

AGRONOMIC PROTOCOLS

NATIONAL CEMETERY ADMINISTRATION

MSN IV

Agronomic Protocol #1

Turf grass Re-Establishment on Sunken Gravesites or Initial Establishment on Newly Filled Graves.

Operational Procedures

Situation Specifics: Individual or a limited number of gravesites have settled over time and created an unsatisfactory appearance and maintenance situation. The extent of the problem does not warrant the total renovation of an entire burial section.

Procedures: Determine the approximate volume of topsoil required to raise the sunken gravesites or fill the newly dug graves to the desired levels. Procure high quality topsoil of similar characteristics and texture to that already present on the site. Allow sufficient excess material to account for forced settling and compacting of the raised or filled gravesites.

1. Determine if the existing turf grass stand on each gravesite to be raised is of adequate quality and species composition to warrant its retention. If not, spray those gravesites with Round Up Pro herbicide at the maximum label recommended rate for the complete elimination of perennial grasses and weeds. Allow 7 days to elapse for the herbicide to circulate throughout all plant parts.
2. Fill gravesite to final settled and compacted level in conformance with the surrounding area.
3. Apply a standard turf grass starter fertilizer such as a 12-25-10 at 6 to 8 lbs. per 1000 sq.ft. on each filled gravesite. Spread selected seed mixture at the recommended seeding rate for the turf grass species being used. On small individual areas such as gravesites, hand spreading of the seed is the most efficient method to use. (See Turf grass Re-Establishment Protocol for recommended turf grass seed mixtures.)
4. Lightly rake seed into the top 0.5 inch of topsoil. Roll area with standard turf grass roller half full of water to firm the soil around the seed.
5. Mulch: Apply clean weed free straw-matting, S-150, and carefully remove it following satisfactory turf grass cover. Although expensive compared to straw, it can be reused, is weed free, and quite effective for small projects.
6. Irrigate area routinely and as required to ensure satisfactory and complete seed germination and turf grass cover of each gravesite.

7. Begin mowing emerged turf grass seedlings when they reach 4.0 inches in height. Mow as required at desired maintenance height of 3.5 inches never removing more than 1/3 of the total leaf surface.

Continue irrigation and mowing until the seedling turf grass is well established and ready to persist on the routine maintenance regime of the remainder of the

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Agronomic Protocol # 2

Turf grass Re-Establishment in Areas Designated for Total Renovation
Operational Procedures

Situation Specifics: Burial section(s) requires a complete replacement of the existing turf grass cover. This may be due to the need for extensive headstone raising and realignment, a general deterioration of the turf grass stand over time, extensive sunken gravesites and/or wash boarding appearance over time or any other circumstance which has rendered the turf grass stand unsatisfactory.

- A. **Procedures:** Collect and submit soil samples from the site several weeks prior to the intended operation to determine fertility and pH adjustment requirements.
 1. Mow target area several times removing grass clippings each time. Initial mowing in this sequence should be at normal maintenance height (i.e. 2.5 to 3 inches) and subsequent mowing 2 or 3 days apart should be at lowered height (i.e. 1.5 to 2 inches).
 2. After a minimum of two or more preparatory mowings, the entire vegetated area should be sprayed with Round Up Pro herbicide. Application rate should be the maximum label recommended rate for the complete elimination of perennial grass species and contaminant weeds. Allow 7 days to elapse for herbicide to circulate throughout all plant parts.
 3. Power rake or verticut entire treated area to loosen and facilitate removal of residual plant debris including thatch. Apply soil test recommended quantities of starter fertilizer and ground agricultural limestone. Spread evenly over entire area using any suitable broadcast application device. Roto till area to a minimum depth of 3 inches to uniformly mix fertilizer, lime, and topsoil. Grade site to achieve desired finished appearance. If this process does not achieve desired finished grade due to numerous depressions, import high quality topsoil of similar characteristics and texture to the soil already present on site. Apply sufficient topsoil to eliminate these depressions and achieve the desired finish grade.
 4. Firm finished seedbed by rolling in several directions with a standard turf grass roller filled with water.
 5. Seeding: Only Blue Tag certified seed designated as “Sod Quality” and with a satisfactory(85% minimum germination) current season germination test should be used. Brand to be used: **Tall Fescue Blend Select Certified**

B.

Seeding Rate

5 lbs./1000 sq.ft.

