

HACCP

**Hazard Analysis & Critical Control Point
Planning to Prevent the Spread of Invasive Species**

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Chapter 1

Invasive Species Impacts

Learning Objectives:

At the end of Chapter 1, participants will be able to:

- identify invasive species impacts.
- define non-indigenous species vs. invasive species (and synonyms).
- define target, non-target, pathway and vector.
- identify local and global invasive species pathways.
- list key invasive species legislation

Invasive Species Impacts

Nationwide, the cost of controlling and managing **invasive species** has exceeded billions of dollars. In 2010, Sam Hamilton, former Director of the U.S. Fish & Wildlife Service, said that invasive species are “probably the single greatest threat in our country to our native wildlife.”

Invasive species impact our environment and the diversity of life on our planet in many ways. The ecosystems into which these organisms are introduced often lack the conditions that limit range expansion in their natural habitats (e.g., predators, pests, or diseases). This factor, accompanied by characteristics such as high reproductive rates, the ability to utilize a variety of resources, and wide tolerances to a range of environmental conditions, allow invasive species to spread quickly following introduction, often resulting in serious impacts to the environment. Consequences of invasion include the extinction of native species through predation, competition for food or space, hybridization, and introduction of harmful pathogens and parasites. **Non-indigenous species** also can profoundly alter ecosystems through changes to the food web, fire regimes, and hydrology.

Key Definitions:

Invasive Species – a non-indigenous organism whose introduction does or is likely to cause economic or environmental harm or harm to human health.

Non-indigenous Species – an individual, group, or population of a species that is introduced by human intervention into an area or ecosystem outside of its historic native geographic range. Synonymous with “alien,” “non-native,” “exotic,” and “introduced.”

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HACCP Planning to Prevent the Spread of Invasive Species

In addition to the severe and permanent damage to the habitats they invade, invasive species also hinder economic development. Exotic organisms reduce production of fisheries, decrease water availability, block transport routes, foul industrial pipelines, degrade water quality, and decrease property values. Through damage to human enterprises, invasive species inflict an enormous economic cost; the cost to manage non-native species in the U.S. is currently estimated at \$137 billion per year. This number is likely an underestimate as it does not consider ecosystem health or the aesthetic value of nature, which can influence tourism and recreational revenue.



Zebra mussels attached to a native freshwater mussel. Photo Credit: USFWS

Additionally, invasive species may serve as vectors of human disease. Throughout recorded history, epidemics such as malaria, yellow fever, typhus, and bubonic plague have used non-indigenous organisms as vectors. Waterborne disease agents, such as cholera bacteria (*Vibrio cholerae*), are often transported in the ballast water of ships. The effect of invasive species on public health extends beyond the immediate effects of disease and parasites, as chemicals used to control invasive species can pollute soil and water. Other invasive

species, including invasive mussels, may increase human and wildlife exposure to organic pollutants such as polychlorinated biphenyls (PCBs), as these toxins accumulate in their tissues and are passed up the food chain.

Pathways

Invasive species can arrive through many different **pathways** and **vectors**, but most species considered invasive in North America arrived as a direct result of human activity. For example, it is widely accepted that zebra mussels, *Dreissena polymorpha*, were introduced to the Great Lakes through ballast water discharge by ships arriving from foreign ports. Shippers did not intend to move zebra mussels when using ballast water to safely cross the ocean and manage cargo loading/unloading. Unfortunately, many species can survive transoceanic trips in ballast water, essentially “hitchhiking” to new ports. Likewise, the horticultural industry has inadvertently provided pathways by which plant pests have been imported to the United States, causing problems in agricultural and natural areas. Some of our worst insect invaders, such as the Formosan termite (*Coptotermes formosanus shiraki*) arrived in packing and crating materials. These are just a couple of examples of how species are moved around the planet unintentionally. However, the problem is ubiquitous and all too common.

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Key Definitions:

Pathway – an activity or process through which a species may be transferred to a new location where it could become invasive (e.g., shipping, air travel).

Vector – the specific means by which an invasive species moves within a particular pathway (e.g., a ship, agricultural products, boots).

On a local scale, invasive species can be spread unintentionally to new habitats through a wide variety of human activities, including work in natural resource management. For example, the tiny size of the New Zealand mudsnail (*Potamopyrgus antipodarum*) and its ability to clone itself help this species invade new water bodies by hitchhiking to new habitats on **targets** such as waders, boats, and other aquatic gear. Similarly, terrestrial species can be moved via field or farm equipment, clothing, and/or native species that are moved to new areas for conservation purposes. Species monitoring, collections, natural resource surveys, and stocking of fish are all potential pathways for moving invasive species during natural resource management activities. Because invasive species are not the “target” of these activities, we can refer to them more generally as “non-targets.”

Key Definitions:

Target – anything that is intentionally moved. For example, if your management activity calls for you to stock largemouth bass, then your targets would be largemouth bass and any equipment and personnel used to carry out this activity.

Non-target – anything, including any organism, that is not intentionally moved. For example, if your management activity calls for you to stock largemouth bass, then any other species of fish (or other organism) would be a non-target. Your intent would be to only move largemouth bass.

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HACCP Planning to Prevent the Spread of Invasive Species

HACCP Spotlight: Target vs. Non-target



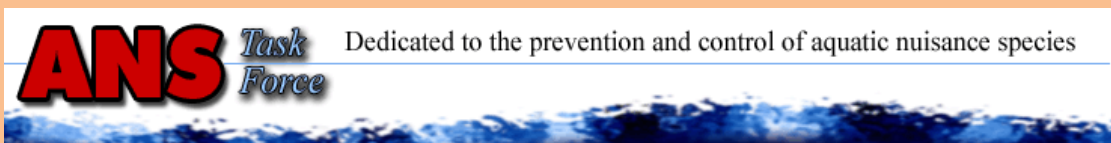
Invasive purple loosestrife at Montezuma National Wildlife Refuge. John and Karen Hollingsworth, USFWS.

The use of “target” and “non-target” in HACCP can be confusing to those involved in control of weeds and other invasive species. For pesticide applications, invasive species are the “targets,” and “non-targets” are the beneficial species to be avoided. Confusion over these overlapping terms can be reduced if you remember that HACCP focuses on preventing invasions before they happen. From a prevention standpoint, we only want the targets of an activity to be moved.

Invasive Species Legislation

The invasion of zebra mussels in the mid-1980s caused a surge of invasive species awareness and prompted federal legislation in the form of the Non-indigenous Aquatic Nuisance Protection and Control Act of 1990. This act was reauthorized and amended to the National Invasive Species Act in 1996. Under these federal programs, specific regulations and national management plans are dedicated to the control and management of species such as the Chinese mitten crab, New Zealand mudsnail, killer sea weed *Caulerpa*, silver carp, and purple loosestrife. Many other species are not covered by a national management and control plan but are still a concern.

HACCP Spotlight: NISA



Congress passed the **Non-indigenous Aquatic Nuisance Protection and Control Act of 1990** in response to the invasion of the zebra mussel and other species that damaged the Great Lakes. That law brought much-needed attention to the global movement of aquatic species. It also established the federal interagency Aquatic Nuisance Species Task Force, which became a key resource for regional and state efforts. The 1990 law’s strictest and most detailed provisions required that ships headed for the Great Lakes exchange their ballast water at sea. The law was reauthorized, renamed the **National Invasive Species Act, or NISA**, and expanded slightly in 1996. Then all ships arriving from outside the 200-mile U.S. Exclusive Economic Zone were encouraged to exchange their ballast water, but required to report whether they had. NISA also authorized important research and linked its results to decisions about whether further ballast water regulation was needed.

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In February 1999, Presidential Executive Order 13112 created the National Invasive Species Council and the Invasive Species Advisory Committee in response to growing concern over invasive species. This Executive Order states that “each federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law...not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless, pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions.” This broad directive has implications for non-federal agencies as well, particularly those working in partnership with federal agencies. But, it also raises risk-management questions. What is “practicable”? What are “feasible and prudent measures to minimize risk of harm”? HACCP can help provide the answers.

Understanding pathways and developing plans to remove non-target species and prevent biological contamination is necessary to prevent invasive species impacts. When it comes to natural resource management activities, these introductions should not be considered simply “accidental.” It is our responsibility as resource professionals to strive to do no harm. Understanding invasive species pathways and developing plans to remove hitchhiking species are necessary to prevent unintended spread.

***Remember, if you are not part of the solution,
then you are part of the problem.***

Chapter 2

What is HACCP?

Learning Objectives:

At the end of Chapter 2, participants will be able to:

- explain why "planning is essential"
- describe the five steps of HACCP Planning.
- explain the benefits of a strong HACCP Planning team.

What is HACCP?

Hazard Analysis and Critical Control Point (HACCP) Planning is about risk management. It features five integrated steps that can reduce the risk of spreading invasive species and other non-targets via human-based pathways. HACCP examines activities to determine if and when particular invasive species might be unintentionally moved. Where this potential exists, the tool helps to identify the most effective opportunities during an activity to reduce that risk and the specific **control measures** that are needed. Safeguards are included through the use of **prescribed ranges, limits, or criteria** (previously called a control limit) and **corrective actions** that ensure that control measures are operating as intended. Control measures, prescribed ranges, limits or criteria and corrective actions will be discussed in more detail in later chapters.

Key Definitions:

Control Measure – an action that can be used to control a potential hazard (sometimes referred to as a preventive measure). Control measures are the first, and sometimes only, line of defense against the spread of non-targets. If control measures fail, corrective actions should be implemented.

Prescribed Range, Limit, or Criterion (PRLC) - (previously called a "control limit") – a specific measureable attribute that can be used to determine if control measures are effectively minimizing the risk (e.g., a minimum dose of a disinfectant, a minimum exposure time, or an acceptable range of temperatures).

Corrective Action - a procedure that must be followed if a control measure fails at a critical control point. A corrective action is backup procedure used as a second line of defense that may be necessary to prevent the spread of a non-target if the first-line defense (a control measure) fails to control a non-target.

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The Origins of HACCP

HACCP has been around for decades and has its roots in the food industry. In fact, the Pillsbury Company pioneered the HACCP concept in the early 1960s in partnership with NASA as a way to combat food contaminants in the food supply for the U.S. space program. Since then, HACCP has been recognized and used around the world as a proactive method to ensure product purity. HACCP planning is widely used and accepted by industry for good reason: It works!

The National Sea Grant Program first adapted HACCP to reduce the risk of spreading aquatic invasive species. The U.S. Fish & Wildlife Service has since widely adopted this method, and has developed many HACCP plans for fish hatcheries, watershed surveys, fish passage projects, and other natural resource management activities. Use of HACCP to prevent the spread of invasive species has even become an American Society for Testing and Materials (ASTM) International standard under the Standard Guide for Conducting Hazard Analysis-Critical Control Point Evaluations (ASTM E2590-09).

Planning Is Essential

Like many plans, a large part of the value of developing a HACCP plan is the planning process itself. While examining their planned actions in detail, planners will reveal new questions and insights that can identify unrecognized prevention opportunities. In the short run, this may not make work easier, but in the long run it can eliminate serious problems that could emerge from unintended invasions, and negate any benefits from the original work. Therefore, through proper HACCP planning, natural resources will be better protected.

In order to be successful, HACCP planning requires commitment from agency heads, managers, and field staff. Involving this range of participants in HACCP plan development not only ensures a comprehensive analysis of a specific activity and its risks but promotes the “buy-in” necessary to assure effective implementation.

Planning is nothing new for biologists and managers, but applying HACCP planning to natural resource work may be a relatively new concept for some of us. Without appropriate planning, the management work that takes biologists, technicians, and their equipment to many different habitats could be pathways for invasive species spread. HACCP planning is a tool that manages the risk of moving non-targets in natural resource management activities.

HACCP identifies high-risk activities and focuses attention on those actions needed to reduce the movement of non-targets. Plans documenting risks and methods used to remove non-target species give managers the opportunity to weigh such risks for species spread against benefits from natural resource actions. For some pathways, the risks outweigh resource benefits until better procedures to remove non-target species

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are identified. HACCP planning provides a systematic method to make consistent decisions based on identified risks. HACCP plans also create a reference source to document best management practices and standard operating procedures that can be shared with other offices, agencies, and the private sector to reduce the risk of species spread through pathways with similar characteristics.

First-time HACCP planners tend to pick only well-known invasive species as non-targets to remove from pathways. While these species deserve increased attention, biologists recognize that many local species could become invasive if introduced outside their native range. HACCP planning for natural resource pathways is intended to remove all non-targets, following the **precautionary principle**.

HACCP Spotlight: The Precautionary Principle



Invasive brown tree snake (Boiga irregularis). Photo credit: Gordon H. Rodda, USGS.

The precautionary principle states that if an action could plausibly cause harm, but there is not yet a scientific consensus that the action is actually harmful, the burden of proof that such an action is not harmful falls on those taking the action. The precautionary principle implies a social responsibility to protect the environment from exposure to harm when careful consideration has found a plausible risk. This protection can be relaxed only if scientific findings emerge that provide sound, convincing evidence that no harm will result.

Using the precautionary principle, (HACCP) focuses on potential or known invasive species, but could include diseases or species not yet known to be invasive. History demonstrates that many invasive species do not reveal their invasiveness until long after an introduction occurs. Caution should be practiced in the context of uncertainty. The examples used in this manual show how HACCP planning can help prevent similar types of spread for other species.

"Always have a plan and believe in it. Nothing happens by accident."
(Chuck Knox, Football Coach)

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Five Steps to HACCP Planning

There are five steps to HACCP planning:

1. **Describing the activity:** The activity description includes specific information such as the who, what, when, where, how, and why of the project. The description offers a historical, working reference to facilitate plan review and communication with the facility staff and other resource management agency personnel.
2. **Charting the flow of tasks for the activity:** This step provides an important visual tool that the HACCP team can use to complete the remaining steps of the plan. Here, a clear and concise, yet complete description of the tasks necessary to complete the overall activity is diagramed in a linear fashion.
3. **Identifying potential non-targets:** Any species that has a reasonable potential to be moved or introduced to new habitats should be identified in order to implement appropriate control measures to prevent an unintended invasion. These may include vertebrates, invertebrates, plants, or other organisms (e.g., diseases, pathogens, and parasites).
4. **Analyzing non-targets:** It is crucial to identify significant non-targets with respect to each required task within a larger activity so that effective measures to control them may be employed. During the analysis, the significance of each potential non-target is assessed by considering risk.
5. **Completing the action plan:** The action plan addresses specific methods to control risks of non-target species. It lists specific information about controls, monitoring procedures, methods for evaluation, and corrective actions.

Each of the above steps corresponds to a specific form in the HACCP process, and each step builds on prior steps. Blank forms are included in Appendix A (page 70).

Starting Out in the Right Direction

A successful HACCP program depends on the firm foundation of management commitment, HACCP training, and assembly of an effective HACCP team. Attempting to implement a HACCP program without these components will likely lead to HACCP planning that lacks a thorough assessment of the potential non-targets and commitment to apply HACCP planning consistently in the field.

Management Commitment - For HACCP planning to work, it is considerably important to have the support of everyone in the agency, from the Director to the biological technicians in the field. Without support, the plan will not become an agency priority or be effectively implemented.

HACCP Training - Education and training are important elements in developing and implementing a HACCP program. Employees who will be responsible for the HACCP program must be adequately trained in its fundamentals. HACCP can be a fairly

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straightforward process, but incomplete understanding of key concepts can lead to incomplete plans.

HACCP Team Assembly - Assembling a team is an essential step in building a HACCP program. Although one person might be able to analyze risks and develop a plan successfully, a team approach maximizes the breadth of expertise needed to comprehensively evaluate an activity, identify all potential non-targets, and brainstorm the full spectrum of available prevention options.

HACCP Spotlight: SOP's vs. HACCP



Was an SOP in place to decontaminate this boat before launch? Photo Credit: Steve Hillebrand, USFWS.

"But I already have this covered in my standard operating procedures..."

A list of prevention measures in your standard operating procedures is a great way to reduce the spread of invasive species, but it is not the same thing as a HACCP plan. HACCP is a process that requires a team to think comprehensively about what invasive species might be introduced through all parts of an activity, analyzes the significance of those risks, identifies the most effective opportunity to reduce risks, monitors whether the risk reduction measures are working, and if they're not, provides a back-up

plan. HACCP will help you generate a list of prevention measures (e.g., decontamination procedures), but simply using a list without going through the HACCP process can be a shot in the dark. From this standpoint, HACCP isn't something more comprehensive than a list of best management practices; it **is** a best management practice.

"Man often oppose a thing merely because they have no agency in planning it, or because it may have been planned by whom they dislike."

(Alexander Hamilton, American President)

Chapter 3

Case Studies: When HACCP Could Have Helped

Learning objectives:

At the end of Chapter 3, participants will be able to:

- identify target species and potential non-target species in example case studies.
- explain how HACCP could have helped reduce the risk of invasive species introductions in two case studies.

Case study: Inks Dam National Fish Hatchery (NFH)

Inks Dam NFH is a warm-water facility operated by the U.S. Fish & Wildlife Service (Service) in central Texas. It is used for raising sport-fish for stocking throughout the Service's Southwest Region. One of the programs at Inks Dam NFH is the production of largemouth bass, which are stocked in tribal waters of Arizona. The facility pumps raw water from nearby Lake Buchanan to fill their ponds. Lake Buchanan contains a suite of warm-water fish species native to central Texas. Annually largemouth bass brood-stock are spawned in ponds. The fry from the spawning adults are separated and reared in ponds, and eventually loaded into the stocking truck and transported to Arizona or New Mexico.

Prior to the implementation of HACCP at Inks Dam NFH, shipments of largemouth bass sometimes contained non-target organisms including fish, invertebrates, and plants that were then inadvertently spread to receiving waters. This caused fish-management challenges and possibly led to the establishment of invasive species in Arizona and New Mexico. In fact, a shipment of largemouth bass from Inks Dam NFH was determined to be the source of the introduction of gizzard shad across the Continental Divide to Morgan Lake, New Mexico in 1998. Loads of bass transported to Morgan Lake from the hatchery were found to have as many as nine different species besides largemouth bass (fish species included Guadalupe bass, logperch, gizzard shad, white bass, bluegill, and dollar sunfish). These shipments were refused but gizzard shad were already firmly established in Morgan Lake. Logistics prevent shad from being chemically removed from Morgan Lake, which is an important largemouth bass sport fishery on the Navajo Reservation. The 1200 acre lake provides water to the APS power plant near Shiprock. Lowering the lake would require a power-plant shut-down for an extended period. Poisoning the water without lowering the lake would block intakes with dead fish and effectively shut down the power plant. In 2000, gizzard shad were found in Lake Powell, and have since spread significantly within the Colorado River system. The source of the Lake Powell introduction is still officially undetermined.

