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1 **RATIONALE**

2

3 Invasive plants are plants that through human intervention have moved out of their native
4 region into a new one where they displace native vegetation, which, in turn, causes an array of
5 ecological and economic problems, including but not limited to destruction of habitat essential to
6 local wildlife; damage to water supplies, recreational resources, and agriculture; and changes to
7 soils, fire regimes, and hydrological systems.¹

8 Unfortunately, many invasive plants are still widely sold and used in the horticultural and
9 landscaping industries, because existing laws preventing the distribution of noxious weeds cover
10 only a small subset of invasive plants and because insufficient information is available at the
11 local level to know what plants are invasive in a particular region.

12 Many organizations around the world are combating the problems of invasive plants, and
13 green building and landscaping programs are beginning to discourage the use of these plants, but
14 there is as of yet no widely recognized science-based protocol to create a list for what is and
15 what is not invasive to a given area. This standard aims to address this gap and, in doing so, take
16 an important step forward in preventing the spread of invasive plants.

¹ See, for example, Richard N. Mack *et al*, "Biotic Invasions: Causes, Epidemiology, Global Consequences, and Control," *Ecological Applications*, June 2000, Vol. 10, No. 3, pp. 689-710; Sarah Hayden Reichard and Peter White, "Horticulture as a Pathway of Invasive Plant Introductions in the United States," *BioScience*, February 2001, Vol. 51 No. 2, pp. 103-113; US Environmental Protection Agency, "Nonindigenous Species – An Emerging Issue for the EPA," May 2001; and multiple resources at the University of Georgia Center for Invasive Species and Ecosystem Health, www.bugwood.org.

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17 Model building codes and rating systems that aim to improve the environmental performance
18 of buildings and their sites increasingly incorporate clauses to address the ecological damage
19 related to invasive plants in landscaping. For example, the *International green Construction*
20 *Code* (IGCC), *ASHRAE 189.1 Standard for the Design of High-Performance Green Buildings*
21 (ASHRAE 189.1), Leadership in Energy & Environmental Design® (LEED) rating systems, and
22 the Sustainable Sites Initiative rating system all contain requirements or credits to reduce the use
23 and presence of invasive plants on a building site.

24 The implementation of these requirements, however, is often dependent on the existence of a
25 valid list of invasive plants for the region in which the building is located. For example, the
26 definition of invasive plant species in IGCC is as follows:

27

28 **INVASIVE PLANT SPECIES.** Species that are not native to the ecosystem
29 under consideration and that cause, or are likely to cause, economic or
30 environmental harm or harm to human, animal or plant health, defined by using
31 the best scientific knowledge of that region. Consideration for inclusion as an
32 invasive species shall include, but shall not be limited to, those species identified
33 on:

- 34 1. *Approved* city, county or regional lists.
- 35 2. State noxious weeds laws,
- 36 3. Federal noxious weeds laws.

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38 Existing State and Federal noxious weed lists are generally insufficient: most have not kept
39 pace with the latest science in the field, and many focus predominantly on agricultural, rather
40 than ecological, impacts.² Furthermore, few local governments have yet to develop their own
41 lists. With definitions (such as that in IgCC) dependent on the existence of local, State, and
42 Federal lists, the invasive plant requirements in green building codes will have little effect.

43 Around the US as well as around the world, experts from universities, public and private land
44 management organizations, and other non-governmental organizations have developed region-
45 specific lists of ecologically-damaging plants. Though the lists may be developed using sound
46 scientific approaches, the approaches themselves have varied, because currently there is no
47 single agreed-upon, standardized approach to determining whether a plant species qualifies as
48 invasive in a given area.

49 The goals of this work item are to create a standard that 1) describes the criteria and
50 procedures by which to develop an invasive plant list for a defined region and 2) will be useful as
51 the foundation for creating lists of invasive plants to support building codes and related
52 applications.

53 In developing the language for this work item, the E60.01 Site Development and Urban
54 Planning task group profiled the invasive plant listing criteria and procedures used by
55 organizations in the US and abroad, including those used by nonprofit invasive plant councils

² This statement is supported by a recent article by Lauren Quinn, et al, entitled "Navigating the 'Noxious' and 'Invasive' Regulatory Landscape: Suggestions for Improved Regulation," *BioScience*, 63: 124-131.

