ATTACHMENT 4

INVASIVE SPECIES CONTROL METHODS FOR MAINTENANCE AND CONSTRUCTION, 9/10/04

This attachment is considered to be a “living document” and will be updated and revised, as appropriate, to incorporate innovations and advances in the science of invasive species control.


1. Identification – Learn to identify the priority invasive plant species in your area. Throughout NYS, four priority species are Purple Loosestrife, Common Reed (Phragmites), Japanese Knotweed and Giant Hogweed. Additional invasive species may be of priority concern in your area. Once you know which invasive species are a priority in your area, learn to identify these plants.

2. Inventory – Developing an inventory of the priority invasive plants in your area is important for several reasons. First and foremost, knowing where the invasive plants live is essential to any future control efforts. Secondly, since invasive species will not disappear on their own (too bad, huh!), once their locations are known, they will continue to exist and spread until they are controlled. Thirdly, since invasive species can show-up at any time and are easiest to control when they first invade an area, it’s important to continually update the inventory.

3. Early Detection and Rapid Response – Invasive species, by there nature, spread very rapidly once introduced to a new area. Therefore it is essential that new infestations be identified and controlled as quickly as possible. Control practices for small populations are far more likely to succeed, are significantly less expensive and provide more options for control methodology.

4. Minimize Soil Disturbance – Due to the nature of invasive plants to rapidly colonize areas of disturbed soil, out-compete native species and become firmly established very quickly, it is essential to minimize areas of soil disturbance.

5. Temporary Erosion and Sediment Control – Department policy requires sound temporary erosion and sediment control practices on all projects that disturb soil. This practice is particularly important in preventing the introduction and continued spread of invasive plant species. Where invasive species are known to exist, rapid and diligent erosion and sediment control, as per section 209 of the Department Specifications is particularly important.

Note: Some of the methods described below require actual digging or pulling of plants from the

soil. In all cases they require removal of vegetation whether or not there is actual soil disturbance. Each situation must be studied to determine if the proposed control method will destabilize soils to the point where erosion is threatened (or invasive plants may re-establish).

6. Mulch – Due to the nature of invasive plants to rapidly colonize any area of disturbed soil, it is essential that all disturbed areas be mulched and seeded as soon as possible. If outside the growing season for seed germination, disturbed sites should still be mulched. Sources of mulch should be free of invasive plant parts or seeds. Use of straw or wood fiber mulch is preferred. If hay mulch is used, it should be verified as originating from a invasive free source.

7. Rapid Revegetation - Although not a specific condition, replanting or reseeding with native species is highly desired. All of the control methods below are aimed at reducing or eliminating invasive species so that natives are encouraged to grow and re-establish stable conditions that are not conducive to invasive colonization. In most cases removal or reduction of invasive populations will be enough to release native species and re-establish their dominance on a site. Replanting may be desirable on private lands where it can be used as a quid pro quo with the landowner for permission to remove invasive plants.

II. General Control Concepts by Activity Type – Developed by NYSDOT, Kyle Williams, 9/10/04

1. Mowing - Don’t be “Johnny Phragmite Seed”! Maintenance roadside mowing, while essential for safety, operational, aesthetic and environmental purposes, can, has and does play a significant role in the introduction, spread and proliferation of invasive plants. If considered as a control practice, due to the tremendous reproduction and rapid growth rates of invasive plants, repeated and time-specific mowing will be required. Considering that mechanical mowing spreads invasive plant seeds and that each segment of many invasive plants, including the rootstock, can vegetatively sprout a new plant, priority invasive plant species should be mowed with due consideration for the following factors:

Note – Since drainage ditches, streams and wetlands can rapidly spread invasive plants through dispersal of seeds and, to a lesser degree, plant parts, it is strongly recommended to control (herbicide, excavate, etc.) priority invasive plant populations in and adjacent to drainage ditches and streams, prior to mowing. This also will provide operational benefits because invasive plant populations in the drainage system that are “only” mowed will immediately re-grow and spread and therefore require additional mowing. Isolated (upland) roadside populations of invasive plants can be mowed with less chance of dispersing the plant seeds and parts to new areas, however mowing should always be done prior to seed maturation – generally prior to August 1st.
Mowing Considerations:

a. When mowing untreated or uncontrolled invasive plant populations, do so prior to seed maturation (generally prior to **August 1st** for the first mowing of the year);
b. Plan on mowing invasive plant populations 2 – 3 times per year, prior to seed maturation, for successive years if mowing is the only control practice used. The “mowing only” option should be used in locations that are not in or adjacent to drainage ditches and are inaccessible or too large for other control options;
c. Control small invasive plant populations comprised of tender, young plants with herbicide early in the summer, prior to mowing, especially in and adjacent to drainage ditches;
d. If invasive plant populations consist of large, mature plants, mow the plants prior to seed maturation, allow the plants to re-grow to a height of 2 - 4 feet and then treat with foliar herbicide, especially in or adjacent to drainage ditches;
e. Physically remove flower or seed heads (cut and bag) of small invasive plant populations prior to mowing, especially in and adjacent to drainage ditches;
f. Physically remove rootstock (mechanically excavate) of small invasive plant populations prior to mowing, especially in and adjacent to drainage ditches;
g. Control large purple loosestrife plant populations with biocontrol beetles (Hylobias sp. or Galruccella sp.) prior to mowing. Beetle releases will take several years to significantly reduce purple loosestrife populations;
h. If mowing occurs after seed maturation, hand clean, with brush or broom, upper parts of contaminated mowing equipment prior to moving to new locations – especially uncontaminated locations. This is especially important for purple loosestrife as each mature plant is capable of producing up to 2.5 million viable seeds;
i. Take care to minimize scalping and rutting during mowing operations. These situations can be avoided by properly adjusting the equipment and avoiding operating equipment directly in wet areas or rough terrain. Any scalped or rutted areas should be immediately seeded and mulched. Any badly rutted areas should be repaired, seeded and mulched; and
j. Use of optional mowing equipment, such as “over-the-rail” boom-type mowers may be necessary in some situations to reach invasive plants;