Chapter 3: Case Studies: When HACCP Could Have Helped *HACCP Planning to Prevent the Spread of Invasive Species*

At Inks Dam NFH, the pathways identified as potential sources for introduction of non-target species included the water in which the largemouth bass were raised. Water from Lake Buchanan is directly supplied to the hatchery with the possibility of moving numerous species, including Guadalupe bass, several sunfishes, threadfin and gizzard shad, logperch, and several others. Other non-targets that could be present in the ponds include bullfrogs, invertebrates, aquatic plants, and fish pathogens. Another potential pathway for non-targets was the water used to fill the stocking truck, which originally came directly from the lake.

The HACCP plan for stocking of largemouth bass from Inks Dam NFH identified an opportunity to fill trucks with well water instead of raw lake water (a practice that



Inks Dam National Fish Hatchery is located 60 miles northwest of Austin, Texas. Photo Credit - Bob Pitman & Robert Lindsey/USFWS

continues today). Additionally, hatchery personnel now use flow-through holding tanks to remove non-target plants and invertebrates. Large-mesh dip nets are used to collect the largemouth bass while allowing the smaller non-target fish to pass through. Finally, hatchery personnel inspect all holding tanks to ensure that non-targets are removed prior to loading the fish in the stocking truck.

As a check on the effectiveness of these control measures to remove non-target species from shipments of largemouth bass to Arizona, Service biologists on the receiving end inspect

every shipment of fish prior to the bass being stocked. Since the HACCP plans have been implemented at Inks Dam NFH, unintended shipment of non-target organisms has effectively been minimized.

Case study: Ridgefield National Wildlife Refuge (NWR)

Ridgefield NWR, located in southwest Washington State, has a total of 5,218 acres of marshes, grasslands and woodlands. Management objectives include preserving the natural Columbia River floodplain and providing habitat for waterfowl and other wetland wildlife. In particular, the refuge was established to secure vital winter habitat for dusky Canada geese and other wintering waterfowl. As part of wetland creation/restoration projects undertaken at Ridgefield NWR, rice screenings from the Sacramento Valley of California were spread and harrowed within borrow areas for eight wetlands that were scraped to mineral soil during September 1999. This activity was performed in order to establish a seed source for moist-soil vegetation in areas where the seed bank was

Chapter 3: Case Studies: When HACCP Could Have Helped *HACCP Planning to Prevent the Spread of Invasive Species*

removed as a result of the scraping. Rice screenings are composed of seed and other non-rice vegetation remaining after cleaning and processing of harvested rice. These screenings are primarily composed of moist-soil plants seeds (e.g., wild millet, smart weeds) that are considered high-quality food for aquatic, migratory birds. The seed mixture applied to the refuge contained predominately wild millet, smartweeds, and an unidentified bulrush.

During the spring/summer 2000, the unknown bulrush germinated in refuge wetlands and was subsequently identified as Eurasian ricefield bulrush, a known invasive. In the Sacramento Valley, this species has become ubiquitous in wetlands and rice fields and is considered a nuisance weed.

Beyond the original eight wetlands contaminated in 1999, the invasive bulrush has since infested six additional wetlands at the refuge. Because this bulrush had not been previously recorded in the Pacific Northwest, the infestation at the refuge represented an introduction of a new invasive species. Accordingly, Ridgefield NWR has established an aggressive eradication/control program. The following are potential vectors by which this bulrush seed spread to new areas: water flow in drainage and delivery ditches, farm equipment and vehicles, and wildlife and humans (e.g. refuge visitors, hunters and refuge staff). Although the actual mechanism by which this bulrush has infested additional wetlands on the refuge is unknown, the likely vector was water flow between units. Because drainage water is annually pumped from the refuge into the Columbia River, there are further risks of the bulrush escaping into additional sites within the Columbia River System.



Ridgefield National Wildlife Refuge is located just north of Vancouver, Washington. Photo Credit – Friends of the Ridgefield National Wildlife Refuge

Although it is not possible to determine with certainty whether a HACCP plan would have prevented the introduction of this invasive plant to Ridgefield NWR, HACCP would have facilitated analysis of threats from the source area and helped identify prevention measures such as seed purity protocols and quarantine procedures.

"The significant problems we face cannot be solved at the same level of thinking we were at when we created them."

(Albert Einstein, Nobel Prize Winner, Physics)

Chapter 4

HACCP Planning

Step 1 – Activity Description

Learning Objectives:

At the end of Step 1, participants will be able to:

- identify the essential components of a well-written Activity Description.
- write an Activity Description encompassing all six description components.

Once a HACCP team is established, the members first describe the activity, the method of accomplishing the activity, and the intended purpose and need for the activity.

Examples of activities include, but are not limited to the following:

- Forest thinning operations
- Raising and/or stocking of fish and other organisms
- Wildland fire fighting
- Field surveys (aquatic and terrestrial)
- Habitat restoration projects
- Research field work
- Road construction and maintenance
- Trail building and maintenance
- Introducing an organism for biological control
- Landscaping
- Invasive plant removal projects

The HACCP Plan title and management objective should be clearly stated at the top of the Step 1 form. The management objective should state the overall goal of the activity or project to be performed. A contact person also should be identified. This person will be the point of contact for any questions regarding the HACCP plan; in most situations the contact person will be the HACCP team lead, project coordinator, or site manager.

The activity description should provide historical references and background information to help facilitate communication between staff members conducting the activity as well as other resource management agency personnel that may be involved. The activity

Chapter 4: HACCP Planning: Step 1 – Activity Description

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description should be a narrative description that includes the “who, what, when, where, why, and how” of a particular project:

- **Who:** The project manager, site manager, or field staff that manage and conduct the activity.
- **What:** A statement about what is done during the activity.
- **When:** The timing and frequency of the activity (i.e., is it a one-time occurrence or does it occur repeatedly such as maintenance, annual surveys, or seasonal fish distribution?).
- **Where:** The location(s) where the activity takes place.
- **Why:** A statement about the need and the objective of the activity.
- **How:** A general statement about the methods used to complete the activity

The Activity Description should be complete, accurate, and thorough, but succinct. The objective is to allow someone unfamiliar with the activity to be able to understand the context and details of the HACCP plan.

The form on the following page provides a consistent template for Step 1.



Fieldwork may involve intentionally moving a particular species. But, what else are you dragging along? Photo Credit: Peter Pattavina, USFWS.

A Hypothetical Example

Chapter 4 will take you through the five steps of HACCP planning. At the end of each Step, this manual will use a hypothetical example to demonstrate the application of HACCP concepts. Our example is based on a specific activity, riparian habitat surveys, conducted by the Cutthroat Trout National Fish Hatchery. Staff members of this facility measure riparian vegetation densities within the Thompson River Basin once a month throughout the year. The purpose of the surveys is to gather data and information on riparian habitat to guide cutthroat trout recovery actions within the Thompson River Basin. Specialized survey gear is stored, while not in use, in a warehouse on hatchery property. Surveys are begun by first retrieving necessary gear from the warehouse at the beginning of the day. Once loaded into a pickup truck, staff members travel with the gear to the sampling site chosen for the day. After the gear is unloaded, the staff conducts the sampling activity using the appropriate gear. At the end of the day, staff members return the gear to the truck, load it, and then return to warehouse. The gear is then unloaded and put away until needed for the next survey. Within the Thompson Basin, several potential invasive species, parasites or diseases have been determined to be of significant concern. These include bullfrogs (*Rana catesbeiana*), New Zealand mud snails (*Potamopyrgus antipodarum*), Eurasian milfoil (*Myriophyllum spicatum*), purple loosestrife (*Lythrum salicaria*), Chytrid fungus, and whirling disease (*Myxobolus cerebralis*).

HACCP Step 1 – Activity Description

Management Objective & Contact Information	
HACCP Plan Title	
Management Objective:	Contact Person:
	Phone:
	Email:

Activity Description i.e. Who; What; Where; When; How; Why	

Chapter 4: HACCP Planning: Step 1 – Activity Description

HACCP Planning to Prevent the Spread of Invasive Species

Here is an example Activity Description for the hypothetical example introduced in Chapter 4: Step 1 (page 16).

HACCP Step 1 – Activity Description

Management Objective & Contact Information	
Title: Hypothetical HACCP Plan	
Management Objective: Habitat survey for the recovery of cutthroat trout (CT)	Contact Person: Jonathan Thompson
	Phone: (800) LUV-FISH
	Email: jonathan_thompson@fws.gov

Activity Description i.e. Who; What; Where; When; How; Why
Who: Cutthroat Trout National Fish Hatchery personnel What: Measurement of Riparian Vegetation Density Where: Thompson River Basin When: Year-round, once a month How: Retrieve the appropriate gear from a warehouse at the beginning of the day. Travel to the sampling site and conduct the sampling activity. Return to the warehouse. Gear is unloaded and stored. Why: To gather data and information on riparian habitat to guide cutthroat trout recover actions

Step 2 – Activity Flow Chart

Learning Objectives:

At the end of Step 2, participants will be able to:

- discuss the relationship between the Activity Description and the Activity Flow Chart.
- identify all of the tasks required to complete the activity described in Step 1.
- complete an Activity Flow Chart.

An Activity Flow Chart is a method for outlining the sequence of tasks that occur when completing an activity covered by the HACCP plan. It is important to include all the tasks within the activity. The flow chart should contain a task number, title and description. This information is taken from the Activity Description (Chapter 4, Step 1). If a task is missed, a significant non-target may not be addressed.

All tasks covered by a HACCP plan should be included in an Activity Flow Chart. If your activity includes any tasks that occur in parallel (simultaneously), then the activity is too general for a single HACCP plan. This is one of the most common mistakes made when people first start creating HACCP plans. In this case, break the activity into two or more sub-activities and create HACCP plans for each sub-activity. Each sub-activity should have its own Activity Flow Chart that contains only sequential tasks.

When an activity involves one or more tasks that are only included to prevent the spread of invasive species, the HACCP plan will be stronger if those tasks are not included as “tasks” but, instead, are included as control measures for a related task. For example, consider a forest survey team that proactively decontaminates its vehicles upon entry and exit to a new site. The team might prepare a HACCP plan for this activity that includes the decontamination process as one of the tasks, since it is part of their normal operations. However, the plan could instead identify the tasks more simply as site entry and exit, and then identify the decontamination process as an associated control measure. These two approaches may not seem much different, but only the latter allows the HACCP plan to provide valuable documentation, monitoring and evaluation of the decontamination process, and prescribed corrective actions should the decontamination process (control measure) fail. You will learn more about control measures and corrective actions in Steps 4 and 5.

Chapter 4: HACCP Planning: Step 2 – Activity Flow Chart

HACCP Planning to Prevent the Spread of Invasive Species

HACCP Spotlight: Lumpers vs. Splitters



Is this one task or multiple tasks? Photo Credit: USGS.

A Note on “Lumpers vs. Splitters”

The number of tasks required to complete the activity will depend on the activity’s complexity and whether your HACCP team consists of “lumpers” or “splitters.” If you have a team of “lumpers” (i.e. they define very broad tasks), you will have few tasks and it might be difficult to distinguish specific prevention opportunities. On the other hand, if your team identifies more than ten tasks, your team is probably splitting too much. Remember, a HACCP plan will not be effective if the tasks defined for your activity are too narrowly or too broadly defined. Be specific yet concise.

The HACCP team should evaluate the entire activity or operation and make any changes required in the flow chart. The evaluation allows each team member to gain an overall picture of how the activity is conducted. The Activity Flow Chart is an important tool that the HACCP team will use to complete the remaining steps of the plan. In addition, an optional diagram of the activity based on the flow chart’s tasks is a useful aide in visualizing the activity and completing the risk analysis in Step 4.

An Activity Flow Chart template is provided on the next page, followed by an Activity Flow Chart and an example activity diagram for the hypothetical example introduced in Chapter 4: Step 1 (page 16).

"A common mistake people make when trying to design something foolproof is to underestimate the ingenuity of complete fools."

(Douglas Adams, Author)

Chapter 4: HACCP Planning: Step 2 – Activity Flow Chart
HACCP Planning to Prevent the Spread of Invasive Species

HACCP Step 2 – Activity Flow Chart
Outline Sequential Tasks of Activity

Task 1	Title:
	Description:



Task 2	Title:
	Description:



Task 3	Title:
	Description:



Task 4	Title:
	Description:



Task 5	Title:
	Description:

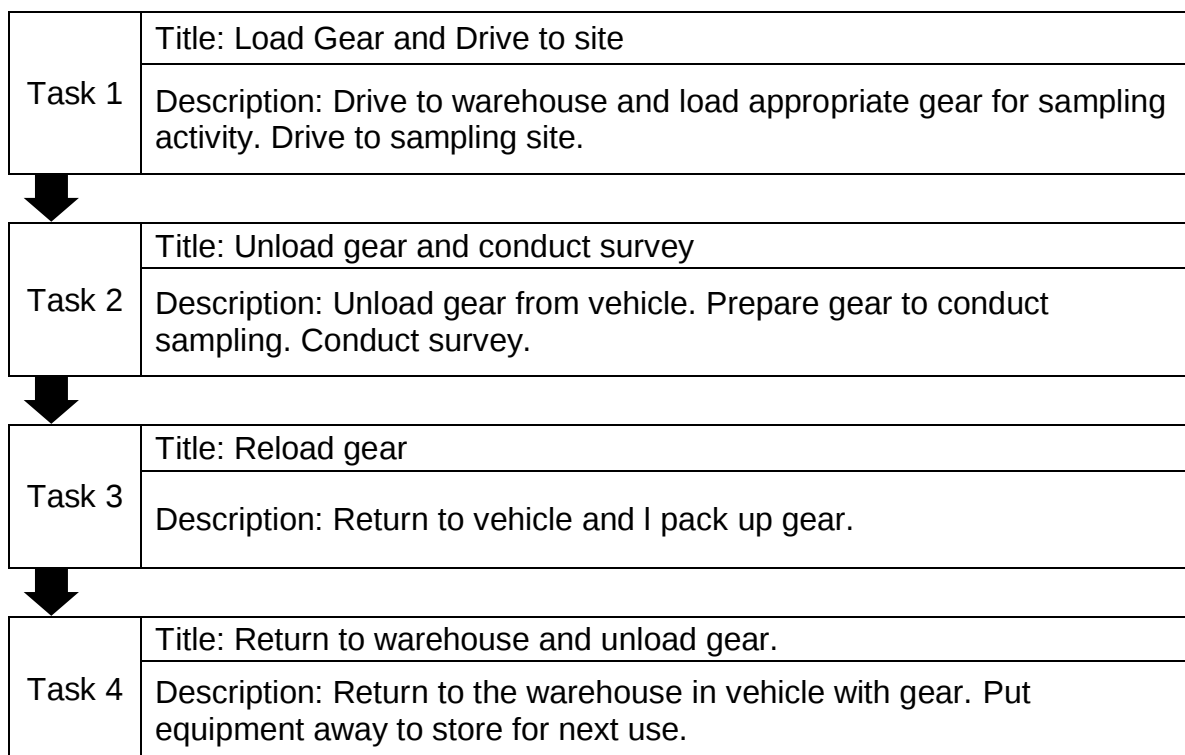
Chapter 4: HACCP Planning: Step 2 – Activity Flow Chart

HACCP Planning to Prevent the Spread of Invasive Species

Here is an example Activity Flow Chart that shows how the HACCP team completed Step 2 for the hypothetical example introduced in Chapter 4: Step 1 (page 16).

HACCP Step 2 – Activity Flow Chart

Outline Sequential Tasks of Activity

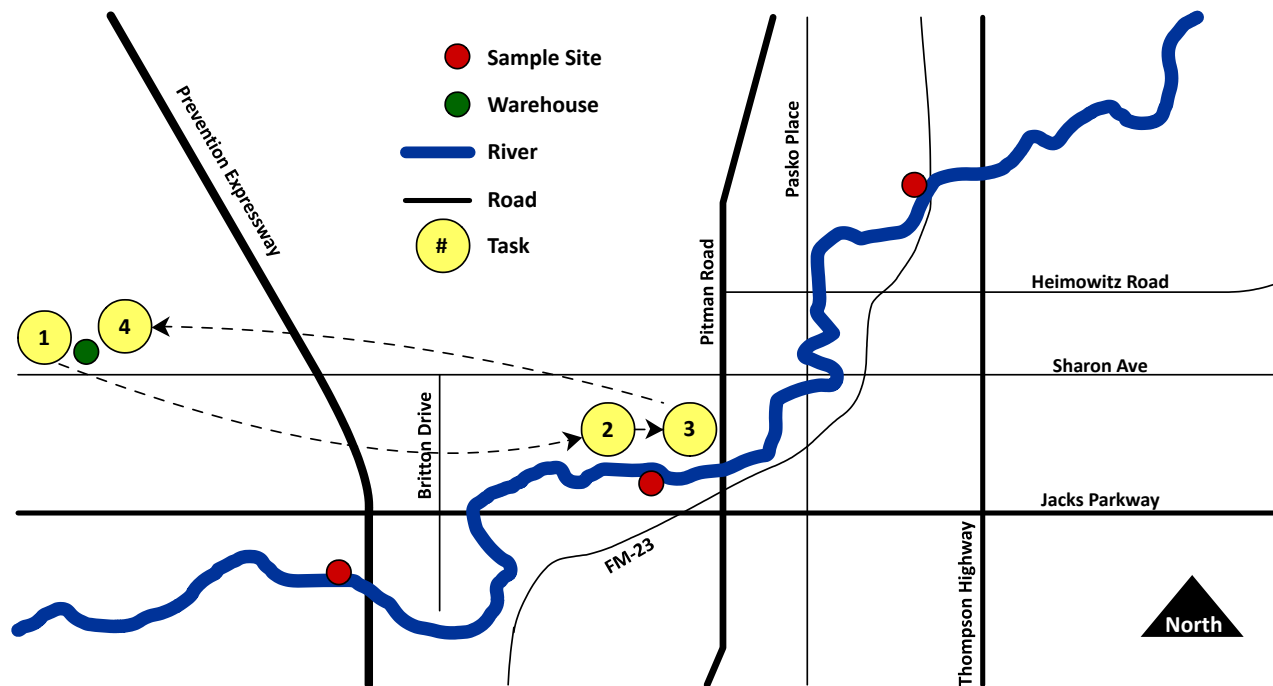


Chapter 4: HACCP Planning: Step 2 – Activity Flow Chart

HACCP Planning to Prevent the Spread of Invasive Species

An Activity Flow Diagram like the one below is optional. Sometimes it is helpful to sketch the linear sequence of tasks when the tasks for an activity are conducted in more than one location. If this helps your HACCP team produce an Activity Flow Chart, then please consider using a diagram in addition to the Activity Flow Chart.