- C. Spread seed uniformly over entire area. Divide total seed required into two equal quantities and spread in two directions at right angles to each other. Use a broadcast seeding device that will uniformly spread the seed.
- D. Lightly rake (incorporate the seed) seed into the top 0.5 inch of soil. Roll area with a standard turf grass roller that is half full of water to firm the seedbed.
6. Mulch: Apply clean weed free straw mulch at a rate of 1 to 1.5 bales per 1000 sq. ft. Spread in such a manner that approximately 25% bare ground is visible through the straw and any excess can be easily removed following satisfactory turf grass cover.
7. Irrigate area routinely and as required to ensure complete and satisfactory seed germination and turf grass cover of the site.
8. Begin mowing emerged turf grass seedlings when they reach 3.5 to 4.0 inches in height. Mow as required at desired maintenance height of 2.5 to 3.0 inches never removing more than 1/3 of the total leaf surface.
9. Continue mowing and irrigation until complete cover of turf grass satisfactory to the MSN IV Agronomist has been achieved and final inspection approval granted.

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General Turf Grass Maintenance Operations

Situation Specifics: The daily maintenance of the established turf grass portion of the grounds occupied by a national cemetery should be consistent with commonly recognized best practices designed to provide the highest quality turf grass possible with a modest expenditure of operating capital.

Procedures: Mowing, fertilization, irrigation, general pest control, aerification and thatch removal are the maintenance operations routinely required to achieve a high quality stand of turf grass.

- **Mowing:** It is important to remember that mowing turf grasses always represents a stress to the turf grass plants. They are able to tolerate this constant defoliation because of their subapical meristems and unique ability to increase their density below the mowing height. The commonly used turf grass species can produce a healthy dense stand of turf when routinely mowed at a height and frequency best suited to the specific growth characteristics of each type. Turf grass species best adapted to the climatic conditions that exist in MSN IV fall in the cool season turf grass category. Those best suited to the cultural practices most appropriate in a cemetery include Kentucky Bluegrass, Tall Fescue and Perennial Ryegrass. The fine fescues as a general rule are not recommended for use in MSN IV. The following aspects of maintenance mowing of cemetery turf grass should be practiced:
 - ✓ Keep mower blades sharp at all times. Rotary mowers are the standard equipment to be used.
 - ✓ Never remove more than 1/3 of the total leaf surface in a single mowing.
 - ✓ Alternate the direction of mowing where possible.
 - ✓ Do not remove clippings as a routine practice. This should only be done if mowing interval has been lengthened due to uncontrollable environmental factors and excess clippings result.
 - ✓ Maintain a height of cut of 3.5 inches.
- **Fertilization:** Soil testing prior to the establishment of a new stand of turf grass is the best method for determining the general nutrient and pH status of the soil at the site. Applications made in conjunction with the establishment process are intended to be responsive to the soil test recommendations. Subsequent maintenance applications are based on generally recognized turf nutritional requirements and additional soil testing is only recommended once every 3 to 5 years. Application of an appropriate quantity of essential plant nutrients is one of the most frequently abused turf grass maintenance practices. The timing of these applications is also often inappropriate. A common misconception involves the initial spring application. This application should be delayed

until weeks after spring green-up and the normal strong flush of growth that accompanies it. The exact timing of this first seasonal application will vary by location, the age of the turf grass stand, the general health and vigor of the turf, and the environmental conditions to which it has been exposed during the past winter and current spring. Even in the Southern most areas of MSN IV, the first application in the spring should not occur before May 1. Fertilization during the warm/hot temperatures of summer should also be generally avoided. In recent years, it has been determined that cool season turf grass species benefit substantially from a late fall application of fertilizer, particularly nitrogen. This application is generally made following the last mowing of the season.

Conventional wisdom states that established stands of turf grass utilize the essential basic plant nutrients; nitrogen, phosphorus, and potassium in a ratio of approximately 4:1:2. With this in mind, fertilizers with an analysis that approximates this ratio, such as a 24-6-12 or 30-7-15, should be selected for general maintenance fertilization. The following fertilizer regime represents a seasonal program suitable for the turf grass growing in the cemeteries of MSN IV. Slight variations in application timing will occur across the north to south latitude range of the region. A mid point across the region such as Indianapolis, Dayton, and Quincy was chosen for the application times listed.

Application # 1 --- May 1 --- 24-6-12 at 2 to 3 lb per 1000 sq.ft.

Application # 2 --- June 1 --- 24-6-12 at 2 to 3 lb per 1000 sq.ft.

