

# Final Wetland Mitigation Plan NC 12 Replacement of Herbert C. Bonner Bridge (Bridge No. 11) over Oregon Inlet

---

*Federal-Aid No. BRS-2358(15)*

*NCDOT Project Definition: 32635*

*TIP Project No. B-2500*

*Dare County, North Carolina*

*Prepared by*

*United States National Park Service*

*North Carolina Department of Transportation*

*January 30, 2013*

## TABLE OF CONTENTS

|  |    |
|--|----|
| BASELINE INFORMATION .....                             | 3  |
| MITIGATION GOALS AND OBJECTIVES .....                  | 4  |
| MITIGATION OBJECTIVES .....                            | 5  |
| AFFECTED WETLANDS AND MITIGATION .....                 | 8  |
| INTENDED COMPENSATION CONTRIBUTION .....               | 8  |
| ONSITE MITIGATION .....                                | 9  |
| EFFECTS OF PHRAGMITES INVASION OF COASTAL MARSHES..... | 11 |
| TREATMENT OPTIONS .....                                | 13 |
| PROPOSED MITIGATION .....                              | 14 |
| WORK PLAN .....  | 14 |
| ADAPTIVE MANAGEMENT .....                              | 16 |
| SITE PROTECTION AND MAINTENANCE .....                  | 21 |
| FINANCIAL ASSURANCES .....                             | 21 |
| PROJECT COMMITMENTS.....                               | 21 |

## **BASELINE INFORMATION**

This Wetland Mitigation Plan details the proposed mitigation to be performed by the North Carolina Department of Transportation (NCDOT) for wetland impacts associated with the NC 12 Replacement of the Herbert C. Bonner Bridge over Oregon Inlet. Impacts to Section 404 jurisdictional wetlands on Federally owned lands managed by the National Park Service (NPS) and by the United States Fish and Wildlife Service (USFWS), within the Cape Hatteras National Seashore (the Seashore), will occur during Phase I of the bridge replacement. The proposed mitigation will be used to offset impacts for Phase I and for future phases as appropriate. Section 404 jurisdictional wetland impacts associated with Phase I of the Selected Alternative will be approximately 0.50 acres, of which 0.02 acres are considered CAMA jurisdictional wetlands.

The NPS worked with NCDOT to identify potential compensatory mitigation sites for the anticipated impacts to Section 404 jurisdictional wetlands. Several mitigation options were explored and prioritized. These options are discussed in detail in the Final Environmental Impact Statement (FEIS) dated September 17, 2008.

The NPS identified restoration of high-quality wetland communities designated as Significant Natural Heritage Areas (SNHAs) within the NPS property as the highest priority mitigation option. Many sites with high-quality or rare natural communities, rare species, and special animal habitats have been identified by the NPS and North Carolina Heritage Program (NCNHP) as being important for conservation of the State's biodiversity. The ecological significance of these areas has been documented through a 1987 Registry agreement, as amended, for the protection and management of Significant Natural Heritage Areas (SNHAs).

The NPS has identified the Bodie Island Lighthouse Pond SNHA as one such area (vicinity of 35°49'7.07"N, 75°33'48.60"W). NCDOT field surveys and mapping efforts estimated that approximately 50 acres of formerly *Spartina*-dominated marsh habitat has been displaced by the invasion of the exotic plant *Phragmites* in an area surrounding the Bodie

Island Lighthouse. This *Wetland Mitigation Plan* identifies the proposed work plan and performance measures to guide the restoration of the former marsh habitat through exotic plant control measures in this area of high management priority within the Seashore.

## **MITIGATION GOALS AND OBJECTIVES**

The goal of this proposed mitigation plan is to compensate for unavoidable wetland impacts by developing a single proposal that (a) meets the compensation requirements of both the Executive Order 11990: Protection of Wetlands and the USACE Section 404 permit procedures (33 CFR 320-330); and (b) meets the NPS goal of “no net loss of wetlands” on NPS property. As explained in E.O. 11990, a Wetland Statement of Findings (SOF) must be prepared if an NPS action has the potential to have adverse impacts on wetlands unless the action is “excepted”. A Wetland SOF is being prepared under separate cover for the B-2500 bridge replacement project. This mitigation plan is excepted from the requirement of a Wetland SOF under Section 4.2.1 (h): **Actions designed to restore degraded (or completely lost) wetland, stream, riparian, or other aquatic habitats or ecological processes.**

*Compensatory mitigation* means the restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved. Restoration should generally be the first option considered because the likelihood of success is greater and the impacts to potentially ecologically important uplands are reduced compared to establishment, and the potential gains in terms of aquatic resource functions are greater, compared to enhancement and preservation.

Mitigation options are defined below according to **COMPENSATORY MITIGATION FOR LOSSES OF AQUATIC RESOURCES, 33 CFR PART 332:**

1. **Restoration** means the manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or

degraded aquatic resource. For the purpose of tracking net gains in aquatic resource area, restoration is divided into two categories: re-establishment and rehabilitation.

- a. **Re-establishment** means the manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former aquatic resource. Re-establishment results in rebuilding a former aquatic resource and results in a gain in aquatic resource area and functions.
  - b. **Rehabilitation** means the manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded aquatic resource. Rehabilitation results in a gain in aquatic resource function, but does not result in a gain in aquatic resource area.
2. **Establishment** (creation) means the manipulation of the physical, chemical, or biological characteristics present to develop an aquatic resource that did not previously exist at an upland site. Establishment results in a gain in aquatic resource area and functions.
  3. **Enhancement** means the manipulation of the physical, chemical, or biological characteristics of an aquatic resource to heighten, intensify, or improve a specific aquatic resource function(s). Enhancement results in the gain of selected aquatic resource function(s), but may also lead to a decline in other aquatic resource function(s). Enhancement does not result in a gain in aquatic resource area.
  4. **Preservation** means the removal of a threat to, or preventing the decline of, aquatic resources by an action in or near those aquatic resources. This term includes activities commonly associated with the protection and maintenance of aquatic resources through the implementation of appropriate legal and physical mechanisms. Preservation does not result in a gain of aquatic resource area or functions.

### *MITIGATION OBJECTIVES*

The proposed on-site mitigation, defined as restoration above, provides for the rehabilitation of the integrity of natural resources, native vegetation mosaic, and habitat values at the Bodie Island Lighthouse Pond. In a December 2010 meeting with NCDOT, the NPS identified this site as a high management priority within the Seashore.

Examples of high management priority areas are areas that have been jointly identified by NPS and the North Carolina Natural Heritage Program (NCNHP) and are Registered Significant Natural Heritage Areas (SNHAs). Registration of SNHAs means that the NPS and NCNHP have signed a Registry agreement that documents their joint interest and commitment to protect the integrity of natural resources within a particular area. The 1987 Registry agreement states that the NPS will:

....refrain from making or permitting changes that negatively affect the natural values for which [these areas were] registered....Specifically, the National Park Service agrees to manage and maintain the designated natural areas for the perpetuation and protection of their primary biological resources. In some cases, manipulation—by burning, mowing, cutting, control of exotic species, managed water levels, or placement of dredged materials—may be appropriate to control natural vegetational succession and maintain habitats for rare or special-interest species...A monitoring program will be maintained for endangered and threatened species of animals and plants.

Each SNHA profile includes specific management action recommendations. The following management goals in this plan are based on those identified in national invasive species guidance, including the *National Invasive Species Management Plan* (National Invasive Species Council, 2008). Each goal has a set of related management objectives, which are statements of purpose that describe what must be accomplished for the plan to be considered a success in the Seashore. Adaptive management, an integral part of this plan, is a process that allows for decision making in spite of uncertainty, with an aim to reduce uncertainty over time via system monitoring. This process allows resource objectives to be met while information is gathered and lessons are learned, in hopes of continually improving future management.

Independent of the specific project location, the following goals and management objectives are applicable to exotic plant control efforts within the Seashore:

**Goal 1: Inventory** – Initiate a comprehensive and systematic exotic plant inventory to establish a baseline from which to measure progress.