Example Activity Diagram



"Proper preparation prevents poor performance"
(Charlie Batch, Two-time Super Bowl Winning Quarterback)

Step 3 – Potential Non-Targets

Learning Objectives:

At the end of Step 3, participants will be able to:

- discuss the difference between a target and a non-target.
- identify the different non-target categories (Vertebrates, Invertebrates, Plants, and Other Organisms).
- identify non-targets that potentially could be moved during your activities.
- complete a form for HACCP Step 3.

In Step 3 of the HACCP planning process, the team needs to identify the potential non-targets that may be moved through the tasks identified in Step 2.

Remember that targets can include yourself, your gear, and/or a species that you intend to move. Non-targets are anything that you do not want to be moved from one area to another. Non-target organisms can be categorized into four general categories: vertebrates, invertebrates, plants, and other organisms (e.g., fungi or microbial pathogens). Species considered non-targets vary from state to state, agency to agency, and biologist to biologist. Your HACCP team should consider **ALL** potential non-targets that have a reasonable probability of being moved through the tasks identified in Step 2. In later Steps of the HACCP planning process, you will have an opportunity to narrow down your list to the truly significant non-targets. For now, if your HACCP team is on the fence about whether something should or should not be listed as a potential non-target, it probably *should* be listed (remember the precautionary principle). You may need to do some research or consult with local experts to determine which species should be considered non-targets (see Chapter 7 for helpful resources, page 58). Discussions about non-targets can help focus planning objectives and establish the basic foundation for each HACCP plan. In the end, the HACCP planning process may reveal non-target species that were not previously recognized as present in the activity area.

Remember our discussion about “lumpers” and “splitters” in Step 2? This concept also applies to potential non-targets. If you need a refresher, check out the **HACCP Spotlight** on page 20.

The form on the following page provides a consistent template for Step 3.

Chapter 4: HACCP Planning: Step 3 – Potential Non-Targets
HACCP Planning to Prevent the Spread of Invasive Species

HACCP Step 3 – Identify Potential Non-Targets

Non-Targets That May Potentially Be Moved/Introduced
Vertebrates:
Invertebrates:
Plants:
Other Organisms (pathogens, parasites, etc.):

Chapter 4: HACCP Planning: Step 3 – Potential Non-Targets

HACCP Planning to Prevent the Spread of Invasive Species

Here is an example that shows how the HACCP team completed Step 3 for the hypothetical example introduced in Chapter 4: Step 1 (page 16).

HACCP Step 3 – Identify Potential Non-Targets

Non-Targets That May Potentially Be Moved/Introduced
Vertebrates: Amphibians Bullfrog (<i>Rana catesbeiana</i>)
Invertebrates: New Zealand Mudsnail (<i>Potamopyrgus antipodarum</i>)
Plants: Eurasian milfoil (<i>Myriophyllum spicatum</i>) Purple loosestrife (<i>Lythrum salicaria</i>)
Other Organisms (pathogens, parasites, etc.): Chytrid fungus Whirling disease (<i>Myxobolus cerebralis</i>)

Chapter 4: HACCP Planning: Step 3 – Potential Non-Targets

HACCP Planning to Prevent the Spread of Invasive Species



Sometimes non-target species are obvious and easily spotted. Sometimes they are not. What are you moving? Photo Credit - USGS

"To be prepared is half the victory."
(Miguel de Cervantes Saavedra, Author, Poet and Playwright)

Step 4 – Non-Target Analysis Worksheet (NTAW)

Learning Objectives:

At the end of Step 4, the participant will be able to:

- describe the relationship between Steps 1, 2, 3 and 4 of the HACCP Planning Process.
- evaluate the significance and severity of each non-target using risk assessment.
- define control measure, control point, and critical control point.
- given a significant non-target risk, determine if the control measure action is a critical control point or an optional control point.
- complete a Non-Target Analysis Worksheet using information from Steps 1, 2 and 3.

The Non-Target Analysis Worksheet (NTAW) is a pivotal step in the HACCP planning process because it determines if an activity poses a significant risk for moving invasive species or non-targets, and if so, what control measures can be applied to eliminate or reduce this risk to an acceptable level. As such, Step 4 is more complicated than the first three steps.

The form on the following page provides a consistent template for Step 4.

To complete Step 4, first list the title of each task described in Step 2 (Activity Flow Chart) in column 1 of the NTAW. Record potential non-targets identified in Step 3 (Potential Non-Targets) in column 2. The third column in the worksheet asks a qualitative question: "Are the potential non-targets significant?" The "yes" or "no" answer is subjective. Your HACCP team must determine the appropriate answer by conducting a risk assessment of the potential to move invasive species for each task.

"An ounce of prevention is worth a pound of cure."
(Benjamin Franklin, Founding Father of the United States)

Chapter 4: HACCP Planning: Step 4 – Non-Target Analysis Worksheet (NTAW)
HACCP Planning to Prevent the Spread of Invasive Species

HACCP Step 4 – Non-Target Analysis Worksheet

1	2	3	4	5	6	7
Tasks	Potential Non-targets	Risk Assessment	Justification	Control	CCP?	Justification
(From Step 2)	(From Step 3)	Are any non-targets significant? Yes or No	Justify your answer in Column 3	What control measures can be applied during this task to reduce the risk of non-targets?	Is this task a CCP? Yes or No	Justify your answer in Column 6

Task # Title:	Vertebrates					
	Invertebrates					
	Plants					
	Others					

Task # Title:	Vertebrates					
	Invertebrates					
	Plants					
	Others					

Analyzing the Risk of Non-Targets

Analyzing potential risk is fundamental in HACCP. Risk assessments assist in defining the risk parameters surrounding the activity described under the management objective in Step 1. Risk assessments can be extremely complicated, using significant quantitative data and mathematical models, or they can be simple and more qualitative based on the best information available and best professional judgment.

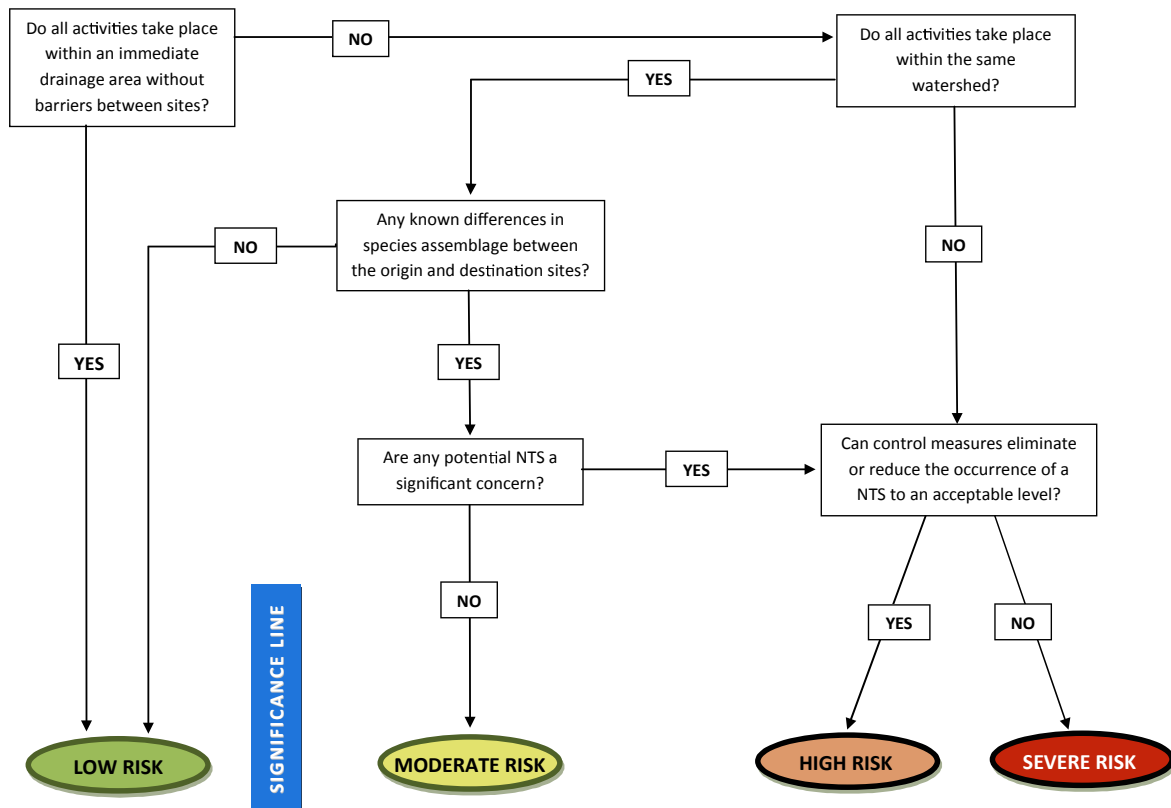
Risk assessments measure the likelihood of an event occurring and the severity of negative impacts from such an event. Because it is difficult to predict when an introduction of a non-indigenous species will cause ecological, economic, or human health damage, the precautionary principle suggests that it is reasonable for HACCP planning to assume that a significant risk of introduction will include a significant risk of unacceptable negative effects. We are making the assumption that the risk of unacceptable negative effects is equal for all species and all situations to simplify this process. With all impacts assumed to be significantly negative, this leaves only “likelihood” to be assessed. Here likelihood is defined as the probability of moving non-target species (determined in Step 3) during individual tasks (from Step 2). HACCP makes the general assumption that significant negative impacts will occur following the introduction of a non-indigenous species as a part of the risk assessment; however, the process may also include an assessment of impacts if necessary, but this is not covered in this manual.

Because HACCP plans are relatively simple risk-management plans, the associated risk assessment also can be abbreviated, erring, of course, on the side of caution. It is important to keep the “big picture” in mind: the purpose of a HACCP plan is to prevent the transport of non-targets. If there is **ANY** reasonable risk of invasion, we must employ effective prevention techniques or control measures (described in Step 4, Column 5). In some cases, a risk assessment can be as simple as an informed judgment call without using any tools other than common sense. In other cases, it may be necessary to employ some sort of analytical tools to help determine whether any potential non-targets are significant. **Remember that on the most basic level, the risk assessment is used to determine the likelihood of moving invasive species during particular tasks.**

On the next page is an example of a flow diagram used for risk assessment for Aquatic Management Activities (additional examples are available in Appendix C).

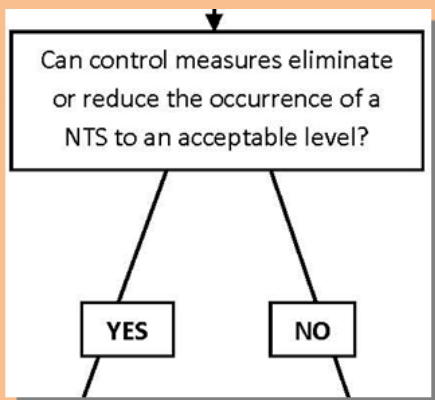
Chapter 4: HACCP Planning: Step 4 – Non-Target Analysis Worksheet (NTAW) HACCP Planning to Prevent the Spread of Invasive Species

Example of Risk Assessment for Aquatic Management Activities



* In the above risk assessment example, tasks identified as moderate, high, or severe risk should be considered to have a significant potential to move non-target species and control measures are warranted.

HACCP Spotlight Acceptable Risk



When is a risk acceptable?

The previous Risk Assessment example mentions "reducing the occurrence of a non-target (NTS) to an acceptable level." The question is "what constitutes an acceptable level?" There is no single answer to this question, but ultimately your team will need to make this determination when identifying critical control points later in Step 4. This is the risk management aspect of HACCP. Science can help you determine if your control measure will remove, for example, 90% versus 100% of a non-target, but your team must ultimately determine which of those goals is appropriate to your situation.

Chapter 4: HACCP Planning: Step 4 – Non-Target Analysis Worksheet (NTAW)

HACCP Planning to Prevent the Spread of Invasive Species

The example risk assessment on the previous page goes beyond an "informed judgment call" in order to provide a justification that explains the "yes" or "no" answer for why a task does or does not pose a significant risk (in Column 3). The justification, based on the risk assessment, will be summarized in Column 4. It is simply a statement of why there is or is not a potential for a moving a non-target for the individual task.

It is imperative to stress that any activity will have some element of risk even if all the best procedures are applied. HACCP minimizes risks; it rarely eliminates them. A risk-free environment is an ideal situation that just does not exist in the real world. Given practical, real-world conditions, the HACCP team should focus on risks that have a reasonable likelihood of occurring and must decide what is reasonable and what is not. Even if the team determines there is no reasonable risk, it is important to complete a HACCP plan to document how you came to this decision. In addition, if and when circumstances change, a HACCP plan would make re-evaluating any new risks associated with the activity much easier.

The example risk assessment separates tasks into progressive risk levels (low, moderate, high, severe) based on task attributes like drainage location, similar species assemblages and the presence of non-target species. Increases in risk severity are based on the presence of significant non-targets at the task location(s). This process begins to quantify the level of risk. By quantifying risk, a HACCP team can evaluate whether or not a task, or on a larger scale the activity, should proceed given the level of risk. A task is assigned the highest level of risk (Severe Risk) when potential non-targets cannot be effectively managed by any control measure. When the risk assessment determines there is a severe risk, the task or activity should not occur unless the benefits of this activity clearly outweigh the potential impacts of introducing non-targets.

This specific risk-assessment process is only one example. However, any risk assessment process can be used if your HACCP team has something more appropriate for your activity. Your HACCP team may prefer to use a different tool (even if it is only common sense). Any tool is acceptable if it can determine whether moving a non-target is possible. Nevertheless, it is important to document the risk assessment tool that was used (see "Supporting Documentation" in Step 5).

Once you have completed a risk assessment, any task that is identified as a significant risk ("yes" in column 3) needs control measures (described in column 5.)

Chapter 4: HACCP Planning: Step 4 – Non-Target Analysis Worksheet (NTAW) *HACCP Planning to Prevent the Spread of Invasive Species*

HACCP Spotlight: Risk



Wildland fire operations employ risk management tools. Photo Credit: USFWS.

Risk Assessment vs. Risk Management – What’s the Difference?

Risk assessment is part of the larger concept of risk management. The assessment phase is analytical and based on measurements or estimates of severity and probability. Risk management also includes more subjective elements including risk prioritization, risk tolerance, and associated decisions that weigh the benefits and costs of risk minimization options.

Developing Effective Control Measures

If the HACCP team determines that a risk is significant, then control measures (i.e., preventive measures) are required to reduce the non-target risk to an acceptable level. Control measures are actions that can be used to control and remove identified non-targets.

The next two pages (pages 34-35) show how the HACCP Team completed Step 4 for the hypothetical example introduced in Chapter 4: Step 1 (page 16). The HACCP team determined that potential non-targets were not significant (low risk) during the first two tasks, but they were significant during the third and fourth tasks.

Task #1 – “Load gear and drive to site” is low risk for moving non-target species, which is justified by the statement within Column 4: “Risk is low because all equipment was cleaned and disinfected following prior use.” See page 34.

Task #2 – “Unload gear and conduct sampling” is also low risk. “Risk is low because sampling occurs only at one location, plus all equipment was cleaned and disinfected before storage,” according to the justification in Column 4 on page 34.

Task #3 – “Reload gear” provides an example where a control measure is necessary. The HACCP team determined that all of the categories (vertebrates, invertebrates, plants, and other organisms) posed a significant risk since non-target species could be transferred. Note the “Yes” for each non-target category in column 3 of the NTAW on page 35.

Task #4 – “Return to warehouse and unload gear” is also a task requiring a control measure. All non-target species from each category were determined to pose a significant risk since non-target species can “survive on equipment overnight.” Note the “Yes” for each non-target category in column 3 of the NTAW on page 35.

Chapter 4: HACCP Planning: Step 4 – Non-Target Analysis Worksheet (NTAW)
HACCP Planning to Prevent the Spread of Invasive Species

HACCP Step 4 – Non-Target Analysis Worksheet

1 Tasks (From Step 2)	2 Potential Non-targets (From Step 3)	3 Risk Assessment Are any non- targets significant? Yes or No	4 Justification Justify your answer in Column 3	5 Control What control measures can be applied during this task to stop the spread of non-targets?	6 CCP? Is this task a CCP? Yes or No	7 Justification Justify your answer in Column 6
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Task #1 Title: Load gear and drive to site	Vertebrates Amphibians, including bullfrogs	No	Risk is low because all equipment was cleaned and disinfected following prior use	N/A	No	There are no significant non- targets during this task.
	Invertebrates NZMS	No		N/A	No	
	Plants Eurasian milfoil Purple loosestrife	No		N/A	No	
	Others Chytrid fungus Whirling disease	No		N/A	No	

Task #2 Title: Unload gear and conduct sampling	Vertebrates Amphibians, including bullfrogs	No	Risk is low because sampling occurs only at one location, plus all equipment was cleaned and disinfected before storage	N/A	No	There are no significant non- targets during this task.
	Invertebrates NZMS	No		N/A	No	
	Plants Eurasian milfoil Purple loosestrife	No		N/A	No	
	Others Chytrid fungus Whirling disease	No		N/A	No	

Chapter 4: HACCP Planning: Step 4 – Non-Target Analysis Worksheet (NTAW)
HACCP Planning to Prevent the Spread of Invasive Species

HACCP Step 4 – Non-Target Analysis Worksheet

1 Tasks (From Step 2)	2 Potential Non-targets (From Step 3)	3 Risk Assessment Are any non- targets significant? Yes or No	4 Justification Justify your answer in Column 3	5 Control What control measures can be applied during this task to stop the spread of non-targets?	6 CCP? Is this task a CCP? Yes or No	7 Justification Justify your answer in Column 6
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Task #3 Title: Reload gear	Vertebrates Amphibians, including bullfrogs	Yes	High risk that bullfrog eggs or adults may be in gear after sampling	Visually inspect all gear for non-targets and remove anything found by hand before proceeding to Task #4	No	Hand removal, cleaning, and disinfecting would be better accomplished in Task #4 at a decontamination station back at the warehouse.
	Invertebrates NZMS	Yes	High risk that invertebrates could be in gear after sampling		No	
	Plants Eurasian milfoil Purple loosestrife	Yes	High risk that plants or seeds could be attached to gear after sampling		No	
	Others Chytrid fungus Whirling disease	Yes	High risk that unwanted organisms could survive on gear		No	

Task #4 Title: Return to warehouse and unload gear	Vertebrates Amphibians, including bullfrogs	Yes	High risk that bullfrog eggs or adults may be in gear after sampling	Remove any vertebrates then clean and disinfect all equipment using approved disinfectant solution to kill eggs.	Yes	If the equipment is not decontaminated during this task, then it will not be clean for use next time it is needed. This task is the point of no return.
	Invertebrates NZMS	Yes	High risk that invertebrates could be in gear after sampling	Clean and disinfect all equipment using approved disinfectant solution.	Yes	
	Plants Eurasian milfoil Purple loosestrife	Yes	High risk that plants or seeds could be attached to gear after sampling	Clean and disinfect all equipment using approved disinfectant solution and rinse undercarriage of vehicles with high-pressure water spray.	Yes	
	Others Chytrid fungus Whirling disease	Yes	High risk that unwanted organisms could survive on gear	Clean and disinfect all equipment using approved disinfectant solution.	Yes	

Chapter 4: HACCP Planning: Step 4 – Non-Target Analysis Worksheet (NTAW)

HACCP Planning to Prevent the Spread of Invasive Species

Because the risk associated with some tasks is considered significant, control measures are needed to remove the threat of a non-target. The team determined that the risk could be reduced in Task #3 if all gear was thoroughly inspected and all non-targets were removed by hand before proceeding to Task #4. However, hand removal, cleaning, and disinfecting would be better accomplished in Task #4 once everything was back at the warehouse. The warehouse has a decontamination station, disinfectant solution, and high pressure sprayers that are not available in the field.