Application # 3 --- August 15 --- 24-6-12 at 4 lb per 1000 sq.ft.

Application # 4 --- Late Fall --- 24-6-12 at 4 to 5 lb per 1000 sq.ft.

The fertilizer products selected as the standard maintenance materials for a program such as the one outlined above, should contain a minimum of 30 up to 50% of their nitrogen from controlled release sources. These sources include sulfur-coated urea, polymer coated urea, IBDU, urea formaldehyde, methylene urea, aminoureaformaldehyde, and stabilized nitrogen. (See Protocol # 4, "Turf grass Fertilizer Selection" for a thorough discussion of the various nitrogen sources available.) Utilization of slow release sources of nitrogen provides the turf with a more uniform feeding experience that is extended over a longer period of time.

Applications of lime to established stands of turf grass are of limited value. If the soil on the site required an adjustment in its pH, it should have been made during establishment by the thorough incorporation into the soil of the required quantity of ground agricultural limestone. Since Calcium and Magnesium are almost immobile in soil, surface applications of lime to established stands of turf grass are not very effective for CORrecting a growth limiting pH problem.

In addition to the three basic nutrients found in all complete fertilizer products, turf grass requires minute amounts of a number of micronutrients. These include iron, manganese, boron, copper, zinc and several others. Most soils contain adequate levels of these nutrients to meet turf grass needs. An occasional application of a fertilizer product that contains, in addition to the basic nutrients, a micronutrient package is an acceptable practice.

- **Irrigation:** Supplemental applications of water to relieve the environmental stresses caused by periods of drought are desirable if the cemetery grounds are equipped with an irrigation system. Irrigation should only be used when moisture stress is significant enough to cause the turf grass permanent injury. At cemetery sites that do not have an irrigation capability, the turf grass will experience a period of dormancy. Cool season turf grass species have the ability to enter a state of drought-induced dormancy when prolonged periods of drought occur. During such times, all activity possible on the turf grass surface should be suspended until sufficient moisture has been received and normal growth resumes. If irrigation is available and employed, water should always be applied in sufficient quantity to wet the entire root zone of the turf grass plants, usually to a minimum depth of 6 inches. Where agronomic considerations are used to determine the best time of the day to water turf, the early morning hours are the best.
- **Aerification:** This is a process of cultivating the soil supporting a stand of turf grass that is unique in the plant world. Unlike annual crops such as CORN and soybeans, where the soil in which they are grown can be completely plowed each season to relieve compaction and aerate the soil, turf grass is a perennial crop where that is not possible. Alternatively, the process of CORE aeration is employed on turf grass stands for this purpose. Specialized equipment is available that removes numerous soil COREs from 3 up to 6-inch depths as it passes across the turf grass surface. These COREs are then removed from the site or mechanically broken apart into small pieces. The resulting holes allow improved air, water, and nutrient penetration into the turf grass canopy and root zone. Although CORE aerification is mostly a beneficial cultural practice, it is generally not necessary more than one time per growing season on turf grass areas that are not subjected to continual heavy traffic. Athletic fields, golf course putting greens and other high traffic areas are subjected to continuous compaction pressures that require more aggressive aerification schedules. The turf grass stands at national cemeteries are not subjected to such pressures and will be more than adequately benefited by a single annual aerification. This operation should be conducted in the late summer shortly after Labor Day.
- **Thatch Removal:** Thatch is an organic layer that develops in turf grass stands above the soil and below the green tissue of the living canopy. It is composed of a combination of dead organic debris and the living roots, crowns, and stems of the grass. If allowed to accumulate for a number of growing seasons without remedial steps, thatch can have a significant negative impact on the health and vigor of the turf grass population. Judicious use of nitrogen fertilizer, fungicides and irrigation, beneficial mowing practices, and periodic aerification will greatly reduce the rate at which thatch accumulates in a stand of turf grass. A minimal thatch layer(½ inch or less) in turf is a positive attribute. It is a

good media for macro- and microorganisms, serves as a natural filter to reduce pesticide movement into groundwater, and moderates the effects of summer heat stress.

Thatch prevention or minimization is the primary and preferred approach for controlling thatch in cemetery turf. The operational procedures already discussed in this protocol are designed with this as one of its goals. Adhering closely to them will greatly reduce the likelihood of thatch becoming a serious detriment to the health and vigor of the turf grass stand. If a thatch layer accumulates that requires removal, one of several mechanical approaches can be employed. Vertical mowers or power rakes are two such approaches. Both can be effective, but a vertical mower with steel blades mounted solidly to an axle tends to do a more thorough job of thatch removal with less ripping of the turf canopy. The blades of the device should be adjusted so that they barely scratch the soil surface. A thatch removal operation generally produces a significant volume of plant debris. This of course must be removed from the area. A dethatched turf grass stand will normally exhibit a major growth surge that may require more frequent mowing and possible clipping removal for a short period of time.