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56 and the US Department of Agriculture's Animal and Plant Health Inspection Service.³ The task
57 group then created a set of requirements that reflect the common elements of those existing
58 procedures and that emphasize the creation of invasive plant lists that are science-based,
59 transparent, and supported by a range of stakeholders.

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³ See, for example, DR Gordon et al, "IFAS Assessment – Predictive Tool," March 2009; Ohio Invasive Plants Council, "Ohio Invasive Plant Assessment Protocol," July 2012; U.S. Department of Agriculture, "Weed-Initiated Pest Risk Assessment Guidelines for Qualitative Assessments," August 2004; Anthony L. Koop et al, "Development and validation of a weed screening tool for the United States," *Biol Invasions*, July 2011; Curtis C. Daehler et al, "A Risk-Assessment System for Screening Out Invasive Pest Plants from Hawaii and Other Pacific Islands," *Conservation Biology*, April 2004; and California Invasive Plant Council, *California Invasive Plant Inventory*, February 2006.

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Standard Practice for Creating a List of Invasive Plants for a

Defined Region⁴

This standard is issued under the fixed designation X XXXX; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice establishes minimum procedures for creating a list of plants that are invasive to a defined geographical region.

1.2 The procedures and outputs of this practice are intended to provide a basis for decision-making regarding the use and importation of plant species. They are not intended to place legal restrictions on the use or importation of any species, but may be used to inform the decision-making leading to such restrictions.

1.3 The procedures in this practice are based on the assessment of current ecological harm and risk of future ecological harm posed by plants. The consideration of the economic or public health impacts of plants, both beneficial and harmful, is outside the scope of this standard.

⁴ This Practice/Guide is under the jurisdiction of ASTM Committee E60 on Sustainability and is the direct responsibility of Subcommittee E60.01 on Buildings and Construction.

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80 1.4 *This standard does not purport to address all of the safety concerns, if any, associated*
81 *with its use. It is the responsibility of the user of this standard to establish appropriate safety*
82 *and health practices and determine the applicability of regulatory limitations prior to use.*

83 2 Terminology

84 2.1 Definitions:

85 2.1.1 *ecological harm*, n - adverse effects to an ecosystem.

86 Discussion: Adverse effects are characterized by alteration of abiotic ecosystem processes,
87 reduced complexity of plant communities, or direct harm to wildlife species or degradation of
88 their habitat.

89 2.1.2 *invasive plant species*, n - a plant species that is not native to the ecosystem under
90 consideration and that causes, or is likely to cause, ecological harm.

91 2.1.3 *peer-reviewed methodology*, n - a methodology that has been published as an article in
92 a journal that 1) conducts a process by which scholars in the relevant subject matter critically
93 review submitted articles and 2) only publish articles that meet the approval of those scholars.

94 2.1.4 *plant*, n - an individual of the kingdom Plantae.

95 2.1.5 *species*, n - Basic unit of biological classification used to describe a group of organisms
96 capable of interbreeding and producing fertile offspring.

97 3 Summary of Practice

98 3.1 A geographical region is defined for the area in which an invasive plant list is to be
99 developed. A plan is created to delineate a set of plants for assessment.

Commented [GS1]: This definition will be revised to reflect the definition in Executive Order 13112

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100 Each plant species identified as per the plan is assessed as to its current ecological harm or
101 risk of future ecological harm, considering, at a minimum, a list of effects and risk factors
102 that are provided. Processes for review, interpretation, and reporting of the results of the
103 assessments ensure multi-stakeholder contribution, a focus on the plants' role in ecological
104 systems, and transparency.

105 **4 Significance and Use**

106 4.1 Use of this practice will assist in creating lists of plant species that are determined to be
107 invasive in a specific geographical area. Lists of invasive species created under this standard are
108 intended to inform decisions regarding importation, use, and management of plants.

109 4.2 Users of this practice include government officials that seek to identify for their citizens
110 the plants in their areas that may cause ecological harm through their planting and spread;
111 governmental or other groups that create, or seek to create, lists of invasive plant species for
112 given regions; natural resource managers charged with stewarding parks and preserves; private
113 landowners seeking to protect their ecological resources; developers of model building codes and
114 green building rating systems; providers and purchasers of landscaping, landscape design, and
115 landscape architecture services; and entities which frequently buy, import, or facilitate the
116 introduction, of plants.