2. Herbicides – Judicious use of herbicides is an important tool in invasive plant control efforts. All herbicide use shall be in accordance with label instructions, state and federal law (including adjacent landowner notification requirements) and will be conducted by, or under the supervision of certified applicators. Herbicide application techniques will generally fall under two types – foliar application or stem cut and treat. As a general rule, foliar herbicides should be applied to young, tender, actively growing plants prior to flowering. If the plants are too mature for effective herbicide application, a common practice is to mow an invasive plant infestation prior to seed maturation, allow the plants to re-grow to a height of 2 – 4 feet and then apply the appropriate foliar herbicide. This process will weaken the plant and prevent spread by seed, and maximize the effectiveness of the herbicide application. Due to the vigorous nature of many invasive plants, especially knotweed and phragmites, this process may need to be repeated 2 or 3
times over consecutive years. Stem “cut and treat” herbicide applications involve the cutting and removal of the growing plant stems and then the spot application of herbicide to the freshly cut surface of the remaining rooted portion of the stem. The herbicide will then be translocated down into the plants root system. “Garlon” works well for this type of treatment. The “spot” application can be accomplished with a swab or hand sprayer and should occur as soon as possible but not more than one hour from the time the stem is cut (within 15 minutes is preferred for best results). A common practice is to have one person cut the stems while a second person follows and applies the herbicide to the recently cut stems. It is important to mark which stems have been treated – using a marker dye is a common technique. This technique is recommended in situations where foliar treatments are not possible or effective – this technique works well with Japanese Knotweed. If stands of invasive plants extend beyond the R.O.W., consider obtaining a written release from the adjacent landowner to implement controls. All sites where herbicides are applied should be inspected 3 – 4 weeks post application to assess success and to determine if natural re-vegetation by native or non-invasive plants is adequate or if additional restoration, e.g. seeding and mulching, is required;

3. Biological Controls – On large, dense stands of purple loosestrife (1/2 acre or larger), use of Hylobius sp. and Galrucella sp. beetles is a very effective control option. Cornell University conducted extensive research prior to the selection of this particular species and prepared a Generic Environmental Impact Statement for their release throughout New York State. These beetles feed exclusively on purple loosestrife (they will starve rather than eat any other plants), will reproduce after release and can be harvested from prior release sites for use in other locations. NYSDOT currently has a hylobius “doner” site in Region 2 at the Utica Marsh complex. See Page 8, No. 3 for additional information regarding biological controls.

Research is currently well underway by Cornell University to identify and test an effective biological control(s) for Common Reed (Phragmites). Unfortunately, no acceptable biocontrols currently exist for Japanese Knotweed;

4. Ditching - Many priority invasive plants prefer moist soil conditions and are tolerant of saline environments; therefore they grow very well in highway drainage ditches and other components of the drainage system. As the dense root systems of invasive plants such as purple loosestrife, phragmites and Japanese knotweed proliferate, they rapidly clog drainage ditches and reduce sight distances, especially where water velocities slow, e.g. up gradient of culvert inverts, above check dams, etc. Due to the rapid growth of invasive plants, maintenance cycles are far more frequent where they exist. Prior to excavating the plants from drainage ditches, the entire invasive plant infestation should be treated with the appropriate herbicide, e.g. rodeo or other aquatic-use registered herbicide. This will ensure that the plants, seeds and root parts will not spread and re-establish. Failure to treat the invasive plants prior to physical removal will most likely result in immediate re-growth of the plants in the ditch and the spread of the plant to adjacent and downstream areas. In addition, if the invasive plants are not killed prior to ditch
cleaning, the spoil produced can further spread the plants upon disposal (see No. 8. below);

5. Shoulder Scraping - Removing the build-up of organic material along highway shoulders is essential to maintaining pavement quality, providing adequate sheet flow drainage and providing safe driving conditions. Due to their disturbed nature and harsh growing conditions, highway shoulders provide a prime area for invasive plants to establish and spread. This is due to the nature of invasive plants to rapidly colonize disturbed areas and to tolerate harsh environmental conditions. Therefore it is essential that shoulder scraping activities address invasive plant control. Prior to scraping highway shoulders, all existing priority invasive plants should be treated with appropriate herbicide or other control measure to kill seeds and plant parts, including the root stock. This will prevent the plant from reseeding, re-sprouting in-situ or spreading to adjacent areas via, water, wind, hitching a ride on equipment or through spoil disposal (See No. 8. below regarding disposal);

6. Vine, Brush and Tree Removal - Several common species of vines, brush and trees that grow profusely along highway roadsides are considered invasive species. These species frequently cause a nuisance to maintenance workers, block traffic signs or limit sight distances and therefore are removed in routine maintenance operations. In the evaluation of these removal priorities, invasive species should be given preference and controlled by accepted practices that will ensure no re-sprouting and prevent additional spread through seed dispersal. Since these species do not reproduce vegetatively, plant parts do not need to be buried or land-filled and equipment does not require cleaning. Accepted methods of control include foliar herbicide treatment or cutting followed by stump treatment with herbicide. Mowing alone, frequently results in re-sprouting and cloning and is not an effective control methodology;

7. Poisonous Plant Removal - A few invasive species pose serious a threat to worker safety and public health. Giant Hogweed, *Heracleum mantegazzianum*, is such a plant. Upon dermal contact this plant causes severe skin burns which are exacerbated through exposure to sunlight. Where ever this plant is encountered, the location should be located using GPS coordinates and reference marker identification, the size of the population noted and maintained in a regional database. When encountered, Giant Hogweed populations should be controlled using the guidance on page 12 – 13. This plant’s distribution is being tracked by the NYS Department of Ag & Markets and NYSDOT can provide significant information to this statewide inventory effort. A similar invasive plant that is spreading throughout the state is Cow Parsnip, *Heracleum lanatum*. This plant is smaller than Giant Hogweed and results in many of the same symptoms although to a far less severe degree. We’ll have to keep an eye on Cow Parsnip as it appears to be spreading along roadsides and may elevate to a status of statewide significance.;

8. Disposal – Proper disposal of harvested invasive plant parts and soil containing invasive plant seeds or root stock (rhizomes) is essential to controlling the spread of invasive plants. Full consideration should be given, as appropriate, as follows:
**Transportation** - While on the treatment site, bag all cut living plant material in heavy duty, 3 mil or thicker, black contractor quality plastic clean-up bags. Securely tie the bags and transport from the site in a truck with a topper or cap to securely fasten the load, in order to prevent spread of the plant material from the project work site. Transport the material to an appropriate disposal location;