*Management Objectives:*

- Document the abundance and distribution of exotic plants in the target areas
- Provide a foundation for prioritizing threats and for carrying out management planning efforts
- Provide a foundation for the development of short- and long-term programmatic plans

**Goal 2: Treatment** – Treat exotic plant populations that pose the greatest threat to park resources.

*Management Objectives:*

- Use the most effective and appropriate tool, or combination of tools, to eradicate or reduce the impact of exotic plants
- Reduce the impact of exotic plants on sites of cultural, scenic, and high ecological value, including habitat for special status species
- Restore ecosystems and key ecological processes that have been affected by invasive species to meet desired future conditions
- Integrate ecological restoration practices in exotic plant control treatments to guard against reinfestation
- Minimize secondary impacts from control efforts
- Protect human health and safety of persons potentially affected by the exotic plant control treatments

**Goal 3: Monitoring** – Ensure that the exotic plant control program is regularly monitored and improved, environmentally safe, and supported by science and research.

*Management Objectives:*

- Monitor and evaluate the overall program effectiveness to inform management regarding whether the program is of sufficient scope to meet program goals

- Monitor and evaluate the effectiveness of control techniques by species and adapt as necessary, based on results
- Monitor effects on native plant communities, based on results, adapt control techniques
- Identify vectors of spread to determine ways of preventing new species and populations from becoming established in targeted areas
- Promote research in the park upon which to base future management decisions

**Goal 4: Educate, Outreach, and Research** – Educate, inform, consult, and collaborate with stakeholders (e.g., NPS and other government agencies, organizations, concessioners, visitors, partners, private property owners, and gateway communities) to share information and address exotic plant issues.

*Management Objectives:*

- Continue developing partnerships to encourage participation in the management of exotic plants throughout the Outer Banks region
- Expand collaborative efforts among park neighbors, park partners, gateway communities, and the public to share methods of preventing and controlling the spread of exotic plants
- Ensure that interested parties are well-informed about the timing and locations of upcoming exotic plant control treatments
- Educate and inform park visitors on exotic plants
- Provide stewardship opportunities for the public
- Continue to support and develop exotic plant research

**AFFECTED WETLANDS AND MITIGATION**

*INTENDED COMPENSATION CONTRIBUTION*

The proposed construction of B-2500 will permanently impact 0.50 acre of jurisdictional wetlands, which includes 0.01 acre CAMA jurisdictional wetlands.

Individual impact sites and acres are summarized in the wetland impact sheet included in the permit application. Specific community descriptions and wetland types are described in detail in the Final Environmental Impact Statement dated September 2008.

### *ONSITE MITIGATION*

To date, the NPS has identified the rehabilitation of approximately 50 acres of wetland within the Bodie Island Lighthouse Pond SNHA as the highest priority site for the proposed on-site mitigation for wetland impacts. The NPS and NCNHP identified control of exotic plant species is essential to prevent the degradation or loss of function of this SNHA.

#### Bodie Island Lighthouse Pond SNHA (Site Id #1134)

The Bodie Island Lighthouse Pond is located on the Oregon Inlet 7.5 USGS topographic quad map, approximately 3 miles north of Oregon Inlet. It is the largest pond in the Seashore, measuring nearly one mile long and 0.4 mile wide. This fresh to slightly brackish pond is likely not a natural body of water. It was probably created by a waterfowl hunt club by placing a dam on a small outlet stream to the Pamlico Sound. However, the history of the pond is poorly known, and it predates the designation of the Cape Hatteras National Seashore.

Today, the Lighthouse Pond is primarily used for nature study. Large numbers of birdwatchers and sightseers visit the pond each year, accessing the Pond area on a recently upgraded (now handicap-accessible) wildlife viewing platform. Hunting and fishing are prohibited.

The site was described by the NCNHP as having significance due to its outstanding collection of water birds, with several rare plant and animal species. Historically, the pond was bordered by a diverse, though somewhat narrow, border of fresh-brackish marsh. Several rare plants occurred in the marsh. The Lighthouse Pond is habitat for very large numbers of waterbirds, making it one of the best bird watching sites in North Carolina

(Buchanan 2009). For most of the year, thousands of waterbirds forage in the mud and shallow water at the pond. Several species of waterfowl nest in the vegetation at the edge of the pond, including black duck, gadwall, and blue-winged teal. During the warmer months a large variety of shorebirds, herons, egrets, and ibises forage at the pond. Several uncommon shorebird species occur annually, including Hudsonian godwit and Wilson's phalarope. From early autumn into spring, the pond is often covered with waterfowl including tundra swans, Canada geese, and snow geese. Peregrine falcons pass through the area in fall migration, and one or two individuals are often present in the vicinity of the pond in fall or winter.

The following lists the special status species of plants and animals known to occur in the vicinity of the pond:

- Black-necked stilt (*Himantopus mexicanus*), State Significantly Rare
- Peregrine falcon (*Falco peregrinus*), State Endangered
- Black rail (*Laterallus jamaicensis*), State Species of Concern
- Saltmarsh spikerush (*Eleocharis halophila*), State Threatened
- Beaked spikerush (*Eleocharis rostellata*), State Threatened
- Olney's three-square (*Schoenoplectus americanus*), State Watch List

The 1987 Registry agreement includes specific management and protection recommendations for the Bodie Island Lighthouse Pond SNHA. The site will continue to be a visitor destination within the Seashore, for birdwatchers and lighthouse tourists alike. However, the NPS is presently neither managing the water level for the benefit of the bird populations nor is the NPS presently monitoring or managing infestations of exotic plant species, with a specific emphasis on *Phragmites australis*.

The European genotype of the common reed (*P. australis*) occurs in large bands around the edge of the pond; this is an exotic species which is now abundant in habitats once occupied by the genotype native to the United States. Population decline and local extinctions of the native genotypes may be a result of competitive displacement by the exotic genotype

and/or anthropogenic disturbance. Approximately 900 acres of marsh are infested by the exotic *P. australis* throughout the entire Seashore. In 2008, the NPS originally estimated and mapped approximately 35 acres of marsh infested by the exotic *P. australis* within the Bodie Island Lighthouse Pond SNHA. In 2011, NCDOT in coordination with NPS mapped 51.73 acres of phragmites within the marsh at Bodie Island Lighthouse pond.

#### *EFFECTS OF PHRAGMITES INVASION OF COASTAL MARSHES*

*Phragmites australis* is a tall perennial grass which can attain heights of up to 4.5 m (USACE 2005), significantly greater than that of native marsh species, such as *Spartina alterniflora*, *Spartina patens*, *Juncus roemarianus*, and *Typha latifolia*. Although it is a prolific seed producer, *Phragmites* most often spreads locally through vigorous growth of rhizomes and stolons, which can grow up to 2 m per year (Batterson and Hall 1984). *Phragmites* can eventually sustain stem densities of up to 300 culms per square meter through development of a dense root mat (Hara et al. 1993). In addition to vigorous biomass growth, *Phragmites* is also reported to release the allelopathic chemical gallic acid into the soil, which inhibits the establishment and growth of other marsh species (Rudrappa et al. 2007). As a result of these physiological characteristics, *Phragmites*, once established, frequently develops dense, monospecific colonies over extensive areas and can exclude shorter native marsh species (USACE 2005). The Virginia Department of Conservation and Recreation (2009) reported that aggressive *Phragmites* colonies threatened the habitat of 29 rare plant species in Virginia.

The effect of *Phragmites* invasion on communities of associated wildlife has been most pronounced with respect to birds. While the observed effect on populations of native fish, benthic infauna, aquatic invertebrates, and decapod crustaceans has been variable (Posey et al. 2003, Hanson et al. 2002, Able and Hagan 2000, Fell et al. 1998), the shift in habitat from native low marsh vegetation to monotypic stands of *Phragmites* has demonstrated a more consistent effect on bird populations. In a study of marsh birds in Connecticut, it was demonstrated that there were fewer species present in *Phragmites*-dominated stands than in native short-grass marshes, particularly among rare bird species (Benoit and Askins 1999).

The authors concluded that the dense, monotypic stands of *Phragmites* reduce the structural habitat heterogeneity and plant diversity needed by many species. In addition, the height and density of the thick *Phragmites* stems may physically exclude waterfowl and wading birds from the marsh interior, or substantially reduce hunting efficiency, rendering these sites unproductive. Similarly, Bontje (1987) found increased bird richness in restored cordgrass marshes compared with reference *Phragmites*, and Paxton (2007) reported that avian marsh species in Virginia rarely utilized stands of *Phragmites*. *Phragmites* has been reported to negatively affect the habitat of 22 rare animal species including 13 birds in the state of Virginia (VDCR 2009).