117 4.3 It is intended that the reports developed under this standard provide information that is
118 useful not only to the population of the geographical area covered by any given invasive plant
119 list, but also to those in other geographical areas. Invasive plant lists may be developed at any
120 geographical scale, e.g., city, state, ecoregion, metropolitan area, etc. As lists of plant species are

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121 developed for an increasing number of geographical areas, it is hoped that those who work on the
122 development of such lists will consider the information contained in the lists and accompanying
123 reports of nearby or related geographical areas. This has the potential to decrease the effort
124 required to make new lists, to increase the quality of new lists and, to the extent that
125 discrepancies are discovered or information is interpreted differently, to serve as a catalyst for
126 greater communication on the assessment of plants' invasiveness.

127 **5 Procedure**

128 5.1 Region. The geographical region for which an invasive plant list is being developed or
129 refined shall be defined.

130 Discussion: The region may be based on political boundaries, ecological regions, or other
131 factors.

132 5.2 Classification system. A system shall be established for classifying each plant in
133 accordance with the results of the assessment conducted as per 5.4. The classification shall be
134 based solely on available information related to the current and potential ecological harm posed
135 by the plant species. The system shall include a minimum of three categories, as follows:

136 5.2.1 Invasive: A category that contains the names of those plant species for
137 which the assessments demonstrate that the species exceed an acceptable
138 threshold of current ecological harm, potential for future ecological harm, or both.

139

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140 Discussion: This standard does not set exact thresholds for what qualifies
141 a plant to be considered invasive. Thresholds may vary and often depend on
142 the informed evaluation and interpretation of the assessments by experts who
143 are participating in the development of the invasive plant list. The process by
144 which the plants are categorized should be a transparent one and described in
145 the report (see Section 6).

146
147 5.2.2 Not invasive: A category that contains the names of those plant species for
148 which the assessments demonstrate that the species are at or below an acceptable
149 threshold of current ecological harm and potential for future ecological harm.

150
151 Discussion: Because ecological systems change over time, species may be re-
152 assessed in the future.

153
154 5.2.3 Further assessment needed: A category that contains the names of those
155 plant species for which the results of the assessments were unclear or where
156 insufficient information was available.

157

158 5.3 Plant species to be assessed.

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159 5.3.1 A plan for selecting the plant species to be assessed for potential inclusion in the
160 invasive plants list shall be developed. The plan shall state, at a minimum, the parameters
161 that define which plant species will be considered, e.g., a published flora for the region, the
162 number of assessments that can be conducted within a given budget, a plant or plants
163 previously assessed and for which new information is available, etc.

164 Discussion: There is no prescribed approach to the selection of plants for consideration,
165 nor any minimum number of plants that must be considered at any given time.

166

167 5.3.2 If an invasive plant list prepared in accordance with this standard already exists for
168 the defined region, a user may use that list as the basis for a new list, i.e., one, multiple, or all
169 plants from the existing list may be transferred to the new one without conducting new
170 assessments for those plants.

171

172 5.4 Species assessment. Plant species shall be selected for assessment as per the plan
173 developed under 5.3.1. For each selected plant species, an assessment of the species' current
174 ecological harm or risk of future ecological harm shall be conducted as per 5.4.2.

175 Discussion: A given plant species that is present in an area but not causing ecological harm
176 would be assessed for risk of future ecological harm. A species that is present and causing
177 current ecological harm would be assessed both for current harm and may also be assessed for
178 risk of future ecological harm, since future harm may be substantially greater than current harm.

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179 A species that is not present in the area may be assessed for risk of future harm if it is likely to
180 move into the area.

181
182 5.4.1 Sub-species, varieties, cultivars, and interspecific hybrids. This standard requires
183 assessments and listing at the species level. Where a species is determined to be invasive, but
184 scientific data exists to demonstrate that an infraspecific taxon, cultivar, or hybrid of that
185 species is not invasive, an exception for that plant may be included in the published list.
186 Where a species is determined not to be invasive, but scientific data exists to demonstrate
187 that a sub-species, variety, cultivar, or hybrid of that species is likely to be invasive, that
188 taxon shall be assessed separately.

189
190 5.4.2. Assessment methodology. For each plant species, the current and potential future
191 ecological harm to the defined region shall be assessed, taking into consideration, at a
192 minimum, the factors included in 5.4.2.1 and 5.4.2.2.