**Compost** - Because of the extremely robust nature of invasive species, composting in a typical backyard compost pile or composting bin is not appropriate. However, methods can be used whereby sun-generated heat can be used to destroy the harvested plant materials. For instance, storage in a sealed 3 mil thickness (minimum) black plastic garbage bags on blacktop in the sun until the plant materials liquefy is effective. If a larger section of blacktop is available, make a black plastic (4 mil thickness minimum) envelope sealed on the edges with sand bags. The plant material left exposed to the sun will liquefy in the sealed envelope without danger of dispersal by wind. The bags or envelopes must be monitored to make sure the plants do not escape through rips, tears or seams in the plastic;

**Bury** – Due to the incredible capacity of many invasive species to reproduce by seed, clone and vegetative propagation, it is absolutely imperative that spoil material contaminated with invasive plant material **NOT** be disposed-of in an indiscriminant manner. It is recognized that the Contractor owns spoil material and therefore, contract documents should identify locations of contaminated soil and address disposal options. Spoil material that contains invasive plant material should be buried in an excavated pit, covered with woven geotextile and covered with at least three feet of uncontaminated fill material;

**Landfill** – If harvested invasive plant parts or spoil material containing invasive plant material is not, composted or buried, it should be transported directly to a sanitary landfill for proper disposal;

**9. Bridge Washing** – All bridge washing activities, whether for biannual maintenance or in preparation for re-painting, require the use of water. Several invasive plant and animal species are aquatic or are dispersed through water, therefore, Department activities that require the transport and use of water need to consider invasive species control. Control considerations include use of municipal water sources, filters on water intakes, decontamination/sanitation of equipment and use of in-situ water sources. In addition, the equipment used in transporting and spraying water should be cleaned prior to use or between use at sites in different watersheds. See additional guidance in NYSDOT Engineering Instruction EI 02-032 “Maintenance Cleaning and Washing of Bridges”, 10/07/02.;

**10. Construction Equipment in Water Bodies** – Several invasive species are aquatic and many additional non-aquatic species are readily spread by the movement of flowing water. Many aquatic invasive species are capable of survival out of water for extended periods. To prevent the accidental introduction of invasive species that are “hitching a ride” on construction equipment, all equipment that is to be placed in a water body should be cleaned, as appropriate,
e.g. tracks, buckets, to remove invasive species and their seeds and propagules. This requirement applies to equipment arriving on the project and equipment that is being relocated within the project;

11. **Restricted Construction Equipment Access** – To prevent the accidental introduction of invasive plants during construction or maintenance activities, all tracked equipment involved in earthwork should be cleaned to remove plants, seeds and propagules that may be hitch hiking, prior to arrival on-site. If tracked equipment is used in earth work on a portion of a project where invasive species are known to exist, this portion of the earthwork should be conducted last, or the equipment shall be cleaned *prior* to use on any portion of the site that is known to be free of invasive plants; and

12. **Cleaning of Construction Equipment** - Cleaning should occur prior to equipment arriving on-site. Once on-site, if equipment involved in earthwork is contaminated with invasive species, the equipment should be cleaned prior to moving into uncontaminated areas. Cleaning shall consist of using physical means and hand tools, such as brushes, brooms, rakes or shovels, on all track and bucket/blade components to adequately remove all visible dirt and plant debris. If water is used, the water/slurry shall be contained so as to restrict introduction of invasive plants, seeds and propagules into the project or off-site through future surplus material disposal.

**III. Detailed Control Practices by Priority Plant Species** - Developed by the Adirondack Park Invasive Plant Program Principle Partners, March 2004

**PURPLE LOOSESTRIFE, *Lythrum salicaria***

**Plant Description**
Purple loosestrife is a wetland perennial native to Eurasia that forms large, monotypic stands throughout the temperate regions of the U.S. and Canada. It has a vigorous rootstock that serves as a storage organ, providing resources for growth in spring and re-growth if the plant has been damaged from cuttings. New stems emerge from the perennial roots enabling the plant to establish dense stands within a few years. Seedling densities can approach 10,000-20,000 plants/m\(^5\) with growth rates exceeding 1 cm/day. A single, mature plant can produce more than 2.5 million seeds annually which can remain viable after 20 months of submergence in water. In addition, plant fragments produced by animals and mechanical clipping can contribute to the spread of purple loosestrife through rivers and lakes.

**Management Options**

1. **Digging/pulling**
Effectiveness: Can be effective in small stands i.e.:<100 plants, low-med density(1-75%area), & <3 acres, especially on younger plants.
Methods: Hand-pull plants<2 years old. Use mini-tiller for plants>2 years - gets most of roots w/minimum soil disturbance, has 3 heavy duty prongs on 1 side that are pushed under base of
plant, then pry back on handle to leverage plant out of ground. Use weed wrench for plants > 2 years old - good w/minimal soil disturbance. In mucky conditions, put base of wrench on small piece of wood (e.g.: piece of 2x4) to keep wrench from sinking into mud. Use shovel for plants > 2 years old - dig up plant, then replace soil and any existing cover. Cautions: May increase habitat disturbance & increase spread of loosestrife. Requires follow-up treatments of sites for 3 years to eliminate re-sprouting from fragments left behind. Must pull/dig ENTIRE rootstock or re-sprouting will occur. Must pull/dig before the plants begin setting seed or must remove flower/seed heads first (cut into bags) to prevent spread of seeds. Also remove previous year= dry seed heads. Erosion control may be necessary. Disposal: Bag all plant parts & remove from site (compost at DOT Residency, dispose of in approved landfill or incinerate with appropriate permits).

2. Cutting
Effectiveness: Can be effective in small stands i.e.<100 plants, low-med density (1-75% area), & <3 acres, especially on younger plants.
Methods: Remove flower heads before they go to seed, so seed isn't spread when cutting or mowing. Must do repeated cutting & mulching to permit growth of grasses.
Cautions: Need to repeat for several years to reduce spread of plants. Doesn't affect rootstalk & thus, cut pieces can be spread that will re-sprout. Once severed, stems are buoyant and may disperse to other areas and re-sprout. Disposal: Bag all plant parts & remove from site (compost at DOT Residency, dispose of in approved landfill or incinerate with appropriate permits).

3. Herbicide
Effectiveness: Use when>100 plants & <3-4 acres in size.
Methods: Use glyphosate formulations only. If possible spray seedlings before they reach 12" in height. Cut and bag flower heads before applying herbicide. Apply prior to or when in flower (late July/Aug) so plants are actively growing.
For spot application use:
- sponge tip applicator w/wick.
- injection into stem(w/large gauge needle).
Cautions: Be careful to avoid non-target plant species(i.e.: if spraying, do<25-50% plant foliage to minimize over-spraying to other plants). Use RODEO formulation if loosestrife is growing in standing water or if spray will contact water.

