can take to reduce the introduction of new IAS. This should include on-going selective herbicide treatments of target weed species to reduce the spread of invasive plants across the project site and follow-up biological surveys to determine any new species introduced.

Post Detection Response – Facilities Management

Strategy G: Develop Response Initiatives for Island-Wide Incursions

Post-detection responses should be developed for prioritized IAS of risk.

ACTIONS

- G1. **Determine the taxon of potential threat and identify professionals experienced in detection and extirpation.**

Confirm the species detected and adapt the appropriate vessel grounding response plans (Section 3.2.3 Action A3) for facilities based use. NALF SCI should develop relationships with various professionals that are experienced in detecting incursions at low densities, especially in island contexts. NALF SCI will need to determine if the threat is high enough to quickly contract eradication professionals to prevent a non-native vertebrate population from establishing.

- G2. **Implement rapid response protocols.**

Response plans are most effective if established well in advance of any incursion, especially to prevent the introduction of Norway rat.

- G3. **Stage IAS spill kits in easily accessible places in facilities around the island.**

Multi-target kits should not possess any anti-coagulants or toxic baits due to regulatory constraints and the potential for off-target consumption (island fox). The following serves as an example of contents in a multi-target spill kit:

- Gnaw sticks or other indicator baits such as peanut butter, molasses, oat loaves, cat food
- Rapid response camera traps
- Snake, mesopredator, rat, and small mammal traps (Sherman traps)
- Rat tunnels, papers, and paint (Black Trakka; Appendix C)

- Nets

G4. If an invasive animal is contained on NALF SCI: determine species and sex, quarantine, dispatch and perform necropsy.

Time is of the utmost importance when containing newly introduced IAS. Performing necropsies will be important to delineate stomach contents and to identify if the animal has reproduced recently.

Biosecurity Education – Facilities Management

Strategy H: Outreach

Increase education of IAS to island visitors and personnel by developing an educational station at the NALF SCI Airfield.

ACTIONS

H1. Create an educational station near facilities at the NALF SCI Airfield walkthrough (Figure 4-23).

An engaging multi-media station would serve to educate all visitors on the SCI ecosystem, SCI military mission, SCI biosecurity concerns, and the damages inflicted on habitat and the military mission by IAS.

H2. Develop a “weed box” and install an accompanying educational panel and additional footwear cleaning brushes.

A transparent vinyl-type box should contain weed seeds and other debris captured on personnel’s clothing, footwear, Velcro, and luggage. Photos should also accompany the weed seeds of the plants and the damages they inflict. This educational opportunity informs visitors about the risks of unclean footwear and allows the “last chance” opportunity to clean boots off on foot brushes at the educational station.



Figure 4-23. This walkthrough area provides visitors arriving from the mainland the first opportunity to learn about NALF SCI. Adjacent to the NALF SCI Airport waiting room, this space is large enough to not create any foot traffic bottlenecks.

4.1.2. On-Island Source Material

Some materials are produced on SCI, such as gravel for fill, topsoil from borrow pits, and occasionally concrete at a temporary concrete plant. Personnel participating in construction and maintenance activities may be island personnel, temporary contractors or military groups such as Seabee Construction Battalions. Materials sourced from on-island have the potential to significantly reduce IAS risks in the long term; however, measures will have to ensure that invasive species already present on the island are contained.

Mid-Island Quarry and SWAT 1 Quarry are the two sources of fill and high-salt content gravel on the island. Materials sourced from these locations are typically used for projects that do not require high-quality materials. These sites are significantly disturbed and therefore easily colonized by many invading plant species. Equipment used at these sites and solely on the island presents less of a risk than imported equipment, but may still spread invasive species locally. Areas of probable invasive species contamination issues are shown in Figure 4-24.

Table 4-2. On-island source material biosecurity effort priority index and action value table.

Action Number	Potentially Prevented Taxa	Action	Implementation Index	Personnel Index	Cost Index	Additive Effort Score	Action Value Score
Prevention of Incursions							
A1.	invertebrates, invasive plant propagules	Require that on island quarries or facilities that collect aggregates follow protocols on gravel piles or stockpiles.	1	1	1	3	2
A2.	invertebrates, invasive plant propagules	Preferentially utilize old stockpiles to minimize length of time materials are sitting.	1	1	1	3	1
A3.	invertebrates, invasive plant propagules, small mammals	Implement vehicle cleaning standards (Appendix A).	1	1	1	3	1
A4.	invertebrates, invasive plant propagules	Pressure wash and vacuum vehicles before movement to new yards or sourcing sites on island.	2	2	2	6	3
A5.	invertebrates, invasive plant propagules	Incorporate the BMPs in Cal-IPC's Weed Free for Quarry Managers.	2	2	3	7	3
A6.	invertebrates	Grade quarries to ensure consistent surface topography.	2	2	3	7	3
Early Detection and Monitoring							
B1.	all taxa	Coordinate with pest, restoration and weed managers to assess opportunities to include monitoring for IAS. Monitor NALF SCI facilities where on-island source materials are being utilized.	1	1	1	3	2
B2.		Maintain geospatial data of disturbed areas and the materials associated with or sourced from them.	2	1	1	4	1
Post Detection Response							
IAS already established on NALF SCI							
Biosecurity Education							
C1.	all taxa	Distribute NALF SCI Naval Instruction.	1	1	1	3	1
C2.		Deliver the general PowerPoint included in the mandatory in brief of all NALF SCI visitors.	2	2	2	6	1

Prevention of Incursion – On-Island Source Material

Strategy A: On-Island Source Materials

Require that quarries and other sourcing facilities implement BMPs to reduce the spread of IAS aggregate sourcing on-island.

ACTIONS

- A1. **Require that on island quarries or facilities that collect aggregates follow protocols on gravel piles or stockpiles.**
Do not allow aggregate piles to sit or collect for lengthy periods of time. The longer a stockpile sits, the higher the chances that invasive plants can contaminate the stocked aggregate. Preventatively treat aggregate piles with a non-selective, pre-emergent herbicide biannually (e.g., imazapyr). This can eliminate growth of invasive plants growing out of aggregate piles (Figure 4-25).
- A2. **Preferentially utilize old stockpiles to minimize length of time materials are sitting.**
Older stockpiles have more time for weed seeds to infest. Institute a standard rotation of materials that are older are to be used first.
- A3. **Implement vehicle cleaning standards (Appendix A).**

Personnel using vehicles at sites for source materials should be especially vigilant about washing protocols and also ensure that propagule containing water is collected and disposed of at proper waste treatment facilities.

A4. Pressure wash and vacuum vehicles before movement to new yards or sourcing sites on island.

Vehicles should be pressure washed in their respective yards prior to departing for another site or working at a quarry to limit the transfer to invasive seed propagules to the sourcing site. Ensure that paint is clean and free of dust, dirt, and debris. Tires should be free of dirt, dust, mud, and visible sign of IAS in tire treads. Vehicle appendages should be free of seed-grabbing materials such as cobwebs. The undercarriage should be high pressure washed and free of mud, dirt, and debris.

A5. Incorporate the BMPs in Cal-IPC's Weed Free for Quarry Managers.

Require that personnel sourcing materials for use on island (e.g. aggregates and concrete) read and incorporate the BMPs for NALF SCI sourcing materials operations.

A6. Grade quarries to ensure consistent surface topography.

Pools of water collect in ditches and culverts and should be discouraged to reduce the risk of waterfowl attraction, especially at quarry sites (Figure 4-26). Surfaces should have a uniform grade and allow proper water drainage. This will reduce the risk of introduced federally-listed branchiopods transported by waterfowl to NALF SCI and mosquito-borne diseases (e.g. West Nile).

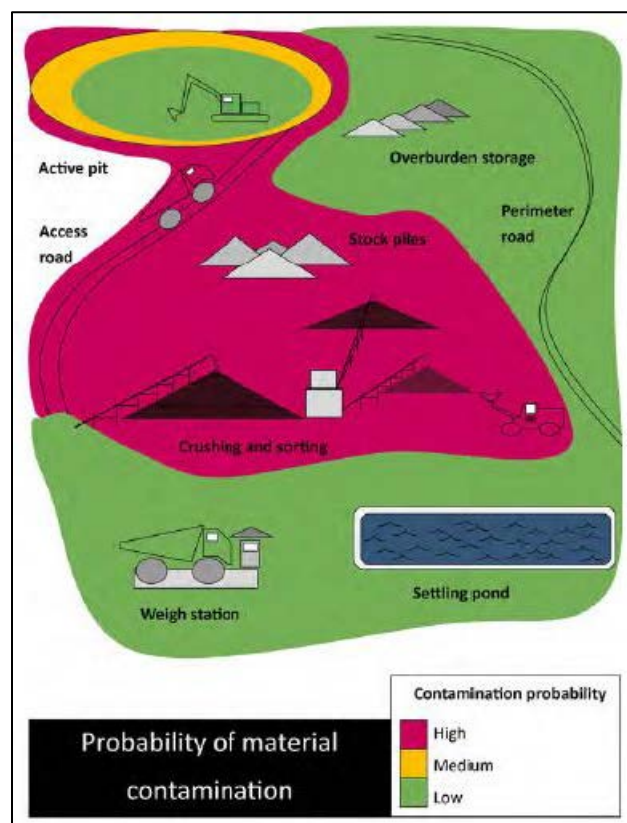


Figure 4-24. IAS contamination probabilities of areas surrounding materials sourcing pits. Source: Cal-IPC.



Figure 4-25. Tree tobacco, (*Nicotiana glauca*), growing out of a MarOps aggregate pile. Collections of aggregate are vectors for the transport of weed species not only from the mainland, but throughout the island. Recommendations emphasize the need for herbicide treatment of gravel piles. Source: Emma Havstad, Soil Ecology and Restoration Group (SERG).



Figure 4-26. Collections of water in quarry sites may be attractive to waterfowl that have ingested federally-listed branchiopods from the mainland.

Early Detection and Monitoring – On-Island Source Material

Strategy B: Early Detection

Develop standardized monitoring where on-island source materials are being utilized.