- **General Pest Control:** Stands of turf grass are exposed to various types of pests. Weeds and insects are the most commonly encountered on cemetery turf. Although several fungal diseases are not completely unheard of in a cemetery environment, the cultural practices being utilized are generally not conducive to significant disease occurrence. Specific protocols dealing with weed control, both pre and post emergence to germinated weeds, and general approaches to common insect problems have been developed and should be followed in these circumstances.

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Agronomic Protocol # 4 is not included

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Agronomic Protocol # 5

Selective Broadleaf Weed Control in Established Stands of Turf grass

Introduction: Conventional wisdom implies that the best way to avoid broadleaf weed encroachment in a stand of turf grass is by producing a healthy, vigorous, dense stand of the desired turf grass species. This of course is the case and the cultural practices recommended for use on NCA properties are designed with minimization of broadleaf weeds as one of their objectives. When however, this approach alone is not completely successful, other methods may become necessary.

Cultural Controls: Utilization of appropriate cultural practices will greatly reduce the necessity of frequent chemical control measures. The most common cultural control technique in turf is the routine mowing (defoliation) that is practiced. Only a limited number of broadleaf weed species are able to tolerate the frequent mowing. That is the good news. The bad news is that a number of the species that can tolerate the mowing are quite competitive once established and often difficult to control with any method.

Other cultural practices that have a significant impact on weed encroachment are fertilization, irrigation and aerification. Proper timing, quantity, and nutrient content of the fertilizer products used on a stand of turf grass can favor the growth of the desired turf grass species while not encouraging weed species to develop or thrive. Cool season turf grass species will benefit most with spring and fall applications of fertilizer. Summer annual weeds on the other hand would be encouraged if mid summer applications were made. Fertilizer analyses low or absent phosphorus also favor the turf grass species and not germinating weed seedlings. Established stands of perennial turf grass should be irrigated infrequently, in sufficient quantity to penetrate to a minimum soil depth of 6 inches and then allowed to dry before another irrigation is required. Irrigation that is applied in frequent light quantities will only encourage the germination of weed seeds located near the soil surface and help them to become established. Core aerification should never be conducted during the spring, which is the primary germination period of most summer annual broadleaf weeds and would provide an ideal opportunity for seedling weeds to emerge in the aerification holes.

Mechanical Control: Hand removal of a few isolated weeds is the obvious method of choice when the number involved is small or the species is not a particularly common turf pest and unlikely to invade in great numbers. A sharp pocketknife or suitable substitute for cutting out the offending plant(s) will discourage many casual weed invaders.

Chemical Control: Occasionally it will be necessary to employ an effective broadleaf herbicide to control an infestation of unwanted weed species. The most difficult species of broadleaf weeds to deal with in turf are those that have a low spreading habit of growth and can tolerate the mowing heights commonly employed for turf grasses. Species such as clover, black medic, wild violet, ground ivy, knotweed, prostrate spurge, veronica, and chickweed are some of the most troublesome. Scattered small patches of these or other broadleaf weed species can be selectively controlled and removed by spot treating only the affected areas. Small hand held or backpack style sprayers are available that can hold 2 to 4 gallons of spray solution and have a hand held spray wand attached. It is a relatively simple task to uniformly spray the target patches of weeds without any damage to the desired turf grass species. The most common error made by an untrained user of one of these devices is to apply a significantly greater quantity of spray solution than is recommended or required for effective control. To avoid this occurrence, the spray solution should be delivered in a single pass over the target weeds so that the foliage of the weeds is uniformly wet. Do not pass the wand back and forth several times just for good measure. The proper technique should simulate the delivery from a large spray boom attached to a tractor that is driven over a large area at a constant rate of speed for treatment.

Of course, if a large expanse of turf becomes infested with broadleaf weeds, larger tractor or utility cart mounted spray equipment should be employed to apply the selective herbicide. The process and herbicide employed would be the same as in spot treating but the scale is significantly larger.