3. Biocontrol
Two species of leaf-feeding beetle, Galerucella calmariensis and G. pusilla, have been shown to be effective in controlling purple loosestrife. Over 5 million of these beetles have been released in 30 states including New York, the northeastern and midwestern states as well as all of the Canadian Provinces. The beetles have shown dramatic decreases in purple loosestrife populations with subsequent increases in populations of native species. The scientific literature indicates that the beetles are very specific to purple loosestrife with only minor A@pillover@effects that do not compromise non-target plant populations.
Effectiveness: Use if site has at least a half acre of purple loosestrife of medium to thick density.
Best type of control for large patches of loosestrife>3-4 acres.  
Methods:  The number of beetles released per site should be based on the size of the site, the density of loosestrife and the economics of purchase.  More beetles are generally better than fewer.  
Cautions:  Use only if mowing, pesticide and herbicide use are not active practices on the site.  The site must not be permanently flooded and should be sunny.  Use only if winged loosestrife, (Lythrum alatum) and waterwillow (Decodon verticillatus) are not major components of the plant community on the release site.  

**COMMON REED (PHRAGMITES), *Phragmites australis***  
**Plant Description**  
Common Reed, or Phragmites, is a perennial grass that can grow to 14 feet in height.  Flowering and seed set occur between July and September, resulting in a large feathery inflorescence, purple-hued turning to tan.  Phragmites is capable of vigorous vegetative reproduction and often forms dense, virtually monospecific stands.  It is unclear what proportion of the many seeds that Phragmites produces are viable.  

Note:  In addition to the non-native invasive phragmites, a native variety, *Phragmites australis var. berlandieri*, also occurs in New York State although it is far less common than non-native phragmites, especially inland.  In general, native phragmites has a lower stem density and has a reddish-purple basal-stem coloration in the spring and summer.  In fall the native stem bases fade to chestnut brown and continue to fade to lighter brown-gray during winter.  Non-native phragmites stem bases are uniform tan in color.  Stems of native phragmites are smooth and shiny, as if polished, particularly in the winter, while the stems of non-native phragmites are dull, rough and ribbed.  Specific identification guidelines can be found at [www.invasiveplants.net/invasiveplants/phragmites/nativeandintroduced.asp](http://www.invasiveplants.net/invasiveplants/phragmites/nativeandintroduced.asp).  Information on assistance with diagnostic services are available through Cornell University at the same site.  

**Management Options**  
1. **Cutting and Pulling**  
Effectiveness:  Need to repeat annually for several years to reduce spread of plants.  Hand-pulling, though labor intensive, is an effective technique for controlling phragmites in small areas with sandy soils.  
Methods:  The best time to cut phragmites is when most of food reserves are in aerial portion of plant (when close to tassel stage, e.g. at end of July/early August to decrease plant = vigor.  Some patches may be too large to cut by hand, but repeated cutting of the perimeter of a stand can prevent vegetative expansion.  Phragmites stems should be cut below the lowest leaf, leaving a 6" or shorter stump.  Hand-held cutters and gas-powered hedge trimmers work well.  Weed whackers with a circular blade were found to be particularly efficient, though dangerous.  
Cautions:  If cut before in tassel stage or at wrong time, stand density may increase because Phragmites is a grass.  Remove cut shoots to prevent sprouting & forming stolons.
Disposal: Cut or pulled material should be removed from the site and composted or allowed to decay on the upland to prevent sprouting and formation of stolons. Do not attempt to compost rhizomes.

2. Hericide
Effectiveness: Hericide use is a 2 year, 2 step process because the plants may need a touch-up application, especially in dense stands since subdominant plants are protected by thick canopy & may not receive adequate herbicide in the first application.
Methods: Use glyphosate formulations only. Apply after tasseling stage when nutrients going back to rhizome and will translocate herbicide into roots. After 2 to 3 weeks following application of glyphosate, cut or mow down the stalks to stimulate the emergence and growth of other plants previously suppressed. If the plants are too tall to spray, cut back in mid summer and apply glyphosate when re-growth reaches 2 to 3 ft. tall. Use spray bottle for individual foliar spot treatments. For smaller sites use swab or syringe w/large gauge needle to apply 1-2 drops directly to cut stems if cutting done first.
Cautions: This herbicide is not selective (kills both monocots & dicots), thus should be applied carefully to prevent killing of non-target species. All tank mixes should be mixed with clean (ideally distilled) water because glyphosate binds tightly to sediments, which reduces toxicity to plants. Do not apply in windy conditions because spray will drift and kill other plants. Do not apply if rain is forecast w/in 12 hours because herbicide will be washed away before it can act. Choose Rodeo formulation for applications in standing water or along a shoreline.

3. Black Plastic
Effectiveness: Can be effective in small stands i.e.:<100 plants, low-med density(1-75%area). Plants die off w/in 3-10 days, depending on sun exposure.
Methods: Cut plants first to 6-8" (hand-pushed bush hog or week whacker w/blade). After cutting a stand of phragmites, anchor a sheet of black plastic over the cut area using sand bags or rocks. High temperatures under the plastic will eventually kill off the plants. This technique works best when the treated area is in direct sunlight. Black plastic is better than clear plastic because has higher heat levels. Should be at least 6 millimeters thick Hold plastic in place with sandbags, rocks, etc. Can treat runners along edge w/spot application of Rodeo or Roundup. Cut holes in plastic in Oct.- Nov. to promote germination of cattail shoots. The plastic can be removed the following year when the covered plants have been killed. A few phragmites shoots may return. These can be cut or hand-pulled.
Cautions: Must monitor to determine if shoots are extending out from under the plastic.
Disposal: Can leave cut material under plastic or bag all plant parts & remove from site (compost at DOT Residency, dispose of in approved landfill or incinerate with appropriate permits.

4. Cutting/Mulching
Effectiveness: Can be effective in small stands i.e.<100 plants, low-med density (1-75%area) & <3 acres.
Methods: Cut and mulch dead stems in winter to remove them and promote germination of other species. Repeat in second year and then every 3-5 years. Can do after herbicides (late
summer/fall application of Rodeo while leaves are still green).
Sanitation: Clean all clothing, boots, & equipment to prevent spread of seed.