The table below provides a brief list of example control measures. * For a detailed explanation and additional examples see “Suggested References for Control Measures” in Chapter 7 (page 61).

Method	Example
Chemical decontamination	Soak or spray equipment for at least 1 minute with a 2% bleach solution. If invasive pathogens or diseases are suspected, a 10% solution should be used
Desiccation	Allow for 5 days of drying time before reuse.
Freezing	Expose equipment to 14 °F for 2 hours
Manual Removal	Brush, Vacuum, Adhesive Roller
Heat Treatment	Use of steam, hot air, or hot water to bring an object's surface temperature up to 140 °F for 30 seconds.
Water Washing	Pressure wash vehicles at minimum of 90 pounds per square inch (psi).
Dedicated Equipment	Wading gear only used in specific watershed
Managing Field Operations	Sampling a stream from upstream to downstream

As discussed in Step 2, when an activity involves one or more tasks that are specifically included to prevent the spread of invasive species, the HACCP plan will be stronger if those procedures instead are listed as "control measures" rather than "tasks." Both "control measures" and "tasks" are specific procedures required to complete an activity. However, control measures require the HACCP plan to provide valuable documentation, monitoring and evaluation of the decontamination process, and prescribed corrective actions should the control measures fail. Tasks do not have this requirement. "Tasks" should be limited to only procedures necessary to complete the management objective.

Chapter 4: HACCP Planning: Step 4 – Non-Target Analysis Worksheet (NTAW)

HACCP Planning to Prevent the Spread of Invasive Species

"Control measures" are additional procedures necessary to eliminate or reduce the likelihood of moving non-target species should a task present a significant risk. While tasks can stand alone, control measures always correspond to a specific task. That is, tasks are necessary to advance the management objective. Control measures, by themselves, usually do not advance the management objective, but are required to mitigate risks encountered while completing some specific task. An effective HACCP plan will reflect this distinction.

Developing effective control measures relies on assembling a HACCP team with the expertise to understand the overall conditions and potential non-target risks associated with the proposed activity. The risk assessment process will guide teams to define the possible significance and severity of risks associated with an activity. It is an important responsibility of the HACCP team to expand and enlist all available knowledge in Step 4 to further evaluate these risks and develop appropriate control measures that reduce non-target risks to an acceptable level.



Filtering "sock" on pond water supply line. Photo Credit: Bob Pitman & Robert Lindsey, USFWS

Keep in mind that there may be differences of opinion, even among experts, as to 1) the type of control measure that will be effective at reducing the non-target risk, or 2) whether control measures are warranted given the severity of the non-target risk. Although risk assessments set the initial level of risk, the HACCP team must weigh all opinions for each risk to determine an effective control measure. It is important to include brainstorming if there are differing views or if conditions surrounding the activity are not clear. In many cases, uniform protocols for managing particular invasive species do

not exist. This may be due to lack of research, inconsistent results from existing research studies, or methods that are highly variable based on the environment and materials involved. Having the right level of expertise on the HACCP planning team, and making use of available reference materials, will better inform decisions on appropriate control measures. The constant evolution of invasive species management is yet another reason to think of a HACCP plan as a "living document."

HACCP planning may become difficult if the team focuses narrowly on identifying too many specific non-targets. This dilutes your ability to focus efforts and control the truly significant risks. Accordingly, it is essential that only significant non-target species be controlled with the HACCP plan. The difficulty is deciding what is "significant." As a general guideline, a non-target must be controlled if 1) it is reasonably likely to occur beyond an acceptable level, **and** 2) if not properly controlled, the non-target is likely to result in harm to the resource.

Chapter 4: HACCP Planning: Step 4 – Non-Target Analysis Worksheet (NTAW)

HACCP Planning to Prevent the Spread of Invasive Species

If control measures cannot be applied to reduce risk, then the HACCP team should re-evaluate the management objective, the activity, and individual tasks to determine if the non-target risk can be reduced to an acceptable level. This can be accomplished by adjusting the activity to remove the issue or expand the team to include more expertise to determine if further control measures can be incorporated. After further assessment, if the activity or any task still cannot be adjusted to reduce risk to an acceptable level, then the team must determine if the activity is worth the risk, considering the potential impacts that could manifest should an unwanted introduction occur. In general, it is recommended that such an activity should be discontinued under the prescribed management objective until effective control measures can be implemented to a degree that reduces risk to an acceptable level. Notable exceptions might include emergency operations, activities performed for national security and/or situations where the ecological benefits clearly outweigh the risks associated with potential invasive species.

Determining Critical Control Points

After a control measure has been described, a decision must be made on whether or not the task and its associated control measure(s) should be considered a **critical control point (CCP)** for the overall activity (recorded as "yes" or "no" in column 6, with justification in column 7). If any potential non-targets have been identified in Step 3, then you must identify at least one task as a critical control point within your HACCP plan. Later, when you complete Step 5, you will specify the controlled conditions under which all activities identified as CCPs are completed.

Key Definitions:

Control Point - any step or task during which potential hazards can be controlled. Control points may be critical control points or optional control points. Only critical control points are essential for preventing risk, however, if resources allow, optional control points may also be employed to further minimize risk well below acceptable levels.

Critical Control Point (CCP) - the best point, step, or procedure at which significant hazards (non-targets) can be controlled, prevented, or reduced to acceptable levels in order to minimize the risk of spread.

Optional Control Point - a task during which control measures could be applied to prevent or reduce the risk of significant non-target hazards, but control at this point, although potentially helpful, is not essential for removing or reducing the significant non-target hazard (usually because control measures are more effective if applied during another task).

Chapter 4: HACCP Planning: Step 4 – Non-Target Analysis Worksheet (NTAW)

HACCP Planning to Prevent the Spread of Invasive Species

For every significant non-target identified during the task risk assessment, there must be an associated control measure to address the non-target risk. The point during a task when a control measure is implemented is known as a control point. In the hypothetical example (Chapter 4: Page 16), Task #4 "Return to warehouse and unload gear" is a control point. The associated control measure is "Remov(ing) any visible adult bullfrogs" and "clean(ing) and disinfect(ing) all equipment using a disinfectant solution." (page 35).

How can you determine if a control point is critical or not?

Control points are categorized as either optional or critical. Optional control points may not be the best point to remove a significant non-target risk, but still may be an important ancillary strategy for reducing non-targets within the activity. The control measures implemented at an optional control point help in reducing the risk of these non-target species impacting a later task. Establishing control measures for optional control points often makes sense when there is little cost or effort but much to gain in terms of reduced risk.

Critical Control Points (CCPs) are crucial in reducing the non-target risk to an acceptable level to complete a successful activity under the management objective. Points may be identified as CCPs where the risk of non-target hazards can be prevented **once-and-for-all**.

Designated CCPs should be limited only to those tasks where control of the significant non-target risks can be best achieved.

Differentiating between CCPs and optional control points varies from activity to activity and depends on the uniqueness of the activity. When designating CCPs, you must also consider any applicable statutes or rules. For example, if it is illegal to transport a particular non-target species over land in a given state, preventing contamination at a prior step becomes a CCP, even if from a biological standpoint, the CCP makes more sense at the receiving water.

During the non-target risk analysis in the previous section, you learned how to determine where non-targets enter an activity. Often, the best place to control a non-target is at the point of entry. But this is not always true. The CCP can be several tasks away from the point at which the significant non-target risk is introduced.

A series of questions can help you identify CCPs for an activity. The questions are shown in table form and in the form of a CCP Decision Tree (on pages 40-41). You should consider completing the Decision Tree for each type of non-target risk listed for each task containing control measures. For example, if you have two types of non-targets and four tasks within your activity, then you would need to run through the Decision Tree a total of eight times ($2 \times 4 = 8$) in order to cover each unique non-target/task combination. Properly used, the CCP Decision Tree can be a helpful tool in identifying CCPs, but it is not perfect. Use your best judgment.

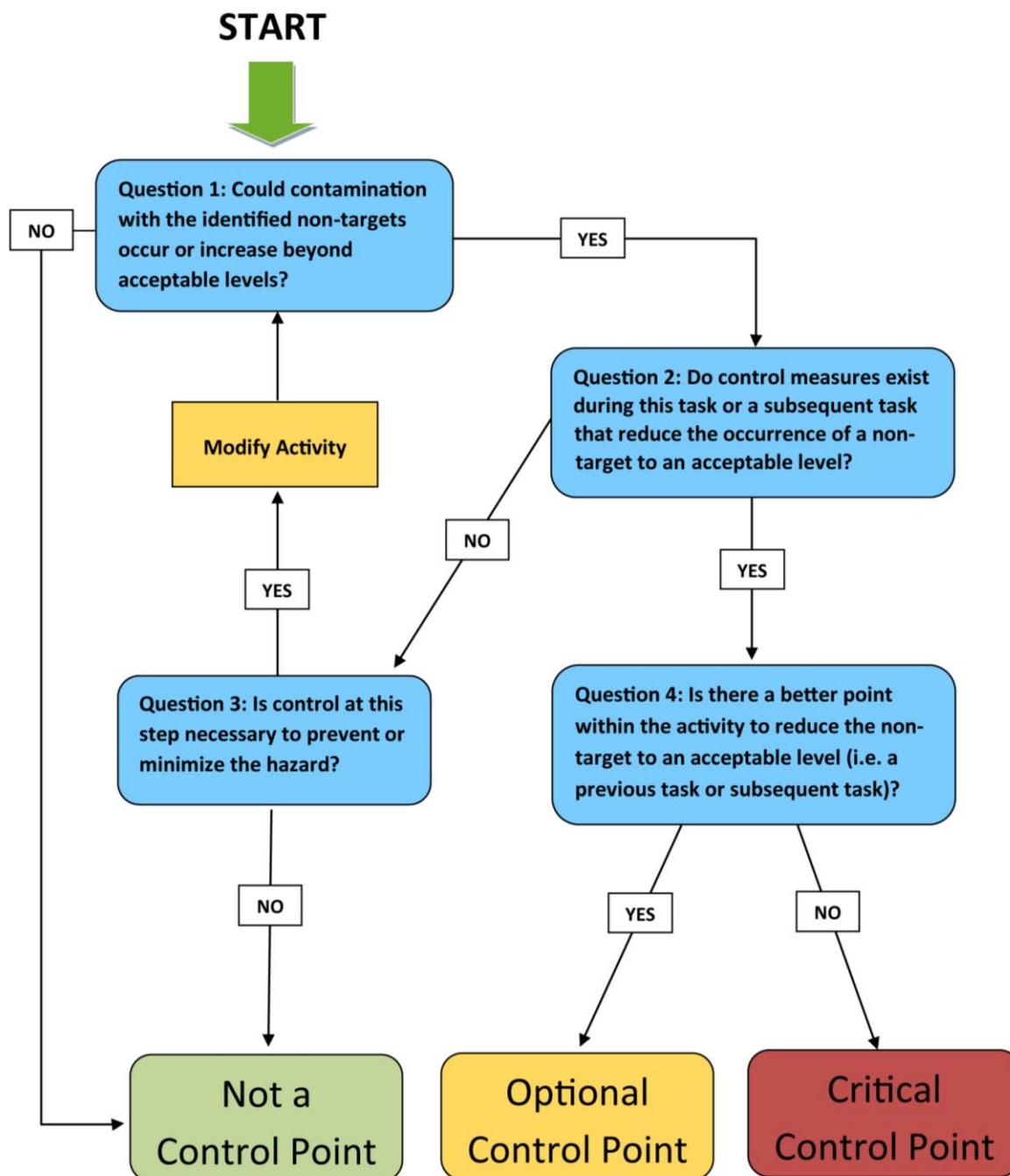
Chapter 4: HACCP Planning: Step 4 – Non-Target Analysis Worksheet (NTAW)

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Once each control point is evaluated, any task identified as having a critical control point needs to be carried on to Step 5, the Non-Target Risk Action Plan Form, to develop a plan for addressing the significant non-targets. In the event that no critical control points are identified for the entire activity, the HACCP team needs to reconsider their analysis and/or consider whether one or more tasks in the activity need to be modified.

Question 1	Could contamination with the identified non-targets occur or increase beyond acceptable levels? • If “yes,” ask question 2. • If “no,” then stop. This task is not a control point, which means that it is also not a CCP.
Question 2	Do control measures exist during this task or a subsequent task that reduce the occurrence of a non-target to an acceptable level? • If “yes,” skip question 3 and ask question 4. • If “no”, ask question 3.
Question 3	Is control at this step necessary to prevent or minimize the hazard? • If “yes,” you have identified a significant non-target hazard that will not be controlled. If you continue, it is likely that you will spread the non-target. The task must be redesigned to include a control measure. Sometimes there is no reasonable control measure available. In such cases, you need to consider whether to modify or halt the activity given the potential ecological, economic, and legal consequences. • If “no,” the task is not a CCP for the non-target hazard.
Question 4	Is there a better point within the activity to reduce the non-target to an acceptable level (i.e. a previous task or subsequent task)? • If “yes,” this task is not a CCP for the hazard, but it is an optional control point. Continue evaluating subsequent tasks to identify if another task is an actual CCP. • If “no,” this task is a CCP. Control measures must be applied at this point (task) in order to prevent the spread of the non-target.

Critical Control Point Decision Tree



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HACCP Spotlight: Too Many CCP's



Is this an optional or critical control point. Photo Credit: Paul Nelson, USGS.

A HACCP plan can lose focus if control points are unnecessarily identified as CCPs.

If control measures are not applied, then that task does not have a control point. This means the task is neither an optional control point nor a critical control point (CCP). Only points where control measures are implemented are control points. Moreover, only points at which significant risks ***must*** be controlled are considered critical control points. Those new to the HACCP planning process tend to designate many optional control points as CCPs. This may unnecessarily increase effort and reduce efficiency. Although it may make sense to have multiple CCPs to address multiple targets that have unique control needs, HACCP planning teams should look carefully at multiple CCPs that cover the same target species...this likely indicates unnecessary redundancy.

Step 5 – Non-Target Risk Action Plan (NTRAP)

Learning Objectives:

At the end of Step 5, the participants will be able to:

- explain how Steps 1, 2, 3 and 4 of the HACCP Planning process apply to the Non-Target Risk Action Plan (NTRAP).
- define the prescribed limit, range, or criterion for control measures.
- describe the process for monitoring and evaluating control measures and establish corrective actions if needed.
- describe the importance and use of supporting documentation.
- complete a Step 5 NTRAP form.

In order to complete the final form in your HACCP plan, you will need information completed in Step 4 (the Non-Target Analysis Worksheet). Find the tasks that you have identified as Critical Control Points (CCPs) in column 6 of the Non-Target Analysis Worksheet. An effective HACCP plan must have at least one CCP if there is any reasonable chance of reducing the risk posed by non-targets. You will complete a separate form for each CCP identified from your Non-Target Analysis Worksheet. Each CCP should be addressed by the Non-Target Risk Action Plan (NTRAP).

Management Objective

Review the Activity Description (HACCP Step 1) and copy the management objective into the first box of the NTRAP (HACCP Step 5). This information is included to remind those using the form of the overall reason for the management activity.

Critical Control Point Task

Review your Non-Target Analysis Worksheet (HACCP Step 4) and find the first CCP (see column 6). Copy the title of the task that corresponds to this CCP into the appropriate box on the NTRAP. Also, add the task number in the adjacent box.

Significant Non-Targets

The same NTRAP form can be used for multiple non-targets as long as they use the same control measure. If different control measures are required for different non-targets then an NTRAP form is necessary for each unique control measure/non-target combination. Review your Non-Target Analysis Worksheet (HACCP Step 4) and find the non-target risks that you identified as significant (See Step 4 column 3). Each significant non-target risk must be copied into the appropriate box on the NTRAP.

Chapter 4: HACCP Planning: Step 5 – Non-Target Risk Action Plan (NTRAP)

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Control Measures

For each significant non-target risk, a control measure should be identified and listed on the Non-Target Analysis Worksheet (Step 4). Copy the control measures that correspond to each significant risk into the appropriate box on the NTRAP.

This form provides a consistent template for Step 5.

HACCP Step 5 – Non-Target Risk Action Plan (NTRAP)

(Use this form for any "Yes" from Column 6 of HACCP Step 4 - Non-Target Analysis Worksheet) One page for each Critical Control Point			
Management Objective From Step 1			
Critical Control Point: Task #		Title:	
Significant Non-Target(s) (Step 4, Column 3)			
Control Measure(s) (Step 4, Column 5)			
Precribed ranges, limits, or criteria for control measure(s): (PRLC)			
Monitoring the Control Measure(s)		Who?	
		How?	
		Where?	
		How often?	
Corrective Action(s) if Control Measures Fail (or PRLC cannot be met)			
Supporting Documents (For example, Management Plan, Checklist, Decontamination Techniques, SOPs, Scientific Journal Articles, etc.)			
Development Team Members			
Date Developed:		Date(s) Reviewed:	

* all gray fields are required

Chapter 4: HACCP Planning: Step 5 – Non-Target Risk Action Plan (NTRAP)

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Pages 45-46 show how the HACCP team completed Step 5 for the hypothetical example introduced in Chapter 4: Step 1 (page 16).