Some researchers have suggested that changes in vegetation growth form and structure between native marsh grasses and invasive *Phragmites* may affect soil and hydrology characteristics of wetland sites. *Phragmites* colonies typically have fewer but significantly larger stems than native species, which may affect water flow through the marsh, sediment deposition rates and processes, detrital production and accumulation rates, sediment organic content, and nutrient cycling (Meyerson et al. 2000, Talley and Levin 2001, Rooth and Stevenson 2000, Windham 2001, Leonard et al. 2002). Windham and Lathrop (1999) stated that *Phragmites* stands may increase detritus accumulation over time, and thus, may elevate the substrate surface and smooth surface microtopography. Such gradual aggradation of the substrate surface may ultimately eliminate surface hydrology features relevant to aquatic species. *Phragmites* stands have demonstrated significantly greater rates of internal nitrogen cycling (both immobilization and mineralization) as compared to stands of native *Spartina patens* (Windham and Ehrenfeld 2003). *Phragmites* sequestered more nitrogen in live biomass and detritus compared to *Spartina patens*, but simultaneously stimulated microbial nitrogen mineralization at an equivalent rate, potentially affecting total nitrogen pools within the wetland along with pathways of nitrogen export. Similarly, Findlay et al. (2003) demonstrated that the ability of wetlands to serve as a nitrogen sink was reduced when former *Phragmites* stands were restored to a more diverse plant community.

## TREATMENT OPTIONS

Throughout the United States and Europe, a full suite and combination of physical and chemical techniques have been tested experimentally in laboratory and field conditions to gain insight into the control and eradication of exotic *P. australis*. Experimental control efforts have varying degrees of success, and no singular effective technique has been identified as the best approach to managing *P. australis* infestations. Physical controls tested include manual and mechanical means of inducing stress (e.g., shading, drowning, mowing, burning), alteration of site hydrology (e.g., filling ditches, creating ditches, creating ponds), and excavation of root systems.

Minchinton and Bertness (2003) demonstrated that alteration of vegetation adjacent to *P. australis* plots and nutrient pulses each resulted in increased density, height, and biomass of *P. australis* shoots. The combination of these treatments also resulted in an increase in the distance that shoots expanded and their reproductive output. Thus, limiting disturbance of native vegetation and reducing nutrient loading are critical to preventing the spread of existing *P. australis* infestations.

Chemical controls include herbicide application, typically in combination with some form of physical control for well-established infestations in large areas. Chemical control of *P. australis* has been achieved most frequently with a foliar application of imazapyr or glyphosate, a non-selective herbicide, applied in July to mid-September. (Mozdzer et al, 2008) Herbicide application followed by burning has shown to be relatively effective and may stimulate the native plant community recovery (Boone et al, 1987)

The NPS has completed an Environmental Assessment for the Outer Banks Group Fire Management Plan (2001) and a Finding of No Significant Impact (FONSI) was received (2002) to allow the Seashore to use prescribed burning to manage hazardous fuel loads. The Seashore conducted a prescribed burn in early 2012.

## **PROPOSED MITIGATION**

The NCDOT proposes to restore of approximately 50 acres of phragmites dominated wetland within the Bodie Island Lighthouse Pond SNHA by rehabilitation to its former function as a brackish marsh. NCDOT proposes a 5:1 ratio for this onsite wetland restoration to offset wetland impacts associated with Phase I of B-2500. Remaining assets on the site must have regulatory agency approval prior to use as mitigation on other projects.

### *WORK PLAN*

#### **Goal 1: Inventory**

The NPS identified that control of exotic plant infestation in the Bodie Island SNHAs is the highest priority site for the proposed mitigation for wetland impacts resulting from the bridge replacement project.. In 2008, the NPS preliminarily estimated and mapped approximately 35 acres infested by the exotic *P. australis* within this SNHA. In 2011, NCDOT mapped 51.73 acres based on field surveys and photogrammetric analysis as shown in Figure 1 below.

Prior to site treatment, fixed photo points and vegetation survey plots and will be established within the marsh area. Photo points will be established near the edges of phragmites stands. Fourteen (14) 1 square-meter plots will be randomly located within the surveyed phragmites stands outlined in yellow on Figure 1 below. Additional plots will be located outside the phragmites stands as control plots. Vegetation plots will be inventoried for % aerial coverage of phragmites within each plot. Native vegetation will also be recorded.

Figure 1



## Goal 2: Treatment

The use of herbicide treatment(s) (initial and spot treatments) is recommended as the primary control method and the first step toward effective control. After the initial herbicide treatment, one or more follow-up methods at each site will be required.

NCDOT and NPS treatment plan follows procedures established in *A Guide to the Control and Management of Invasive Phragmites, 2<sup>nd</sup> Edition* published by the Michigan Department of Natural Resources in cooperation with several other state and federal agencies. The guide presents a compilation of techniques, based on four years of research and more than ten years of land managers' on-the-ground experience, to control the nonnative variety of phragmites.

NCDOT will follow the Guide's specific recommendations of Approach 2 management strategy for large, dense stands of phragmites on a wet site:

1. Treat phragmites stands with Imazapyr and Glyphosate herbicides in mid-summer or late summer. Wait at least two weeks to allow plant exposure.
2. If prescribed burning is recommended, conduct in the year following herbicide treatment either in winter (January until prior to spring green-up) or during the summer.
3. Check site the following growing season for phragmites regrowth and spot-treat with herbicide if needed.

### *ADAPTIVE MANAGEMENT*

Controlling *Phragmites* infestations has proven to be a challenging and unpredictable undertaking for resource managers and landowners across the country. Therefore, adaptive management is crucial for this wetland restoration project to be successful. Adaptive management is a process that allows for decision making in spite of uncertainty, with an aim to reduce uncertainty over time via system monitoring. Our goal is that NCDOT and NPS Resource Management (RM) staff at CAHA keeps open communication throughout the duration of the mitigation project in order to achieve success. The following outline is proposed for the duration of the monitoring period to allow for annual adjustment in the treatment plan based on success criteria.

- January-March, annually
  - Prepare and submit NPS Pesticide Use Proposal (PUP) must be submitted by NPS on annual basis, requesting authorization to apply specific herbicide.
  - NPS will notify NCDOT of authorization to apply herbicides via PUP approval from the NPS Southeast Regional Office.
  - NPS authorizes herbicides on individual basis; therefore, there shall be no substitution of herbicide without written authorization via PUP approval.
  - Submit copy of current NC Certified Applicator License(s) must be submitted to NPS annually and prior to application of herbicide

- March-June, annually
  - Identify areas aerial treatment proposed to occur
    - Initial aerial treatment area includes the entire band of marsh around the Lighthouse pond (except where spot treatment preferred)
    - Subsequent aerial treatment areas will be determined by annual evaluation
  - Identify areas spot treatment proposed to occur
    - Initial spot treatment areas include areas in close proximity of listed species as identified by field surveys and areas in close proximity to visitor use as identified by NPS
    - Subsequent spot treatment areas will be determined by annual evaluation
  - Evaluate recover of target species
    - Identify areas not on target to meet success criteria for recover of target species (bare areas)
    - Determine if supplemental planting is appropriate
  
- Mid Summer through mid-November, annually
  - Conduct aerial or spot application of aquatic herbicide in identified areas
  - Herbicide must be stored, handled, applied, and disposed of by a NC Certified Applicator in accordance with the label and MSDS
  - NC Certified Applicator must be on-site when herbicides are being applied
  - NC Certified Applicator is accountable for any and all individuals working under Applicator's License
  - Daily Pesticide Use Log must be maintained by applicator
  
- By December 31, annually
  - Pesticide Use Log must be submitted to NPS
  - Monitoring report must be submitted to NPS and agencies

## AVOIDANCE MEASURES

In order to minimize adverse impacts to the resources at Bodie Island Lighthouse Pond, several mitigation measures must be put in place for proposed activities. These include, but are not limited to:

- Avoid impacts of herbicides to rare plants:
  - Physical cover for individual stems
  - Establish buffer zones around sizeable populations of rare plants
  - Minimize drift by applying herbicides with proper technique and under proper conditions through contract specifications. Table 1 below relates droplet size and expected drift.

Accuflow nozzles allow the user to customize the orifice size to accommodate different spray jobs. Each nozzle has an array of 32 needle outlets in a circular configuration. The system operates with 20 psi boom pressure and under 5 psi nozzle pressure. This boom/nozzle combination produces droplet sizes of 1000 - 1500 microns, depending on which orifice used.