Herbicide Selection: Ever since the end of the Second World War, the standard for broadleaf weed control in turf has been 2,4-D or one of its close relatives in the phenoxy family of herbicides. Various two or three way combinations of this class of herbicides are still widely used. MCPP, MCPA, or 2,4-DP are the relatives most commonly included along with another newer material known as dicamba. The development of dicamba during 1960's and its inclusion in mixtures with 2,4-D and MCPP created a minor revolution in herbicide performance. These three way combination products provided very broad-spectrum control of many of the difficult to control weed species. One of the limiting characteristics of such combinations involved the propensity of dicamba to leach downward into the soil and occasionally cause injury to woody shrubs and trees through root uptake of this molecule. This limitation does not create an insurmountable problem as reduced rate treatments and avoidance of the most potentially sensitive areas greatly reduced the likelihood of any damage. Another limitation involves its use in an ester formulation that poses volatility concerns for damage to nearby sensitive plants such as tomatoes and various flowers. Low volatile esters or amine formulations should be used under these circumstances.

2,4-D and several of its woody species active relatives, 2,4,5-T and 2,4,5-TP came under increased environmental and health hazard scrutiny during and following their use in the Vietnam War. Pressures to reduce or eliminate their use resulted in the development and release during the late 1980's and early 90's within the industry of a new class of chemistry, the pyridines. These molecules are very effective on a range of difficult to control broadleaf weed species. Numerous new combination products based on this new chemistry are now available and widely used as replacements for 2,4-D and its relatives. Triclopyr and clopyralid sold as Turflon,

Confront, Millennium and other trade names are the pyridine molecules available for use on turf grasses. As with all of the herbicide molecules discussed here, these possess excellent levels of tolerance for use on the commonly grown cool season turf grasses.

Application Timing: Although these selective broadleaf herbicides can be used anytime that the target weeds are present and growing and the turf grass is mature and actively growing, there are preferential time periods that will deliver the best results.

- **Summer annual broadleaf weeds:** This category of weed species completes its life cycle in less than one year. They germinate during the spring, grow rapidly into early summer, flower and produce seed during the summer and usually die as a result of the first killing frost in the fall. If herbicide treatment is deemed necessary for summer annual species, it should be completed well before the plants have a chance to produce seed and contaminate the soil with a future population of offspring. Common examples of this category include, pigweed, prostrate spurge, black medic and yellow woodsorrel.
- **Winter annual broadleaf weeds:** This category of weed species also completes its life cycle in less than one year. They, however, germinate during late summer and early fall, grow rapidly through the fall, over-winter in a semi-dormant state and resume active growth the following spring, flower and produce seed and die during the warmer temperatures of summer. Treatment to control these species can be made during the initial late summer/fall growing period or the following spring prior to flowering and seed production. Common examples of this category include chickweed, henbit, Virginia pepperweed and CORn speedwell.
- **Perennial broadleaf weeds:** This category of weed species is often the most difficult to control as they live two or more seasons and don't need to come back from seed each year. Treatment to control perennials is best made in the early fall when plants are translocating carbohydrates downward into their root systems as storage reserves for winter survival. During this process, the applied herbicides are also translocated into the root system to facilitate a complete kill of the target weed plant. Common examples of perennials broadleaves include Canada thistle, wild carrot, ground ivy (creeping Charlie), white clover, wild violet and dandelion.

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Preemergence Control of Crabgrass and Other Annual Grass Weeds in Turf grass

Introduction: Crabgrass is without doubt the single most commonly recognized weed pest in established stands of cool season turf grass. Even the average homeowner with a lawn of any size is aware of this pest and has probably joined the annual battle to control it. The professional lawn care industry in the United States was built on the promise of dark green lawns free of crabgrass. The crabgrass species in question here is most likely *Digitaria sanguinalis*, common name, large crabgrass. There are, however, several other members of the same family that could be involved. Whether they are or not is unimportant. The control tactics discussed here are the same regardless of the actual family members involved. In addition to crabgrass, several other annual weed grass pests are often encountered across the geography of MSN IV. These include foxtail, both yellow and green, barnyardgrass, goosegrass, and annual bluegrass (*Poa annua*). With the exception of annual bluegrass, which is a winter annual and germinates around Labor Day, the others are summer annuals and germinate during the spring.

