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# Communicating Biophilic Design: Start With the Grasslands

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To protect remnant ecosystems within urban areas, guidelines are needed for the biophilic design, construction, and ongoing occupation of the suburban subdivisions, industrial land, or business parks surrounding them. Planners, urban designers, architects, landscape architects, road engineers, and the community need tools to help design and manage urban landscapes in a way that puts the ecosystem's requirements on par with urban development. The Victorian National Parks Association recognized this need and developed *Start with the grasslands* (*SWTG*) as a set of biophilic urban design guidelines to protect remnant grasslands within urban areas. South-eastern Australia's grasslands are Australia's most endangered ecosystem, with <2% remaining. Many are within or at the fringes of urban areas and are in continuing decline in extent and quality. Because of considerable challenges to acceptance, the development of these biophilic design guidelines was as important as the guidelines themselves. The process was structured to maximize inclusivity and stakeholder buy-in, educate, shift debate from traditional lines of argument, and to communicate the complex relationships to be negotiated for a successful outcome. The guidelines needed to be evidence-based, trans-disciplinary, and refer directly to on-the-ground case studies. Organizational partnerships further built legitimacy. Recommendations span spatial scales from the highly local to the regional and consider the full timescale of urban development. *SWTG* communicates through non-confrontational language and visual techniques.

Keywords: remnant, engagement, biodiversity, conservation, urban design, sustainable development, transdisciplinary

## INTRODUCTION

Cities and towns are often established in areas of high biodiversity value (Seto et al., 2013) and consequently remnant natural habitats are subject to local extinction, habitat loss, fragmentation, edge effects, invasion by exotic species and altered disturbance regimes (Grimm et al., 2008; Gaston, 2010; Aronson et al., 2014). Maintaining urban biodiversity is important not just for the ecosystem services that biodiverse environments provide, but also for its intrinsic values and benefits to human well-being (Gobster et al., 2007; Säumel et al., 2015; Taylor and Hochuli, 2015). Increasing urbanization will only place additional pressure on urban biodiversity (Seto et al., 2012). Consequently, it is crucial we act to strengthen urban biodiversity and the systems that support it.

To sustain biodiversity in cities, attention needs to be paid to evidence-based urban design (Ahern et al., 2014). Doing so can increase the habitat value of the landscape, its connectivity and the integrity of its ecosystems, as well as establishing a landscape that encourages positive human

perception of its natural values to build ecological stewardship (Nassauer, 1995; Chawla, 1999; Miller, 2005; Gobster et al., 2007; Scannell and Gifford, 2010). However, evidence, *per se*, is insufficient. For instance, the role of roads as barriers to faunal movement is well-documented, but fauna-specific road crossings are rarely included in road designs (van der Ree et al., 2015). Biophilic design seeks to use humans' inherent affinity with natural systems (Wilson, 1984) to produce design outcomes that improve both human well-being and promote natural values (Beatley, 2011). Effectively including biophilic and ecological principles into the design of the built environment requires greater interaction and collaboration between ecologists and built form professionals (e.g., planners, urban designers, architects, landscape architects) (Steiner et al., 2013; Ives and Kelly, 2015). This requires effective communication, or *translation*, of evidence-based biophilic design concepts into a form that enables uptake and action by built form professionals and managers.

Remnant vegetation is a key element of the biodiversity of many cities, but it is often threatened by habitat destruction, fragmentation, and loss of quality. The native grasslands of south-eastern Australia offer a case in point. Pastoralism, agriculture and more recently urbanization have taken the ecosystem to the point of extinction, with <2% of its original extent remaining (Williams and Morgan, 2015). In the State of Victoria, much of the best quality remnant grassland is found within and at the fringes of Melbourne, a city experiencing ongoing urban sprawl (Barlow and Ross, 2001). This is because agricultural investment, in particular the application of superphosphate fertilizer, was not undertaken due to the likelihood of purchase for urban development (Williams et al., 2005). Nevertheless, it was only in 2008 that federal legislation was enacted to protect these grasslands, although their destruction is still permitted through strategic assessment processes and biodiversity offsetting (Gordon et al., 2011).