HACCP Step 5 – Non-Target Risk Action Plan (NTRAP)

(Use this form for any "Yes" from Column 6 of HACCP Step 4 - Non-Target Analysis Worksheet) One page for each Critical Control Point			
Management Objective From Step 1		Habitat Survey for the Recovery of Cutthroat Trout (CT)	
Critical Control Point: Task #	4	Title:	Return to warehouse and unload gear
Significant Non-Target(s) (Step 4, Column 3)		Vertebrates, Invertebrates, Plants, and Other Organisms (All listed in step 3)	
Control Measure(s) (Step 4, Column 5)		Clean and disinfect all equipment using approved disinfectant solution	
Precibed ranges, limits, or criteria for control measure(s): (PRLC)		Use disinfectant solution that contains quaternary ammonium mixed at a concentration of at least 1% but no more than 3%. Contact time with gear must be at least 10 minutes.	
Monitoring the Control Measure(s)		Who? Hatchery staff	
		How? Check immersion time with timer. Ensure concentration is correct with AQA1507 Quaternary Ammonium Test Kit (or similar)	
		Where? Decontamination station at the warehouse	
		How often? Every time that gear is unloaded and stored	
Corrective Action(s) if Control Measures Fail (or PRLC cannot be met)		Mix new (fresh) dosage of disinfectant solution and repeat the cleaning/disinfectant procedure from the beginning. If gear cannot be disinfected, it must be clearly tagged as "contaminated" and isolated until it can be disinfected before being allowed back in the field.	
Supporting Documents (For example, Management Plan, Checklist, Decontamination Techniques, SOPs, Scientific Journal Articles, etc.)			
Logan River Sampling Protocol, Louanne River Sampling Protocol, Quaternary Ammonium Disinfectant Information Sheet, Nevada Noxious Weed List, California Noxious Weed List			
Development Team Members		Jonathan Thompson, Ronald Smith, Louanne McMartin	
Date Developed:	7/29/2010	Date(s) Reviewed:	Not yet reviewed

* all gray fields are required

Chapter 4: HACCP Planning: Step 5 – Non-Target Risk Action Plan (NTRAP)
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HACCP Step 5 – Non-Target Risk Action Plan (NTRAP)

(Use this form for any "Yes" from Column 6 of HACCP Step 4 - Non-Target Analysis Worksheet) One page for each Critical Control Point			
Management Objective From Step 1		Habitat Survey for the Recovery of Cutthroat Trout (CT)	
Critical Control Point: Task #	4	Title:	Return to warehouse and unload gear
Significant Non-Target(s) (Step 4, Column 3)		Vertebrates (Bullfrogs)	
Control Measure(s) (Step 4, Column 5)		Visually inspect gear and remove all visible adult bullfrogs	
Prescribed ranges, limits, or criteria for control measure(s): (PRLC)		Check all exposed areas at least twice until no visible adult bullfrogs remain.	
Monitoring the Control Measure(s)	Who?	Field crew supervisor	
	How?	Visual observation	
	Where?	Decontamination station at the warehouse	
	How often?	Every time that gear is unloaded and stored	
Corrective Action(s) if Control Measures Fail (or PRLC cannot be met)		Have another staff member repeat the control measure.	
Supporting Documents <i>(For example, Management Plan, Checklist, Decontamination Techniques, SOPs, Scientific Journal Articles, etc.)</i> Logan River Sampling Protocol, Louanne River Sampling Protocol, Quaternary Ammonium Disinfectant Information Sheet, Nevada Noxious Weed List, California Noxious Weed List			
Development Team Members		Jonathan Thompson, Ronald Smith, Louanne McMartin	
Date Developed:	7/29/2010	Date(s) Reviewed:	Not yet reviewed

** all gray fields are required*

Chapter 4: HACCP Planning: Step 5 – Non-Target Risk Action Plan (NTRAP)

HACCP Planning to Prevent the Spread of Invasive Species

Prescribed Ranges, Limits, or Criteria for Control Measure

There should be boundaries or criteria that must be met for your control measure to be effective. These are referred to as your **Prescribed Ranges, Limits, or Criteria (PRLC)**. Prescribed Ranges, Limits, or Criteria (previous versions of HACCP refer to this as a “control limit”) are specific measureable attributes that can be used to determine if control measures are effectively minimizing risk (e.g., a minimum dose of a disinfectant, a minimum exposure time, or an acceptable range of temperatures).

If possible, allow for a margin of error around your absolute minimum and/or maximum threshold. Routine operating limits should be more stringent than absolute control limits. This approach is analogous to safety factors that engineers incorporate into building bridges, buildings, and other structures, where a protective measure may be designed at ten times the level needed to withstand the maximum known risk factor. For example, if a certain chemical concentration, say 5 ppm, is required to control (i.e., kill) non-target species, then a manager might set the PRLC above this minimum concentration needed to ensure effective treatment. This manager, for example, might set the PRLC to at least 10 ppm in order to ensure the desired effect.

Alternatively, rather than an absolute limit, there may be a range associated with the control measure. For instance, a chlorine bleach solution of at least 5% may be effective in controlling New Zealand mudsnails, but 10% may damage equipment. Therefore, your range would be at least 5% but less than 10%. The PRLC from the CCP (Task #4) in the hypothetical example sets a minimum disinfectant solution of 1% (the range is 1% to 3% quaternary ammonium). In this case, adhering to a minimum specific duration of contact time (10 minutes) controls the vertebrate, invertebrate, plant, and other organisms.

In many cases, a limit for the appropriate control may not be readily apparent or available. The hypothetical example's other control measure (for adult bullfrogs) is to visually inspect and remove all adult bullfrogs. The PRLC for this control measure is to check all areas that were exposed twice and verify that no visible adult bullfrogs remain. Checking twice and having nothing remain are the criteria by which effectiveness can be confirmed. Tests may need to be conducted or information gathered from sources such as scientific publications, regulatory guidelines, experts, or experimental studies if the information needed to define a PRLC is unavailable. In the end, a value should be selected that errs on the side of caution. Additionally, regular review of existing HACCP plans allows for inclusion of new PRLC as better information becomes available. The rationale and reference material used to establish controls and their ranges, limits, or criteria should become part of the **supporting documentation** for the HACCP plan and will help with periodic review.

Every control measure must have some Prescribed Range, Limit, or Criterion. Without such, there is no way to ensure effectiveness of the control measure. Be specific and keep in mind that you may need supporting documentation to justify your PRLC. List your PRLC in the appropriate box on the Non-Target Risk Action Plan.

Chapter 4: HACCP Planning: Step 5 – Non-Target Risk Action Plan (NTRAP)

HACCP Planning to Prevent the Spread of Invasive Species

Control Measure Monitoring

Control measure monitoring is the process that managers rely upon to maintain control at a CCP. Accurate monitoring indicates when a PRLC has not been met. When controls are not adequate, corrective actions are needed. Reviewing the monitoring records can determine the extent of the problem and the corrective action needed. Documented monitoring ensures that activities from the HACCP plan were followed. The following monitoring questions need to be answered in the appropriate box on the NTRAP.

Who monitors the control measures and the appropriate PRLC to ensure that they are implemented appropriately?

Assignment of the responsibility for monitoring is an important consideration when developing a HACCP plan. The individual assigned to CCP monitoring could be the manager, biologist, or technician. In some situations, it may be performed best by an independent party. Including all personnel in the HACCP planning process builds a broad base of understanding and commitment to the program. Any unusual occurrences or deviations from controls should be reported immediately to make sure that adjustment and corrective action are timely. All records and documents associated with CCP monitoring should be signed or initialed by the person doing the monitoring.

How is the control measure monitored? Where does the monitoring occur?

The purpose of monitoring is to evaluate whether the PRLC has been met. In most cases, monitoring must be designed to provide rapid real-time results. There is usually no time for lengthy analytical testing because control failures must be detected quickly and appropriate corrective actions instituted before the activity provides a pathway for invasion. This is best done by monitoring the potential invasion pathway (the activity) rather than the habitat one intends to protect. Monitoring control measure effectiveness should not rely on simply watching to see if the non-target begins to invade a protected area. Containing an established invasion is difficult and sometimes impossible. Reactive habitat monitoring often does not provide information until it is too late. Your first priority should be to stop an invasion before it occurs. Nevertheless, monitoring for new species invasions in addition to HACCP planning is a good complementary strategy. It can help point out if there is a major failure in the HACCP plan control measures, but moreover, can sometimes facilitate initiating a response while an invasion is still manageable.

Physical and chemical measurements are preferred monitoring methods because testing can be done rapidly. Example physical measurements include the following:

- ***Time and temperature*** - This combination of measurements is often used to monitor the effectiveness of procedures used to control non-target contamination of collection gear, nets, and other natural resource survey equipment and materials. An example control measure for this would be drying or freezing equipment for a specific time to kill a contaminant.
- ***Water flow rate*** - Since plant fragments, eggs, and many invertebrates cannot swim against the current, holding fish in flowing water to separate them from hitchhikers is one way to control the non-target. Measuring flow rate and the time

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required for complete water exchange is an example of physical measurements that may need to be monitored.

- **Visual examination** - Observations for the presence of non-target contamination of equipment - such as firefighting equipment, agricultural implements, sample nets, species collection gear, and boats and trailers - is one way to monitor for non-target presence. Note that when visual inspection/manual removal is an actual control measure (e.g., as a method to remove weed seeds from field clothing), visual examination would not be appropriate to also serve as a method to monitor control effectiveness. In that case, the monitoring would involve a means to confirm that the visual inspection was conducted properly (e.g., a crew supervisor verifying that the crew members conducted their visual inspection/manual removal effort for an appropriate amount of time).

How often are the control measures checked to ensure that they are administered appropriately?

Monitoring can be continuous or intermittent. When possible, monitor continuously. Continuous monitoring is possible for many types of physical and chemical parameters. A monitoring instrument that produces a continuous record does not control the hazard on its own; it needs to be observed periodically so that action is taken when needed. This too is a component of monitoring. The length of time between checks directly affects the corrective action needed when a deviation from a PRLC is found. The frequency of intermittent monitoring should be determined from what you know about the activity, pathway, and life history of the non-target species.

Corrective Action

A corrective action is only necessary if you have determined that a control measure failed, either through direct observation of something that has clearly gone wrong, or indirectly measured through a failed PRLC. When control measures are not implemented correctly at a CCP, predetermined and documented corrective actions should be instituted immediately. A corrective action is essentially a “back-up plan.” All control measures within a HACCP plan should have a viable back-up plan because, in the real world, control measures will sometimes fail.

Effective corrective actions depend heavily on an adequate monitoring program. The primary objective is to establish a HACCP plan that permits rapid identification of deviations from a PRLC for the control measure. The sooner the deviation is identified, the more easily corrective actions can be taken and the greater the potential for minimizing the risk of spread. An individual who has a thorough understanding of the activity, pathway, and HACCP plan, and who has the authority to make decisions should be assigned the responsibility of implementing corrective actions.

Murphy’s Law states that if something can go wrong, it will. Thus, corrective actions are a necessary back-up strategy and are written in advance into the HACCP plan in order to protect our resources from a deviation from the PRLC. For example, if a PRLC for decontaminating field gear through freezing is not met because of a power failure, does the HACCP plan require another round of freezing later, or an alternate

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decontamination method now, or does it authorize the activity to continue without further decontamination? The answer depends on the nature of the risks and activity, but without including any answer, a HACCP plan is incomplete.

Corrective actions must bring the CCP back under control. A corrective action should take care of the immediate (short-term) problem as well as provide long-term solutions. The objective is to implement a short-term fix so that control can be re-established as soon as possible without further deviations. Any unanticipated failure of control measures necessitates a re-evaluation of the HACCP plan and the corresponding control measure.

A permanent solution to eliminating or minimizing the initial cause or causes for the deviation should be implemented if necessary. Specific instructions for corrective actions must be available to all workers in the operation and should be part of the documented HACCP plan.

If a control measure failure occurs, a report is helpful as supporting documentation and should contain a description of the activity/pathway, a description of the deviation, and results of any evaluations.

Supporting Documentation

The purpose of supporting documentation is to provide objective evidence that all essential elements of the plan have a scientific basis and represent a valid approach to controlling the pathway hazards. There are several approaches to validating the HACCP plan, including incorporation of fundamental scientific principles, use of scientific data, reliance on expert opinion, or conducting of specific observations or tests.

Validation can be performed by the HACCP team or by an individual qualified by training or experience. Validation activities may be similar in scope and time commitment to the original plan development. Actual components of the plan should be validated before relying on the HACCP plan and/or when factors warrant. These factors could include changes in the pathway, using new or different techniques, new scientific information about potential hazards or their control, or new infestations of invasive species. Validation involves a scientific and technical review of the rationale behind each part of the HACCP plan from hazard analysis through each CCP verification strategy.

Support documents include information and data used to develop the plan. This includes the written Non-Target Analysis Worksheet (Step 4) and records of any information used in performing the risk assessment, hazard analysis, and establishing the controls. Support documents may include information about the current geographic range of non-targets that may get into the pathway and sufficient data used to establish the adequacy of any barriers to this contamination. In addition to data, support documents may also include correspondence with consultants or other experts. Support documents should also include a list of the HACCP team and each member's

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responsibilities. A section at the bottom of the Non-Target Risk Action Plan is provided for this information.

Multiple Critical Control Points

If you identified more than one CCP on your Non-Target Analysis Worksheet, then you will need to complete an additional Non-Target Risk Action Plan form for each additional CCP that you identified. That is, you need at least one separate action plan for each CCP. If a CCP requires different control measures for different non-target species, you will need one separate action plan for each control measure/non-target species combination. In this case, a single CCP may require more than one action plan.

Once you have completed an action plan (or plans) for each CCP, your HACCP Plan is finished. However, do not just file it away and forget it. Please review the Non-Target Risk Action Plan every time your covered activity is performed and re-evaluate your HACCP plan frequently, especially if the activity changes.

Chapter 5

Implementing HACCP

Learning Objectives:

At the end of Chapter 5, participants will be able to:

- explain the importance of HACCP plan implementation, and associated options for verification.
- explain how periodic review of HACCP plans is essential.
- describe how sharing plans can help others as well as your own HACCP team.
- reflect on the ultimate purpose of HACCP planning.

Supporting Documentation and Periodic Review

Like many plans, a common problem that faces the HACCP process is implementation. Many plans are constructed and then become dust collectors on a shelf. This is not the intent for a HACCP plan. Plans by themselves are only pieces of paper (or an electronic equivalent). The planning process is what is important and should not cease once a HACCP plan is completed. Circumstances change! Procedures change! Materials and personnel change! We live in a dynamic world where we need to periodically re-evaluate our actions to ensure that our precautions are still valid.

Supporting documents and periodic review are essential to the implementation of the HACCP process on the ground level. As described in the Chapter 4 (Step 5), supporting documents can be checklists for verifying that work has been completed, equipment manuals, standard operating procedures, decontamination literature, or any other documents that are relevant to the activity. Peer-reviewed scientific journal articles that provide evidence for the effectiveness of a particular control measure could be important to document the validity of your established procedures. With time, new information becomes available and such information could substantially impact how your activity meets your management objectives and could impact the effectiveness of your control measures. Conducting a periodic review of the plan ensures that plan components stay fresh. During the course of a year, many projects may have employee turnover, change standard operating procedures, and/or add activities. Meanwhile, additional invasive species continually enter new habitats. A periodic review on at least an annual basis will ensure that new pathways for spreading invasive species are recognized and controlled.

It is important to consider HACCP planning as a living document for review with ever changing environmental conditions and the possibility of new non-target species influencing our field activities. Considering these challenges, we recommend that you and your partners make a reasonable effort to review standard operating procedures and HACCP documents on a consistent and timely basis. Do not rely on corporate

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memory that may retire with your most senior employees. Preserve best management practices within a fully documented HACCP plan.

One approach for ensuring implementation of HACCP plans is to use the NTRAP from Step 5 as a part of compliance documentation. For internal use, this might simply be a requirement that the responsible party sign the completed NTRAP and file it for a prescribed period of time. Where HACCP planning becomes a requirement for others (e.g., recipients of grant funds for restoration projects), the signed NTRAP can serve as written documentation that the plan will be or has been followed.

Sharing Plans

Sharing plans at <http://www.haccp-nrm.org> is a way to share your HACCP process information. The website can be used to provide examples to other professionals that are working to prevent the spread of invasive species in their activities. Also, share your HACCP plans with partners and public entities. The more you expose those that might be affected by non-target movement and potential invasive species introductions, the better the opportunity to reduce the risk through effective communications and constructive planning. By putting your HACCP plan online, you also provide a way for others to provide valuable feedback. Interested parties or others who perform similar management activities may have ideas or suggestions that did not initially come to your HACCP team. The on-line database of HACCP plans is available to connect others around the globe and further our common goal of conserving our valuable natural resources.

HACCP and Conservation Ethics

In the end, creating and implementing a HACCP plan for natural resource activities is not really about filling out forms, protecting ourselves with the cover of supporting documents, or adding a new layer of compliance tracking. It is about doing no harm! As stewards of natural resources it is our responsibility to do our best to protect and preserve. This responsibility includes not spreading invasive species in the course of our conservation efforts. None of us wants to experience the irony of permanently damaging the resources that we work so hard to conserve. Conservation must be properly planned. A good steward will take in the larger picture and evaluate the consequences of his or her own actions (or inactions).

**“A good plan violently executed now is
better than a perfect plan next week.”**
(George Patton, American General)

Chapter 6

Glossary

AIS – Aquatic Invasive Species

Alien – an organism that is outside of its native range; an organism that is foreign to its current geographic location. See non-indigenous.

ANS – Aquatic Nuisance Species

Aquarium Release – a type of intentional introduction whereby a captive or aquatic pet animal, aquarium plant, or contaminated water is released into open waters by an aquarium hobbyist.

Aquatic Nuisance Species – a non-indigenous species that threatens the diversity or abundance of native species; the ecological stability of infested waters; or commercial, agricultural, aquaculture, or recreational activities dependent on such waters.

Aquatic Invasive Species – marine, estuarine, or freshwater organisms that, when introduced into new habitats, negatively affect aquatic ecosystems as well as human use of these natural resources. Also see invasive species.

ASTM International – formerly the American Society for Testing and Materials.

BMP – Best Management Practices.

CCP – Critical Control Point.

Control – (a) [verb] to manage the conditions of an activity or a non-target to maintain compliance with established criteria (e.g. to control a non-target means to prevent its spread). (b) [noun] the state in which correct procedures are followed and criteria are met.

Control Limit – a specific criterion that must be met for each control measure associated with a critical control point. For example, if the application of a bleach solution was used as a control measure to prevent the spread of a non-target species, the control limit might be the minimum concentration of that solution (e.g. ≥5% bleach solution). In this example, a 3% bleach solution would fail to meet the control limit.

Control Measure – an action that can be used to control a potential hazard (sometimes referred to as a preventive measure). Control measures are the first, and sometimes only, line of defense against the spread of non-targets. If control measures fail, corrective actions should be implemented.