5. **Pulling**
Effectiveness: Can be effective in small plants i.e. \(<100\) plants. Very labor intensive. OK for small patches. Best with sandy soils.
Methods: Hand-pull plants\(<2\) years old. Use shovel for plants\(>2\) years old-dig up plant, then replace soil and any existing cover.
Disposal: Bag all plant parts & remove from site (compost at DOT Residency, dispose of in approved landfill or incinerate with appropriate permits).
Sanitation: Clean all clothing, boots, & equipment to prevent spread of seed.

6. **Excavation**
Effectiveness: Can be effective for patches up to 2 acre. Cost is the limiting factor.
Methods: Heavy equipment that may be tracked or rubber tired will be used.
Cautions: The patch should be excavated to below the depth of rhizome development. Follow-ups later in the season or the following year must be conducted to verify that all the plants have been removed.
Disposal: Bag all plant parts & remove from site (compost at DOT Residency, dispose of in approved landfill or incinerate with appropriate permits).

**JAPANESE KNOTWEED, Polygonum cuspidatum**

**Plant Description**
Japanese knotweed is an herbaceous perennial which forms dense clumps 1-3 meters (3-10 feet) high. Its broad leaves are somewhat triangular and pointed at the tip. Clusters of tiny greenish-white flowers are borne in leaf axils during August and September. The fruit is a small, brown triangular achene. Knotweed reproduces via seed and by vegetative growth through stout, aggressive rhizomes. It spreads rapidly to form dense thickets that can alter natural ecosystems. Japanese knotweed can tolerate a variety of adverse conditions including full shade, high temperatures, high salinity, and drought. It is found near water sources, in low-lying areas, waste places, and utility rights of way. It poses a significant threat to riparian areas, where it can survive severe floods.

**Management Options**

1. **Digging**
Effectiveness: This method is appropriate for very small populations.
Methods: Remove the entire plant including all roots and runners using a digging tool. Juvenile plants can be hand-pulled depending on soil conditions and root development.
Cautions: Care must be taken not to spread rhizome or stem fragments. Any portions of the root system or the plant stem not removed will potentially re-sprout.
Disposal: All plant parts, including mature fruit, should be bagged and disposed of in the trash to prevent re-establishment (stockpile at DOT Residency, dispose of in approved landfill or incinerate with appropriate permits).
Sanitation: Clean all clothing, boots, & equipment to prevent spread of seed.

2. Cutting
Effectiveness: Repeated cutting may be effective in eliminating Japanese knotweed. Manual control is labor intensive, but is a good option where populations are small and isolated or in environmentally sensitive areas.
Methods: Cut the knotweed close to the ground at least 3 times a year. Plant native species as competitors as an alternative to continued treatment.
Cautions: This strategy must be carried out for several years to obtain success. Both mechanical and herbicidal control methods require continued treatment to prevent reestablishment of knotweed.
Disposal: Bag all plant parts & remove from site (stockpile at DOT Residency, dispose of in an approved landfill or incinerate with appropriate permits).
Sanitation: Clean all clothing, boots, & equipment to prevent spread of seed.

3. Herbicide
Effectiveness: Glyphosate or Trichlopyr (Garlon) treatments in late summer or early fall are much more effective in preventing re-growth of Japanese knotweed the following year.
Methods: Use Glyphosate or Trichlopyr (Garlon) formulations only.
Strategy:
1) Late June - Cut or mow down stalks.
2) Allow knotweed to re-grow.
3) After August 1, spray knotweed with ROUNDUP, RODEO or GARLON
Cautions: Established stands of Japanese knotweed are difficult to eradicate even with repeated herbicide treatments. However, herbicide treatments will greatly weaken the plant and prevent it from dominating a site. Adequate control is usually not possible unless the entire stand of knotweed is treated (otherwise, it will re-invade via creeping rootstocks from untreated areas). Empirical evidence is that Garlon is more effective than Roundup in causing Japanese knotweed mortality.

4. Compost
Because of the extremely robust nature of invasive species, composting in a typical backyard compost pile or composting bin is not appropriate. However, methods can be used whereby sun-generated heat can be used to destroy the harvested plant materials. For instance, storage in a sealed 3 mil thickness (minimum) black plastic garbage bags on blacktop in the sun until the plant materials liquefy is effective. If a larger section of blacktop is available, make a black plastic (4 mil thickness minimum) envelope sealed on the edges with sand bags. The plant material left exposed to the sun will liquefy in the sealed envelope without danger of dispersal by wind. The bags or envelopes must be monitored to make sure the plants do not escape through rips, tears or seams in the plastic.
GIANT HOGWEED, *Heracleum mantegazzianum* – Developed by NYSDOT, Kyle Williams, 9/10/04

**Plant Description**

Giant Hogweed is a biennial or perennial herb growing from a forked or branched taproot. Plants sprout in early spring from the roots or from seeds. The best time to identify Giant Hogweed is when it’s blooming in late summer. Numerous small white flowers in July, clustered into a flat-topped umbel up to 2 ½ feet across. Stems are hollow, ridged, 2-4 inches in diameter, 8-14 feet tall with purple blotches and coarse hairs. The hairs are especially prominent that circle the stem at the base of the leaf stalks. Leaves are lobed, deeply incised and up to 5 feet across. Fruit (containing the seed) is dry, flattened. Oval, about 3/8 inch long and tan with brown lines. Giant Hogweed can be confused with the following 3 plants that also grow along roadsides: 1. Cow Parsnip, *Heracleum lanatum*; 2. Angelica, *Angelica atropurpurea*; and 3. Poison Hemlock, *Conium maculatum*. All 3 of these plants are much smaller and flower earlier, May – June, typically. Cow Parsnip is the most likely to be confused with giant hogweed, however in addition to being much smaller, only 5-8 feet tall, the stems are only 1-2 inches in diameter and lack purple blotches and leaves are only 2-2 ½ inches in diameter. Angelica is also much smaller, seldom reaching 8 feet tall, has a smooth stem, round greenish-white flower clusters and 2 foot diameter compound leaves with dozens of small leaflets. Poison Hemlock is 4-9 feet tall with smooth stems with purple blotches. Leaves are very finely dissected and fernlike and small white flowers are arranged in numerous flat-topped clusters on many branches.