Grasslands are one of the most studied ecosystems in Australia (Williams and Marshall, 2015). Despite the extent of published ecological and environmental psychology knowledge available to inform good evidence-based grassland management and design decisions, the condition and extent of these remnants continues to decline (Williams et al., 2005). Poor outcomes for grasslands are due to many factors, for instance underfunding, complex management requirements, habitat fragmentation, disturbance (e.g., dumping of rubbish, trail bike riding) and weed invasion. The ecosystem also suffers from poor public perception (Williams and Cary, 2001).

This paper critically reflects on a project that aimed to maintain the ecological integrity of natural vegetation in both new Australian residential subdivisions and older neighborhoods through biophilic design. It aims to identify the features of, and strategies used in the project so that they can be incorporated into similar projects internationally. *Start with the grasslands* (Marshall, 2013) is a 104 page book published by the Victorian National Parks Association (VNPA) that provides a set of biophilic design guidelines for the urban *context* of remnant native grasslands. These guidelines position grasslands as part of a complex urban system rather than focusing *per se* on the

management of the processes within the grassland (vital though those are).

*Start with the grasslands* (*SWTG*) has been readily taken up by many native grassland stakeholders, especially local government, landscape architectural practices and the tertiary education sector. It is used as a tool for establishing the framework for discussing how to effectively integrate biophilic principles into on-the-ground practice, and it is helping to change the way residential subdivisions are done. Its digital version is actively downloaded at least a hundred times a year, and its print version of 1,000 copies was fully distributed. One of Australia's eminent grassland ecologists described it as "the most innovative and ground-breaking book on urban grassland conservation ever produced in Australia. Most of the content is relevant to any fragmented ecosystem" (Lunt, 2014). *SWTG* received the Australian Institute of Landscape Architects (AILA, Victoria) President's Award in 2014. It has been used as a compulsory reference document for the tender for construction of a major prison on former grassland (Department of Justice, 2014). Recently the peak state government planning authority with oversight of greenfield development began a process of formally incorporating *SWTG*'s principles into their planning process (Metropolitan Planning Authority, 2015), putting the consideration of grasslands (and other remnant vegetation) at the earliest stages of development. *SWTG* has also been used as a text to inform tertiary ecology and design studies.

## Reflections on the Document Development Process

From the outset *Start with the grasslands* was conceptualized as a practical biophilic design tool which would facilitate the protection of native grasslands in Australian cities while at the same time providing environmental, economic and well-being benefits to people living in the neighborhoods around them. It was developed by the lead author of this paper (AM) who approached Victorian National Parks Association as a volunteer offering his landscape architecture expertise and experience with native grasslands. The VNPA is a community conservation organization dedicated to the protection of Victoria's natural heritage (VNPA, 2018). It helps people connect with nature through activities, community education and engagement, and citizen science, and it undertakes advocacy that focuses on the environmental conservation of the national park system in the State of Victoria.

Hence the goal of the document was clear early on: to provide guidelines on what to do—and what not to do—to support long-term ecological integrity of grasslands in an urban context. It was to be a practical biophilic design tool that would effectively present biophilic design concepts supported by the ecological and environmental psychology evidence base and communicate them simply to a broad range of stakeholders in an authoritative, inclusive manner. A summary of the steps in the *SWTG* development process, and key outcomes that influenced the success of the project, are included in **Table 1**. *SWTG* includes background on the history, context, and ecology of south-eastern Australia's native grasslands. Specific guidelines are organized by