**Table 1:** Influence of droplet size on distance of drift. (Klingman, Potts, Akesson, Yates)

| Droplet diameter<br>(microns) | Type of Droplet | Time Required<br>to fall 10 feet | Lateral distance<br>droplets travel<br>in a 3 mph wind |
|-------------------------------|-----------------|----------------------------------|--|
| 5                             | Fog             | 66 minutes                       | 3 miles  |
| 20                            | Very fine spray | 4.2 minutes                      | 1,100 feet   |
| 100                           | Fine spray      | 10 seconds                       | 44 feet  |
| 240                           | Medium spray    | 6 seconds                        | 28 feet  |
| 400                           | Coarse spray    | 2 seconds                        | 8.5 feet   |
| 1,000                         | Fine rain       | 1 second                         | 4.7 feet   |

- Avoid impacts to wetland soils/hydrology:
  - Use aerial application for initial treatments
  - Convert to backpack application after control established
  
- Avoid impacts to water quality:
  - Use herbicides that are safe for application in standing water
  - Prevent spills of contaminants from entering water bodies or wetlands
  
- Avoid impacts to visitor experience:
  - Perform herbicide application and prescribed burns when visitor use in the area is as minimal as possible (CAHA staff will provide preferred timeline)
  - Inform public of activities through posting signs, press releases, etc.
  
- Actions must be consistent with NC Coastal Area Management Act
  
- Prescribed burn actions must be consistent with Minimum Impact Suppression Tactics (MIST) practices and follow an approved burn plan

### **Goal 3: Monitoring**

Monitoring the results of *Phragmites* control treatments provides critical information that will allow NPS and NCDOT to assess the efficacy of their actions at the site. NCDOT will be responsible for all monitoring activities, including coordination with NPS and NHP.

- Fixed photo points will be established across the site at edges or boundaries of phragmites stands.
- Fourteen (14) 1 square-meter plots will be randomly located within the surveyed phragmites stands as shown on Figure 1. This density is less than recommended in the NMFS guidelines but data will be supplemented by aerial photo interpretation. Three (3) additional plots will be located outside the phragmites stands as control plots.

- The vegetation component of the wetland site will be deemed successful if the following criteria are met:
  - After the first year treatment, the total aerial coverage of dense phragmites stands decreases from the current 50 acres mapped as shown on Figure 1. This will be reported in the Spring of the following year.
  - This trend of decreased aerial coverage of mapped phragmites will continue each treatment year.
  - At the end of the final monitoring year, the total aerial coverage of dense phragmites stands will be 10 acres or less with stems less than three feet tall.
- Annual reports will be prepared and distributed at the end of each treatment year.
- Subsequent year treatment areas and type of treatment (aerial or spot herbicide, prescribed burn) will be mapped and reported in the Spring of each year.

#### **Goal 4: Educate, Outreach, and Research**

The project will provide an educational opportunity for NPS by incorporating invasive species issues into the interpretive programs provided to visitors. According to NPS, the goal of these programs “is to provide memorable and meaningful learning and recreational experiences, foster development of a personal stewardship ethic, and broaden public support for preserving park resources. Such programs will be successful when they forge emotional and intellectual connections among park resources, visitors, the community, and park management”. Visitors may learn how to identify phragmites, the cause and effects of invasive species in our state’s natural communities and how they can help to prevent the spread of invasive species. NCDOT will continue to coordinate with NPS to notify all stakeholders and potential visitors when treatment will take place. Additionally, as large stands of phragmites die-off, it will be important to provide the visitors an explanation of what may temporarily appear as destructive, is actually crucial to restoring the natural community. To this end, NCDOT will explore installing interpretive signage with NPS near the lighthouse illustrating the needs and goals of the restoration process.

An adaptive management plan will provide a valuable site specific opportunity for the NCDOT, NPS and other stakeholders to learn and understand the best methods of treatment and how the natural community responds. This information will help provide an effective method of treatment to ensure the long-term success of phragmites control that may also be applied to other areas of the Seashore and surrounding coastal areas. Specific details regarding methods, rates and timing of pesticide application, prescribed burns and effectiveness will be recorded and available to the public and stakeholders.

### **SITE PROTECTION AND MAINTENANCE**

The site is located completely on National Park Service land and is afforded long-term protection under federal laws and maintained under NPS regulations.

### **FINANCIAL ASSURANCES**

NCDOT is held by permit conditions associated with B-2500 to complete the mitigation and monitoring plan for this site. NCDOT has established funds for each project and within each Division to monitor the mitigation site.

### **PROJECT COMMITMENTS**

NCDOT will work with NPS to solicit grant funding for long term management of the site by NPS. NCDOT has coordinated with the Division and utility personnel to minimize encroachment of phragmites from outside the site along the eastern boundary. Dominion Power and NCDOT Division Roadside Environmental Unit have agreed to discontinue mowing of phragmites stands within the utility easement and along the roadway adjacent to the Bodie Island Lighthouse pond. Vegetation management in these areas will be achieved through herbicide treatment.

## REFERENCES

- Able, K.W. and Hagan, S.M. 2000. Effects of common reed (*Phragmites australis*) invasion on marsh surface macrofauna: response of fishes and decapod crustaceans. *Estuaries* 23(5): 633-646.
- Batterson, T.R. and Hall, D.W. 1984. Common reed – *Phragmites australis* (Cav.) Trin. ex Steudel. *Aquatics* 6(2): 16-17, 20.
- Benoit, L.K. and Askins, R.A. 1999. Impact of the spread of *Phragmites* on the distribution of birds in Connecticut tidal marshes. *Wetlands* 19(1): 194-208.
- Bertness, M.D., P.J. Ewanchuk, and B.R. Silliman. 2002. Anthropogenic modification of New England salt marsh landscapes. *Proceedings of the National Academy of Science* 99: 1395-1398.
- Bontje, M.P. 1987. The application of science and engineering to restore a salt marsh. pp. 16-23 *In* Proceedings of the 15<sup>th</sup> Annual Conference on Wetlands Restoration and Creation. Hillsborough Community College, Tampa, FL, USA.
- Boone, J.L., C.E. Furbish, and K. Turner. 1987. Control of *Phragmites communis*. Results of burning, cutting, and covering with plastic in a North Carolina salt marsh. Institute of Ecology, University of Georgia, CPSU Technical Report No. 42.
- Chambers, R.M., L.A. Meyerson, and K. Saltonstall. 1999. Expansion of *Phragmites australis* into tidal wetlands of North America. *Aquatic Botany* 64: 261-273.
- Fell, P. Weissbach, S.P., Jones, D.A., Fallon, M.A., Zeppieri, J.A., Faison, E.K., Lennon, K.A., Newberry, K.J., Reddington, L.K. 1998. Does invasion of oligohaline tidal marshes by reed grass, *Phragmites australis* (Cav.) Trin. ex Steud., affect the availability of prey sources for the mummichog, *Fundulus heteroclitus* L. *Journal of Experimental Marine Biology and Ecology* 222: 59-77.

- Findlay, S., Groffman, P., Dye, S. 2003. Effects of *Phragmites australis* removal on marsh nutrient cycling. *Wetlands Ecology and Management* 11(3): 157-165.
- Hanson, S.R., Osgood, D.T., Yozzo, D.J. 2002. Nekton use of a *Phragmites australis* marsh on the Hudson River, New York. *Wetlands* 22(2): 326-337.
- Hara, T., van der Toorn, J., Mook, J.H. 1993. Growth dynamics and size structure of shoots of *Phragmites australis*, clonal plant. *Journal of Ecology* 81: 47-60.
- Leonard, L.A., Wren, P.A., Beavers, R.L. 2002. Flow dynamics and sedimentation in *Spartina alterniflora* and *Phragmites australis* marshes of the Chesapeake Bay. *Wetlands* 22: 415-424.
- Meyerson, L.A., K. Saltonstall, L. Windham, E. Kiviat, and S. Findlay. 2000. A comparison of *Phragmites australis* in freshwater and brackish environments in North America. *Wetlands Ecology and Management* 8: 89-103.
- Minchinton, T. E. and M. D. Bertness. 2003. Disturbance-Mediated Competition and the Spread of *Phragmites australis* in a Coastal Marsh. *Ecological Applications* 13(5): 1400-1416.
- Mozdzer, T.J., C. J. Hutto, P.A. Clarke, and D. P. 2008. Field Efficacy of Imazapyr and Glyphosate in the Control of Non-Native *Phragmites australis*. *Restoration Ecology*, 16(2): 221–224.
- National Invasive Species Council. 2008. 2008-2012 National Invasive Species Management Plan. 35 pp.
- National Park Service. 2002. Director's Order #77-1: Wetland Protection. Available on the internet at: <http://www.nps.gov/policy/DOrders/DO77-1-Reissue.htm>

National Park Service. 2012. National Park Service Procedural Manual #77-1: Wetland Protection. Available on the internet at:

[http://www.nature.nps.gov/water/wetlands/assets/docs/DO\\_77-1\\_PROC\\_MANUAL\\_2012\\_Revision\\_FINAL.pdf](http://www.nature.nps.gov/water/wetlands/assets/docs/DO_77-1_PROC_MANUAL_2012_Revision_FINAL.pdf)

Paxton, B. 2007. Potential impact of common reed expansion on threatened high-marsh bird communities on the seaside: breeding bird surveys of selected high-marsh patches. Center for Conservation Biology Technical Report Series, CCBTR-07-03. College of William and Mary, Williamsburg, VA. 19 pp.