**About Giant Hogweed**

Giant Hogweed is a member of the carrot or parsley family. It is native to the Caucasus region of Eurasia and was introduced to North America in the early 1900’s. It’s massive size and imposing appearance made it desirable for arboretums and gardens, however it soon escaped from cultivation and became established in rich moist soils along roadside ditches, stream banks, waste ground, along tree lines and open wooded areas. In New York State, giant hogweed escaped from cultivation near Rochester and has spread from this point, primarily east and west along the Thruway corridor.

**Health and Safety Concerns**

This robust plant is a worker and public health hazard because of it’s potential to cause severe skin irritation in susceptible people. Plant sap produces painful, burning blisters with 24-48 hours after contact. Plant juices can also produce painless red blotsches that later develop into purplish or brownish scars that may persist for several years. For an adverse reaction to occur, the skin, contaminated with plant juices, must be moist (perspiration) and then exposed to sunlight. Giant hogweed is a Federal Noxious weed, making it unlawful to propagate, sell or transport this plant. The NYS Department of Agriculture and Markets should be notified whenever this plant is encountered.
Management Options
1. **Digging**
   Digging is NOT recommended as a control option due to the large perennial root system that will soon resprout.

2. **Cutting**
   Mowing, cutting or weed whacking are NOT recommend as control options because the large perennial root system will soon re-sprout and because of the potential exposure to the plant sap. The exception to not cutting, is that mature seed heads should be hand cut, placed in black plastic garbage bags and disposed of at a licensed landfill.

3. **Herbicide**
   Recommend foliar spray application by certified applicator and in accordance with all label instructions and state and federal laws of Thinvert, Garlon or Glyphosate. To minimize risk of exposure to the plant’s sap, cutting the plant prior to herbicide application is not recommended.

IV. Sample NYSDOT Regional Specifications and Special Notes

1. Region 1 Note – Zebra Mussel Control
2. Region 8 Note – Zebra Mussel Control
3. Region 8 Specification – Invasive Plant Control
4. Region 7 Specification – Japanese Knotweed Control
5. Region 1 Specification – Phragmites Control

1. Region 1 Zebra Mussel Control Special Note

   **Special Note**

   **Lake George Drainage Basin**

   Zebra Mussel Decontamination and Disinfection Procedures for Equipment and Tools

   Procedures for the Transfer of Construction Equipment from possible Infested Waters to Waters in the Lake George Drainage Basin

   Machinery, tools, work clothing and other equipment used in water bodies outside of the Lake George Drainage Basin, will be thoroughly cleaned, decontaminated and disinfected before being used in any water body or tributary to Lake George. The cost of disinfecting equipment, tools and other supplies is included in the payment for the work in which it is used. No separate payment will be made for disinfecting. New equipment, being used for the first time, will be exempt from these requirements.
The moving of large and small construction equipment from one body of water to another may contribute to the spread of zebra mussels. Construction activities need to take great care to avoid the transfer of zebra mussel "stowaways". The smaller the mussel the more less likely it is to be seen and therefore inadvertently transported. Although an adult mussel can survive for a week or more in a cool, moist, shaded area, smaller mussels and veligers, the larval stage, cannot survive out of water for as long. Veligers can die quite quickly when exposed to drying or the sun. Equipment that has been in the water for more than 1 or 2 days may have mussels attached to it. More often the mussels are found attached to aquatic plants that have been snagged by ropes or pump units. These are easily transported from water body to water body, and make a naturally moist and shaded environment in which the mussel may remain alive. The zebra mussel can also be inadvertently transported in tanks, drums, cooling systems, and on other equipment parts.

Zebra mussels also settle on aquatic plants that can be caught on props, anchors, chains, that hold in place items like turbidity curtains and silt fences and can be accidentally transported from an infested water source to a clean one. Once relocated, they could easily establish a dense population. Following the guidelines below will not only help to slow the spread of the zebra mussel across North America, but will help to prevent zebra mussels from fouling Lake George and contractors equipment, and avoid potentially expensive removal procedures.

The agencies responsible for the Lake George Drainage Basin, the various state and federal agencies recommend taking the following precautions to minimize further unintentional zebra mussel introductions into currently uninfested waters.

**Methods for equipment decontamination**

**Small equipment (pumps, hoses, barriers, silt fences, floating booms, cofferdams, shovels, rakes, jumping jacks, plate tampers, boots, buckets, etc.)**

All field equipment needs to be visually inspected and all mussels removed and killed. The equipment must then be cleaned by soaking, dipping in, or scrubbing with a chlorine solution or steam-cleaned and allowed to dry completely before use. Particular attention must be given to places where the mussels could be accidentally trapped, such as the treads of boots, inside of pumps and hoses, ropes and chains, attached to fabric of silt fences or floating booms, etc.

**Large equipment (backhoes, excavators, trucks, rollers, trailers, etc.)**

All surfaces and other compartments that could hold water from an area outside of the Lake George Drainage Basin area will be drained of water before bringing to the project area, and flushed with disinfectant solution and/or hot water or steam cleaned, and allowed to dry before the next use. If appropriate, the possible contaminated water may be drained back into the original body of water, as long as conditions are such that this would not cause chemical or biological contamination. Otherwise, such water must be collected into a suitable container for treatment prior to final disposal.

*If water is drained and collected, it must be disinfected and then disposed of by suitable means to avoid causing environmental damage or contamination.*
After washing and/or draining contained water, all inaccessible compartments should be filled with a disinfecting solution, and whenever feasible, the disinfectant should be retained in the compartment until arrival at the next site. If the compartment is too large to make filling practical, rinse it thoroughly with a disinfecting solution, and repeat.

**Equipment surfaces:**

Option 1: All surfaces must be scrubbed to remove any clinging material from the field site, then visually inspected and any remaining material removed, and finally steam cleaned or hosed down with high pressure water.

Option 2: All equipment surfaces will be assumed to be free of live mussels if they have been thoroughly scrubbed, visually inspected, any visible field site material removed, and has remained dry and out of the water for at least 2 weeks, or 1 week in dry weather > 20 ºC.

Regardless of which option is used for cleaning, visual inspection must follow with *special attention* being paid to: 1) cracks and crevices in which mussels may become trapped, and 2) aquatic plants, (milfoil, Lilly pads, etc.) harboring juvenile mussels that may be present on all surfaces. Particular attention must be paid to soft materials, (erosion fabrics, plastic sheeting, gloves, waders, etc.) which could trap tiny mussels. If possible, such material should be removed from the equipment before doing work in the Lake George Drainage Basin.