**TABLE 1 |** Chronological steps in *SWTG*'s development and outcomes that contributed to project success.

| | |
|---|---|
| Project creation | Right organization for the job: VNPA not only advocates, but works with scientists, has a focus on engagement with nature. Has large membership. Expertise in workshops. Expertise in negotiating political landscape. Right researcher for the job: landscape architect with good cross-disciplinary skills, including writing and visual communication. |
| Establishing brief | Clear brief from outset: to be a practical tool, establish legitimacy, maximize stakeholder buy-in. |
| Advisory panel selection | Small, focussed group. Ecologist, Environmental psychologist, well-well-regarded grasslands land manager with strong community focus. Panel guides academic research, site visits and initial drafts of publication. |
| Academic research | Grounding in evidence. Establishes legitimacy. |
| Site visits | Grounding in evidence. Establishes legitimacy. Provides high-quality visual material for publication. Provides basis for later grassland tours and engagement with grassland-related community groups. |
| Drafting | Feedback from advisory board and VNPA CEO. |
| Establishing organizational partnership | Broadening stakeholders: AILA membership aligned with government and development. Establishing legitimacy. Increasing capacity. |
| Calls for feedback | Mailout to all VNPA and AILA members. Broadening stakeholders. Establishing legitimacy. Extra resources. |
| Drafting | Feedback from mailout, advisory board and VNPA CEO. |
| Workshop | Broadening stakeholders. Establishing legitimacy. Communication strategies refined. |
| Establishing editorial board | Members bring local and state government expertise, and include tertiary sector researcher, professional writer, community group advocate, NGO leader, who bring skills, knowledge of policy frameworks, further networks. Establishing legitimacy. |
| Drafting | Feedback from editorial board allows document to focus toward completion and meeting the brief. |
| Grassland tours | Engages AILA membership. Educational outreach. |
| Launch | Using product to continue to reinforce message. Establishing legitimacy. Expanding audience. |
| Reviews | Communicating. Establishing legitimacy. Expanding audience. |
| Talks, forums | Using product to continue reinforcing message. |
| Grassland tours | Engages AILA membership. Educational outreach. |
| AILA Awards | Establishing legitimacy. |
| Promotion in scientific literature | Conferences, publication, inclusion as text for tertiary design studios and urban ecological teaching. Using product to continue reinforcing message. Getting cited. |

the staging of the urban development process; from planning and then design, through to the transition to construction and finally to the maintenance of the grasslands once the urban area has been developed. Checklist summaries are provided for each stage. It provides an extensive bibliography, references, case studies, and an appendix on appropriate species selection for plantings to buffer the grasslands, to suppress weed invasion, and to provide native species habitat adjacent to grasslands and within their broader suburban context. To clearly promote its message, *SWTG* summarized its content in a set of seven guiding principles (**Table 2**).

## Factors Contributing to Success

We believe a number of factors have contributed to the document's success (**Table 3**). Understanding these factors may help others meet the challenge of preservation of remnant patches within the urban fabric, and also to effectively communicate and implement biophilic design.

### A New Approach, and a Campaign Approach

Despite a long history of conservation efforts, the extent and quality of native grasslands continue to decline. A fresh approach was able to invigorate discussion around the means of preserving remnant grasslands within the urban context, and to initiate action. The guidelines provide that approach by focusing on the urban context of grasslands. This is a key difference from previous grassland conservation strategies, and it recognizes that management of the grassland *per se* is insufficient due to the potential significant negative effects of the surrounding urban

landscape on the biodiversity of grassland patches (Williams et al., 2006). *SWTG* moves discussion into both the broader social context of the way people interact with nature, and the realm of built-form professionals. The increased number of stakeholders, the urgency of action required, and the need for a fresh approach, together created the leverage that could make the project a success.

From its inception, the project was conceived in terms of an ongoing campaign in which the development process would help create the conditions for the success of the final document. We felt it was particularly important to establish stakeholder buy-in, legitimacy, and to ground the work in case studies. Having an overarching strategy assisted in project delivery and kept project focus.

### Stakeholder Buy-In

Stakeholders were progressively included in the content development process. Firstly, an initial project reference group was established. Through this reference group, some further key stakeholders were identified, and face to face and phone interviews followed. Once a broad outline of the content had been established, feedback was sought on multiple drafts from professional organizations such as the Australian Institute of Landscape Architects (AILA), local government networks such as the Biodiversity Officers Network, and the extensive VNPA membership. Engagement was also generated by running a workshop targeting staff across government departments and levels, ecologists, community groups, naturalists, academics, land managers, landscape architects, urban designers, and planners.