Herbicide Selection and Factors Effecting Performance: There are a number of commercially available herbicide products that will effectively control the germinating seeds of crabgrass and other annual grass weeds listed above. The best choice for each turf grass maintenance situation can be made following consideration of a number of factors. These might include cost, formulations available, soil residual properties, turf grass species tolerance, weed efficacy spectrum and user handling and safety. It is therefore beneficial to have an understanding of the characteristics of the available choices in order to make an informed decision. The list of products from which a user can choose includes, benefin (trade name Balan), trifluralin+benefin (trade name Team and Team Pro), pendimethalin (trade name Pendulum and Pre-M), prodiamine (trade name Barricade) and dithiopyr (trade name Dimension).

Four of the five products listed above belong to the same chemical family, dinitroanilines, and they clearly dominate this category of herbicide usage. Dithiopyr is the only product not a member of this family. All preemergence herbicides must however share the same basic properties in order to perform effectively. They must be soil active materials in order to kill weed seeds as they germinate, they must not be prone to soil leaching so they will remain near the soil surface where the weed seeds germinate and also so they don't come into contact with the principle root mass of the desirable perennial turf grass species, they must possess sufficient soil residual longevity in order to remain above herbicidal activity thresholds during the primary germination period of the target annual weeds but not so long they impede reseeding or over-seeding operations should those be necessary and of course, they must demonstrate a wide range of tolerance for use on all commonly grown turf grass species. It is also comforting to know that any pesticide product that has been registered for general use under the very stringent Federal and State guidelines existing today has successfully cleared all environmental, ecological, and

human safety test hurdles. The user marketplace itself will determine whether a pesticide product performs well enough to be a commercial success. All of the products listed above have been in use for some time and have definitely established themselves as highly effective herbicides when properly used.

Application Timing and Formulation Options: The most common error users make when applying a preemergence herbicide involves application timing. Usually, applications are made much earlier than necessary to achieve optimum performance. Crabgrass begins to germinate in the spring after soil temperatures in the top 1 to 2 inches of soil have reached 50 – 55 degrees Fahrenheit. The germination process will not begin just because there have been a few unseasonably warm days in March or April. Soil temperatures are slow to warm in the spring. If the soils have been more moist than normal the warming process will be even slower. Water is a very poor conductor of heat. If the herbicide is applied 4 to 6 weeks before germination begins, you will be wasting a significant percentage of the active ingredient, as it begins to degrade in the soil as soon as it is applied. Ideally, application should be timed one to two weeks prior to the onset of germination. It is also critical however, that the application not be delayed until after germination. Although all of these herbicides will control a recently emerged one to two-leaf stage crabgrass plant, they should not be counted on to reach back any further than that. **Bottom line** -- Don't rely on artificial signals or old wives tales such as when the forsythia blooms. Buy several inexpensive soil thermometers, place them at strategic locations around the property at a soil depth of 2 inches and let science be your guide. When they reCORd in excess of 50 degrees during mid afternoon for 3 to 4 consecutive days, make your application.

All of these products are commercially available from numerous sources and in several different formulations. They can be purchased in several sprayable formulations, true liquids, wettable powders, flowables or dry flowables. Uniform application to the target area is of course essential. Generally speaking, most users will find that a granular or fertilizer combination formulation is easier to apply. Standard fertilizer spreading equipment will do the job efficiently and with less likelihood of error than with a spraying procedure. Fertilizer combination products that have the selected herbicide impregnated on them have become very popular. This approach kills two birds with one stone as they say. It is also easier to uniformly spread the higher volume of product recommended with a fertilizer combination than with a straight granular formulation of the herbicide alone.

In general, a single properly timed application of one the herbicides discussed will control in excess of 90% of any annual weed grass seeds that germinate during a normal spring season across MSN IV. Although it is a common practice among many professional lawn care companies and high dollar golf courses to make two sequential crabgrass control applications to ensure total full season control, this practice is not deemed appropriate or necessary on MSN IV cemetery properties.

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Maintenance Weed Control Practices for Landscape Ornamental Plantings

Introduction: Landscape planting beds containing various plant materials including woody shrubs, ground covers, perennial and annual flowering plants, trees and bedding plants are an integral part of the landscape environment at many NCA properties. Keeping these areas free of unwanted vegetation can become a very labor and time intensive process. Simple replacement or replenishment of the various mulching materials used in these planting areas will not prevent or eliminate the encroachment of unwanted vegetation. Such vegetation is most often the result of weed seeds germinating and emerging from the soil below or from within the mulch itself. It is also possible that the turf grass species surrounding these plant beds has spread by vegetative growth structures (rhizomes most likely) into the bed. Regardless of the source, this unwanted vegetation must be prevented or eliminated to maintain the desired appearance of the cemetery landscape. Some manual labor will always be required to properly maintain these beds, but the availability of several exceptionally effective chemical tools should greatly reduce the cost and labor required.