ACTIONS

- B1. Coordinate with pest, restoration and weed managers to assess opportunities to include monitoring for IAS. Monitor NALF SCI facilities where on-island source materials are being utilized.**

The biosecurity manager should work collaboratively with other managers to assess options for incorporating early detection surveys into existing management activities. However, managers from across the California Islands archipelago are currently developing protocols for island-wide invasive plant surveys in order to monitor and detect new populations of IAS before establishment. Ground monitoring accomplishes surveys in smaller, targeted locations and are difficult to implement over large land areas. Aerial surveys for invasive plants can be conducted to create a baseline of species identified and their distribution/extent on the island. These can be repeated every five years to monitor changes in baseline conditions and detect spread and introduction of IAS. For example, Santa Cruz Island's invasive plant monitoring program is currently conducting island-wide aerial invasive plant surveys every five years in order to track eradication progress as well as to detect new biosecurity threats (J. Knapp, pers. comm.).

- B2. Maintain geospatial data of disturbed areas and the materials associated with or sourced from them.**

This will aid in tracking the sources and locations of materials. Geospatial data can help identify quarries or other sites that need additional management.

Post Detection Response – On-Island Source Material

Because on-island source material is already present on SCI, any IAS that shows up elsewhere is already known to occur on the island. Therefore, IPM and invasive weed management plans will have to address the control of already established species.

Biosecurity Education – On-Island Source Material

Strategy C: Outreach

Increase education of, and outreach to, those who may be potential sources for IAS introductions through the transport of vehicles and heavy equipment.

ACTIONS

- C1. Write and distribute NALF SCI Naval Instruction.**

The first task of a biosecurity manager should be to assemble recommendations made herein for the Commanding Officer to authorize and sign. The recommendations that are employed by NBSD and NALF SCI should be reflected in Naval Instructions signed by

the commander as well as contracting language. Naval Instruction should have a section on responsibly sourcing materials and storage of aggregates.

C2. Deliver the general PowerPoint included in the mandatory in brief of all NALF SCI visitors.

Alert personnel to the risks of transporting source materials across the island and aggregate stockpiling.

4.1.3. Roadway and Airfield Mowing

Mowing increases light availability, changes biomass (by decreasing living biomass and temporarily increasing litter), and introduces moderate disturbance. The added disturbance makes new niche spaces available, which may be appropriated by either native or non-native species propagules. Depending on timing and the phenology of the species present, mowing interrupts seeding or flowering, or disperses seeds if they are mature. Carefully timed mowing may be beneficial depending on the species composition of the stand and the desired end goal. If timed properly and repeated yearly, mowing can exhaust seed banks and prevent flowering of the unwanted species. In general, mowing benefits low-growing species with high specific leaf area.

Regular mowing currently occurs along road shoulders and around the airfield on SCI. Mowing of road shoulders is done to increase fox visibility to motorists and subsequently decrease vehicle collisions and fox mortality. In 2010, 108 miles of road shoulders were mowed on SCI (Navy 2013).

However, mowing also has the potential to expand and disperse invasive plant populations, especially around the road corridors that pose the risk of transport across the island and the airfield. For example, mowing has substantially expanded the population of a wind dispersed weed species, *Tragopogon porrifolius*. Airfield mowing was implemented with disregard for *T. porrifolius* phenology and its dispersal mechanism, and the species has expanded into native habitat nearby as well as along roadsides that are mowed regularly. Mowing does not inhibit growth or seed production, and may in fact encourage secondary flowering and seeding of this species and many other invasive species adapted to thrive under ground disturbance regimes (E. Howe, pers. obs.). The physical disturbance of the mower contributes to seed spread by projecting seeds into the air where they could be carried further off site. This presents a significant biosecurity risk and may result in long-distance introductions. Even mowing equipment that is designated for on-island use only can be problematic because it can further spread invasive plant populations already present on SCI to new areas.

Mowing programs should be implemented carefully and consider the phenology of various desired controlled species when determining timing and location of mowing activities. Recommendations are directed at prevention strategies and collaboration with weed management plans, fox management plans, and any objectives for Bird Airstrike Hazards (BASH).

Table 4-3. Roadway and airfield mowing biosecurity effort priority index and action value table.

Action Number	Potentially Prevented Taxa	Action	Implementation Index	Personnel Index	Cost Index	Additive Effort Score	Action Value Score
Prevention of Incursions							
A1.	invertebrates, invasive plant propagules, small mammals	Mowers and all associated equipment must be pressure washed and cleaned at a pre-determined interval.	2	2	1	5	2
A2.	invertebrates, invasive plant propagules, small mammals, reptiles	Forbid the transfer of mowers from the mainland to the island without a stringent protocol.	2	2	2	6	3
A3.	invasive plants	Thoroughly map all roadsides and determine species composition in order to determine if a mowing program should be maintained.	2	2	2	6	2
A4.	invasive plants	Implement a properly timed mowing program.	3	2	2	7	3
B1.	invasive plants	Investigate the restoration of roadsides in place of mowing.	1	1	1	3	3
Early Detection and Monitoring							
C1.	invasive plants	Map all roadside edges.	2	2	2	6	1
Post Detection Response							
D1.	invertebrates, invasive plants	Implement a rapid response treatment protocol.	2	2	2	6	1
Biosecurity Education							
E1.	invasive plants	Increase outreach to public utilities departments about the biological consequences of mowing.	1	1	1	3	1

Prevention of Incursion – Mowing

Strategy A: Limit the Spread of IAS Infestations by Mowing

Determine species compositions along roads and utilize mowing to exhaust seed banks and prevent flowering of targeted IAS.

ACTIONS

- A1. Mowers and all associated equipment must be pressure washed and cleaned at a pre-determined interval.**
The biosecurity manager and restoration managers should work collaboratively to determine the interval that equipment should be washed. The goal is to limit the spreading of invasive plant species to new habitats from IAS-contaminated mowers travelling around the island.
- A2. Forbid the transfer of mowers from the mainland to the island without a stringent protocol.**
Limit the potential for infestation and maintain on-island designated mowers. Additional cleaning measures should be developed if mowers are to be transferred between the mainland and NALF SCI.
- A3. Thoroughly map all roadsides and determine species composition in order to determine if a mowing program should be maintained.**
The data collected should inform managers on mow timing based off the composition and weed species of concern phenology. If it is not feasible to responsibly mow road

edges without introducing or further dispersing seeds, or if mowing encourages aggressive re-growth of various weed species, other alternatives should be investigated.

A4. Implement a properly timed mowing program.

If species phenology and the timing of mowing can coincide to responsibly mow road-edges, continue roadside mowing to prevent the infestation of non-infested habitat and to increase fox visibility and limit vehicle-caused mortalities.

Strategy B: Encourage Roadside Establishment of Native Perennial Grasses

Prevent the spread of IAS by restoring roadsides, reducing roadside maintenance and preventing the spread of invasive weeds by developing a native grass road margin establishment program.

ACTIONS

B1. Investigate the restoration of roadsides in place of mowing.

Invasive weeds require a regular mowing program in conjunction with herbicide treatments, but repeatedly re-infest the same roadsides and have the potential to spread to other un-infested areas of the island. Yolo County Regional Conservation District published a report on the process of establishing roadside natives and this should be carefully researched to determine feasibility for SCI. The process takes approximately three years and involves intensive herbicide treatments and hydroseeding of low-growing native bunchgrasses (Wrynski, N.D; Appendix F.) Another consideration is that this type of plan would require the development of a seed crop to be produced from island stock.

Early Detection and Monitoring – Mowing

Strategy C: Early Detection

Develop a standardized monitoring system focused on early detection for high priority IAS around areas heavily trafficked by vehicles and all roadways.

ACTIONS

C1. Map all roadside edges.

An invasive plant program manager should determine the timing of surveys but periodically, all roadside edges to 10-meters should be surveyed for high priority invasive weeds.

Post Detection Response – Mowing

Strategy D: Develop Response Initiatives

Post detection responses should work cooperatively with biosecurity managers and invasive plant program managers.

ACTIONS

D1. Implement a rapid response treatment protocol.

It should be up to the discretion of the invasive plant program manager to determine proper treatment protocols depending on the species detected, but efforts should be coordinated with the biosecurity manager to limit the spread of the infestation.

Biosecurity Education – Mowing

Strategy E: Outreach

Educational efforts should be targeted to all personnel involved in mowing on NALF SCI to inform on the biological implications of mowing.

ACTIONS

E1. Increase outreach to public utilities departments about the biological consequences of mowing.

Encourage collaborative roadside maintenance between different entities on island. An invasive plant program in concert with the biosecurity manager should detail the biological benefits and damages incurred by mowing.

4.1.4. Military Operations

The SCI Range Complex is the cornerstone of the tactical training ranges for the Southern California Operations Area which in turn supports the largest concentration of naval forces in the world. The land, air, and sea ranges provide the U.S. Navy, U.S. Marine Corps, and other military services, space and facilities to conduct readiness training, and test and evaluation activities. SCORE has control over all these activities for operations, scheduling, and maintenance. SCORE presently manages and operates 27 training range sites on the island and five on the San Diego mainland. These range sites are in support of the following training missions and communications utilities: Amphibious Warfare, Air Warfare, Command & Control Warfare, Ground Truth Data, Mine Interdiction Warfare, Navy Special Warfare, Research, Development & Testing, Strike Warfare, Surface Warfare, Under Sea Warfare, and inter-site communications (SCORE's Development History 2007).

Military training flights and transport of military personnel and material pass through NALF SCI's airfield regularly. Aircraft of all sizes and purposes, for example the Lockheed C-130 Hercules, originating from around the world may land or perform "touch and go" training sessions. Some aircraft may also land in other locations on the island. For instance, military aircraft may perform training missions at SWATs 1 and 2 and MV-22 Osprey aircraft land crews all at VC3, while helicopters may touch down at a number of locations across the island.

In compliance with SCI INRMP's Conservation Measure AVMC-M-7, the Navy requires the following measures to reduce the potential for transport of invasive plants to the island: "Prior to coming to SCI, military and non-military personnel will be asked to conduct a brief check for visible plant material, dirt, or mud on equipment and shoes. Any visible plant material, dirt or mud should be removed before leaving for SCI. Tactical ground vehicles will be washed of visible plant material, dirt and mud prior to embarkation for SCI. Additional washing is not required for amphibious vehicles after 15 minutes of self-propelled travel through salt water prior to coming

ashore on SCI” (Navy 2013). However, it may be necessary to ensure cargo and cargo bay are free of IAS prior to embarkation.

The complexity of different training missions and the equipment necessary to support these training missions has inherent biosecurity risks. Military equipment is used in locations all over the world, and may transport IAS that otherwise would not encounter vectors capable of transportation to the U.S. and subsequently SCI. Equipment that should receive extra scrutiny includes aircraft, tracked vehicles that may travel off road either abroad or on the island, and amphibious vehicles such as landing craft air cushion vehicles (LCAC).