193
194 Exception: Where a factor is deemed inapplicable to a plant species or for the defined
195 region, it may be omitted from the assessment. The omission and justification shall be noted
196 in the assessment report.

197
198 Discussion: This standard specifies the factors that must be considered in an assessment,
199 but does not specify a structure for scoring these factors and generating an actual assessment.

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200 The use of existing assessment methodologies is encouraged, particularly but not limited to
201 peer-reviewed methodologies and those that have been demonstrated to be highly effective in
202 predicting potential for plant invasiveness.

203

204 5.4.2.1. Current ecological harm. The assessment shall evaluate the extent to which the plant
205 under evaluation causes the following abiotic and biotic effects:

206 5.4.2.1.1 Alteration of ecosystem processes, including but not limited to:

- 207 • fire occurrence, frequency, and intensity; geomorphological
208 processes such as erosion and sedimentation;
- 209 • hydrological regimes, including soil water table;
- 210 • nutrient and mineral dynamics, including salinity, alkalinity,
211 and pH; and
- 212 • light availability.

213

214 5.4.2.1.2 Alteration of plant community composition, structure, and interactions, especially
215 those that involve rare or keystone species or rare community types, including but not limited to:

- 216 • formation of stands dominated by the species;
- 217 • occlusion of a native canopy, including a water surface, that
218 eliminates or degrades layers below;

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- 219 • significant reduction or extirpation of populations of one or
- 220 more native species;
- 221 • reduction in native species richness, evenness, or productivity;
- 222 • reduction in propagule dispersal, seedling recruitment, or
- 223 survivorship of native species;
- 224 • creation of a new structural layer, including substantial thatch
- 225 or litter, without elimination or replacement of a pre-existing
- 226 layer;
- 227 • change in density or depth of a structural layer;
- 228 • change in horizontal distribution patterns or fragmentation of a
- 229 native community;
- 230 • hybridization with native plant species; and
- 231 • creation of a vector or intermediate host of pests or pathogens
- 232 that infect native plant species.

- 233
- 234 5.4.2.1.3 Impact to wildlife such as animals, fungi, microbes, and
- 235 other organisms, especially rare or keystone species or rare
- 236 community types, including but not limited to:
- 237 • extirpation or endangerment of an existing native species or
 - 238 population;

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- 239 • elimination or reduction in native species' nesting or foraging
- 240 sites, cover, or other critical habitat resources;
- 241 • reduction in food availability or quality;
- 242 • reduction in habitat connectivity or migratory corridors;
- 243 • interference with native pollinators;
- 244 • injurious components, such as awns or spines that damage the
- 245 mouth and gut of wildlife; and
- 246 • production of anti-digestive or acutely toxic chemicals that can
- 247 poison wildlife.

248

249 5.4.2.2 Future ecological harm. The assessment shall examine, at a
250 minimum, the following risk factors:

251 5.4.2.2.1 Known ecological harm already caused by the plant
252 species in the defined region.

253

254 Discussion: Many plant species that have become invasive in a
255 region have potential for increased harm in the future, and the
256 existing harm under 5.4.2.1 is an important factor in gauging
257 potential future harm.

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259 5.4.2.2.2 Behavior and impact outside the defined region,

260 including but not limited to:

- 261 • ecological harm caused elsewhere, especially in regions with
- 262 climates similar to that of the defined region;
- 263 • ecological harm caused by closely related plants; and
- 264 • observed rate of spread elsewhere.

265
266 5.4.2.2.3 Reproductive potential, including but not limited to:

- 267 • age of first reproduction;
- 268 • amount and frequency of seed set;
- 269 • longevity of seeds in the seed bank;
- 270 • capacity for vegetative reproduction; ability to resprout; and
- 271 • potential for outcrossing to increase reproductive vigor.

272
273 5.4.2.2.4 The extent to which a species is able to establish itself in

274 natural areas without disturbance, or to capitalize on a range of

275 types of disturbance, including but not limited to:

- 276 • roads and trails;
- 277 • construction;
- 278 • wildfire; floods; landslides, windstorms;

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- 279 • altered fire regimes, including fire suppression; cultivation;
- 280 • altered hydrology due to dams, diversions, irrigation, etc.;
- 281 • silvicultural practices;
- 282 • nutrient loading from fertilizers, runoff, etc.;
- 283 • grazing, browsing, and rooting by domestic livestock and feral
- 284 animals; and
- 285 • wildlife activities such as burrowing, grazing, or browsing.