**TABLE 2 |** Principles and example actions to promote the biophilic design of grassland contexts.

| Principle | Example action |
|---|---|
| Principle 1: Start with the grasslands. Grasslands must be placed in the center of decision making, and such decision making be embedded at all levels of the development or retrofitting process, from planners to maintenance staff. | Include *SWTG* principles in planning framework. |
| Principle 2: Collaborate. Many synergies and better outcomes can be gained by stakeholders working in a cross-disciplinary manner at all stages of development. | Project manager organizes meetings with as broad a range of stakeholders as possible at each stage of development. |
| Principle 3: Integrate, protect, connect. Grasslands must be well-connected, appropriately protected, and seen as part of their urban context. In turn, the urban context must respond to the presence of grasslands in a way that strengthens those grasslands. | Developers ensure an appropriate analysis of the broader site context is conducted as early as possible in the planning process, and they commit to being flexible enough to respond to that context. |
| Principle 4: Design for maintenance. Considerable gains can be made by recognizing the value, in both financial terms and management effectiveness, of building-in management considerations early and throughout the development process. | Fencing, furniture, and signage within the grassland is made fireproof, adjacent roads are used as firebreaks, paths are engineered to support heavy maintenance vehicles, access to water is well-organized, and a location is provided for vehicle wash-down. |
| Principle 5: Communicate. The community must be brought on board to build future stewardship. Communication is also necessary to ensure organizations operate outside their silos. | Managers use planned maintenance activities as an opportunity to doorknock residents and educate them about grassland values. |
| Principle 6: Let people in. Traditional management involved fencing-off these precious remnants and preventing access. In the existing circumstances of considerable neglect, this approach appeared to be counterproductive, creating enmity instead of stewardship. Instead access was to be encouraged. | Landscape architects design well-located, inviting entrances with signage positioned within the grassland to promote entry. |
| Principle 7: Provide cues to care. Joan Nassauer's (1995) concept that by providing visible care to the frame of a difficult to engage with ecosystem, viewers would perceive that care and transfer that perception to the contents of the frame, e.g., the grassland, our most difficult to love ecosystem. | High quality materials are used in the most visibly significant sections of the grassland perimeter, and these are combined with design gestures foregrounded to show care, e.g., garden beds for floral display. |

The workshop was also used to source an editorial board as a resource base to work toward a final draft of the document. In addition, the project ran a series of spin-off activities such as native grassland tours and forums to keep discussion of the issues of native grassland management active across the stakeholder groups, and to ensure that the project stayed grounded in real urban contexts. This process raised and then reinforced awareness of issues of urban grassland conservation. It facilitated uptake because stakeholders became invested in the document.

The document's knowledge base arose from the inputs of many groups of stakeholders, obtained through both face to face and phone interviews, electronic survey, feedback on drafts, workshops and an editorial committee. For instance:

- A Friends group land manager knew how easily good intentions could slip into poor outcomes, and his advice served to ensure recommendations could not be misinterpreted and were clearly targeted at mitigating specific outcomes.
- "Bush crew" contractors responsible for day-to-day ecological management of native grasslands highlighted issues regarding the practicalities of conducting ecological burns for grassland maintenance within the urban context. For example, trees adjacent to grasslands add additional fuel; inappropriate mulches in plantings adjacent to grasslands can smolder post-burn and require significant additional resources to monitor.
- Local government biodiversity staff supplied experience of land management issues, social engagement and knowledge of how to make an effective tool for municipal governments. As a result, simple checklists were provided within the document.

- Senior staff with the state government conservation department ensured recommendations would fit within higher level government policy, liaised with traditional owners on appropriate use of language, and helped refine discussion of the management of predators through fencing.
- A long-time campaigner provided great depth of experience on the effectiveness of communicating messages to community and politicians alike.
- Senior landscape architects contributed their considerable experience in the development of policy documents, and framing the work in a robust, communicable form.
- An ecologist emphasized the need for the mulch used in plantings adjacent to grassland to be low-nutrient (e.g., gravel rather than pine bark) so that it did not favor weed species.

## Establishing Legitimacy

Several approaches served to establish legitimacy: formal relationships with a professional body, broad stakeholder buy-in, context built on academic foundations, and the presentation of the final product.