LCACs currently land at BUDS Beach, Horse Beach Cove, and West Cove on SCI. Because they are propelled through salt-water prior to landing, they are not subjected to any additional cleaning protocols before they land ashore.

A biosecurity manager will be imperative to coordinate and collaborate with the intricacies of military operations on SCI.

Table 4-4. Military operations biosecurity effort priority index and action value table.

Action Number	Potentially Prevented Taxa	Action	Implementation Index	Personnel Index	Cost Index	Additive Effort Score	Action Value Score
Prevention of Incursions							
A1.	taxa specific	Identify related activities for military operations recommendations.	1	1	1	3	1
A2.	invasive plants	Coordinate with other military bases in the region for invasive plant species inventories.	2	2	1	5	2
A3.	all taxa	The biosecurity manager should coordinate preventive measures with military units using SCI for training.	3	3	1	7	2
A4.	invasive plants	Establish weed containment buffer areas at military operations sites where feasible.	3	2	3	8	3
Early Detection and Monitoring							
B1.	all taxa	Coordinate with pest, restoration and weed managers to assess opportunities to include monitoring for IAS.	1	1	1	3	2
B2.	all taxa	Identify optimal budgets for monitoring around facilities in cooperation with the invasive weed manager and determine the interval of monitoring.	1	1	1	3	2
B3.	rodents	Paint 12-inch white rat runs at the bottom of walls in facilities across the island.	1	1	1	3	1
B4.	taxa specific	Develop a facilities based camera trap monitoring plan.	1	1	1	3	2
Post Detection Response							
C1.	taxa specific	Stage IAS spill kits in easily accessible places in facilities around the island.	1	2	2	5	2
C2.		Determine the taxon of potential threat and identify professionals experienced in detection and extirpation.	2	2	2	6	1
C3.		Implement rapid response protocols.	2	2	2	6	1
C4.		If an invasive animal is contained on NALF SCI: determine species and sex, quarantine, euthanize and perform necropsy.	3	3	3	9	1
Biosecurity Education							
D1.	all taxa	Emphasize the NALF SCI Commander's Naval Instruction for biosecurity topics.	1	1	1	3	1
D2.		Deliver the general PowerPoint and include in the mandatory in brief of all NALF SCI military personnel.	2	2	2	6	1

Prevention of Incursion – Military

Strategy A: Prevention

Coordinate with all NALF SCI military personnel to implement biosecurity protocols for amphibious vehicles, road vehicles, aircraft etc.

ACTIONS

- A1. **Identify related activities for military operations recommendations.**
All airborne operations should refer to Section 3.2.2. All amphibious vehicles and ocean-going operations should refer to Section 3.2.1. All military personnel should refer to Section 3.1.4.
- A2. **Coordinate with other military bases in the region for invasive plant species inventories.**
Due to the transfer of troops and equipment between Camp Pendleton, Miramar and other bases within the immediate region, maintaining other bases' current geodatabases will assist NALF SCI management with planning for likely incursions and inform targeted biosecurity efforts.
- A3. **The biosecurity manager should coordinate preventive measures with military units using SCI for training.**
Due to the varied nature of the military mission and activities and the multiple points of embarkation, biosecurity measures will have to evolve with the military mission. For this reason, the biosecurity manager should work with military commands to develop prevention measures on a per project scenario. Many of the prevention strategies have been detailed in this document. However, the specific biosecurity measures of military actions should be the responsibility of the biosecurity manager working with NALF SCI Commander, NRO and other pertinent entities.
- A4. **Establish weed containment buffer areas at military operations sites where feasible.**
Training areas and other general operations should identify which weed containment buffer scheme would best fit the facilities. Training Areas and Ranges, bivouac sites, storage lockers, Infantry Operations Area, Assault Vehicle Maneuvering Area, etc. should all have a treatment plan or pea-gravel buffer encircling the perimeter of facilities. See Section 4.1.1 Strategy A for a full description of weed containment strategies (Figures 4-2 through 4-10).

Early Detection and Monitoring – Military

Strategy B: Early Detection

Develop a standardized monitoring system focused on early detection for high priority IAS around areas heavily trafficked by military equipment.

ACTIONS

- B1. **Coordinate with pest, restoration and weed managers to assess opportunities to include monitoring for IAS.**
The biosecurity manager should work collaboratively with the military to assess options for incorporating early detection surveys into existing management activities.

- B2. **Identify optimal budgets for monitoring around facilities in cooperation with the invasive weed manager and determine the interval of monitoring.**
In order to determine the monitoring schedule, staff should first identify available resources.
- B3. **Paint 12-inch white rat runs at the bottom of walls in facilities across the island.**
Painted white rat runs can enable management to determine if IPM efforts need to be expanded and can monitor existing infestation to track efficacy.
- B4. **Develop a facilities based camera trap monitoring plan.**
Military facilities should incorporate camera trapping near buildings and yards to detect the presence of non-native vertebrates.

Post Detection Response – Military

Strategy C: Develop Response Initiatives for Incursions

Post-detection responses should be developed for prioritized IAS of risk in areas of military operations.

ACTIONS

- C1. **Stage IAS spill kits in easily accessible places in facilities around the island.**
Multi-target kits should not possess any anti-coagulants or toxic baits due to regulatory constraints and the potential for off-target consumption (island fox). The following serves as an example of contents in a multi-target spill kit:
- Gnaw sticks or other indicator baits such as peanut butter, molasses, oat loaves, cat food
 - Rapid response camera traps
 - Snake, mesopredator, rat, and small mammal traps (Sherman traps)
 - Rat tunnels, papers, and paint (Black Trakka; Appendix C)
 - Nets
- C2. **Determine the taxon of potential threat and identify professionals experienced in detection and extirpation.**
Confirm the species detected and adapt the appropriate vessel grounding response plans (Section 3.2.3 Action A3) for facilities based use. NALF SCI should develop relationships with various professionals that are experienced in detecting incursions at low densities, especially in island contexts. NALF SCI will need to determine if the threat is high enough to quickly contract eradication professionals to prevent a non-native vertebrate population from establishing.
- C3. **Implement rapid response protocols.**
Response plans are most effective if established well in advance of any incursion, especially to prevent the introduction of Norway rat.
- C4. **If an invasive animal is contained on NALF SCI: determine species and sex, quarantine, euthanize and perform necropsy.**

Time is of the utmost importance when containing newly introduced IAS. Performing necropsies will be important to delineate stomach contents and to identify if the animal has reproduced recently.

Biosecurity Education – Military

Strategy D: Outreach

Increase education of, and outreach to, military personnel who may be potential sources for IAS introductions through the transport of vehicles, military training, and military infrastructure.

ACTIONS

D1. Emphasize the NALF SCI Commander’s Naval Instruction for biosecurity topics.

The first task of a biosecurity manager should be to assemble recommendations made herein for the Commanding Officer to authorize and sign. The Naval Instructions should detail military expectations on the preparation of cargo, military training impacts, and vehicle protocols.

D2. Deliver the general PowerPoint and include in the mandatory in brief of all NALF SCI military personnel.

Primarily cover SCI topics that affect military personnel and the specific vectors that will affect the military mission. Topics should instruct personnel how to:

- Prepare cargo for transport to NALF SCI
- Prepare vehicles and heavy equipment for transport
- Source on-island materials to reduce spread of invasives
- Properly store food items
- Properly clean clothing, shoes and personal effects
- Identify particular IAS species of concern
- Report sightings and identify points of contact
- And most importantly, demonstrate the impacts IAS have on the NALF SCI military mission and ecosystem

5.0 Natural Processes

Natural processes are a real and potentially high threat for the introduction of non-native species to NALF SCI. However, the distance from the mainland as well as tidal currents and rough seas in the California Bight provide a natural barrier preventing many species from reaching the islands on their own. Despite the natural barrier, there is an obvious risk of invasive species reaching the islands without the deliberate or inadvertent assistance of human activity.

Although natural processes are responsible for the current composition of island species, new non-native introductions can negatively affect the ecosystem as well as introduce zoonotic disease. Recent arrivals, such as Eurasian collared doves (*Streptopelia decaocto*), are poised to introduce zoonotic infections such as Avian pox. House sparrows (*Passer domesticus*) may also

introduce disease to native bird populations. In addition, insects may also arrive on the island under their own power and cause ecological damage as invasive species.

Because of the forces at play, effective biosecurity actions incorporate detailed early detection and rapid response protocols in order to quickly determine if an invasion is imminent.

5.1.1. Zoonoses

The complexity and natural occurrence of zoonotic infections presents a significant biosecurity challenge. Recommendations are focused on monitoring the species of concern that can introduce disease into the population. Then if detected, attempt to isolate the source. A comprehensive table details various diseases, vectors, species of concern, and any viable strategies to prevent or monitor the introduction (Table 5-1). This table is designed to provide the framework to investigate more monitoring and control options, although significant resource investment will be mandatory to work with zoonoses.

Table 5-1. Comprehensive zoonotic disease table listing possibilities for prevention and control strategies.