Posey, M.H., Alphin, T.D., Meyer, D.L., and Johnson, J.M. 2003. Benthic communities of common reed *Phragmites australis* and marsh cordgrass *Spartina alterniflora* marshes in Chesapeake Bay. Marine Ecology Progress Series 261: 51-61.

Rooth, J.E., Stevenson, J.C. 2000. Sediment deposition patterns in *Phragmites australis* communities: implications for coastal areas threatened by rising sea level. Wetlands Ecol. and Manag. 8: 173-183.

Rudrappa, T., Bonsall, J., Gallagher, J., Seliskar, D., Bais, H. 2007. Root-secreted allelochemical in the noxious weed *Phragmites australis* deploys a reactive oxygen species response and microtubule assembly disruption to execute rhizotoxicity. Journal of Chemical Ecology 33: 1898-1919.

Talley, T.S., Levin, L.A. 2001. Modification of sediments and macrofauna by an invasive marsh plant. Biol. Invasions 3: 51-68.

U.S. Army Corps of Engineers. 2005. Environmental Assessment for Control of *Phragmites australis* in South Carolina. 49 pp.

Virginia Department of Conservation and Recreation. 2009. Management Plan for *Phragmites australis* on the Seaside of Virginia's Eastern Shore. Nat. Heritage Tech. Rep. 09-04. 81 pp.

Windham, L. and Ehrenfeld, J.G. 2003. Net impact of a plant invasion on nitrogen-cycling processes within a brackish tidal marsh. *Ecological Applications* 13(4): 883-896.

Windham, L. 2001. Comparison of biomass production and decomposition between *Phragmites australis* (common reed) and *Spartina patens* (salt hay grass) in brackish tidal marshes of New Jersey, USA. *Wetlands* 21: 179-188.

Windham, L. and Lathrop, R. 1999. Effects of *Phragmites australis* (common reed) invasion on above-ground biomass and soil properties in brackish tidal marsh of the Mullica River, New Jersey. *Estuaries* 22: 927-935.

US Army Corps of Engineers and US Environmental Protection Agency. 2003. Memorandum to the Field: Model Compensatory Mitigation Plan Checklist for Aquatic Resource Impacts Under the Corps Regulatory Program Pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act. Dated November 7, 2003. Available on the internet at <http://www.mitigationactionplan.gov/checklist.pdf>

**Appendix A: Material Safety Data Sheets**

**Habitat – Imazapyr**

**Rodeo – Glyphosate**



The Chemical Company

# Safety Data Sheet

## HABITAT HERBICIDE

Revision date : 2012/03/08  
Version: 1.5

Page: 1/9  
(30235835/SDS CPA US/EN)

### 1. Product and Company Identification

Company  
BASF CORPORATION  
100 Park Avenue  
Florham Park, NJ 07932, USA

24 Hour Emergency Response Information  
CHEMTREC: 1-800-424-9300  
BASF HOTLINE: 1-800-832-HELP (4357)

Substance number: 000000063383  
Molecular formula: C(13) H(15) N(3) O(3). C(3) H(9) N  
Chemical family: imidazole derivative  
Synonyms: Isopropylamine salt of imazapyr

### 2. Hazards Identification

#### Emergency overview

CAUTION:  
KEEP OUT OF REACH OF CHILDREN.  
Avoid contact with the skin, eyes and clothing.  
Avoid inhalation of mists/vapours.

See Product Label for additional precautionary statements.

State of matter: liquid  
Colour: blue, clear  
Odour: ammonia-like, faint odour

#### Potential health effects

##### **Primary routes of exposure:**

Routes of entry for solids and liquids include eye and skin contact, ingestion and inhalation. Routes of entry for gases include inhalation and eye contact. Skin contact may be a route of entry for liquified gases.

##### **Acute toxicity:**

Relatively nontoxic after single ingestion. Slightly toxic after short-term skin contact. Relatively nontoxic after short-term inhalation.

##### **Irritation / corrosion:**

May cause slight but temporary irritation to the eyes. May cause slight irritation to the skin.

##### **Sensitization:**

Skin sensitizing effects were not observed in animal studies.

#### Potential environmental effects

# Safety Data Sheet

## HABITAT HERBICIDE

Revision date : 2012/03/08  
Version: 1.5

Page: 2/9  
(30235835/SDS\_CPA\_US/EN)

### Aquatic toxicity:

There is a high probability that the product is not acutely harmful to fish. There is a high probability that the product is not acutely harmful to aquatic invertebrates. Acutely harmful for aquatic plants.

### Terrestrial toxicity:

With high probability not acutely harmful to terrestrial organisms.

---

### 3. Composition / Information on Ingredients

| <u>CAS Number</u> | <u>Content (W/W)</u>           | <u>Chemical name</u>                                       |
|-------------------|--------------------------------|--|
| 81510-83-0        | >= 27.77 - <= 27.8 %<br>72.2 % | Isopropylamine salt of imazapyr<br>Proprietary ingredients |

---

### 4. First-Aid Measures

#### General advice:

First aid providers should wear personal protective equipment to prevent exposure. Remove contaminated clothing. Move person to fresh air. If person is not breathing, call 911 or ambulance, then give artificial respiration, preferably mouth-to-mouth if possible. Call a poison control center or physician for treatment advice. Have the product container or label with you when calling a poison control center or doctor or going for treatment.

#### If inhaled:

Remove the affected individual into fresh air and keep the person calm. Assist in breathing if necessary.

#### If on skin:

Rinse skin immediately with plenty of water for 15 - 20 minutes.

#### If in eyes:

Hold eyes open and rinse slowly and gently with water for 15 to 20 minutes. Remove contact lenses, if present, after first 5 minutes, then continue rinsing.

#### If swallowed:

Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to by a poison control center or doctor. Never induce vomiting or give anything by mouth if the victim is unconscious or having convulsions.

#### Note to physician

Treatment: Treat according to symptoms (decontamination, vital functions), no known specific antidote.

---

### 5. Fire-Fighting Measures

Flash point:

Non-flammable.

Self-ignition temperature:

not self-igniting

#### Suitable extinguishing media:

foam, dry powder, carbon dioxide, water spray

#### Hazards during fire-fighting:

carbon monoxide, carbon dioxide, nitrogen oxide, nitrogen dioxide, Hydrocarbons,  
If product is heated above decomposition temperature, toxic vapours will be released. The substances/groups of substances mentioned can be released if the product is involved in a fire.

#### Protective equipment for fire-fighting:

Firefighters should be equipped with self-contained breathing apparatus and turn-out gear.

# Safety Data Sheet

## HABITAT HERBICIDE

Revision date : 2012/03/08  
Version: 1.5

Page: 3/9  
(30235835/SDS CPA\_US/EN)

### Further information:

Evacuate area of all unnecessary personnel. Contain contaminated water/firefighting water. Do not allow to enter drains or waterways.

---

## 6. Accidental release measures

### Personal precautions:

Take appropriate protective measures. Clear area. Shut off source of leak only under safe conditions. Extinguish sources of ignition nearby and downwind. Ensure adequate ventilation. Wear suitable personal protective clothing and equipment.