By liaising with, and then establishing a formal working relationship with AILA, the document gained a level of legitimacy that might otherwise have been lacking. It is unfortunate that publications produced by conservation groups are often dismissed or ignored by developers even when they are based on good scientific evidence. As a peak professional body, AILA is seen, rightly or wrongly, by many in government and the urban development professions as being less politicized and more balanced than a "green" organization. Consequently, delivering

**TABLE 3 |** Communication strategies used in *SWTG* that contributed to its success.

| VISUAL IMAGERY |
|---|
| Cover: full page image of a baby in a grassland. Encourages acceptance of grassland environment, including diminishing fear of snakes (a real problem in acceptance of grasslands). A reminder of the generational timescale of conservation efforts. Makes publication seem accessible and non-threatening. |
| Full page macro imagery of grassland flowers as section dividers throughout publication. Joltingly beautiful and inspiring readers to look at the (often hidden) beauty of grasslands. Imagery used to strengthen weak points in grassland appreciation. |
| Many large, high resolution, well-taken images illustrating text, as well as diagrams, maps and drawings, assembled to show diversity, drama, and to create a visual parallel to the text. The publication is entertaining as well as informative. |
| Prominent AILA Award medallion of front cover to emphasize legitimacy. |
| Prominent AILA and VNPA logos on inside front cover to emphasis legitimacy and partnership. |

| TEXT |
|---|
| Jargon-free, simple, clear. Speaks audience's language. Emphasizes the role of many different stakeholders in the context of urban grassland management. |
| Captions tell a story. |
| Referencing to assert evidence base and rigor. |
| Glossary, to emphasize seriousness of publication, improve communication, and educate. |
| Set of 7 easy to communicate principles that encapsulate message of publication. |
| Text providing content: a historical overview of grasslands conservation. |
| Division of text into sections according to steps of urban development, e.g., Planning, design, construction, maintenance. |
| Tables that summarize guidelines. |
| Inclusion of case studies grounds guidelines in practical reality, Case studies all presented similarly in terms of maps, aerials, photos, history, observations. |
| Inclusion of checklists that act as summaries of guidelines. |
| Foreword by celebrity designer associated with London Olympics. |
| Bibliography for further reading to educate. |

| OVERALL PUBLICATION |
|---|
| High quality printing, typography, good paper, good binding to ensure product is seen as a quality product. |

the guidelines through AILA is likely to have increased their impact and uptake. Urban conservation groups seeking to effect change could look to similar partnerships to increase their effectiveness.

The broad stakeholder buy-in achieved through multiple document drafts taken out for public consultation, workshop, and then the establishment of an editorial board, also served to provide legitimacy to the project. All were seen to be consulted, all viewpoints taken on-board.

The content of *SWTG* is built on academic foundations. The initial small reference group set-up to guide the author included academics with expertise in ecology and environmental psychology, as well as experienced grassland managers. The academics directed the author to key papers and discussed their relevance to native grasslands. This resulted in important theoretical concepts backed by empirical evidence being

incorporated into biophilic design guidelines. These included the role of the grassland edge in mitigating weed and nutrient inputs, the need for urban design that facilitated rather than hindered ecological burning and the concept of cues to care (Nassauer, 1995). The cues to care concept posits that we can encourage people to appreciate a messy or otherwise unappealing site by physically framing that site in a manner that shows that it is being cared for: people then transfer their positive feelings toward that act of care onto the unappealing site itself. Cues to care became one of the guiding principles of the guidelines. The underpinning science, visible through the presence of referenced facts throughout the document, does a great deal to refute any simplistic debate, and encouraged all stakeholders to "rise to the occasion" and engage in a more sophisticated debate on the role of the grassland's context on grassland conservation.

The presentation of the final document was also important. The range of techniques utilized to promote legitimacy are outlined in **Table 3**.