Zoonotic Infections							
Disease	Aetiological Agent	Vector/Host	Species of Concern	Transmissibility Concerns	Vector Prevention	Vector Monitoring	Vector Control
Leptospirosis	<i>Leptospira interrogans</i> (bacteria)	Rodents (native and non-native), canids, pinnipeds (<i>Zalophus californianus</i> and <i>Callorhinus ursinus</i>), bats	Island fox, San Clemente island deer mouse	Mode of transmission is unknown, however there is a strong association between occurrence of leptospirosis in pinniped and canid populations. May involve direct spread of urine or contact with stagnant sources of fresh water.	<ul style="list-style-type: none"> Prevent introduction of infected rodents/introduced mammals - possible Prevent introduction of infected pinnipeds/bats - not possible Pinniped vaccination - not feasible Can jump taxa groups, but canid vaccines available for various serovars 	Blood sampling for multiple serovars	No known control available
West Nile	West Nile virus (Flavivirus)	Mosquitoes / birds*	San Clemente loggerhead shrike, San Clemente sage sparrow	*Transmitted among birds by ornithophilic mosquitoes to species of concern. Therefore, occurrences on the mainland could be transmitted to island species from avian trans-oceanic flights.	<ul style="list-style-type: none"> Experimental preventative vaccination; not commercially available (University of British Columbia 2013) Infected bird prevention - not possible Water use policy (no pooling/open water) <p>NATURALLY OCCURRING</p>	Special status species testing/mosquito surveillance and testing	<ul style="list-style-type: none"> Water use policy/mosquito abatement
Hantavirus	<i>Sin nombre virus</i>	Deer mouse	San Clemente island deer mouse, invasive rodents. Poses highest concern for public health on island.	Transmission among rodents and from rodents to humans generally occurs through inhalation of aerosolized excreta. In their natural host, hantaviruses establish a persistent infection, which causes no apparent harm. In humans, however, hantaviruses causes cardiopulmonary syndrome in North America.	<ul style="list-style-type: none"> Prevent introduction of infected rodents - possible <p>NATURALLY OCCURRING</p>	Monitor general population	Mouse control
Distemper	Paramyxovirus	Domestic dogs, wildlife	San Clemente Island fox, California bat, pinnipeds	Domestic dogs on island, e.g. work dogs.	<ul style="list-style-type: none"> Prevent introduction of infected non-native carnivores - possible Prevent introduction of infected pinnipeds/bats - not possible <p>NATURALLY OCCURRING</p> <ul style="list-style-type: none"> Can jump taxa groups, but canid vaccines available 	Monitor sensitive populations	No known control available
Avian pox	Avipoxvirus, a subgroup of poxviruses	Mosquitoes, (surfaces or air-borne particles can also result in infection in captive birds)	San Clemente loggerhead shrike, San Clemente sage sparrow	Multiple songbirds can become carriers and spread avian pox among local populations. Aviaries and any captive birds would be a concern as well. Poxvirus is resistant to drying, can pose problems for captive species.	<ul style="list-style-type: none"> Vector control in areas around sensitive populations, i.e. aviaries or small home ranges with limited distributions <p>NATURALLY OCCURRING</p>	Monitor sensitive populations,	No control available
Lyme disease	<i>Borrelia burgdorferi</i> (bacteria)	<i>Ixodes pacificus</i> ; Western black-legged tick, infected rodents & foxes, non-native vertebrates that could host	Island fox	Lyme disease is a bacterial disease spread by ticks that affects dogs, horses, humans. Foxes can also serve as a host for Lyme disease, but don't transmit efficiently to ticks. Disease presentation in canids may take 2-5 months and symptoms include: lameness, joint pain, fever.	<ul style="list-style-type: none"> Prevention of introduction of terrestrial vertebrates - possible <p>NATURALLY OCCURRING</p>	Listed species testing, post-attachment tick monitoring on foxes	Tick control

5.1.2. Currents

Anything man-made, including litter and fishing gear, can become marine debris once lost or thrown into the marine environment and subsequently transported by currents. The most common materials that make up marine debris are plastics, general land-based and ocean-based refuse, derelict fishing gear, and marine-origin debris (MOD). Derelict fishing gear refers to nets, lines, crab/shrimp pots, and other recreational or commercial fishing equipment that has been

lost, abandoned, or discarded in the marine environment and can pose a potential biosecurity threat by translocating species attached to gear.

MOD such as docks, piers, buoys, vessels, aquaculture floats, and other buoyant materials are a large concern because of the high potential for colonizing biofouling organisms. Some of these assemblages of marine organisms have the high potential to become invasive species within the local environment should any MOD be discovered on-island. High profile and high risk species such as wakame (*Undaria pinnatifida*) and the Asian shore crab (*Hemigrapsus sanguineus*) were two of over 90 non-native species discovered on a 188-ton fisheries dock that washed ashore on the Oregon Coast on 5 June 2012 (NOAA 2012). This event indicated the striking potential for MODs' ability to transport potentially serious aquatic invasive species to North America (Figure 4-27).

Prevention is not a realistic objective in the control of invasive species transported by MOD, therefore emphasis is placed on monitoring, response, and increasing awareness.

Table 5-2. Natural processes biosecurity effort priority index and action value table.

Action Number	Potentially Prevented Taxa	Action	Implementation Index	Personnel Index	Cost Index	Additive Effort Score	Action Value Score
<i>Prevention of Incursions</i>							
<i>Not applicable</i>							
<i>Early Detection and Monitoring</i>							
A1.	all species	Develop monitoring strategies for MOD that work closely with existing weed management plans.	2	2	2	6	3
<i>Post Detection Response</i>							
B1.	all species	Contact the NOAA Marine Debris Program.	1	1	1	3	1
<i>Biosecurity Education</i>							
C1.	all species	Improve the outreach and awareness of MIS and topics in biosecurity to military personnel and personnel likely to encounter MOD.	1	1	1	3	1

Early Detection and Monitoring – Currents

Strategy A: Early Detection

Develop a standardized monitoring system focused on early detection for high priority MIS around areas heavily trafficked by vehicles and heavy equipment and all points of entry.

ACTIONS

A1. Develop monitoring strategies for MOD that work closely with existing weed management plans.

Accessible beaches and shorelines should be surveyed at regular intervals, ideally once a quarter to identify new MOD and work to contain any transported species. Non-accessible beaches and shorelines should be surveyed by boat at intervals that utilize current resources.

Post Detection Response – Currents

Strategy B: Contact Federal Officials

Coordinate with established agencies for marine debris coordination and reporting.

ACTIONS

B1. **Contact the NOAA Marine Debris Program.**

For sightings of MOD, contact the NOAA Marine Debris Program which is the United States Federal government's lead for addressing marine debris. The California Regional MOD Coordinator is: Sherry Lippiatt, California Regional Coordinator sherry.lippiatt@noaa.gov as of this writing.

Biosecurity Education – Currents

Strategy C: Develop MOD Section Within Biosecurity Media

Develop the floating marine debris section with all media produced and distributed to various management operators, military, and personnel occupying beach areas.

ACTIONS

C1. **Improve the outreach and awareness of MIS and topics in biosecurity to military personnel and personnel likely to encounter MOD.**

Develop pamphlets of the dangers of MIS and incorporate into Naval Instructions that personnel should report sightings.



Figure 5-1. An example of marine-origin debris. This 188-ton commercial fisheries dock washed ashore on the Oregon coast in 2013 and translocated an assemblage of organisms, including highly invasive *Undaria pinnatifida*.
Source: NOAA.

6.0 Conclusion

The focus of this document was to provide an organizational framework on a vector by vector basis that target audiences could use to inform their management decisions. This fully encompassing framework provides recommendations that apply to species of concern. Specific threats may change through time but vector-based approaches will remain relevant. A successful plan must be able to evolve, but will require the regular review of NALF SCI activities and potential invasive species occurring within the region. This requires a point person that can work between infrastructure, transport, and military to ensure that biosecurity objectives have been met, i.e. a biosecurity manager.

The biosecurity manager must have the ability to communicate effectively with different stakeholders—military, infrastructure and natural resource managers—regarding minimally invasive ways to monitor and must have the authority to stop projects or shipments because of an imminent incursion to NALF SCI.

NALF SCI must also determine what defines a biosecurity breach worthy of response. For example, does a shipment get held up for one invasive plant seed? This is the purpose of a biosecurity manager, to work closely with military mission to ensure effective and logical solutions to practical situations.

In addition to the work of keeping IAS off NALF SCI, vigilance on the island is the only way to determine if a biosecurity breach has occurred. For this reason, a portion of the biosecurity manager or the NRO's time should allocate to island inventory for vertebrate, invertebrate, plants and pathogens. Without a baseline of occurrence, it is impossible to determine whether there is in fact a biosecurity concern at all.

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APPENDICES

Appendix A. Checklist protocol for vehicles and heavy machinery.

Check for invasive alien species (weeds, mesopredators, etc)	Inspected	Cleaned
1. Truck bed		
2. Exhaust systems		
3. Vent openings		
4. Grills: Front and back		
5. Tray under radiator		
6. Top of transmission		
7. Stabilizer bar		
8. Shock absorber joint with axles		
9. Front and rear axles		
10. Top of front suspension units		
11. Wheel well/quarter panels		
12. Ledges under bumper (front and rear)		
13. Tire rims and treads		
14. Between rear wheel brake drums and the rim of the wheel		
15. At the bend in the fuel inlet tube		
16. Spare tire and mounting area		
17. Under the floor mat (inside cab)		
18. Under the seat (inside cab)		
19. Upholstery (inside cab)		
20. Beneath foot pedals (inside cab)		
21. Gear shift cover folds (inside cab)		
22. Buckets on front-loaders		

Adapted from Cal-IPC's Preventing the Spread of Invasive Plants: Best Management Practices for Land Managers.

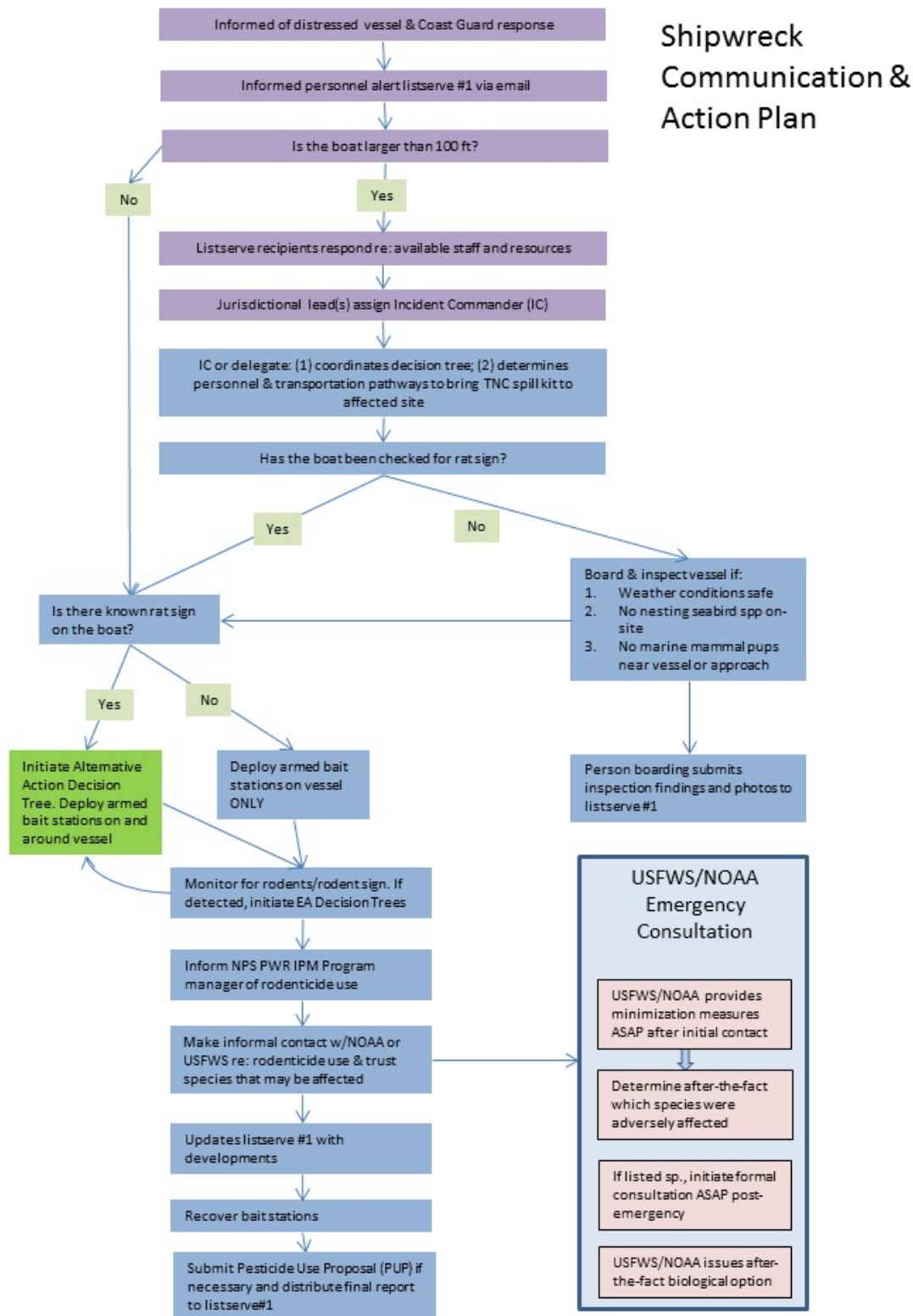
Appendix B. Checklist protocol for personnel clothing and shoes.