Preventative Control of Annual Weed Invasion: Newly established landscape planting beds or existing beds that have been cleaned of all unwanted vegetation and re-mulched should be routinely treated with a preemergence herbicide. Several exceptional materials are now available and fully registered for this use. These products control annual or perennial, for that matter, seeds as they germinate. The new herbicides not only control annual grassy weeds such as crabgrass and foxtail but also a very broad spectrum of annual broadleaf weeds. They can be applied to the soil prior to the addition of mulch in a newly established planting, prior to adding fresh mulch on an already existing bed or overtop of existing mulch in a bed where no addition of mulch is planned. As with all preemergence herbicides, application must occur no less than one to two weeks prior to the anticipated germination of the weed seeds. Precise timing across the north to south latitudes encompassed in MSN IV will vary. Personal experience or recommendations from local cooperative extension authorities can provide the best application timing information for any location. Remember, soil temperature not air temperature is the primary factor influencing the timing of weed seed germination.

- **Herbicide Selection:** The products most effective for the uses described above contain one of several dinitroaniline herbicides, oryzalin (trade name Surflan), trifluralin (trade name Treflan) or pendimethalin (trade name Pendulum) combined with a newer class of material known as isoxaben (trade name Gallery). Several pre-formulated products are also available that combine these materials. They are sold under the family trade name Snapshot. Both a sprayable and a granular formulation are available. The sprayable version combines oryzalin and isoxaben as Snapshot DF and the granular version combines trifluralin and isoxaben as Snapshot TG. Of course, the individual components

of the sprayable combination can be purchased separately and tank mixed for application by the end user.

Elimination of Existing Unwanted Vegetation: The removal of emerged and growing weed species can be accomplished mechanically if that approach is deemed satisfactory. The more common approach however has been through the use of the nonselective total vegetation control herbicide, glyphosate (trade name Round Up). Glyphosate has become the standard for the removal of unwanted vegetation in all categories of vegetation control environments. Although it is nonselective (it kills any green plant tissue that it contacts), it has the unique characteristic of immediate degradation upon contact with soil surfaces and therefore has no residual carryover effect that could damage subsequent planting into a treated site. It is almost certain that every cemetery within the NCA system is familiar with glyphosate and is using it for some vegetation control purposes. What should be added to this practice, when glyphosate is used in landscape planting beds is the tank mix addition of one of the preemergence herbicides discussed above. When glyphosate is used alone, it will only control emerged weed species. Seeds lying in the soil that may germinate later will not be controlled. It is therefore prudent to always mix one of these herbicides with glyphosate when treating a landscape planting bed. Of the products identified above, oryzalin and pendimethalin are the most frequently used materials. Both are broadly labeled for use on ornamentals and possess broad-spectrum weed efficacy.

It is important to note that the dinitroaniline herbicides discussed here all possess chemical properties that make them very strong dyes. The active ingredient within all formulations of these herbicides will impart a yellow to bright orange coloration. When they are mixed with water and sprayed, the spray solution will stain any surface that it contacts. **Care must therefore be taken to avoid contacting any surface other than the actual target area.** On the positive side however, this same characteristic enables the operators to more readily see exactly where they have already sprayed.

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Elimination of White Grubs in Established Stands of Turf grass

Introduction: The insect pests commonly referred too as “grubs” are technically the immature larval stage of several different species of beetles. They damage turf grass stands as they feed on the roots of grass during their periods of active growth. This can occur during the spring and the fall and depends on which of the several species of beetle larvae are present in the soil. As a group, white grubs include the immature larval stages of Japanese beetle, European chafer, northern masked chafer, southern masked chafer, Oriental beetle and Asiatic garden beetle. In general, these species complete their life cycle in one year. Adults emerge from the soil, eggs are laid on or beneath the soil surface, hatch, and the larvae feed on the roots of turf grass during its growing season, potentially causing extensive damage. Another group of white grub species complete their life cycle in 2 or 3 years and are the immature stage of the beetles referred to as May beetles or “June bugs”. In the geography encompassed by MSN IV, Japanese beetles, May beetles, or one of the chafers are the most likely culprits to be encountered. With the insecticides available today for the elimination of these pests however, it makes little or no difference which specific species is present. The recommended products will control them all.