### Environmental precautions:

Do not discharge into the subsoil/soil. Do not discharge into drains/surface waters/groundwater. Contain contaminated water/firefighting water.

### Cleanup:

Dike spillage. Pick up with suitable absorbent material. Place into suitable containers for reuse or disposal in a licensed facility. Spilled substance/product should be recovered and applied according to label rates whenever possible. If application of spilled substance/product is not possible, then spills should be contained, solidified, and placed in suitable containers for disposal. After decontamination, spill area can be washed with water. Collect wash water for approved disposal.

---

## 7. Handling and Storage

### Handling

#### General advice:

RECOMMENDATIONS ARE FOR MANUFACTURING, COMMERCIAL BLENDING, AND PACKAGING WORKERS. PESTICIDE APPLICATORS & WORKERS must refer to the Product Label and Directions for Use attached to the product for Agricultural Use Requirements in accordance with the EPA Worker Protection Standard 40 CFR part 170. Ensure adequate ventilation. Provide good ventilation of working area (local exhaust ventilation if necessary). Keep away from sources of ignition - No smoking. Keep container tightly sealed. Protect contents from the effects of light. Protect against heat. Protect from air. Handle and open container with care. Do not open until ready to use. Once container is opened, content should be used as soon as possible. Avoid aerosol formation. Avoid dust formation. Provide means for controlling leaks and spills. Do not return residues to the storage containers. Follow label warnings even after container is emptied. The substance/product may be handled only by appropriately trained personnel. Avoid all direct contact with the substance/product. Avoid contact with the skin, eyes and clothing. Avoid inhalation of dusts/mists/vapours. Wear suitable personal protective clothing and equipment.

#### Protection against fire and explosion:

The relevant fire protection measures should be noted. Fire extinguishers should be kept handy. Avoid all sources of ignition: heat, sparks, open flame. Sources of ignition should be kept well clear. Avoid extreme heat. Keep away from oxidizable substances. Electrical equipment should conform to national electric code. Ground all transfer equipment properly to prevent electrostatic discharge. Electrostatic discharge may cause ignition.

### Storage

#### General advice:

Keep only in the original container in a cool, dry, well-ventilated place away from ignition sources, heat or flame. Protect containers from physical damage. Protect against contamination. The authority permits and storage regulations must be observed.

#### Storage incompatibility:

General advice: Segregate from incompatible substances. Segregate from foods and animal feeds. Segregate from textiles and similar materials.

#### Temperature tolerance

Protect from temperatures below: 0 °C

Changes in the properties of the product may occur if substance/product is stored below indicated temperature for extended periods of time.

# Safety Data Sheet

## HABITAT HERBICIDE

Revision date : 2012/03/08  
Version: 1.5

Page: 4/9  
(30235835/SDS CPA US/EN)

Protect from temperatures above: 40 °C  
Changes in the properties of the product may occur if substance/product is stored above indicated temperature for extended periods of time.

### 8. Exposure Controls and Personal Protection

Users of a pesticidal product should refer to the product label for personal protective equipment requirements.

#### Advice on system design:

Whenever possible, engineering controls should be used to minimize the need for personal protective equipment.

#### Personal protective equipment

#### RECOMMENDATIONS FOR MANUFACTURING, COMMERCIAL BLENDING, AND PACKAGING WORKERS:

##### Respiratory protection:

Wear respiratory protection if ventilation is inadequate. Wear a NIOSH-certified (or equivalent) TC23C Chemical/Mechanical type filter system to remove a combination of particles, gas and vapours. For situations where the airborne concentrations may exceed the level for which an air purifying respirator is effective, or where the levels are unknown or Immediately Dangerous to Life or Health (IDLH), use NIOSH-certified full facepiece pressure demand self-contained breathing apparatus (SCBA) or a full facepiece pressure demand supplied-air respirator (SAR) with escape provisions.

##### Hand protection:

Chemical resistant protective gloves, Protective glove selection must be based on the user's assessment of the workplace hazards.

##### Eye protection:

Safety glasses with side-shields. Tightly fitting safety goggles (chemical goggles). Wear face shield if splashing hazard exists.

##### Body protection:

Body protection must be chosen depending on activity and possible exposure, e.g. head protection, apron, protective boots, chemical-protection suit.

##### General safety and hygiene measures:

Wear long sleeved work shirt and long work pants in addition to other stated personal protective equipment. Work place should be equipped with a shower and an eye wash. Handle in accordance with good industrial hygiene and safety practice. Personal protective equipment should be decontaminated prior to reuse. Gloves must be inspected regularly and prior to each use. Replace if necessary (e.g. pinhole leaks). Take off immediately all contaminated clothing. Store work clothing separately. Hands and/or face should be washed before breaks and at the end of the shift. No eating, drinking, smoking or tobacco use at the place of work. Keep away from food, drink and animal feeding stuffs.

### 9. Physical and Chemical Properties

|                  |                           |                |                                     |
|------------------|---------------------------|----------------|-------------------------------------|
| Form:            | liquid                    |                |                                     |
| Odour:           | ammonia-like, faint odour |                |                                     |
| Colour:          | blue, clear               |                |                                     |
| pH value:        | 6.6 - 7.2                 |                |                                     |
| Freezing point:  | approx. 0 °C              | ( 1,013.3 hPa) | Information applies to the solvent. |
| Boiling point:   | approx. 100 °C            | ( 1,013.3 hPa) | Information applies to the solvent. |
| Vapour pressure: | approx. 23.3 hPa          | ( 20 °C)       | Information applies to the solvent. |
|                  | < 100 hPa                 | ( 50 °C)       | Information applies to the solvent. |

# Safety Data Sheet

## HABITAT HERBICIDE

Revision date : 2012/03/08  
Version: 1.5

Page: 5/9  
(30235835/SDS CPA US/EN)

|                      |                          |                |
|----------------------|--------------------------|----------------|
| Density:             | 1.04 - 1.09 g/ml         |                |
|                      | 1.0956 g/cm <sup>3</sup> | ( 15 °C)       |
|                      | 1.0755 g/cm <sup>3</sup> | ( 50 °C)       |
| Vapour density:      |                          | not determined |
| Viscosity, dynamic:  | approx. > 1 mPa.s        | ( 20 °C)       |
| Solubility in water: |                          | miscible       |
| Molar mass:          | 320.4 g/mol              |                |

### 10. Stability and Reactivity

**Conditions to avoid:**

Avoid all sources of ignition: heat, sparks, open flame. Avoid prolonged storage. Avoid electro-static discharge. Avoid contamination. Avoid prolonged exposure to extreme heat. Avoid extreme temperatures.

**Substances to avoid:**

oxidizing agents, reducing agents

**Hazardous reactions:**

The product is chemically stable.

**Decomposition products:**

Hazardous decomposition products: No hazardous decomposition products if stored and handled as prescribed/indicated., Prolonged thermal loading can result in products of degradation being given off.

**Thermal decomposition:**

Possible thermal decomposition products:

carbon monoxide, carbon dioxide, nitrogen oxide

Stable at ambient temperature. If product is heated above decomposition temperature toxic vapours may be released. If product is heated above decomposition temperature hazardous fumes may be released.

**Corrosion to metals:**

Corrosive effect on: mild steel brass

**Oxidizing properties:**

not fire-propagating

Not an oxidizer.

### 11. Toxicological information

**Acute toxicity**

**Oral:**

Type of value: LD50

Species: rat (male/female)

Value: > 5,000 mg/kg

**Inhalation:**

Type of value: LC50

Species: rat (male/female)

Value: > 5.3 mg/l (OECD Guideline 403)

Exposure time: 4 h

An aerosol was tested.

**Dermal:**

Type of value: LD50

Species: rabbit (male/female)

Value: > 2,000 mg/kg

**Irritation / corrosion**

# Safety Data Sheet

## HABITAT HERBICIDE

Revision date : 2012/03/08  
Version: 1.5

Page: 6/9  
(30235835/SDS\_CPA\_US/EN)

**Skin:**  
Species: rabbit  
Result: mildly irritating  
Method: Primary skin irritation test

**Eye:**  
Species: rabbit  
Result: non-irritant

**Sensitization:**  
Skin sensitization test  
Species: guinea pig  
Result: Skin sensitizing effects were not observed in animal studies.