Check for soil, seeds, and plant material	Inspected	Cleaned
1. Hats		
2. Hoods		
3. Collars and cuffs		
4. Clothing folds or flaps		
5. Ventilation openings		
6. Pockets		
7. Zippers		
8. Straps or Velcro grips		
9. Belts or buckles		
10. Buttons, fasteners, and rivets		
11. Laces or ties		
12. Gloves		
13. Pant cuffs		
14. Socks		
15. Shoelaces or ties		
16. Straps or Velcro grips		
17. Shoe tongues		
18. Treads		

Appendix C. Examples of TOMCAT snap trap, AEGIS Rodent Bait Station, BlackTrakka animal tracking station, and SnakeTrap.



Appendix D. Example of a rodent rapid response protocol proposed for use in the Northern Channel Islands. Source: Christina Boser, The Nature Conservancy.



Appendix E: Weed Free Aggregates for Quarry Managers

Weed Free Aggregates for Quarry Managers



Introduction



Johnson Grass. NPS Photo

Non-native invasive plants displace native plants and crops, deplete water, increase wildfire severity and frequency, decrease visibility along right-of-ways, degrade pastures, decrease timber yields, degrade wildlife habitat, and inhibit recreation. Land managers control invasive plants to reduce the environmental and economic damage that invasive plants cause. Treating invasive plants over a large area is expensive and often impossible. However, prevention of invasive plant introduction and establishment is the most cost-effective alternative.

Aggregate quarries are high quality habitat for invasive plants and are the source for many invasive plant infestations, especially in transportation corridors and construction sites. When contaminated aggregate is used, invasive plant propagules transplant from one high quality disturbed habitat to the next. Land managers can save thousands of dollars on treatment by preventing the introduction of invasive plants by buying weed-free aggregate. Weed-free aggregate is material purchased from a quarry that has been inspected and certified weed-free. An inspector examines the quarry to determine the likelihood that saleable material leaving the quarry does not contain invasive plant propagules. Upon successful inspection, the inspector issues a weed-free aggregate certificate.

This document provides guidance for land managers interested in starting a weed-free aggregate inspection program. Currently, California does not have a statewide inspection program although several public agencies (e.g. Yosemite National Park, Sequoia-Kings National Park, US Forest Service – Lake Tahoe Basin Management Unit) do inspect nearby aggregate pits and issue weed-free aggregate certificates. These certificates are shared between land managers.

As more land managers join the program, it reduces the cost of inspections. Additionally, the certificate increases product visibility and demand and becomes a marketable tool that highlights the “value-added” to the product.

The demand for weed-free aggregate will increase as land managers realize the cost-savings of purchasing weed-free aggregate as opposed to incurring the cost of treatment. The voluntary collaboration of land management agencies and quarries creates a market driven solution to invasive plants management problems.

Quarries have financial incentive to participate in an inspection program, but they may not have the financial resources or knowledge base to develop an effective invasive plant abatement program. Therefore, the inspector serves dual roles as both inspector and educator. The success of this program hinges on the collaboration between inspectors and quarry managers to develop an integrated pest management program for each quarry. Inspectors work with quarry managers to develop invasive plants identification skills, and provide educational materials to guide managers to develop a successful program.



Klamath NF-- Dyers Woad on Gravel. USFS Photo



Case Studies

- At Great Smoky Mountains National Park in Tennessee, park staff began suspecting aggregate as an invasive plant source after seeing weedy white sweet clover and coltsfoot growing out of stockpiled winter sand. The winter sand was used on the highway and the next year new infestations of white sweet clover and coltsfoot were found scattered along miles of highway. Land managers discovered the highly invasive plant, dyers woad, growing along five miles of road in Klamath National Forest in northern California. Staff manually treated the infestation, but it continues to spread despite all efforts.
- Aggregate from gravel pit infested with black henbane was used to resurface a road in Sublette County, Wyoming on natural gas field roads. New henbane infestations soon popped up along the roads and spread through the region.
- Staff at Golden Spike National Historic Site in Utah, noticed new infestations of dyer's woad growing along miles of railroad grade after the park accidentally imported contaminated gravel to shore up the railroad grade. They had to bring in a specialized National Park Service weed treatment team to treat the problem.
- Emergency repairs for several miles of roadway required the import of fill dirt to stabilize the road edge, after a large flood in Yosemite National Park washed away the road. The fill dirt was contaminated and the following season many new invasive plant infestations sprung up. Yosemite spent hundreds of thousands of dollars to clean up the worst of the most invasive plant species, but many of the highly flammable annual grasses and other weeds remain today.

Sublette County (WY), Great Smoky Mountain National Park (TN), and Yosemite National Park (CA) now inspect aggregate before importing it to prevent paying for the costly treatments that followed these simple mishaps. Agencies across the West have instituted gravel pit inspections in the past fifteen years. The North American Weed Management Association (NAWMA) developed inspections standards in 2007. The U.S. Forest Service (USFS) Lake Tahoe Basin Management Unit has been inspecting gravel pits since 2003, and annually provides each operator with a letter authorizing or denying use of their products for Forest Service projects in the Tahoe Basin. Yellowstone National Park has been inspecting pits since 2003 and now inspects over 50 pits. This program builds upon those programs and provides the resources necessary to land managers and quarry managers looking to start their own program.

Best Management Practices

Quarry managers can take an active hand in invasive plant management that goes beyond treatment. By using Best Management Practices (BMP's), quarry managers can greatly reduce the risk of contaminating material with invasive plants. Below are practices (•), rationale (o), and additional actions (*) that quarry managers can take to prevent spreading invasive plants. Many do not require herbicides.

- Don't leave stockpiles for a long time
 - o The longer a stockpile sits, the higher the chances that invasive plants can contaminate the stocked aggregate. If material is not moving...
 - * Treat invasive plants as they appear on the stockpiles
 - * Move the oldest material off first to prevent establishment
- Create a buffer between stockpiles and any vegetation
 - o Buffers reduce the risk of stockpile contamination
 - * Locate stockpiles in areas away from all vegetation
 - * Treat all invasive plants growing near stockpiles
- Treat invasive plants growing on the perimeter of the active pit
 - o Invasive plant seeds can easily blow into the active pit
- Treat invasive plants growing on the sides of access roads
 - o Invasive plants seeds can easily blow into dump trucks
- Completely clean all material while it is being sorted and crushed
 - o Properly cleaned material is less likely to have invasive plants
 - * Use filters that separate out organic material
- Ensure that overburden material and aggregate remain well separated.
 - o Overburden is highly likely to have invasive plants growing on them
 - * Scrape off all overburden before mining aggregate
 - * Keep overburden piles away from stockpiles, active pit, conveyors, and weigh house. If overburden piles are close to active areas, treat the invasive plants on them
- Equipment and vehicles transport invasive plants not only within a quarry, but from quarry to quarry. When contaminated equipment comes from a weedy quarry, it can easily carry and subsequently spread invasive plant seed. This happens when seeds fall off the vehicle, or especially when contaminated aggregate or fill is transferred between quarries. Washing equipment greatly reduces the probability of equipment spreading seeds. Also monitoring all outsourced material for invasive plants will reduce the risk of the them spreading on the property.

Frequently Asked Questions

Why are quarries weedy?

Quarries are highly disturbed areas due to the nature of the site. Disturbed areas are high quality habitat for many invasive plants. Invasive plant seeds blow around the quarry and infest recently mined material, which is then transplanted to roadsides and construction sites.

Why should we participate?

Increased marketability In a tight economy land managers are looking to cut costs, and weed-free aggregate is one of the most cost-effective prevention measures versus treating invasive plants. As more land managers join the weed-free aggregate buying consortium, those suppliers that provide weed-free aggregate will have a competitive edge into this market.

Quality product

Weedy aggregate is low quality aggregate. Certified weed-free aggregate adds a layer of product quality.

Stewardship

Supplying weed-free aggregate contributes to healthy native ecosystems and public safety. Invasive plants outcompete native vegetation, reduce visibility along roadsides and create fire hazards in right-of-ways.

Reclamation

Well established invasive plants seriously impair the establishment of desired species during reclamation of quarries. Desired vegetation are more likely to establish by treating invasive plant populations while actively mining and well before reclamation begins. The success of reclamation projects are judged in part by the success

of the revegetation component. To prevent invasive plants from hindering reclamation efforts the California Surface Mining and Reclamation Act (Article 9 Section 3705) states that "Noxious weeds shall be managed: (1) when they threaten the success of the proposed revegetation; (2) to prevent spreading to nearby areas; and (3) to eliminate fire hazard."

How much will the inspection, certificate, and educational materials cost?

Nothing. The inspection, certification, help with the weed-management plan and any educational materials provided by the inspector are provided for free.