Control Strategies: The first step in developing an effective control strategy for these common insect pests, is determining whether the soil population of larvae is sufficiently large to warrant application of an insecticide. The presence of a few larvae per square foot does not constitute a population level high enough to cause significant turf grass damage. At what level does this occur? The answer to this question varies with the nature of the turf grass area. Golf courses would tolerate higher populations in their roughs than in their close cut fairways or putting greens. The turf in the cemeteries of MSN IV can also tolerate higher white grub populations than a golf course fairway. Generally however, a white grub population in excess of 12 to 15 per sq. ft. would warrant an insecticide treatment. Periodic population counts should be made in areas with a history of previous grub damage, turf grass bordering wooded areas where high levels of adult beetle activity have been observed, areas where turf grass injury symptoms appear, in areas where significant mole activity is observed or where skunks or raccoons are seen digging up the turf in search of food.

Counts are best conducted by laying back a section of sod that has been sliced on three sides to expose the soil surface at the root soil interface of the turf grass. This is best timed in late May or September when beetle larvae are most likely to be actively feeding near the soil surface. In order to get a more thorough accounting of all grubs in the area, prepare a solution of sudsy water and pour it over the entire exposed soil surface. This will drive any grubs not fully visible out of hiding and onto the soil surface.

Recommended Insecticide Treatments: Two approaches for the control of white grubs are in general use by turf grass managers. The more common employs a moderately residual insecticide applied in a preemptive manner during the spring feeding period. This treatment will control grubs actively feeding then as well as exhibit sufficient soil residual activity to control any larvae that surface for feeding in late August through September. Two newer molecules are being widely used in this approach. Imidacloprid (Trade name Merit) and halofenozide (Trade name Mach 2) are both highly effective for controlling white grubs when used in this manner. Of course, application of these two products can also be made in late summer prior to the heavy fall feeding period of newly hatched beetle larvae. In situations where white grub populations have progressed beyond reasonable expectations of control from Merit or Mach 2 and a rescue treatment is warranted, the choice is trichlorfon (Trade names Dylox and Proxol). Trichlorfon is an organophosphate insecticide and as such should be handled with care to avoid any exposure to applicators or others. Of course as with all pesticides, proper storage, safe handling and application procedures must be adhered to at all times.

It is suggested that annual monitoring for white grub population levels become a routine part of the turf grass maintenance operation at every MSN IV cemetery property. Detecting and treating when populations warrant will prevent a serious build up to potentially damaging levels.

NATIONAL CEMETERY ADMINISTRATION
MSN IV
Agronomic Protocol # 9

Dormant Overseeding to Fill Voids in Turf grass Cover

Introduction: Turf grass stands can have gaps or voids in their complete coverage of an area resulting from disease or insect damage, drought stress, winter injury or from a failure of the original establishment seeding to achieve complete cover. There are a number of approaches that can be initiated to correct the problem and fill these void areas. Most involve a significant disturbance of the turf grass stand to prepare the soil in the void area to properly receive newly spread seed. It is essential during any turf grass reseeding procedure that intimate contact between the new seed and the existing soil be established. The following procedure takes advantage of mother natures' activity to create that contact while eliminating any mechanical disturbance of the soil and the existing stand of turf.

Environmental Conditions and Timing: This procedure has very specific environmental requirements to be successful and therefore will not always be feasible. The turf grass area to be reseeded must be fully exposed (not covered with snow) to the elements, it must then be subjected to a heavy frost during one of the early morning days of late winter and the soil within the void areas becomes honeycombed. Under this set of circumstances, turf grass seed that is broadcast over a dormant stand of turf with numerous voids will fall largely into the honeycombed pockets created by the frost. As the soil then warms over time, the soil surrounding these seeds spreads out to engulf and capture the seed. This creates the intimate seed to soil contact essential for successful turf grass seed germination and survival. This seed will obviously not begin to germinate until soil temperatures have warmed sufficiently. This will most likely not occur for a number of weeks following the actual date of seeding. There is no problem with this delay. In fact, the reality is that even with this delay the seed will generally germinate earlier than would have occurred had a more traditional approach of mechanically preparing the soil during early spring and then reseeding been undertaken.

Although a precise date for this dormant seeding technique cannot be established, it will most likely occur during the last half of March or very early April in more northern areas. Of course, it is essential that if this approach is planned, the supplies and equipment required must be on hand and ready for immediate implementation when the environmental conditions occur. If they never materialize, a reversion to the more traditional reseeding technique can be