**Acceptable methods for disinfection**

**Chemical disinfection:** The effectiveness of chemical disinfection is dependent on the concentration of the disinfectant used and the contact time. Since adult zebra mussels can close up and survive for extended periods of time under toxic external conditions, chemical disinfecting as a means to kill adult mussels.

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<tr>
<th>Disinfectant</th>
<th>Concentration</th>
<th>Minimum Contact Time</th>
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<tr>
<td>Chlorine Bleach (&gt;5% sodium hypochlorite)</td>
<td>100ml/20 L of Solution (3 oz/5 gallons of water)</td>
<td>1 Hour</td>
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**Heat:** Temperature and exposure time determine the effectiveness of temperature treatments. Live steam, autoclaving, or boiling are all believed to be 100-percent effective against all zebra mussel life stages, as well as potential parasites they may contain. Minimum exposure times of 3 min at full heat for individual mussels and 10 min for clusters are recommended.

**Freezing:** Adult zebra mussels have a relatively low tolerance to freezing. Equipment must be kept at a temperature equal to or below -10 ºC (14°F) for a minimum of 4 hr. For example, the equipment has been stored outside all winter and hasn’t been in use since then, it is safely assume a combination of freezing and dessication has destroyed the mussels.

**Physical:** Crushing is an effective way to kill adult mussels, but may not be effective against attached larval or juvenile stages. Therefore, crushed adult remains should also be exposed to a chemical disinfectant solution prior to final disposal.

**Desiccation:** Desiccation is effective if allowed to continue for a long enough period of time. There are
reports that live adult zebra mussels have survived for up to 21 days out of water under ideal conditions in a controlled laboratory setting. However, complete desiccation and exposure to warm dry air and/or direct sunlight should be effective in a week or less, but must be confirmed.

2. Region 8 Zebra Mussel Control Special Note

SPECIAL NOTES FOR BRIDGE WASHING
IN THE NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION WATERSHED

For bridges that cross water bodies or wetlands within the New York City Department of Environmental Protection (NYCDEP) watershed area, the contractor may either withdraw water from local (on-site) sources for bridge washing or bring stored water that can be verified as originating from a zebra mussel free source. All water storage and application equipment shall be sanitized in such a manner as to eliminate the threat of zebra mussel contamination of the reservoir system by the use of such equipment. If the contractor elects to withdraw water from the NYC source, s/he must contact the NYCDEP for prior written permission. If the contractor chooses to use water from an off-site source, s/he must notify NYCDEP.

3. Region 8 Invasive Plant Control Specification

DESCRIPTION
This work shall consist of controlling invasive plants in accordance with the contract documents and as directed by the Engineer.

MATERIALS
Six (6) mil Polyethylene Sheeting, black color.
Glyphosate based herbicide or equivalent water-soluble, non-selective foliar applied herbicide having no residual soil activity conforming to Section 713-13.

CONSTRUCTION DETAILS
Season. The work shall be performed during the season(s) specified in the contract documents.

a. Plants shall be treated with an herbicide at least once during the active growing season between May and October.
b. If the invasive plants have reached a height of greater than one (1) meter (m), the Contractor shall cut the specified plants to a height of 250-500 mm.
c. Immediately after cutting, all plant parts shall be carefully placed in heavy black plastic bags and tightly secured and moved off-site.
d. Within two (2) hours following cutting, the remaining stems and plant parts of the invasive shall be treated with the herbicide.
e. Six (6) to eight (8) weeks after the initial herbicide application, the invasive species shall be inspected for re-growth and all re-sprouted plants shall be cut to a height of 250-500 mm. Cuttings shall be removed as described in (c) and cut plants immediately treated with the approved herbicide mixture as described in (d).
f. A final inspection of the treated area shall be performed in late September/early October. If re-growth has occurred, (b), (c) and (d) shall be repeated.
g. The herbicide application shall be accomplished by, or under the direct supervision of a NYS Department of Environmental Conservation certified commercial applicator in the Highway-Right-of-Way category.
h. Herbicide application shall be accomplished by hand-sprayer, back pack, wick application, stem injection or herbicide clippers. Broadcast herbicide applications are not allowed.
i. The contractor shall abide by the special notes and provisions contained in the contract documents.
j. The contractor shall abide by any environmental and other permits necessary to complete the work.
k. Usage of any herbicide other than glyphosate shall be approved by the Regional Maintenance Environmental Coordinator or Regional Landscape Architect/Environmental Manager.

**Disposal of Material.** Material bagged and removed from the project site or from cleaning operations, shall be dried or decomposed at an approved location, disposed of in an approved landfill or incinerated at an approved facility or with the appropriate burn permits. Secure disposal shall be accomplished in such a manner as to prevent the invasive plant from re-establishing at a new location either by seed, roots or other viable plant parts.

**Equipment Cleaning.** All clothing, boots, and equipment used in areas containing invasive plant species shall be cleaned prior to leaving the site to prevent the spread of seeds, roots, or other viable plant parts. Loose material that has been removed from clothing, boots, or equipment shall be securely disposed as described above.

**METHOD OF MEASUREMENT**
This work will be measured as the number of square meters of each satisfactory completion of one cutting and herbicide treatment cycle of invasive plants.

**BASIS OF PAYMENT**
The unit price bid shall include the cost of furnishing all labor, materials, equipment, disposal, and incidentals necessary to satisfactorily complete the work.

**DESCRIPTION**
This work shall consist of applying herbicides, cutting, removing, transporting, and isolated disposal of identified invasive plant species as currently recommended by the best management practices of The Nature Conservancy, USDA Natural Resource Conservation Service, The Invasive Plant Council of New York or The Adirondack Park Agency General Permit GP 2002G-2. The objective of this item is to eliminate the invasive infestation and/or regrowth at specified locations in the contract documents or as directed by the Engineer in Charge (EIC).

**MATERIALS**
A water-soluble, non-selective foliar applied herbicide having no residual soil activity conforming to Section 713. The herbicide shall be approved for use by the EIC.

4. Region 7 Invasive Plant Control Specification – Japanese Knotweed

CONSTRUCTION DETAILS

An invasive plant management plan shall be submitted to the engineer for approval 5 days prior to beginning the application process. The management plan shall be based on current best management practices from the above sources. As a minimum the plan shall include:

1. Locations to be treated
2. Herbicide and application rates
3. Application timing
4. Site preparation
5. Eradication monitoring dates
6. Remediation plans
7. Proposed disposal isolation methods
8. Herbicide Material Safety Data Sheet (MSDS)
9. Adirondack Park Agency application form 2002G-2 (If project is within park)

Within the Adirondack Park, application and material limitations are described under the Adirondack Park Agency General Permit GP-2002G-2 “Management of terrestrial invasive plant species in or within 100' of wetlands in the Adirondack Park”.