How much does it cost to treat invasive plants?

It varies, but treatment costs increase when invasive plant populations are large, difficult to access, or when there are large varieties of species. Costs tend to decrease by treating in-house versus using contractor services. Reduce costs by treating invasive plant populations before they get large and by treating invasive plants every year rather than treating every few years. Talk to your county agricultural commissioner for assistance assessing treatment costs.

What areas in the quarry are most likely to have invasive plants?

- access roads
- perimeter
- stock piles
- standing water
- overburden storage
- equipment and vehicle parking



What areas in the quarry are most likely to contaminate the aggregate?

- access roads
- active mining areas
- stock piles
- standing water

What other factors could also contaminate aggregate?

- neighbors
- water source
- prevailing wind
- stockpiling aggregate outside the quarry

For more information about
invasive plant treatment and
prevention, visit
www.cal-ipc.org

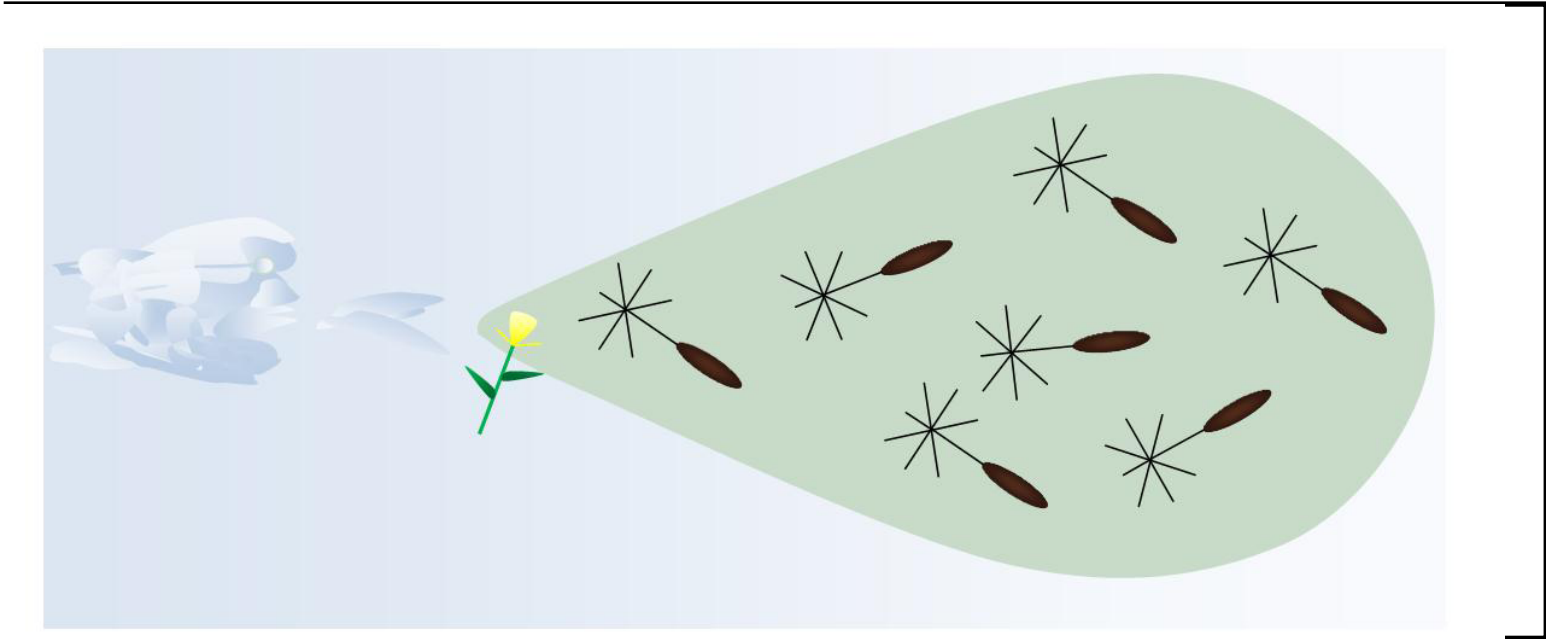
Seed Dispersal

Most invasive plant seeds fall close to the parent plant, some of the seeds disperse further from the plant, and a few seeds fall very far from the parent plant. Seed dispersal can be either 1) directional, or 2) evenly distributed around the parent plant.

1) Directional distribution occurs when wind blows seeds away from the parent plant.

- Seeds spread within a cone away from the parent plant instead of a circle.
- Plants on a slope spread their seeds further because gravity pulls them down.
- Humans pick up seeds and disperse them along roads, trails, or developed areas.
- Animals drop seeds along a corridor

2) Seeds spread evenly in a circle away from the parent plant when outside factors do not influence seed distribution directionally. For example, lupine seeds burst out of the pods in random directions and distribute close to the parent plant.



Wind disperses seeds away from the parent plant and can contaminate large areas with seed.

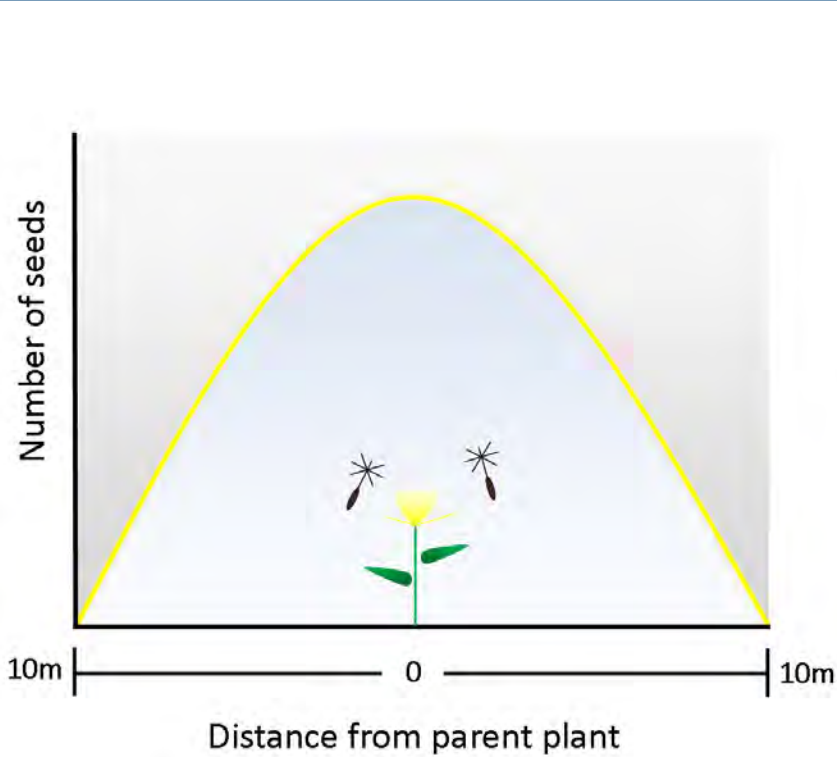
Multiple factors can combine to increase the dispersal distance of a seed. If the seed has a pappus, it travels further than a seed lacking a pappus. The distribution may increase again if the plant is at the top of a slope, and so the dispersal circle increases.

Seed characteristics that increase seed dispersal distance:

- Hooks, spines, burs
cling to animal fur or clothing (e.g. cheat grass)
- Edible
animals eat then spread seeds (e.g. blackberry)
- Pappus, wings
parachute-like structure helps seeds catch the wind (e.g. dandelion)

When parent plants go to seed, any seeds that do not germinate form a seedbank and contaminate a site for years. It usually takes years of treatment before a site is no longer contaminated.

Equipment and vehicles transport invasive plants not only within a quarry, but from quarry to quarry. When contaminated equipment comes from a weedy quarry, it can easily carry and subsequently spread invasive plant seed. This happens when seeds fall off the vehicle, or especially when contaminated aggregate or fill is transferred between quarries. Washing equipment greatly reduces the probability of equipment spreading seeds. Also monitoring all outsourced material for invasive plants will reduce the risk of them spreading on the property.



Most seeds disperse close to the parent plant, but some can travel long distances based on outside factors.

Probability of Invasive Plant Occurrence

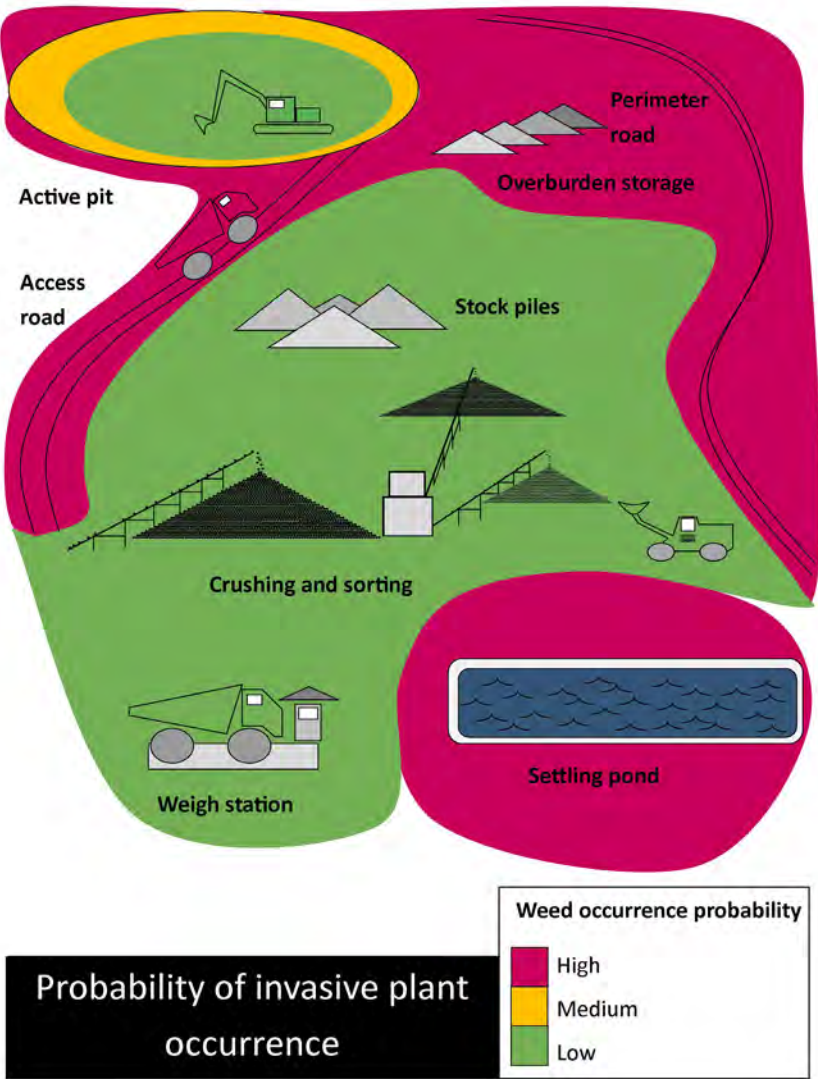
The diagrams on the following pages represent aggregate quarries and show:

- 1) The probability of invasive plant occurrence
- 2) The probability of contamination
- 3) The areas most likely to be contaminated

Each diagram illustrates probability as being either high (red), medium (yellow), or low (green). These hypothetical models of quarries should help guide inspections and treatments. However, quarries and their invasive plant problems differ, and these models will not exactly fit any quarry.