### Genetic toxicity

*Information on: imazapyr*  
*No mutagenic effect was found in various tests with microorganisms and mammals.*

-----

### Carcinogenicity

*Information on: imazapyr*  
*In long-term studies in rats and mice in which the substance was given by feed, a carcinogenic effect was not observed.*

-----

### Reproductive toxicity

*Information on: imazapyr*  
*The results of animal studies gave no indication of a fertility impairing effect.*

-----

### Development:

*Information on: imazapyr*  
*No indications of a developmental toxic / teratogenic effect were seen in animal studies.*

-----

---

## 12. Ecological Information

### Fish

*Information on: imazapyr*  
*Acute:*  
*Oncorhynchus mykiss/LC50 (96 h): > 100 mg/l*

-----

### Aquatic invertebrates

*Information on: imazapyr*  
*Acute:*  
*Daphnia magna/EC50 (48 h): > 100 mg/l*

-----

### Aquatic plants

Toxicity to aquatic plants:  
other swollen duckweed/EC50 (14 d): 0.0228 mg/l  
The product has not been tested. The statement has been derived from products of a similar structure or composition.

# Safety Data Sheet

## HABITAT HERBICIDE

Revision date : 2012/03/08  
Version: 1.5

Page: 7/9  
(30235835/SDS CPA US/EN)

### Non-Mammals

*Information on: imazapyr*

*Other terrestrial non-mammals:*

*mallard duck/LC50: > 5,000 ppm*

*With high probability not acutely harmful to terrestrial organisms.*

*Honey bee/LD50: > 100 ug/bee*

*With high probability not acutely harmful to terrestrial organisms.*

### Degradability / Persistence Biological / Abiological Degradation

Evaluation: Not readily biodegradable (by OECD criteria).

### Other adverse effects:

The ecological data given are those of the active ingredient. Do not release untreated into natural waters.

---

## 13. Disposal considerations

### Waste disposal of substance:

Pesticide wastes are regulated. Improper disposal of excess pesticide, spray mix or rinsate is a violation of federal law. If pesticide wastes cannot be disposed of according to label instructions, contact the State Pesticide or Environmental Control Agency or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

### Container disposal:

Rinse thoroughly at least three times (triple rinse) in accordance with EPA recommendations. Consult state or local disposal authorities for approved alternative procedures such as container recycling. Recommend crushing, puncturing or other means to prevent unauthorized use of used containers.

### RCRA:

This product is not regulated by RCRA.

---

## 14. Transport Information

### Land transport

USDOT

Not classified as a dangerous good under transport regulations

### Sea transport

IMDG

|                       |  |
|-----------------------|--|
| Hazard class:         | 9  |
| Packing group:        | III  |
| ID number:            | UN 3082  |
| Hazard label:         | 9, EHSM  |
| Marine pollutant:     | YES  |
| Proper shipping name: | ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S.<br>(contains IMAZAPYR 23%) |

### Air transport

IATA/ICAO

Hazard class: 9

# Safety Data Sheet

## HABITAT HERBICIDE

Revision date : 2012/03/08  
Version: 1.5

Page: 8/9  
(30235835/SDS CPA US/EN)

Packing group: III  
ID number: UN 3082  
Hazard label: 9, EHS  
Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S.  
(contains IMAZAPYR 23%)

### 15. Regulatory Information

#### Federal Regulations

##### Registration status:

Crop Protection TSCA, US released / exempt

Chemical TSCA, US blocked / not listed

OSHA hazard category: Chronic target organ effects reported; ACGIH TLV established

EPCRA 311/312 (Hazard categories): Acute; Chronic

#### State regulations

##### CA Prop. 65:

There are no listed chemicals in this product.

### 16. Other Information

**Refer to product label for EPA registration number.**

Recommended use: herbicide

##### NFPA Hazard codes:

Health: 1 Fire: 1 Reactivity: 1 Special:

We support worldwide Responsible Care® initiatives. We value the health and safety of our employees, customers, suppliers and neighbors, and the protection of the environment. Our commitment to Responsible Care is integral to conducting our business and operating our facilities in a safe and environmentally responsible fashion, supporting our customers and suppliers in ensuring the safe and environmentally sound handling of our products, and minimizing the impact of our operations on society and the environment during production, storage, transport, use and disposal of our products.

##### MSDS Prepared by:

BASF NA Product Regulations

msds@basf.com

MSDS Prepared on: 2012/03/08

IMPORTANT: WHILE THE DESCRIPTIONS, DESIGNS, DATA AND INFORMATION CONTAINED HEREIN ARE PRESENTED IN GOOD FAITH AND BELIEVED TO BE ACCURATE, IT IS PROVIDED FOR YOUR GUIDANCE ONLY. BECAUSE MANY FACTORS MAY AFFECT PROCESSING OR APPLICATION/USE, WE RECOMMEND THAT YOU MAKE TESTS TO DETERMINE THE SUITABILITY OF A PRODUCT FOR YOUR PARTICULAR PURPOSE PRIOR TO USE. NO WARRANTIES OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE MADE REGARDING PRODUCTS DESCRIBED OR DESIGNS, DATA OR INFORMATION SET FORTH, OR THAT THE PRODUCTS, DESIGNS, DATA OR INFORMATION MAY BE USED WITHOUT

# Safety Data Sheet

## HABITAT HERBICIDE

Revision date : 2012/03/08  
Version: 1.5

Page: 9/9  
(30235835/SDS CPA US/EN)

---

INFRINGING THE INTELLECTUAL PROPERTY RIGHTS OF OTHERS. IN NO CASE SHALL THE DESCRIPTIONS, INFORMATION, DATA OR DESIGNS PROVIDED BE CONSIDERED A PART OF OUR TERMS AND CONDITIONS OF SALE. FURTHER, YOU EXPRESSLY UNDERSTAND AND AGREE THAT THE DESCRIPTIONS, DESIGNS, DATA, AND INFORMATION FURNISHED BY OUR COMPANY HEREUNDER ARE GIVEN GRATIS AND WE ASSUME NO OBLIGATION OR LIABILITY FOR THE DESCRIPTION, DESIGNS, DATA AND INFORMATION GIVEN OR RESULTS OBTAINED, ALL SUCH BEING GIVEN AND ACCEPTED AT YOUR RISK.  
END OF DATA SHEET

# MATERIAL SAFETY DATA SHEET



Emergency Phone: 800-992-5994  
Dow AgroSciences LLC  
Indianapolis, IN 46268

Effective Date: 3/23/04  
Product Code: 84825  
MSDS: 006694

## RODEO\* HERBICIDE

### 1. PRODUCT AND COMPANY IDENTIFICATION:

**PRODUCT:** Rodeo\* Herbicide

#### COMPANY IDENTIFICATION:

Dow AgroSciences LLC  
9330 Zionsville Road  
Indianapolis, IN 46268-1189

### 2. COMPOSITION/INFORMATION ON INGREDIENTS:

|   |                   |       |
|---|-------------------|-------|
| Glyphosate IPA:   | CAS # 038641-94-0 | 53.8% |
| N-(phosphono-methyl)<br>glycine, Isopropylamine<br>Salt |                   |       |
| Balance, Total  |                   | 46.2% |

### 3. HAZARDOUS IDENTIFICATIONS:

#### EMERGENCY OVERVIEW

Clear, pale yellow liquid. May cause eye irritation. Slightly toxic to aquatic organisms.

**EMERGENCY PHONE NUMBER:** 800-992-5994

### 4. FIRST AID:

**EYE:** Flush eyes thoroughly with water for several minutes. Remove contact lenses after initial 1-2 minutes and continue flushing for several additional minutes. If effects occur, consult a physician, preferably an ophthalmologist.

**SKIN:** Wash skin with plenty of water.

**INGESTION:** No emergency medical treatment necessary.

**INHALATION:** Remove person to fresh air; if effects occur, consult a physician.

**NOTE TO PHYSICIAN:** No specific antidote. Treatment of exposure should be directed at the control of symptoms and the clinical condition of the patient.

### 5. FIRE FIGHTING MEASURES:

**FLASH POINT:** >214°F (>101°C)

**METHOD USED:** Setaflash

#### FLAMMABLE LIMITS:

LFL: Not applicable

UFL: Not applicable

**EXTINGUISHING MEDIA:** Foam, CO<sub>2</sub>, Dry Chemical

**FIRE AND EXPLOSION HAZARDS:** Foam fire extinguishing system is preferred because uncontrolled water can spread possible contamination. Toxic irritating gases may be formed under fire conditions.