## Grounded Through Case Studies

From the outset, research was undertaken through case studies that openly investigated the design conditions at a dozen urban, native grassland remnants, with the intention of grounding the document in very real urban situations. For example, a set of grasslands managed by one organization, that were investigated as part of the initial research, were found to be all cheaply fenced, and the fences were high, had locked gates and carried signs warning that the vegetation within was protected (**Figure 1A**). Together these design "features" combined to discourage the visitor from any further engagement with the grasslands and contributed to a sense of resentment toward the grasslands. Another case study presented a distinct contrast: the grasslands fence was high quality, well-detailed and was open to access, with sophisticated signage and seating within the fenceline encouraging visitors to enter, relax and learn (**Figure 1B**). Another example: a grassland located beside extensive public open space was observed to be relatively free of the dumping and human disturbance often associated with grasslands in the urban context, suggesting its colocation with public open space increased passive observation and reduced human pressure on the grassland. Such observations formed the basis of discussion, comparison and the development of the guidelines. They broadened the content and provided excellent visual material to emphasize the points made in the text. These case studies were included as an appendix to the final document and served as the basis for the series of grassland tours offered through AILA that ran parallel to the *SWTG* development process.

## SWTG Puts Grassland First, Not Stakeholder Groups

*Start with the grasslands* does not approach the problem of urban grassland conservation from the view-point of specific professions or organizations. It is not a guide for councils, or friends groups or for grassland ecologists or planners. Rather, it asks what urban design, social and management actions might strengthen these grasslands and only then considers how each profession might act to contribute to such outcomes. This

**FIGURE 1 | (A)** An example of poor biophilic design: Exclusionary fencing, poor maintenance, and minimal interpretive signage only make the residents who live opposite this grassland resentful. Photo: Adrian Marshall CC 4.0. **(B)** Engaging biophilic design: Good quality fencing invites visitors into the grassland experience. Well-positioned and designed signage welcomes visitors. Care is shown. Photo: Adrian Marshall CC 4.0.

eschewing of disciplinarity means problems can be seen in a new light, and a common goal highlighted.

## SWTG Makes a Range of Stakeholder Groups Realize Their Relevance

Many groups, such as landscape architects, utility companies, and road authorities, might not easily make the connection between their profession and the preservation of remnant grassland in an urban context. For instance, during the transition from greenfield site to housing subdivision, much land is left disturbed, unmaintained and temporarily vacant. This can become a source of detrimental impacts such as considerable weed propagule pressure on adjacent grassland or rubbish dumping. By highlighting this process, *SWTG* helps authorities recognize they have a responsibility to ensure stringent weed control in areas adjacent to native grassland throughout the development process. Similarly, by highlighting the importance of cues to care, *SWTG* shows landscape architects the need to raise the quality of fencing around grassland patches from the generally specified cheapest option to one that shows attention has been paid to its design. By reframing the discussion to include the context of grasslands, by showing how that context is relevant, and then directly communicating with the professions actively involved in shaping that context, *SWTG* builds both its audience and a body of future stewards for the grasslands.

## SWTG Communicates Biophilic Design in Its Audience's Language

The language used in *SWTG* is straight forward, non-confrontational and free from jargon. Concepts are explained simply, and its writing style communicates in an inclusive manner that brings people on board a project. Because the author was not a scientist or an expert in grasslands, his ongoing experience in learning the science helped him to explain concepts in a way more readily understood by the document's intended audience. The document is inclusive, incorporating content from all stakeholder groups in a measured response. Visual communication tools are used in a manner that planning professionals, landscape architects and council workers can respond easily to. Two examples: comprehensive checklists are provided for each stage of the development process (**Figure 2**),

which were welcomed by council staff in particular; and a cross-section of a grassland edge with explanatory text was prepared using the visual communication language of landscape architects, urban designers and planners (**Figure 3**).

## Skills Important to Realizing the Project

The author's training as a landscape architect was invaluable. The profession of landscape architecture is an inherently cross-disciplinary one that negotiates competing concerns from a wide range of experts and stakeholders. It emphasizes the compromises necessary to get projects built. It operates across scales from the intimate to the regional, at all levels of government, and in the public, private, and academic spheres. Landscape architects are generally comfortable with planning processes, guidelines, and specifications. Common landscape architectural site analysis will consider sites such as grasslands as elements within an urban context, affected by the orientation of houses and streets, nearby public open space, zoning, topography, view lines, movement paths, and as points in a historical process, systems undergoing change, and cultural constructs, with human action at the center.