Performance: No later than f weeks after initial application, the EIC determines if the identified invasive species has been satisfactorily eliminated. Based upon the results of this inspection it may be necessary for the Contractor to repeat or modify the best management practices until the target invasive plant species is eliminated in the identified areas. Any areas requiring more than one treatment shall be retreated at no cost to the State.

Season: The work shall be performed when recommended by the best management practices in conjunction with herbicide label directions.

Disposal of Material: Plant material shall be covered and secured for removal from the project site. Material transportation and disposal shall follow best management practices of isolation and secure disposal at a landfill, incinerator or other suitable material disposal site that has no possibility for future propagation.

Cleaning: Supplemental to section 107-01 (A) of the Standard Specifications. All clothing, boots, and hand tools used in areas containing invasive plant species shall be cleaned prior to leaving the site to prevent the spread of seeds, roots, or other viable plant parts. Loose material that has been removed from clothing, boots, or equipment shall be disposed of at a secured site.
**Care of Controlled Areas During Construction.** Care shall consist of keeping the areas free of resprouting, by implementing best management practices. The Contractor shall care for the controlled areas of invasive plants until final acceptance of the contract.

**METHOD OF MEASUREMENT**

Controlling invasive plants will be measured as the number of square meters of surface area that have been satisfactorily controlled.

**BASIS OF PAYMENT**

The unit price bid per square meter shall include the cost of all labor, materials and equipment, including disposal, and incidentals necessary to complete the work. The item shall not be considered complete until satisfactory control, as approved by the EIC, of the targeted invasive plants has been achieved.

Payment will be made under:

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<th>Item No.</th>
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<td>________</td>
<td>M Controlling Invasive Plants</td>
<td>Square Meter</td>
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5. **Region 1 Invasive Plant Control Specification - Phragmites**

**DESCRIPTION**

This work shall consist of applying herbicides, cutting, removing, transporting, and disposing of identified invasive plant species, and/or using polyethylene sheeting to control their spread and/or regrowth as specified in the Contract Documents or as directed by the Engineer.

**MATERIALS**

Six (6) mil UV resistant, Polyethylene Sheeting
A water-soluble, non-selective foliar applied herbicide having no residual soil activity, or other herbicide as specified in the Contract Documents conforming to Section 713. The herbicide shall be approved by the Regional Landscape Architect prior to use.

**CONSTRUCTION DETAILS**

**Season.** The work shall be performed during the season(s) specified in the Contract Documents.

**Site Preparation**

I. **Using Polyethylene Sheeting.**

   a. Cut invasive plants to a height of between 150 - 200 mm in the locations shown in the plans and at the times specified in the Contract Documents.
   b. All cut plant parts shall be carefully placed in heavy black plastic bags and tightly secured before moving them off-site or as specified in contract documents.
   c. Cover the cut plant stems with black plastic and securely anchor.
II. **Using Herbicides.**

   a. Cut invasive plants to a height of 100 mm as shown on the plans and at the times specified in the Contract Documents.

   b. All plant parts shall be carefully placed in heavy black plastic bags and tightly secured before moving them off-site.

   c. Immediately after cutting the plant stems, all cut plant stem surfaces shall be carefully treated with an approved mixture of herbicide and distilled water.

   d. Three (3) to four (4) weeks later, all resprouted plants shall be cut to a height of 100 mm, with the cut plant parts carefully bagged and secured before removing from the site. The remaining plant stems shall be immediately treated with the approved herbicide mixture.

III. **By Pulling.**

   A. Hand or mechanically pull all stems and associated roots within the designated areas shown and at the times specified in the Contract Documents.

   B. All cut plant parts shall be carefully placed in heavy black plastic bags and tightly secured before moving them off-site or as specified in the contract documents.

   C. Care shall be taken in pulling stems to remove as much of the root mass as possible. Some supplemental digging may be required.

IV. **By Digging.**

   A. Mechanical methods may be used to remove plant material.

   B. A removal perimeter should be established no less than two times the average height of the adjacent plants to be removed.

   C. Excavation shall extend a minimum of 600 mm below the last part of the root mass.

   D. Material should be transported, covered, to a secure site with no possibility for further propagation.

**Liability.** When the Engineer determines that the identified invasive species have not been satisfactorily eliminated after a suitable period of time has elapsed, the Contractor shall repeat the above-specified steps until the target invasive plant species is satisfactorily controlled in the identified areas. Any areas requiring additional treatments, as determined by the Engineer will be at the Contractor’s expense. The contract will not be accepted until satisfactory control of the targeted invasive plants has been achieved.

**Disposal of Material.** Material bagged and removed from the project site, or from cleaning operations, shall be dried or decomposed at an approved location, disposed of in an approved landfill or incinerated at an approved facility or with the appropriate burn permits.

**Equipment Cleaning.** All clothing, boots, and equipment used in areas containing invasive plant species shall be cleaned prior to entering the site and prior to leaving the site to prevent the spread of seeds, roots, or other viable plant parts. Loose material that has been removed from clothing, boots, or equipment shall be disposed of at a secured site with no possibility for future propagation.

**Care of Controlled Areas During Construction.** Care shall consist of keeping the areas free of resprouting, by repairing/replacing polyethylene sheeting, cutting and treating new sprouts, pulling, or digging newly emergent invasive plants. The Contractor shall care for the controlled areas of invasive
plants until final acceptance of the contract or as required under “Period of Disestablishment for Invasive Plants”.

**Period of Disestablishment for Invasive Plants** shall begin one year after the satisfactory completion of all invasive species control methods or when the contract is complete, whichever is later, as confirmed in writing by the Engineer. The Contractor shall be required to continue the work specified under “Care of Controlled Areas During Construction” for a period of one additional year.

**METHOD OF MEASUREMENT**

Controlling invasive plants will be measured as the number of square meters of surface area that have been satisfactorily controlled.

**BASIS OF PAYMENT**

The unit price bid per square meter shall include the cost of all labor, materials and equipment, including disposal, and incidentals necessary to complete the work.

Payment will be made under:

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