**FIRE-FIGHTING EQUIPMENT:** Use positive-pressure, self-contained breathing apparatus and full protective equipment.

### 6. ACCIDENTAL RELEASE MEASURES:

**ACTION TO TAKE FOR SPILLS:** Absorb small spills with an inert absorbent material such as Hazorb, Zorbball, sand, or dirt. Report large spills to Dow AgroSciences on 800-992-5994.

### 7. HANDLING AND STORAGE:

**PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE:** Keep out of reach of children. Do not swallow. Avoid contact with eyes, skin, and clothing. Avoid breathing vapors and spray mist. Handle concentrate in ventilated area. Wash thoroughly with soap and water after handling and before eating, chewing gum, using tobacco, using the toilet or smoking. Keep away from food, feedstuffs, and water supplies. Store in original container with the lid tightly closed. Store above 10°F (-12°C) to keep from crystallizing.

### 8. EXPOSURE CONTROLS/PERSONAL PROTECTION:

These precautions are suggested for conditions where the potential for exposure exists. Emergency conditions may require additional precautions.

**EXPOSURE GUIDELINES:** None established

**ENGINEERING CONTROLS:** Good general ventilation should be sufficient for most conditions. Local exhaust ventilation may be necessary for some operations.

**RECOMMENDATIONS FOR MANUFACTURING, COMMERCIAL BLENDING, AND PACKAGING WORKERS:**

**EYE/FACE PROTECTION:** Use safety glasses.

**SKIN PROTECTION:** No precautions other than clean body-covering clothing should be needed.

# MATERIAL SAFETY DATA SHEET



Emergency Phone: 800-992-5994  
Dow AgroSciences LLC  
Indianapolis, IN 46268

## RODEO\* HERBICIDE

Effective Date: 3/23/04  
Product Code: 84825  
MSDS: 006694

**RESPIRATORY PROTECTION:** For most conditions, no respiratory protection should be needed; however, if discomfort is experienced, use a NIOSH approved air-purifying respirator.

**APPLICATIONS AND ALL OTHER HANDLERS:** Please refer to the product label for personal protective clothing and equipment.

### 9. PHYSICAL AND CHEMICAL PROPERTIES:

**APPEARANCE:** Clear, pale yellow liquid  
**DENSITY:** 10.0 - 10.5 lbs/gal  
**pH:** 4.8 - 5.0  
**ODOR:** None  
**SOLUBILITY IN WATER:** Miscible  
**SPECIFIC GRAVITY:** 1.21 gm/L  
**FREEZING POINT:** -7°F - -10°F (-21°C - -25°C)

### 10. STABILITY AND REACTIVITY:

**STABILITY: (CONDITIONS TO AVOID)** Stable under normal storage conditions.

**INCOMPATIBILITY: (SPECIFIC MATERIALS TO AVOID)** Galvanized or unlined steel (except stainless steel) containers or spray tanks may produce hydrogen gas which may form a highly combustible gas mixture.

**HAZARDOUS DECOMPOSITION PRODUCTS:** None known.

**HAZARDOUS POLYMERIZATION:** Not known to occur.

### 11. TOXICOLOGICAL INFORMATION:

**EYE:** May cause slight temporary eye irritation. Corneal injury is unlikely.

**SKIN:** Essentially non-irritating to skin. Prolonged skin contact is unlikely to result in absorption of harmful amounts. The LD<sub>50</sub> for skin absorption in rabbits is >5000 mg/kg. Did not cause allergic skin reactions when tested in guinea pigs.

**INGESTION:** Very low toxicity if swallowed. Harmful effects not anticipated from swallowing small amounts. The oral LD<sub>50</sub> for rats is >5000 mg/kg.

**INHALATION:** Brief exposure (minutes) is not likely to cause adverse effects. The aerosol LC<sub>50</sub> for rats is >6.37 mg/L for 4 hours.

**SYSTEMIC (OTHER TARGET ORGAN) EFFECTS:** For a similar material, glyphosate, in animals, effects have been reported on the following organ: liver.

**CANCER INFORMATION:** A similar material, glyphosate, did not cause cancer in laboratory animals.

**TERATOLOGY (BIRTH DEFECTS):** For glyphosate IPA, available data are inadequate for evaluation of potential to cause birth defects.

**REPRODUCTIVE EFFECTS:** For glyphosate IPA, available data are inadequate to determine effects on reproduction.

**MUTAGENICITY:** For a similar material, glyphosate, in-vitro and animal genetic toxicity studies were negative.

### 12. ECOLOGICAL INFORMATION:

#### ENVIRONMENTAL DATA:

#### ECOTOXICOLOGY:

Material is practically non-toxic to aquatic organisms on an acute basis (LC<sub>50</sub> or EC<sub>50</sub> is >100 mg/L in most sensitive species tested).

Acute LC<sub>50</sub> for rainbow trout (*Oncorhynchus mykiss*) is >2500 mg/L.

Acute immobilization EC<sub>50</sub> in water flea (*Daphnia magna*) is 918 mg/L.

Material is practically non-toxic to birds on an acute basis (LD<sub>50</sub> is >2000 mg/kg).

Acute oral LD<sub>50</sub> in bobwhite (*Colinus virginianus*) is >2000 mg/kg.

The LC<sub>50</sub> in earthworm *Eisenia foetida* is >1000 mg/kg.

Acute contact LD<sub>50</sub> in honey bee (*Apis mellifera*) is >100 µg/bee.

Acute oral LD<sub>50</sub> in honey bee (*Apis mellifera*) is >100 µg/bee.

Growth inhibition EC<sub>50</sub> in green alga (*Selenastrum capricornutum*) is 127 mg/L.

Growth inhibition EC<sub>50</sub> in duckweed (*Lemna sp.*) is 24.4 mg/L.

### 13. DISPOSAL CONSIDERATIONS:

**DISPOSAL METHOD:** If wastes and/or containers cannot be disposed of according to the product label directions, disposal of this material must be in accordance with your local or area regulatory authorities.

# MATERIAL SAFETY DATA SHEET



Emergency Phone: 800-992-5994  
Dow AgroSciences LLC  
Indianapolis, IN 46268

Effective Date: 3/23/04  
Product Code: 84825  
MSDS: 006694

## RODEO\* HERBICIDE

This information presented below only applies to the material as supplied. The identification based on characteristic(s) or listing may not apply if the material has been used or otherwise contaminated. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste identification and disposal methods in compliance with applicable regulations.

If the material as supplied becomes a waste, follow all applicable regional, national and local laws and regulations.

### 14. TRANSPORT INFORMATION:

#### U.S. DEPARTMENT OF TRANSPORTATION (DOT) INFORMATION:

For all package sizes and modes of transportation:  
This material is not regulated for transport.

### 15. REGULATORY INFORMATION:

**NOTICE:** The information herein is presented in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with federal, state or provincial, and local laws. The following specific information is made for the purpose of complying with numerous federal, state or provincial, and local laws and regulations.

#### U.S. REGULATIONS

**SARA 313 INFORMATION:** To the best of our knowledge, this product contains no chemical subject to SARA Title III Section 313 supplier notification requirements.

**SARA HAZARD CATEGORY:** This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

Not to have met any hazard category

**TOXIC SUBSTANCES CONTROL ACT (TSCA):** All ingredients are on the TSCA inventory or are not required to be listed on the TSCA inventory.

**STATE RIGHT-TO-KNOW:** This product is not known to contain any substances subject to the disclosure requirements of

New Jersey  
Pennsylvania

**OSHA HAZARD COMMUNICATION STANDARD:** This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

**COMPREHENSIVE ENVIRONMENTAL RESPONSE COMPENSATION AND LIABILITY ACT (CERCLA, or SUPERFUND):** To the best of our knowledge, this product contains no chemical subject to reporting under CERCLA.

#### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) RATINGS:

| <u>CATEGORY</u> | <u>RATING</u> |
|-----------------|---------------|
| Health          | 1             |
| Flammability    | 1             |
| Reactivity      | 0             |

### 16. OTHER INFORMATION:

**MSDS STATUS:** Revised Sections: 3,4,11,12,13,14 & 15  
Reference: DR-0361-8028  
Replaces MSDS Dated: 1/12/00  
Document Code: D03-148-002  
Replaces Document Code: D03-148-001

The Information Herein Is Given In Good Faith, But No Warranty, Express Or Implied, Is Made. Consult Dow AgroSciences For Further Information.