It was important to be able to interpret ecological theories and knowledge in a grounded way and to understand the difficulties of reading and interpreting scientific literature. A non-expert researcher and author can be particularly useful in this regard. Openness to the inputs of multiple disciplines is also useful, for example allowing *SWTG* to embrace the value of the aesthetic and psychological components essential for engagement with grasslands in the urban context. In a multi-disciplinary context, it is important to survey the breadth of opinion, gather a broad range of material, and seek out the experts and to test their opinions against those of other disciplines.

Communication skills are important. The reach of a document such as *Start with the grasslands* can be improved when content is presented using a range of visual communication tools.

The lesson here is that those seeking to communicate and implement biophilic urban design need particular skills. Most importantly, they need to be able to work in a trans-disciplinarily manner. Expertise can be a disadvantage if it is too focused. Verbal, written and visual communication skills are also crucial.

## Checklist: design guidelines

### Planting styles

☐ Species chosen to act as barriers to weeds.
☐ Species chosen to provide barrier to human movement.
☐ Species chosen to provide habitat.
☐ Plantings able to be maintained well, within available budget and skill levels.
☐ Species likely to invade grasslands avoided.
☐ Species requiring additional nutrients avoided.

### Buffer plantings

☐ Buffer plantings visually blended with grasslands.
☐ Dominant grassland tussock species used.
☐ High-density plantings used to suppress weed growth.
☐ Extent of buffer plantings takes into account both degree grasslands need protecting and potential impacts of adjacent activity.
☐ Buffer plantings located beyond reserved extent of grasslands.
☐ Buffer plantings minimum 1 m wide.

### Mown edge

☐ Mown edge located beyond reserved extent of grasslands.
☐ Mown edge located within grassland fenceline except where access strictly discouraged.
☐ Mown edge closely mown to reduce weed seed influx.
☐ Mown edge allows for maintenance vehicles, where required.
☐ Mown edge sufficient to be effective firebreak.
☐ Seating and signage located within mown edge.
☐ Pre-existing grassland species, or otherwise non-invasive species, used.

### Edge plantings

☐ Taller plantings set back to avoid shading grassland.
☐ Taller plantings buffered to create sense of space.
☐ Plantings well-maintained.
☐ Hidden areas promoting dumping avoided.
☐ Invasive plants avoided.
☐ Weed-suppressing plants selected and planted densely.
☐ Indigenous plants used.
☐ Plants chosen to control movement.

### Tree plantings

☐ Trees set back sufficiently to avoid shading grassland.
☐ Street trees integrate grasslands into development.

### Incompatible plantings

☐ Plantings developed in conjunction with council environmental staff.
☐ Invasive exotic and non-indigenous native plants avoided.
☐ Shading of grasslands avoided.
☐ Trees used to reduce bulk and reproductive potential of weeds in landscapes surrounding grasslands.
☐ Debris from trees and shrubs removed when they may smother plants or cover bare ground where seedlings may germinate.
☐ Plantings of trees that necessitate changes to fuel and fire management avoided.

### Mulches

☐ Low-nutrient mulch, such as gravels, used.
☐ Gravels with significant clay content, such as granitic gravel, avoided.
☐ Mulches such as pine bark that may smoulder following ecological burns avoided.
☐ Mulched areas graded away from grasslands.