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HACCP Planning to Prevent the Spread of Invasive Species

Control Point – any step or task during which potential hazards can be controlled.

Control points may be critical control points or optional control points. Only critical control points are essential for preventing risk, however, if resources allow, optional control points may also be employed to further minimize risk well below acceptable levels.

Corrective Action – a procedure that must be followed if a control measure fails at a critical control point. A corrective action is backup procedure used as a second line of defense that may be necessary to prevent the spread of a non–target if the first–line defense (a control measure) fails to control a non–target.

Critical Control Point (CCP) – the best point, step, or procedure at which significant hazards (non–targets) can be controlled, prevented, or reduced to acceptable levels in order to minimize the risk of spread.

Established – an introduced organism with one or more reproducing, sustainable populations.

Exotic – something that is found outside of its native range; something that is foreign (see non-indigenous).

HACCP – Hazard Analysis and Critical Control Points – a system or plan for controlling hazards (non–target species) in order to minimize risk and/or detrimental impact while meeting a management objective.

Hazard – a non–target species that is reasonably likely to be transported through natural resource work and become established, creating negative impacts to native species and/or their habitats.

Indigenous – occurring or found naturally in a particular area or ecosystem (e.g. species that are indigenous to North America are those that historically occurred in North America prior to the arrival of the first European settlers). In contrast to endemic species, indigenous species may be found naturally in more than one particular geographic area. An indigenous species is a member of its native, natural community.

Introduce – the intentional or unintentional process of releasing, or allowing to be released, a non–target species into an ecosystem, region, or specific geographical location where it is not native

Introduced Species – a species moved by humans (or by human actions), either intentionally or unintentionally, to an ecosystem, region, or specific geographical location where it is not native.

Invasive Species – a non-indigenous organism whose introduction does or is likely to cause economic or environmental harm or harm to human health.

Locally Established – an introduced species with one or more naturally reproducing populations but with a very restricted distribution and no evidence of natural

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HACCP Planning to Prevent the Spread of Invasive Species

range expansion (in general, limited to a relatively confined area, such as a small lake).

Lumper – a person who categorizes multiple species or tasks into few broadly defined, inclusive categories.

Monitor – conduct planned observations or measurements to assess whether a critical control point is under control and produce an accurate record for future use in verification.

Native – a species that occurs naturally within a specific geographical range (e.g. species native to North America existed there before the arrival of European settlers). See indigenous.

Naturalized – a well-established species, not originally native to a particular geographic area, but has become integrated with native species into the otherwise natural food web.

NFH – National Fish Hatchery.

NIS – Non-indigenous species.

Non-indigenous Species – an individual, group, or population of a species that is introduced by human intervention into an area or ecosystem outside of its historic, native geographic range. Synonymous with “alien,” “non-native,” “exotic,” and “introduced.”

Non-Native – see Non-indigenous Species

Non-Target – anything, including any organism, that is not intentionally moved. For example, if your management activity calls for you to stock largemouth bass, then any other species of fish (or other organism) would be a non-target. Your intent would be to only move largemouth bass.

NTAW – Non-target Analysis Worksheet. This is completed during the fourth step of the HACCP planning process.

NTRAP – Non-target Risk Action Plan. Formerly called the “HACCP Plan Worksheet,” this is the fifth and final step in the HACCP planning process.

Operating Limits – prescribed limits for control measures used to reduce the risk of contamination by non-target species. Operating limits are usually more stringent than critical limits. For example, if a certain chemical concentration, say 5 ppm, is required to control (i.e., kill) organisms of a non-target species, then a manager might set the operating limit above this minimum concentration needed to ensure effective treatment. This manager, for example, would, perhaps, set the operating limits to 8 to 10 ppm.

Chapter 6: Glossary
HACCP Planning to Prevent the Spread of Invasive Species

Optional Control Point – a task during which control measures could be applied to prevent or reduce the risk of significant non–target hazards, but control at this point, although potentially helpful, is not essential for removing or reducing the significant non–target hazard (usually because control measures are more effective if applied during another task).

Pathway – an activity or process through which a species may be transferred to a new location where it could become invasive (e.g., shipping, air travel).

Pathway Management – the act of assessing a pathway, identifying control points, and incorporating control measures or corrective actions to reduce or eliminate non–target species.

PPM – Parts per million.

Prescribed Range, Limit, or Criterion (PRLC) (previously called a “control limit”) – a specific measureable attribute that can be used to determine if control measures are effectively minimizing the risk (e.g., a minimum dose of a disinfectant, a minimum exposure time, or an acceptable range of temperatures).

PRLC – Prescribed Range, Limit or Criterion.

Risk – combination of the likelihood of a hazard occurring and the severity of its impacts

Severity – the level of detrimental impact of an introduced non–target species (if not properly controlled).

Splitter – A person who categorizes species or tasks into many narrowly defined, exclusive categories.

Target – anything that is intentionally moved. For example, if your management activity calls for you to stock largemouth bass, then your targets would be largemouth bass and any equipment and personnel used to carry out this activity.

USFWS – the United States Fish and Wildlife Service.

Validation – the element of verification focused on collecting and evaluating scientific and technical information to determine whether the HACCP plan, when properly implemented, effectively controls identified pathway hazards.

Vector – the specific means by which an invasive species moves within a particular pathway (e.g., a ship, agricultural products, boots).

Verification – the use of methods, procedures, or tests, in addition to those used in monitoring, that determine whether the HACCP system is in compliance with the HACCP plan and/or whether the plan needs modification.

Chapter 7 References

HACCP Websites

www.seagrant.umn.edu/ais/haccp – Minnesota Sea Grant

www.haccp-nrm.org - HACCP for Natural Resource Management – USFWS/UT Arlington

[www.conabio.gob.mx/invasoras/index.php/Análisis de riesgo](http://www.conabio.gob.mx/invasoras/index.php/Análisis_de_riesgo) - HACCP for Natural Resource Management in Spanish - Conabio

Invasive Species Databases

www.eddmaps.org - Early Detection & Distribution Mapping System - Center for Invasive Species and Ecosystem Health

www.issg.org/database/welcome - Global Invasive Species Database - IUCN

<http://nas.er.usgs.gov> - Non-indigenous Aquatic Species Database – USGS

<http://www.issg.org> —Invasive Species Specialist Group—also a list of “100 of the World’s Worst Invasive Species”

General Invasive Species Information

<http://www.anstaskforce.gov> —Aquatic Nuisance Species Task Force

<http://www.invasivespecies.gov/faq/main.shtml> — National Invasive Species Council—frequently asked questions

<http://nas.er.usgs.gov> — Non-indigenous Aquatic Species—information resource for the Florida Caribbean Science Center of the USGS—huge list of non-indigenous species website links.

<http://bluegoose.arw.r9.fws.gov/resources/weeds.html> — Invasive species resources—links from the U.S. Fish and Wildlife Service invasives webpage

<http://biology.usgs.gov/cro/invasive.htm> - USGS, BRD, Central Region

<http://www.sgnis.org> - Sea Grant Non-indigenous Species

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<http://www.seagrant.umn.edu/pubs/freeorder.html> — Minnesota Sea Grant exotic species publications

<http://contaminants.fws.gov/Issues/InvasiveSpecies.cfm> — FWS Division of Environmental Quality Invasive Species webpage

<http://www.entryway.com/seagrant> —National Aquatic Nuisance Species Clearinghouse

<http://www.nps.gov/plants/alien/index.htm> — Plant Conservation Alliance's Alien Plant Working Group—additional information on invasive plants (including specific species)

<http://www.weedcenter.org> —Center for Invasive Plant Management

Images

<http://www.northeastans.org/imagelinks.htm> — Northeast ANS Panel—links to plant & animal ANS images

Government Publications Available on the Internet

http://www.wws.princeton.edu/~ota/disk1/1993/9325_n.html - U.S. Congress, Office of Technology Assessment. *Harmful Non-Indigenous Species in the United States*. OTA-F-565 (Washington, DC: U.S. Government Printing Office, September 1993).

<http://www.cnies.org/nle/biodv-26.html> - Corn, L., et al. *Harmful Non-Native Species: Issues for Congress*. CRS Issue Brief for Congress. The National Council for Science and the Environment.

<http://www.denix.osd.mil/denix/Public/ES-Programs/Conservation/Invasive/intro.html> - Westbrook, R. *Invasive Plants, Changing the Landscape of America: Fact Book*. Washington, DC: Federal Interagency Committee for the Management of Noxious and Exotic Weeds (FICMNEW), 1998.

Books and Publications

ASTM E2590 - 09 Standard Guide for Conducting Hazard Analysis-Critical Control Point (HACCP) Evaluations. ASTM International, West Conshohocken, PA. 2008. DOI: 10.1520/E2590-09. www.astm.org.

Bright, C. and L. Starke. 1998. *Life out of bounds: bioinvasion in a borderless world*. Worldwatch Institute. W.W. Norton and Company, New York, NY. ISBN: 0393318141.

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Cox, G.W. 1999 Alien species in North America and Hawaii: impacts on natural ecosystems. Island Press. ISBN: 1-55963-680-7.

Devine, R.S. 1998. Alien invasion: America's battle with non-native animals and plants. National Geographic Society. ISBN: 0792274490.

Dillon, M. and Griffith, C., How to HACCP, 2nd Edition, MD. Associates, Grimsby, UK, 1996.

Fuller, P.L., L.G. Nico, and J.D. Williams. 1999. Nonindigenous fishes introduced into inland waters of the United States. American Fisheries Society, Special Publication 27, Bethesda, MD.

Mooney, H.A., and R.J. Hobbs. 2000. Invasive species in a changing world. Island Press. ISBN: 1555963782X.

Minnesota Sea Grant/Michigan Sea Grant, "Hazard Analysis and Critical Control Point Analysis," MN SG-F11/MSG-00-400. University of Minnesota, Duluth, MN, 2001.

Simberloff et al. 1997. Strangers in paradise: impact and management of non indigenous species in Florida. Island Press. ISBN: 1559634308.

Van Driesche, J., and R. Van Driesche. 2000. Nature out of place: biological invasions in the global age. Island Press. ISBN: 1559637579.

Walters, C., Adaptive Management of Renewable Resources, 1986, republished by The Blackburn Press, Caldwell, NJ, 2001.

Williamson, M. 1996. Biological invasions. Chapman and Hall. ISBN: 0412591901.

World Health Organization (WHO), "HACCP: Introducing the Hazard Analysis Critical Control Point System," Document WHO/FSF/FOS, 1997.

Videos

MN Sea Grant video. "Stop Exotics, Clean Your Boat."

MN Sea Grant video. "From Net to Sale: Controlling ANS with the HACCP Approach for Baitfish and Aquaculture Industries"

Information Television Videos:

- "Aquatic Invaders"
- "Plants Out of Place"

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HACCP Planning to Prevent the Spread of Invasive Species

SUGGESTED REFERENCES FOR CONTROL MEASURES

General Guidelines

Alien Invasive Species: A Toolkit of Best Prevention and Management Practices

Wittenberg, R., Cock, M.J.W. (eds.) 2001. Invasive Alien Species: A Toolkit of Best Prevention and Management Practices. CAB International, Wallingford, Oxon, UK, xvii - 228. Available online at: <http://www.gisp.org/publications/toolkit/Toolkiteng.pdf>

This document includes an introductory material, methods for prevention of invasive species, risk-analysis, and early detection.

Assessing and Managing Invasive Species within Protected Areas

Tu, M. 2009. Assessing and Managing Invasive Species within Protected Areas. Protected Area Quick Guide Series. Editor, J. Ervin. Arlington, VA. The Nature Conservancy. 40 pp. Available online at: <http://www.cbd.int/invasive/doc/ias-tnc-guide-2009-en.pdf>

This guide provides protected area managers with guidance on how to create a comprehensive assessment and strategic plan for invasive species.

Biotic Invasions: Causes, Epidemiology, Global Consequences and Control

Ecological Society of America. 2000. Biotic Invasions: Causes, Epidemiology, Global Consequences and Control. Issues in Ecology 5. Available online at: <http://www.esa.org/science/Issues/FileEnglish/issue5.pdf>

A scientific literature review that evaluated the impacts of invasive species as well as methods used to identify future invaders and take effective steps to prevent their dispersal and establishment.

Invasive Free Zone Guidebook

McNamara D. 2007. Invasive Free Zone Guidebook. U.S. Fish and Wildlife Service, Whittlesey Creek National Wildlife Refuge. 40pp.

Available online at: <http://www.fws.gov/midwest/whittleseycreek/documents/IFZGuidebook.pdf>
Whittlesey Creek National Wildlife Refuge, U.S. Fish and Wildlife Service. *This guidebook provides recommendations, information, and insights for creating an Invasive Free Zone; a useful reference for anyone working to control invasive species, especially on a large scale.*

Inspection and Cleaning Manual for Equipment and Vehicles to Prevent the Spread of Invasive Species

U.S. Department of the Interior Bureau of Reclamation. 2009. Technical Memorandum No. 86-68220-07-05. 203 pp. Available online at:

http://www.usbr.gov/pps/EquipmentInspectionandCleaningManual_Sept09.pdf

This manual provides recommendations for inspection and cleaning of vehicles and equipment as a prevention tool to limit the spread of invasive species.

NOAA Restoration Center Invasive Species BMP's

Available Online at: <http://www.habitat.noaa.gov/restoration/programs/invasivespecies.html>

This website provides technical guidance bulletins for the prevention and control of invasive species.

Transfer of Invasive Species Associated with the Movement of Military Equipment and Personnel.

Cofrancesco, Jr. AF., Reaves DR. Averett DE. July 2007. Army Corp of Engineers, Engineer Research and Development Center. ERDC/EL TR-07-8. Washington D.C., 126 pp.

Available online at: <http://el.erdc.usace.army.mil/elpubs/pdf/trel07-8.pdf>

This document provides an overview of the current process that exists to clean, inspect, and regulate the movement of invasive species through ports of embarkation and debarkation.

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Decontamination for Watercraft and Aquatic Equipment

Maine's Safety Net - A Practical Guide to Building Wash Stations

Friends of the Cobbossee Watershed and Lakes Environmental Association. March 2006. 28 pp.
Available online at: <http://www.watershedfriends.com/L.%20L.%20Bean%20handbook.pdf>
This handbook has been designed to assist those organizations and citizens in building Boat Wash Stations.

Preventing Accidental Introductions of Freshwater Invasive Species

U.S. Department of Agriculture, Forest Service. Available online at:
http://www.fs.fed.us/invasivespecies/documents/Aquatic_is_prevention.pdf
This document provides standard sterilization techniques that are effective against New Zealand mudsnail, Whirling disease, and Chytrid Fungus.

Preventing Spread of Aquatic Invasive Organisms Common to the Intermountain Region

U.S. Department of Agriculture, Forest Service. Available online at:
http://www.fs.fed.us/r4/resources/aquatic/guidelines/aq_invasives_interim_fire_guidance08_final.pdf
This document provides guidelines for forestry personnel to avoid the spread of aquatic invasive species.

Protect Your Waters

Aquatic Nuisance Species Task Force. Available online at: <http://protectyourwaters.org>
This site provides recommendations for recreational users who want to help prevent the spread aquatic nuisance species.

Zebra / Quagga Mussel Prevention and Control

Invasive Mussel Guidebook for Recreational Water Managers and Users: Strategies for Local Involvement.

California Resources Agency. October 2008. Available online at:
http://www.resources.ca.gov/quagga/docs/QUAGGA_GUIDEBOOK.pdf
Information presented in this guidebook deals exclusively with prevention and containment of invasive mussels.

Protect Your Boat, Fight Quagga and Zebra Mussels A Guide to Cleaning Boats

California Department of Fish and Game. October 2009. Available online at:
<http://www.nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=4957>
This guide was compiled specifically for boat owners and watercraft users. The information contains general guidelines for all boaters and a basic checklist for inspecting and cleaning boats and recreational equipment for Quagga/Zebra mussels

Protect Your Boat and Engine from Zebra Mussels

Wisconsin Department of Natural Resources.
Available online at: <http://dnr.wi.gov/invasives/publications/pdfs/protectyourboat.pdf>
This document describes simple and proactive steps boat owners may implement to protect their investment and prevent the spread of invasive species into more of Wisconsin's waters.

Quagga / Zebra Mussel Infestation Prevention and Response Planning Guide

National Park Service, Natural Resources Program Center, Fort Collins, Colorado. May 2007. 43 pp.
Available online at: http://www.nature.nps.gov/water/quagga/QuaggaPlanningGuide_ext.pdf
This plan serves as a guiding document for park managers to provide for the prevention, early detection, and rapid response to quagga mussel infestations in western waters.

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Rapid Response Plan for Zebra Mussels in the Columbia River Basin: A Comprehensive Multi-Agency Strategy to Expediently Guide Rapid Response Activities.

Heimowitz P., Phillips S. 2006. 100th Meridian Initiative. 42 pp.

Available online at: http://www.100thmeridian.org/ActionTeams/Columbia/CRB_ZMRR_090106.pdf

The goal of the plan is to serve as a roadmap to guide rapid response following the detection of zebra mussels.

<http://www.100thmeridian.org> - 100th Meridian Initiative; National website on zebra mussel prevention. The website provides tips on decontaminating boats and other gear.

Decontamination for Land Vehicles, Equipment, and Personal Gear

Comparison of Relocatable Commercial Vehicle Washing Systems

Fleming J. September 2008. U.S. Department of Agriculture, Forest Service San Dimas Technology & Development Center. 0851 1809 - SdTDC. 36 pp.

Available online at: http://www.weedcenter.org/management/docs/09_VehicleWashingSystemReport.pdf

This report compares a range of vehicle washing systems with respect to efficacy, economics, waste containment, waste disposal, and the viability of any propagules that were collected in the cleaning process.

National Cooperative Highway Research Program (NCHRP) Synthesis 363: Control of Invasive Species.

The Transportation Research Board of the National Academies. 2006. Transportation Research Board, Washington D.C. 126 pp.

Available online at: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_363.pdf

The report explores the extent to which the state departments of transportation are prevent and controlling invasive species, restoring habitats, and conducting research. Successful practices and documented as well as lessons learned.

Invasive Species Best Management Practices for Transportation and Utility Rights-of-Way

Wisconsin Council on Forestry. January 2010. 63 pp.

Available online at: <http://council.wisconsinforestry.org/invasives/transportation/pdf/ROW-Manual.pdf>

The guidelines in this manual apply to utility and transportation corridor construction and maintenance activities.

Wisconsin's Forestry BMPs for Invasive Species. A Field manual for Foresters, Landowners, and Loggers

Wisconsin Council on Forestry. March 2009. 56 pp.