The probability of invasive plant occurrence diagram displays the likelihood of finding invasive plants at a quarry. Disturbance levels and site history dictate invasive plant occurrence at many aggregate pits. The probabilities of invasive occurrence are:

HIGH	MEDIUM	LOW
<ul style="list-style-type: none">•Around active pit•Road between pit and crushing/sorting area•Stock piles•Perimeter roads•Stock piles (inactive)	<ul style="list-style-type: none">•Inside pit perimeter•Settling pond	<ul style="list-style-type: none">•Stock piles (active)•Crushing/sorting area•Weigh station

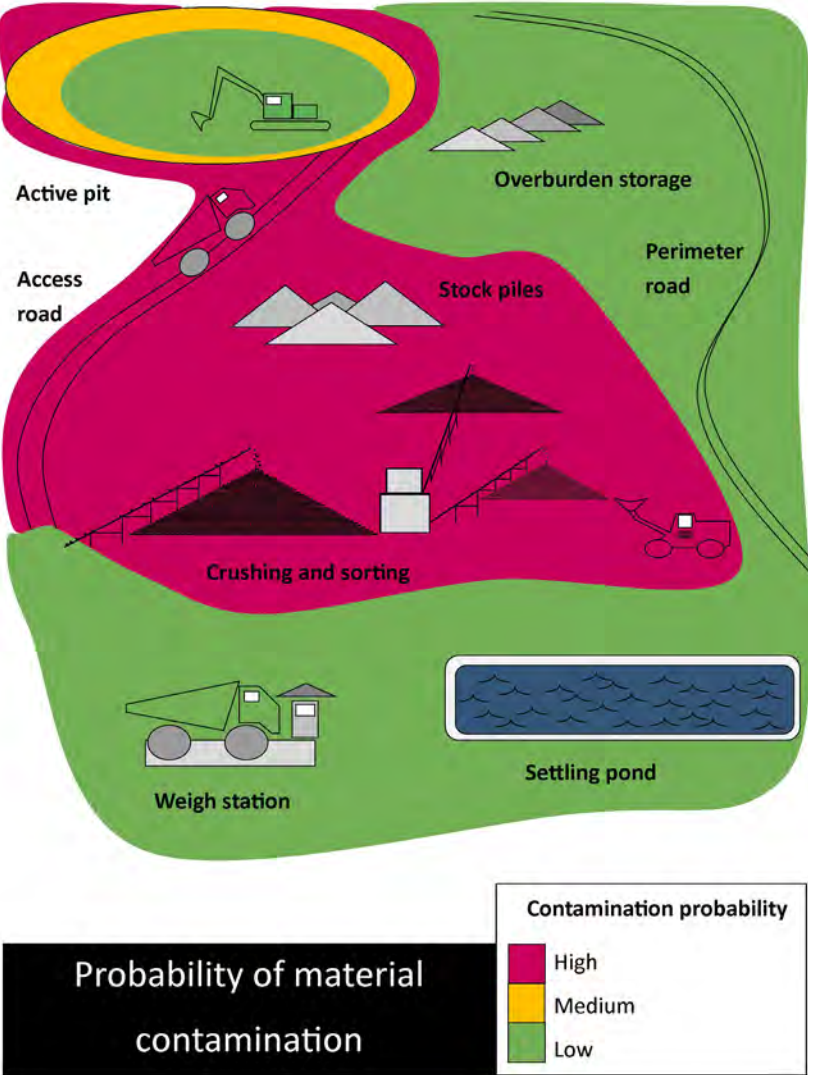


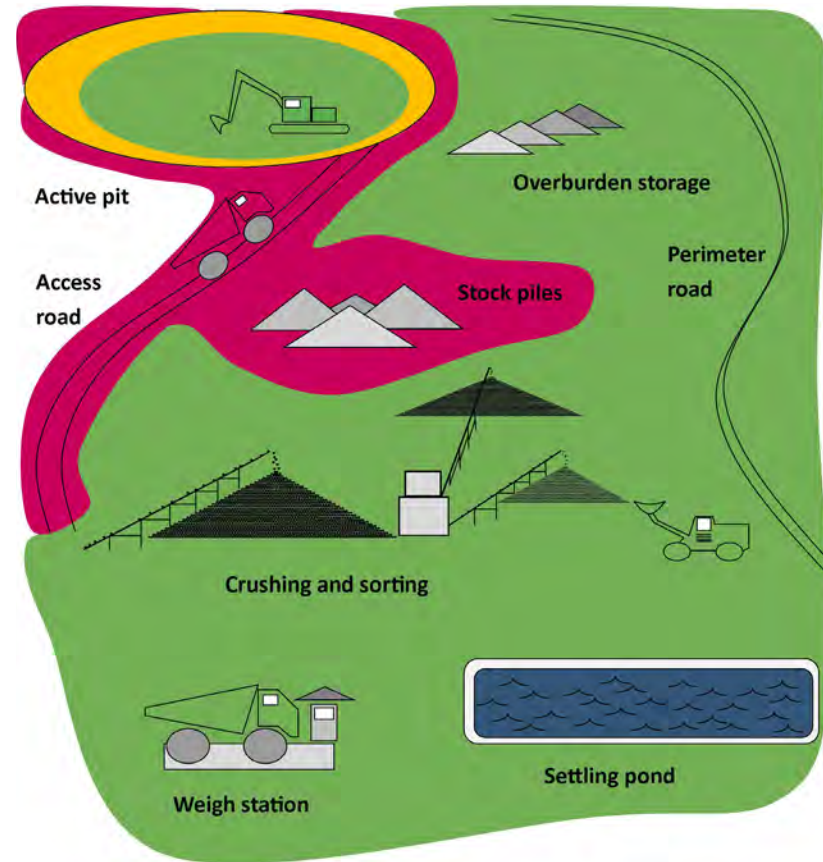
Probability of Contamination

The probability of contamination diagram shows the likelihood that invasive plants, if present, will contaminate exported material. While the probability can be high, if there are no invasive plants, then the contamination is less likely. High probable areas are sites where nearby sources could contaminate exposed aggregate. The probabilities of contamination if invasive plants are present are:

HIGH	MEDIUM	LOW
<ul style="list-style-type: none">•Around active pit•Road between pit and crushing/sorting area•Stock piles	<ul style="list-style-type: none">•Just inside active pit	<ul style="list-style-type: none">•Center of active pit•Perimeter roads•Settling ponds•Overburden storage

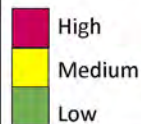
The highest probability areas for contamination are relatively small, but are the most important to monitor and treat for invasive plants. The most likely areas of invasive plant contamination are when the highest probability of occurrence overlaps with the highest probability of contamination. When these areas overlap, quarry managers must take precautions to ensure that aggregate is not contaminated. Quarry managers should prioritize treatments in areas where the probability of contamination is high and invasive plants are present. The areas that are most likely to contaminate material include access roads and the area around pit perimeter. *See diagram, next page.*





Most likely areas
to be contaminated

Most likely contamination



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Appendix F: Roadside Establishment of Native Perennial Grasses

Roadside Establishment of Native Perennial Grasses

Jeanette Wrynski, Yolo County RCD

Perennial bunchgrasses that are native to California can go a long way toward helping solve a series of problems associated with roadside maintenance. At the same time, they can improve the appearance of a part of rural landscapes that are typically weedy in one season or scraped bare in another.

Most road rights-of-way, whether county roads, state highways or interstate freeways, are covered with vegetation that consists primarily of noxious, invasive weeds. These weeds are considered to be a problem source of weed seeds that move into agricultural fields—resulting in herbicide treatments—and continue to reinfest the same roadsides. Efforts to clean up the roadsides usually involve multiple herbicide sprays and/or scrapings. These measures either contribute to pesticide runoff into waterways or leave soil stripped bare and subject to erosion during winter storms or heavy winds.

Bunchgrasses can be very effective competitors with these noxious weeds through shading and competition for nutrients. Their extensive root systems anchor soils during erosive rainstorms, keeping road shoulders more stable and firm, and provide pathways for surface water to percolate into the soil.

In addition to these benefits, native bunchgrasses also provide excellent wildlife habitat, encouraging greater biodiversity. Mature stands of these grasses can harbor a large variety of small mammals, reptiles, game birds, songbirds and insects - including important food crop pollinators.

Establishment

Establishing native grasses requires using some standard farming practices for the first few years. Because of their slow germination, low seedling vigor and slower growth rates, they must be managed as many agricultural crops are with efforts made to reduce competition by more vigorous, non-native, annual weeds. Reduction of weed competition is so important that the process could be started up to a year in advance of the actual planting.

One way to begin site preparation is with a controlled burn in the summer or fall to destroy surface weed seeds and trash. Weeds that germinate later through the winter and spring can be disked under in March or April, before they set seed. The area should be left fallow throughout the growing season, but any additional weeds that germinate should be controlled either with herbicides sprays, tillage, or burning before seeds are mature. Final seedbed preparation in the fall, done by disking or other tillage equipment, may also serve to remove persistent weeds. If clods are large, a scraper or roller may be needed to provide seedbed uniformity and to close up air spaces so as to help conserve soil moisture.