286

287 5.4.2.2.5 Vectors for dispersal of the plant species by propagules

288 (e.g., seeds, fruit, spores, vegetative material), including but not

289 limited to:

- 290 • commercial sales for use in agriculture, ornamental
- 291 horticulture, or aquariums;
- 292 • use as forage, erosion control, or revegetation;
- 293 • presence of propagules as a contaminant in bulk seed, hay,
- 294 feed, soil, packing materials, etc.;
- 295 • spread along transportation and utility corridors such as
- 296 highways, railroads, trails, or canals;
- 297 • transport on boats or boat trailers;
- 298 • propagules that are commonly consumed by birds or other
- 299 animals that travel long distances;

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- 300 • propagules that are sticky or burred and clings to feathers or
- 301 hair of animals;
- 302 • buoyant propagules that are dispersed by flowing water;
- 303 • light propagules that promote long-distance wind dispersal; and
- 304 • plant that can detach and disperse propagules as it is blown
- 305 long distances (e.g., tumbleweed).

306 5.5 Preparation of assessment report.

307 5.5.1 Internal assessment review. Each assessment shall be reviewed and classified into a
308 classification category (see 5.2) by a review team that meets these requirements:

309 5.5.1.1 The review team shall consist of a minimum of seven (7) individuals and

310 5.5.1.2 The majority of the members of the review team shall represent one or more
311 of the following types of organizations:

312 5.5.1.2.1 Governmental natural resource, environmental protection, or land
313 management agencies

314 5.5.1.2.2 Environmental science, forestry, biology, or natural resource
315 management departments of academic institutions

316 5.5.1.2.3 Not-for-profit organizations whose mission focuses on conservation
317 biology, ecology, or natural resource protection

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318 5.5.2 Draft assessment report. A draft assessment report shall be compiled that, at a
319 minimum, includes:

- 320 • the plant's scientific name,
- 321 • one common name for the plant,
- 322 • the date the draft report was completed,
- 323 • any findings or determinations made relevant to the factors listed in 5.4.2,
- 324 • reasons for the omission of any factors listed in 5.4.2,
- 325 • references used, and
- 326 • the classification category determined by the review team.

327

328 5.5.3 Draft assessment report public review. The draft assessment report shall be made
329 available to the public for review and comment for a period of no less than 60 days.

330

331 5.6 Final assessment report. The review team shall consider each public comment that is
332 received, document the decision made vis-à-vis each comment, and revise the report as
333 necessary and in accordance with the decision.

334 Discussion: It is likely the case that more people than the plant assessors and the
335 review team are involved in creating the invasive plant list. The requirements is
336 this standard are written with full recognition that the process is more involved
337 than described here; they are intended only to set a minimum bar, and are not

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338 intended to preclude nor discount the importance of others' participation in the
339 process.

340 **6 Report**

341 6.1 Invasive Plant List. The names of those plants that have been classified as invasive as
342 shall be compiled in a single document. This document shall include, at a minimum, the
343 following information:

344 6.1.1 The scientific name and at least one common name for the plant species.

345 6.1.2 The geographic region for which the report is valid, i.e., the area defined as per
346 5.1.

347 6.1.3 The date that the list was created or updated.

348
349 6.2 A record shall be created of the procedures conducted as per this standard. The record
350 shall be made available free-of-charge via a public website and at a minimum shall include:

351 6.2.1A copy of the plant assessment plan developed as per 5.3.1.

352 6.2.2 A description of the classification system developed as per 5.3.2.

353 6.2.3 A list of the plant species, indicated at a minimum by scientific names, which were
354 assessed as per 5.4.2.

355 6.2.4 For each assessed plant, a description of the methodology or methodologies used to
356 assess it, citations of the information sources used, public comments received, decisions

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357 made in response to the public comments, and the category into which the plant is
358 classified.

359 6.2.5 Names and organizations of the review team (see 5.5.1).

360 6.2.6 Name, phone number and email address for a person who will serve as a point-of-
361 contact.

362 **7 Keywords**

363 invasive species; non-native species; weed risk assessment; ecological harm; plant