Available online at: http://council.wisconsinforestry.org/invasives/pdf/FinalForestryBMPManual_03-26-09.pdf

This document provides information on prevention, control, and monitoring of priority species in forested landscapes.

Wisconsin's Urban Forestry BMPs for Preventing the Introduction and Spread of Invasive Species

Wisconsin Council on Forestry. August 2009, 102 pp.

Available online at: http://council.wisconsinforestry.org/invasives/pdf/UF-BMP-ConsolidatedManual_090811.pdf

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This document provides information on prevention, control, and monitoring of priority species in urban forests.

Weed Prevention and Control

Guide of Noxious Weed Prevention Practices

U.S. Department of Agriculture, Forest Service. July 2001. 25 pp.

Available online at:

http://www.fs.fed.us/rangelands/ftp/invasives/documents/GuidetoNoxWeedPrevPractices_07052001.pdf

This document provides a comprehensive directory of weed prevention practices for use in Forest Service planning and wildland resource management activities and operations.

Invasive Plant Prevention Guidelines

Center for Invasive Plant Management. September 2003. Compiled by J. Clark, Bozemon, MT. 15 pp.

Available online at: http://www.weedcenter.org/store/docs/CIPM_prevention.pdf

This document provides guidelines for prevention and for developing weed management areas.

Invasive Plant Prevention

U.S. Department of Agriculture, Forest Service. 2002. Invasive Plant Management: CIPM Online Textbook. Chapter 10 Invasive Plant Prevention; Adapted from USDA Forest Service Guide to Noxious Weed Prevention Practices. Available online at: http://www.weedcenter.org/textbook/10_prevention.html

This guide provides practical, proactive weed-prevention guidelines.

Manager's Guide to Roadside Revegetation Using Native Plants

Steinfeld DE., Riley SA., Wilkinson KM., Landis TD., Riley LE. 2007. U.S. Department of Transportation. Report # FHWA-WFL/TD-07-006. 28 pp.

Available online at: <http://www.nativererevegetation.org/learn>

This guide summarizes an approach to effectively revegetate roadsides and other disturbance areas associated with road construction, modification, or obliteration.

Roadside Revegetation: An Integrated Approach to Establishing Native Plants

Steinfeld DE., Riley SA., Wilkinson KM., Landis TD., Riley LE. 2007. U.S. Department of Transportation. Report # FHWA-WFL/TD-07-005. 423 pp.

Available online at: <http://www.nativererevegetation.org/learn>

This report offers an integrated approach to facilitate the successful establishment of native plants along roadsides and other areas of disturbance associated with road modifications

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Executive Order 13112

Federal Register: Feb 8, 1999 (Volume 64, Number 25)

By the authority vested in me as President by the Constitution and the laws of the United States of America, including the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.), Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, as amended (16 U.S.C. 4701 et seq.), Lacey Act, as amended (18 U.S.C. 42), Federal Plant Pest Act (7 U.S.C. 150aa et seq.), Federal Noxious Weed Act of 1974, as amended (7 U.S.C. 2801 et seq.), Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.), and other pertinent statutes, to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause, it is ordered as follows:

- Section 1. Definitions
- Section 2. Federal Agency Duties
- Section 3. Invasive Species Council
- Section 4. Duties of the Invasive Species Council
- Section 5. Invasive Species Management Plan
- Section 6. Judicial Review and Administration

Section 1. Definitions.

- (a) "Alien species" means, with respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem.
- (b) "Control" means, as appropriate, eradicating, suppressing, reducing, or managing invasive species populations, preventing spread of invasive species from areas where they are present, and taking steps such as restoration of native species and habitats to reduce the effects of invasive species and to prevent further invasions.
- (c) "Ecosystem" means the complex of a community of organisms and its environment.
- (d) "Federal agency" means an executive department or agency, but does not include independent establishments as defined by 5 U.S.C. 104.
- (e) "Introduction" means the intentional or unintentional escape, release, dissemination, or placement of a species into an ecosystem as a result of human activity.
- (f) "Invasive species" means an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.
- (g) "Native species" means, with respect to a particular ecosystem, a species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem.

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(h) "Species" means a group of organisms all of which have a high degree of physical and genetic similarity, generally interbreed only among themselves, and show persistent differences from members of allied groups of organisms.

(i) "Stakeholders" means, but is not limited to, State, tribal, and local government agencies, academic institutions, the scientific community, nongovernmental entities including environmental, agricultural, and conservation organizations, trade groups, commercial interests, and private landowners.

(j) "United States" means the 50 States, the District of Columbia, Puerto Rico, Guam, and all possessions, territories, and the territorial sea of the United States.

Section 2. Federal Agency Duties.

(a) Each Federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law,

(1) identify such actions;

(2) subject to the availability of appropriations, and within Administration budgetary limits, use relevant programs and authorities to: (i) prevent the introduction of invasive species; (ii) detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner; (iii) monitor invasive species populations accurately and reliably; (iv) provide for restoration of native species and habitat conditions in ecosystems that have been invaded; (v) conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species; and (vi) promote public education on invasive species and the means to address them; and

(3) not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless, pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions.

(b) Federal agencies shall pursue the duties set forth in this section in consultation with the Invasive Species Council, consistent with the Invasive Species Management Plan and in cooperation with stakeholders, as appropriate, and, as approved by the Department of State, when Federal agencies are working with international organizations and foreign nations.

Section 3. Invasive Species Council.

(a) An Invasive Species Council (Council) is hereby established whose members shall include the Secretary of State, the Secretary of the Treasury, the Secretary of Defense,

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the Secretary of the Interior, the Secretary of Agriculture, the Secretary of Commerce, the Secretary of Transportation, and the Administrator of the Environmental Protection Agency. The Council shall be Co-Chaired by the Secretary of the Interior, the Secretary of Agriculture, and the Secretary of Commerce. The Council may invite additional Federal agency representatives to be members, including representatives from subcabinet bureaus or offices with significant responsibilities concerning invasive species, and may prescribe special procedures for their participation. The Secretary of the Interior shall, with concurrence of the Co-Chairs, appoint an Executive Director of the Council and shall provide the staff and administrative support for the Council. (b) The Secretary of the Interior shall establish an advisory committee under the Federal Advisory Committee Act, 5 U.S.C. App., to provide information and advice for consideration by the Council, and shall, after consultation with other members of the Council, appoint members of the advisory committee representing stakeholders. Among other things, the advisory committee shall recommend plans and actions at local, tribal, State, regional, and ecosystem-based levels to achieve the goals and objectives of the Management Plan in section 5 of this order. The advisory committee shall act in cooperation with stakeholders and existing organizations addressing invasive species. The Department of the Interior shall provide the administrative and financial support for the advisory committee.

Section 4. Duties of the Invasive Species Council.

The Invasive Species Council shall provide national leadership regarding invasive species, and shall:

- (a) oversee the implementation of this order and see that the Federal agency activities concerning invasive species are coordinated, complementary, cost-efficient, and effective, relying to the extent feasible and appropriate on existing organizations addressing invasive species, such as the Aquatic Nuisance Species Task Force, the Federal Interagency Committee for the Management of Noxious and Exotic Weeds, and the Committee on Environment and Natural Resources;
- (b) encourage planning and action at local, tribal, State, regional, and ecosystem-based levels to achieve the goals and objectives of the Management Plan in section 5 of this order, in cooperation with stakeholders and existing organizations addressing invasive species;
- (c) develop recommendations for international cooperation in addressing invasive species;
- (d) develop, in consultation with the Council on Environmental Quality, guidance to Federal agencies pursuant to the National Environmental Policy Act on prevention and control of invasive species, including the procurement, use, and maintenance of native species as they affect invasive species;

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(e) facilitate development of a coordinated network among Federal agencies to document, evaluate, and monitor impacts from invasive species on the economy, the environment, and human health;

(f) facilitate establishment of a coordinated, up-to-date information-sharing system that utilizes, to the greatest extent practicable, the Internet; this system shall facilitate access to and exchange of information concerning invasive species, including, but not limited to, information on distribution and abundance of invasive species; life histories of such species and invasive characteristics; economic, environmental, and human health impacts; management techniques, and laws and programs for management, research, and public education; and

(g) prepare and issue a national Invasive Species Management Plan as set forth in section 5 of this order.

Section 5. Invasive Species Management Plan.

(a) Within 18 months after issuance of this order, the Council shall prepare and issue the first edition of a National Invasive Species Management Plan (Management Plan), which shall detail and recommend performance-oriented goals and objectives and specific measures of success for Federal agency efforts concerning invasive species. The Management Plan shall recommend specific objectives and measures for carrying out each of the Federal agency duties established in section 2(a) of this order and shall set forth steps to be taken by the Council to carry out the duties assigned to it under section 4 of this order. The Management Plan shall be developed through a public process and in consultation with Federal agencies and stakeholders.

(b) The first edition of the Management Plan shall include a review of existing and prospective approaches and authorities for preventing the introduction and spread of invasive species, including those for identifying pathways by which invasive species are introduced and for minimizing the risk of introductions via those pathways, and shall identify research needs and recommend measures to minimize the risk that introductions will occur. Such recommended measures shall provide for a science-based process to evaluate risks associated with introduction and spread of invasive species and a coordinated and systematic risk-based process to identify, monitor, and interdict pathways that may be involved in the introduction of invasive species. If recommended measures are not authorized by current law, the Council shall develop and recommend to the President through its Co-Chairs legislative proposals for necessary changes in authority.

(c) The Council shall update the Management Plan biennially and shall concurrently evaluate and report on success in achieving the goals and objectives set forth in the Management Plan. The Management Plan shall identify the personnel, other resources, and additional levels of coordination needed to achieve the Management Plan's identified goals and objectives, and the Council shall provide each edition of the Management Plan and each report on it to the Office of Management and Budget.

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Within 18 months after measures have been recommended by the Council in any edition of the Management Plan, each Federal agency whose action is required to implement such measures shall either take the action recommended or shall provide the Council with an explanation of why the action is not feasible. The Council shall assess the effectiveness of this order no less than once each 5 years after the order is issued and shall report to the Office of Management and Budget on whether the order should be revised.

Section 6. Judicial Review and Administration.

(a) This order is intended only to improve the internal management of the executive branch and is not intended to create any right, benefit, or trust responsibility, substantive or procedural, enforceable at law or equity by a party against the United States, its agencies, its officers, or any other person.

(b) Executive Order 11987 of May 24, 1977, is hereby revoked.

(c) The requirements of this order do not affect the obligations of Federal agencies under 16 U.S.C. 4713 with respect to ballast water programs.

(d) The requirements of section 2(a)(3) of this order shall not apply to any action of the Department of State or Department of Defense if the Secretary of State or the Secretary of Defense finds that exemption from such requirements is necessary for foreign policy or national security reasons.

WILLIAM J. CLINTON
THE WHITE HOUSE,
February 3, 1999.

Appendix A – Blank HACCP Forms
HACCP Planning to Prevent the Spread of Invasive Species

Appendix A - Blank HACCP Forms

HACCP Step 1 – Activity Description

Management Objective & Contact Information	
HACCP Plan Title	
Management Objective:	Contact Person:
	Phone:
	Email:

Activity Description i.e. Who; What; Where; When; How; Why

Appendix A – Blank HACCP Forms
HACCP Planning to Prevent the Spread of Invasive Species

HACCP Step 2 – Activity Flow Chart
Outline Sequential Tasks of Activity

Task 1	Title:
	Description:
	
Task 2	Title:
	Description:
	
Task 3	Title:
	Description:
	
Task 4	Title:
	Description:
	
Task 5	Title:
	Description:

Appendix A – Blank HACCP Forms
HACCP Planning to Prevent the Spread of Invasive Species

HACCP Step 3 – Identify Potential Non-Targets

Non-Targets That May Potentially Be Moved/Introduced
Vertebrates:
Invertebrates:
Plants:
Other Organisms (pathogens, parasites, etc.):

Appendix A – Blank HACCP Forms
HACCP Planning to Prevent the Spread of Invasive Species

HACCP Step 4 – Non-Target Analysis Worksheet

1	2	3	4	5	6	7
Tasks	Potential Non-targets	Risk Assessment	Justification	Control	CCP?	Justification
(From Step 2)	(From Step 3)	Are any non-targets significant? Yes or No	Justify your answer in Column 3	What control measures can be applied during this task to reduce the risk of non-targets?	Is this task a CCP? Yes or No	Justify your answer in Column 6

Task # Title:	Vertebrates					
	Invertebrates					
	Plants					
	Others					

Task # Title:	Vertebrates					
	Invertebrates					
	Plants					
	Others					

Additional copies of this worksheet may be necessary, depending on how many tasks are required by your activity. Typical HACCP plans have between four and ten tasks.

Appendix A – Blank HACCP Forms
HACCP Planning to Prevent the Spread of Invasive Species

HACCP Step 5 – Non-Target Risk Action Plan (NTRAP)

(Use this form for any "Yes" from Column 6 of HACCP Step 4 - Non-Target Analysis Worksheet) One page for each Critical Control Point			
Management Objective From Step 1			
Critical Control Point: Task #		Title:	
Significant Non-Target(s) (Step 4, Column 3)			
Control Measure(s) (Step 4, Column 5)			
Precribed ranges, limits, or criteria for control measure(s): (PRLC)			
Monitoring the Control Measure(s)		Who?	
		How?	
		Where?	
		How often?	
Corrective Action(s) if Control Measures Fail (or PRLC cannot be met)			
Supporting Documents (For example, Management Plan, Checklist, Decontamination Techniques, SOPs, Scientific Journal Articles, etc.)			
Development Team Members			
Date Developed:		Date(s) Reviewed:	

** all gray fields are required*

Additional copies of this worksheet may be necessary, depending on how many Critical Control Points are found in your activity. Typical HACCP plans have one or two CCPs.

Appendix B – Example HACCP Forms (completed)
HACCP Planning to Prevent the Spread of Invasive Species

Appendix B - Example HACCP Forms (completed)

Hypothetical Example HACCP Plan

This example is based on riparian habitat surveys, a specific activity conducted by the fictitious Cutthroat Trout National Fish Hatchery. Staff members of this facility measure riparian vegetation densities within the Thompson River Basin once a month throughout the year. The purpose of the surveys is to gather data and information on riparian habitat to guide cutthroat trout recovery actions within the Thompson River Basin. Specialized survey gear is stored, while not in use, in a warehouse on Hatchery property. Surveys are begun by first retrieving necessary gear from the warehouse at the beginning of the day. Once loaded into a pickup truck, staff members travel with the gear to the sampling site chosen for the day. After the gear is unloaded, the staff conducts the sampling activity using the appropriate gear. At the end of the day, staff members return the gear to the truck, load it, and then return to warehouse. The gear is then unloaded and put away until needed for the next survey. Within the Thompson Basin, several potential invasive species, parasites or diseases have been determined to be of significant concern. These include bullfrogs (*Rana catesbeiana*), New Zealand mud snails (*Potamopyrgus antipodarum*), Eurasian milfoil (*Myriophyllum spicatum*), purple loosestrife (*Lythrum salicaria*), Chytrid fungus, and whirling disease (*Myxobolus cerebralis*).

On the following pages is a completed HACCP plan that covers the activity described above.

Appendix B – Example HACCP Forms (completed)
HACCP Planning to Prevent the Spread of Invasive Species

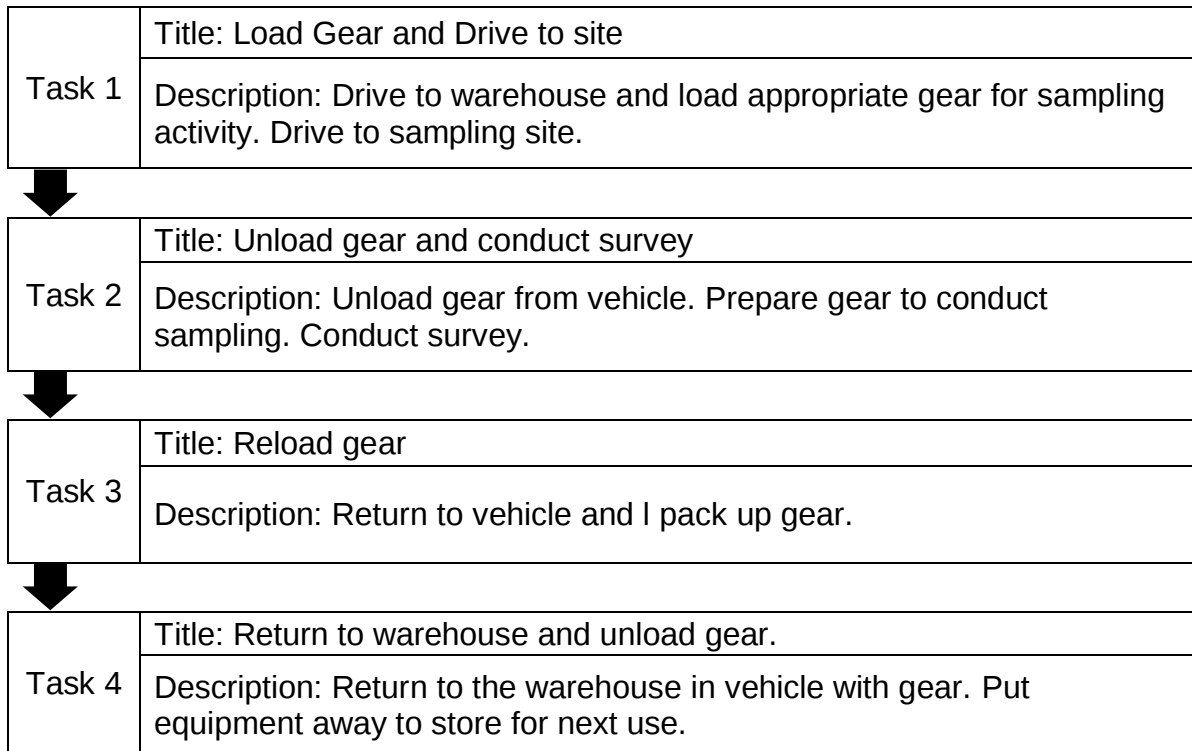
HACCP Step 1 – Activity Description

Management Objective & Contact Information	
Title: Hypothetical HACCP Plan	
Management Objective: Habitat survey for the recovery of cutthroat trout (CT)	Contact Person: Jonathan Thompson
	Phone: (800) LUV-FISH
	Email: jonathan_thompson@fws.gov

Activity Description i.e. Who; What; Where; When; How; Why
Who: Cutthroat Trout National Fish Hatchery personnel What: Measurement of Riparian Vegetation Density Where: Thompson River Basin When: Year-round, once a month How: Retrieve the appropriate gear from a warehouse at the beginning of the day. Travel to the sampling site and conduct the sampling activity. Return to the warehouse. Gear is unloaded and stored. Why: To gather data and information on riparian habitat to guide cutthroat trout recover actions