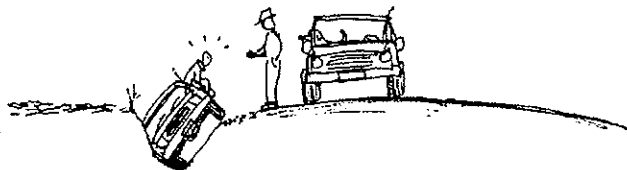


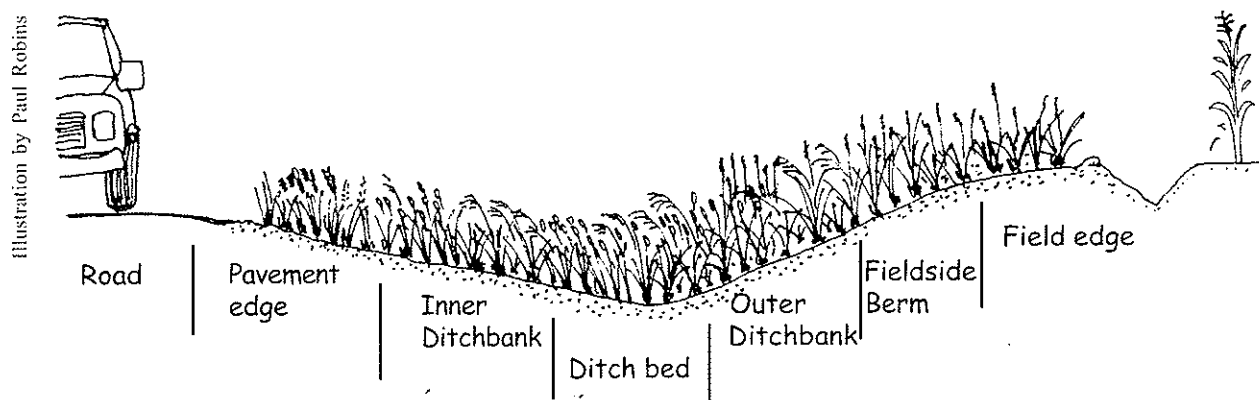
Illustration by Paul Robins

The type of seed selected or the mixture of species will depend on location, soil type and moisture conditions expected throughout the season. Suppliers of native grass seed can provide good information on species to select for different situations. A mixture of varieties, with differing moisture adaptations, is often recommended for roadsides where a ditch or swale is present. Grasses suited to drier conditions will predominate on the higher ground, whereas those that tolerate occasional flowing water will thrive in the lower areas.

Seeding is usually done in the fall, to allow rains to provide the moisture needed for germination. Seed can be drilled directly into the seedbed, as prepared, or into soils managed under no-till situations. Where no-till management has been used, weed control before and shortly after planting can and should be accomplished with herbicides or burning.

Broadcasting is another means of planting native grass seed. After seeding by this method, a light

Cross-section of roadside habitat with sample selections.



Pavement edge: California barley (*Hordeum californicum*), Pine bluegrass (*Poa secunda*), Purple needlegrass (*Nassella pulchra*), Nodding needlegrass (*Nassella cernua*), California oniongrass (*Melica californica*).

Roadside berm and inner ditchbank: California barley, California oniongrass, Meadow barley (*Hordeum brachyantherum*), Nodding needlegrass, Pine bluegrass, Purple Needlegrass, and Squirreltail (*Elymus elymoides*).

Ditch bed: Meadow barley, Purple needlegrass, and sedges and rushes.

Outer ditchbank and fieldside berm:

Deep, Good Soils: Blue wildrye (*Elymus glaucus*), Purple needlegrass, Slender wheatgrass (*Elymus trachycaulus* ssp. *trachycaulus*), California barley, and Deergrass (*Muhlenbergia rigens*).
Poor Soils: Purple needlegrass, Nodding needlegrass, California barley, and Pine bluegrass.

Field edge: Creeping wildrye (*Leymus triticoides*).

harrowing and rolling is usually necessary in order to cover the seed and settle it well into the seedbed. Mulching lightly with native grass straw is often done to seeded areas to aid in erosion control as well as keeping the seedbed moist during dry periods.

Maintenance

Germination of native grass seeds usually occurs in about two weeks for early fall plantings when temperatures are warmer. Later plantings may take up to four weeks. Spraying of any non-selective herbicides for weed control must be done before the young seedlings emerge. Afterwards, weed control options include selective herbicides, rope-wick applications, or timed mowings that will affect taller annual weeds, reducing their canopy and allowing the shorter, less vigorous natives greater access to sunlight.

Long-term maintenance of native grass stands is mostly weed control. This is needed for 2-6 years, depending on the grass species, conditions, and prior weed levels. However, after 3-4 years, when the perennials are well-established, maintenance needs should be minimal. Grazing, mowing and burning are effective, low-cost options for vegetation management. An annual, well-timed treatment may be sufficient to maintain these grasses at a desired height or to reduce dry matter. This type of long-term management could ultimately cost less than the repeated sprays and cultivations traditionally used for roadside weed control.

The table on the following page summarizes the management steps needed for the establishment of native, perennial bunchgrasses along roadsides over a three-year period. Ideally, weed control should start up to one full year in advance of planting.

Native Grass Establishment Schedule

Year 1

Month	Project	Description
March-September	Prepare Seed Bed	<ul style="list-style-type: none"> • disking in spring and/or burning in fall removes weeds and prepares the soil for planting
September-March	Seeding & First Weed Control	<ul style="list-style-type: none"> • drill or broadcast and harrow seed • spray glyphosphate on 1st flush of weeds before native grasses emerge
February-March	Broadleaf Weed Control	<ul style="list-style-type: none"> • spray phenoxy herbicides to eliminate broadleaf weeds in planted area
March-June	Late Grass Weed Control	<ul style="list-style-type: none"> • mow, hay, or lightly graze planted area to remove annual grasses before they go to seed

Year 2

October-December	Fall Weed Control	<ul style="list-style-type: none"> • pre-emergent herbicides (consult Ag Extension) or a broadleaf herbicide after weed emergence
April-June	Spring Weed Control	<ul style="list-style-type: none"> • broad-leaf herbicides, mowing, burning, or grazing can be used, depending on the weeds that are present

Year 3 and Beyond

October-November	Fall Weed Control	<ul style="list-style-type: none"> • pre-emergent herbicide or burning
April-July	Spring or Summer Management of Grasses	<ul style="list-style-type: none"> • mowing, burning, or grazing (grass lands are healthiest when these management practices are alternated from year to year)

Grassed Roadside Installation and Maintenance Cost Estimate (1999)

For one mile of roadside, 15 feet wide (approx. 1.8 acres)

	Cost/hr.		Time		Total Cost	
	Low Range	High Range	Low Range	High Range	Low Range	High Range
Installation						
Earthwork*	\$70.00	\$70.00	2	8 hrs.	\$140.00	\$560.00
Bed preparation	50.00	50.00	2	4 hrs.	100.00	200.00
Pre-plant Herbicide		60.00	0	0.5 gal.	30.00	
Labor		10.00	0	2 hrs.		20.00
Spray rig		25.00	0	2 hrs.		50.00
Seeding:						
20-40 lbs./acre for 1.8 ac.	10.00	35.00	36	72 lbs.	360.00	2,520.00
Broadcast/Harrowing Seed	35.00	35.00	2	8 hrs.	70.00	280.00
Total Installation Cost					\$670.00	\$3,660.00
Maintenance Costs (first three years):						
Mowing	40.00	40.00	2	2 hrs.	80.00	80.00
Spot spray broadleaf weeds	10.00	10.00	1	3 hrs.	10.00	30.00
Herbicide	22.00	60.00	.125	.25 gal.	2.75	15.00
Second mowing		40.00	0	2 hrs.		80.00
Controlled Burn (once in 3 yrs)		10.00	0	7 hrs.		70.00
Annual Cost					\$92.75	\$275.00
Perpetual Costs:**						
Mowing	40.00	40.00	2	4 hrs.	80.00	160.00
Spot spraying		10.00	0	4 hrs.		40.00
Herbicide		60.00	0	.25 gal.		15.00
Controlled burn (every 2nd yr. max.)		10.00	0	10 hrs.		100.00
Annual Cost					\$80.00	\$315.00
Average annual maintenance cost over 10 years					\$83.83	\$303.00

For comparison, standard roadside management in Yolo County (a combination of "blading," spraying, and/or mowing) costs between \$140 and \$490 per year depending on the roadside and management system. This does not include the secondary weed control costs to landowners or downstream water quality problems.

* Depending on your roadside's existing configuration, there may be minimal or extensive regrading required. This grading estimate assumes work done by a county roadside blade operator (in which case, the cost is theirs).

** The degree of long-term maintenance can depend on the individual landowner's tolerance for some weeds or no weeds.

Native Grass Establishment Program Checklist

(reproduce for project reference)

Project/Location _____ Date _____

- _____ Choose a site that will not be awkward to protect and that can be accessed with equipment for maintenance
- _____ Minimize weed generation and seed production on proposed site for at least one year
- _____ Order seed (see vendor list)

Year 1 (Summer/1st Fall-2nd Fall)

- _____ Prepare seed bed by disking in spring and/or burning in fall
- _____ Kill first flush of fall weeds after early rains
- _____ Drill or broadcast seed (preferably before December, but sometimes OK as late as March)
- _____ Spray out weed seedlings that germinate within two weeks of seeding
- _____ In mid-to-late winter, spray phenoxy herbicides to eliminate broadleaf weeds in planted area (use only herbicides such as MCPA that won't burn perennial grass seedlings)
- _____ In spring, mow, hay, or lightly graze planted area to remove annual grasses before they produce viable seed (in a wet spring, this may need to be repeated)
- _____ Late-spring/summer weed control by hoeing, mowing, or with chemicals (as needed)

Year 2 (2nd Fall-3rd Fall)

- _____ (Optional) Apply preemergent herbicides (consult Ag Extension) or a broadleaf herbicide after weed emergence in fall
- _____ In late winter, spot spray phenoxy herbicides or hoe to eliminate broadleaf weeds in planted area
- _____ Mow, hay, or lightly graze planted area to remove annual grasses before they produce viable seed (in a wet spring, this may need to be repeated)
- _____ Late-spring/summer weed control by hoeing or with chemicals (as needed)
- _____ (Optional) Late spring/summer/fall burn to reduce weed seed production and thatch; timing depends on the available fuel (dry matter to carry a fire) and type of weeds present

Year 3 and Beyond

- _____ Fall weed control with preemergent herbicide or fire
- _____ Selective hoeing and spot spraying for winter broadleaf and grass weeds
- _____ Spring mowing, burning, or grazing (grasslands are healthiest when these management practices are alternated from year-to-year)
- _____ Selective hoeing and spot spraying for summer broadleaf and grass weeds