Appendix B – Example HACCP Forms (completed)
HACCP Planning to Prevent the Spread of Invasive Species

HACCP Step 2 – Activity Flow Chart
Outline Sequential Tasks of Activity



Appendix B – Example HACCP Forms (completed)
HACCP Planning to Prevent the Spread of Invasive Species

HACCP Step 3 – Identify Potential Non-Targets

Non-Targets That May Potentially Be Moved/Introduced	
Vertebrates: Amphibians Bullfrog (<i>Rana catesbeiana</i>)	
Invertebrates: New Zealand Mudsail (<i>Potamopyrgus antipodarum</i>)	
Plants: Eurasian milfoil (<i>Myriophyllum spicatum</i>) Purple loosestrife (<i>Lythrum salicaria</i>)	
Other Organisms (pathogens, parasites, etc.): Chytrid fungus Whirling disease (<i>Myxobolus cerebralis</i>)	

Appendix B – Example HACCP Forms (completed)
HACCP Planning to Prevent the Spread of Invasive Species

HACCP Step 4 – Non-Target Analysis Worksheet

1 Tasks (From Step 2)	2 Potential Non-targets (From Step 3)	3 Risk Assessment Are any non- targets significant? Yes or No	4 Justification Justify your answer in Column 3	5 Control What control measures can be applied during this task to stop the spread of non-targets?	6 CCP? Is this task a CCP? Yes or No	7 Justification Justify your answer in Column 6
Task #1 Title: Load gear and drive to site	Vertebrates Amphibians, including bullfrogs	No	Risk is low because all equipment was cleaned and disinfected following prior use	N/A	No	There are no significant non- targets during this task.
	Invertebrates NZMS	No		N/A	No	
	Plants Eurasian milfoil Purple loosestrife	No		N/A	No	
	Others Chytrid fungus Whirling disease	No		N/A	No	
Task #2 Title: Unload gear and conduct sampling	Vertebrates Amphibians, including bullfrogs	No	Risk is low because sampling occurs only at one location, plus all equipment was cleaned and disinfected before storage	N/A	No	There are no significant non- targets during this task.
	Invertebrates NZMS	No		N/A	No	
	Plants Eurasian milfoil Purple loosestrife	No		N/A	No	
	Others Chytrid fungus Whirling disease	No		N/A	No	

Appendix B – Example HACCP Forms (completed)
HACCP Planning to Prevent the Spread of Invasive Species

HACCP Step 4 – Non-Target Analysis Worksheet

1 Tasks (From Step 2)	2 Potential Non-targets (From Step 3)	3 Risk Assessment Are any non- targets significant? Yes or No	4 Justification Justify your answer in Column 3	5 Control What control measures can be applied during this task to stop the spread of non-targets?	6 CCP? Is this task a CCP? Yes or No	7 Justification Justify your answer in Column 6
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Task #3 Title: Reload gear	Vertebrates Amphibians, including bullfrogs	Yes	High risk that bullfrog eggs or adults may be in gear after sampling	Visually inspect all gear for non-targets and remove anything found by hand before proceeding to Task #4	No	Hand removal, cleaning, and disinfecting would be better accomplished in Task #4 at a decontamination station back at the warehouse.
	Invertebrates NZMS	Yes	High risk that invertebrates could be in gear after sampling		No	
	Plants Eurasian milfoil Purple loosestrife	Yes	High risk that plants or seeds could be attached to gear after sampling		No	
	Others Chytrid fungus Whirling disease	Yes	High risk that unwanted organisms could survive on gear		No	

Task #4 Title: Return to warehouse and unload gear	Vertebrates Amphibians, including bullfrogs	Yes	High risk that bullfrog eggs or adults may be in gear after sampling	Remove any vertebrates then clean and disinfect all equipment using approved disinfectant solution to kill eggs.	Yes	If the equipment is not decontaminated during this task, then it will not be clean for use next time it is needed. This task is the point of no return.
	Invertebrates NZMS	Yes	High risk that invertebrates could be in gear after sampling	Clean and disinfect all equipment using approved disinfectant solution.	Yes	
	Plants Eurasian milfoil Purple loosestrife	Yes	High risk that plants or seeds could be attached to gear after sampling	Clean and disinfect all equipment using approved disinfectant solution and rinse undercarriage of vehicles with high- pressure water spray.	Yes	
	Others Chytrid fungus Whirling disease	Yes	High risk that unwanted organisms could survive on gear	Clean and disinfect all equipment using approved disinfectant solution.	Yes	

Appendix B – Example HACCP Forms (completed)
HACCP Planning to Prevent the Spread of Invasive Species

HACCP Step 5 – Non-Target Risk Action Plan (NTRAP)

(Use this form for any "Yes" from Column 6 of HACCP Step 4 - Non-Target Analysis Worksheet) One page for each Critical Control Point			
Management Objective From Step 1		Habitat Survey for the Recovery of Cutthroat Trout (CT)	
Critical Control Point:	Task # 4	Title:	Return to warehouse and unload gear
Significant Non-Target(s) (Step 4, Column 3)		Vertebrates, Invertebrates, Plants, and Other Organisms (All listed in step 3)	
Control Measure(s) (Step 4, Column 5)		Clean and disinfect all equipment using approved disinfectant solution	
Prescribed ranges, limits, or criteria for control measure(s): (PRLC)		Use disinfectant solution that contains quaternary ammonium mixed at a concentration of at least 1% but no more than 3%. Contact time with gear must be at least 10 minutes.	
Monitoring the Control Measure(s)		Who? Hatchery staff	
		How? Check immersion time with timer. Ensure concentration is correct with AQA1507 Quaternary Ammonium Test Kit (or similar)	
		Where? Decontamination station at the warehouse	
		How often? Every time that gear is unloaded and stored	
Corrective Action(s) if Control Measures Fail (or PRLC cannot be met)		Mix new (fresh) dosage of disinfectant solution and repeat the cleaning/disinfectant procedure from the beginning. If gear cannot be disinfected, it must be clearly tagged as "contaminated" and isolated until it can be disinfected before being allowed back in the field.	
Supporting Documents (For example, Management Plan, Checklist, Decontamination Techniques, SOPs, Scientific Journal Articles, etc.)			
Logan River Sampling Protocol, Louanne River Sampling Protocol, Quaternary Ammonium Disinfectant Information Sheet, Nevada Noxious Weed List, California Noxious Weed List			
Development Team Members		Jonathan Thompson, Ronald Smith, Louanne McMartin	
Date Developed:	7/29/2010	Date(s) Reviewed:	Not yet reviewed

** all gray fields are required*

Appendix B – Example HACCP Forms (completed)
HACCP Planning to Prevent the Spread of Invasive Species

HACCP Step 5 – Non-Target Risk Action Plan (NTRAP)

(Use this form for any "Yes" from Column 6 of HACCP Step 4 - Non-Target Analysis Worksheet) One page for each Critical Control Point			
Management Objective From Step 1		Habitat Survey for the Recovery of Cutthroat Trout (CT)	
Critical Control Point:	4	Title:	Return to warehouse and unload gear
Significant Non-Target(s) (Step 4, Column 3)		Vertebrates (Bullfrogs)	
Control Measure(s) (Step 4, Column 5)		Visually inspect gear and remove all visible adult bullfrogs	
Precribed ranges, limits, or criteria for control measure(s): (PRLC)		Check all exposed areas at least twice until no visible adult bullfrogs remain.	
Monitoring the Control Measure(s)		Who? Field crew supervisor	
		How? Visual observation	
		Where? Decontamination station at the warehouse	
		How often? Every time that gear is unloaded and stored	
Corrective Action(s) if Control Measures Fail (or PRLC cannot be met)		Have another staff member repeat the control measure.	
Supporting Documents (For example, Management Plan, Checklist, Decontamination Techniques, SOPs, Scientific Journal Articles, etc.)			
Logan River Sampling Protocol, Louanne River Sampling Protocol, Quaternary Ammonium Disinfectant Information Sheet, Nevada Noxious Weed List, California Noxious Weed List			
Development Team Members		Jonathan Thompson, Ronald Smith, Louanne McMartin	
Date Developed:	7/29/2010	Date(s) Reviewed:	Not yet reviewed

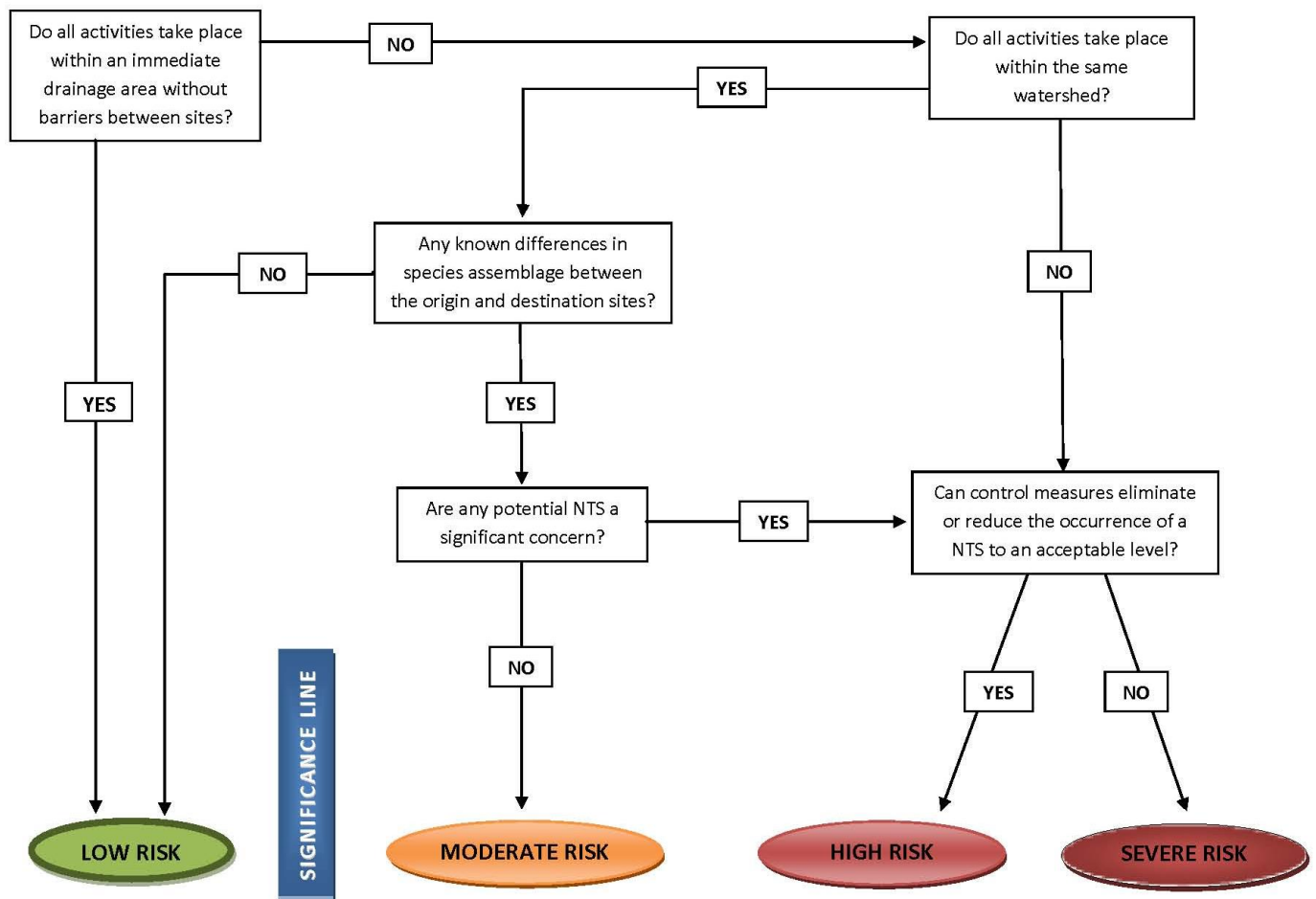
* all gray fields are required

Appendix C – Risk Assessment Diagrams
HACCP Planning to Prevent the Spread of Invasive Species

Appendix C - Risk Assessment Diagrams

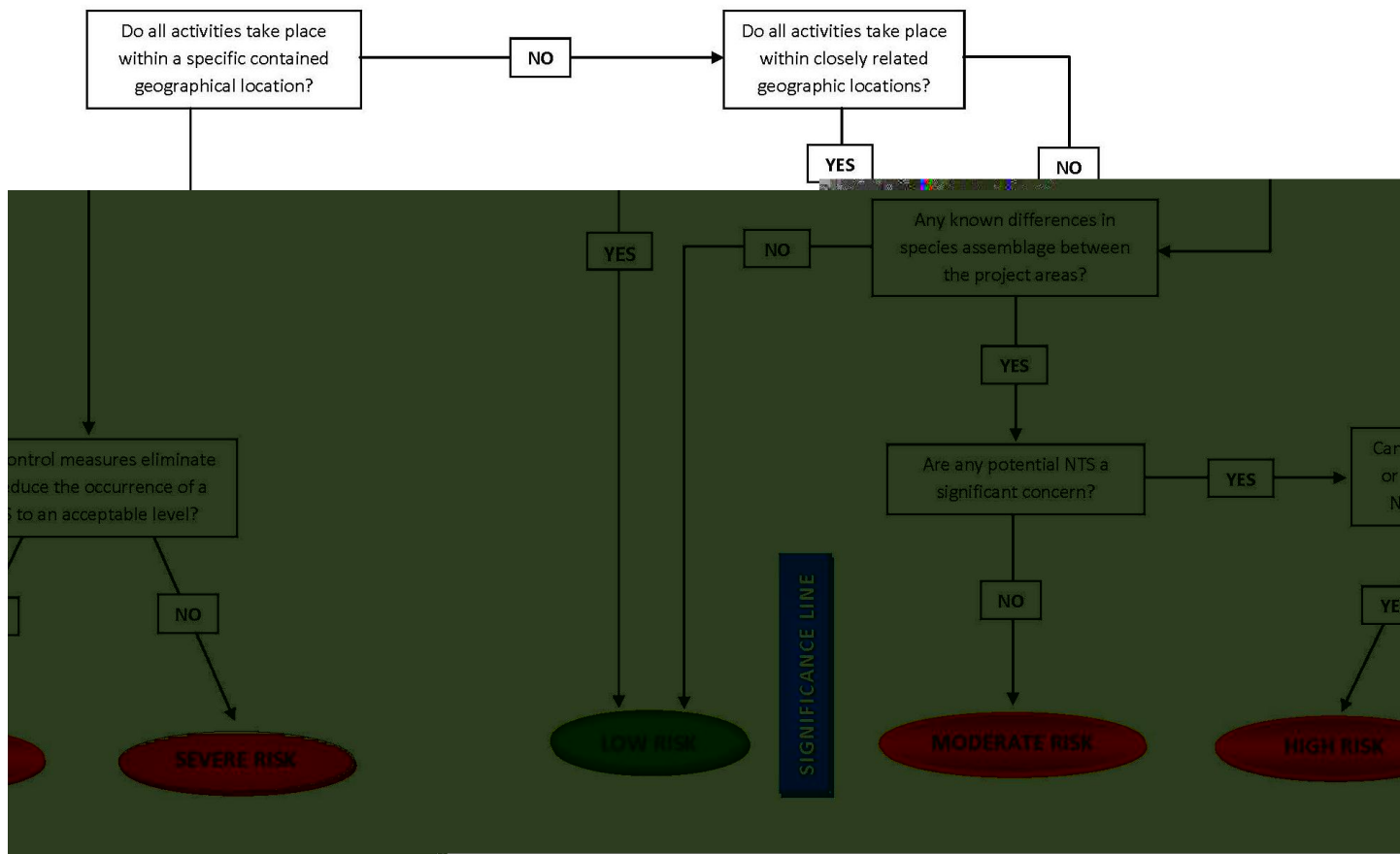
HACCP Planning to Prevent Invasive Species

RISK ASSESSMENT DIAGRAM FOR AQUATIC MANAGEMENT ACTIVITIES



Appendix C – Risk Assessment Diagrams

HACCP Planning to Prevent the Spread of Invasive Species

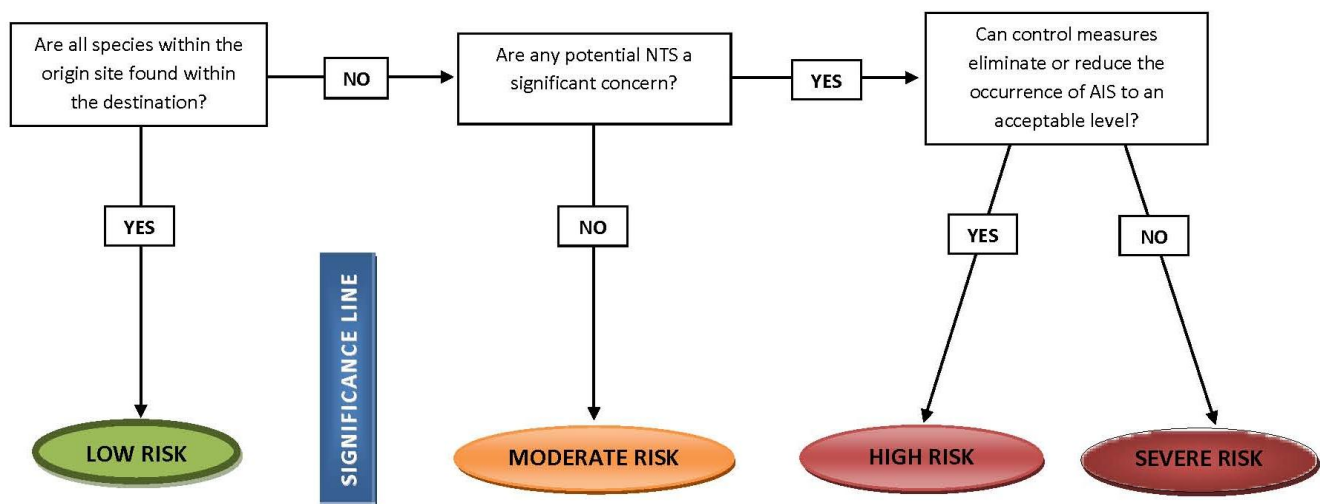


Appendix C – Risk Assessment Diagrams

HACCP Planning to Prevent the Spread of Invasive Species

HACCP Planning to Prevent Invasive Species

RISK ASSESSMENT DIAGRAM FOR THE MOVEMENT OF NATURAL RESOURCES



Appendix D – Critical Control Point Decision Tree
HACCP Planning to Prevent the Spread of Invasive Species

Appendix D – Critical Control Point Decision Tree