### Fencing

☐ Boundary fences beyond reserved extent of grasslands.
☐ Mown edge and buffer zone to grasslands within boundary fence except where access strictly discouraged.
☐ Cues to care shown with good-quality and well-maintained fencing.
☐ Fencing of quality and design appropriate to context.
☐ Fencing appears inclusive rather than exclusive, generally low.
☐ Fencing fire-resistant, unless protected by firebreak.
☐ Some entry allowed.
☐ Fenceposts and bollards minimised where difficult to maintain or may act as sources of unmown weeds.
☐ Fencing wildlife-friendly.
☐ If predator-fencing required, authorities such as Parks Victoria consulted to determine options.
☐ If predator-fencing required, additional education programs considered to counter negative perceptions predator-fencing may create.
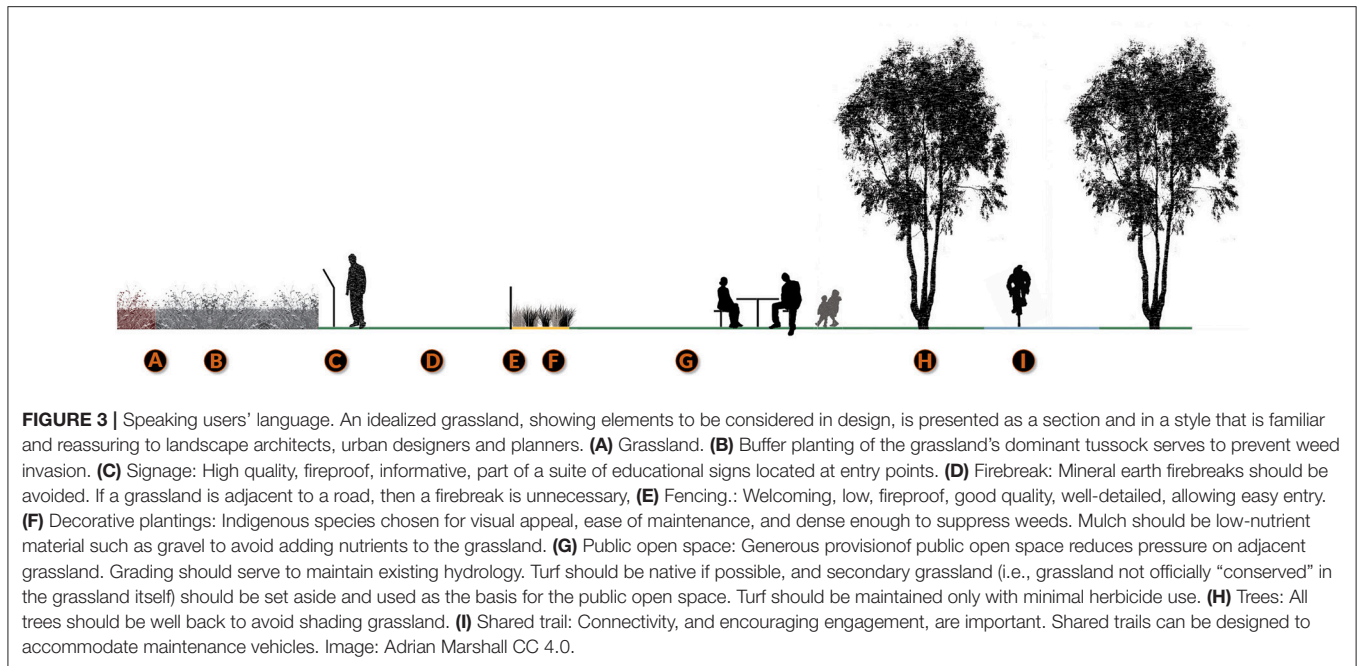
### Alternatives to fencing

☐ Hedges, stone walls, ditches and ha-has considered.
☐ Drainage lines and swales as barriers considered.

**FIGURE 2 |** A simple summary: A checklist from *Start with the grasslands* provides a simple summary of some design guidelines and is a useful tool for council staff against which to assess construction works. Image: Adrian Marshall CC 4.0.

## Applicability to Other Contexts

The seven principles outlined in *SWTG* are readily transferable across most ecosystems and ecological design projects: put the natural systems you are working with at the center of the design process, collaborate, create connectivity, design for future maintenance, communicate, get people engaged with the ecosystems, and express care. More specific recommendations within each of these points may be appropriate to grassland

**FIGURE 3 |** Speaking users' language. An idealized grassland, showing elements to be considered in design, is presented as a section and in a style that is familiar and reassuring to landscape architects, urban designers and planners. **(A)** Grassland. **(B)** Buffer planting of the grassland's dominant tussock serves to prevent weed invasion. **(C)** Signage: High quality, fireproof, informative, part of a suite of educational signs located at entry points. **(D)** Firebreak: Mineral earth firebreaks should be avoided. If a grassland is adjacent to a road, then a firebreak is unnecessary, **(E)** Fencing.: Welcoming, low, fireproof, good quality, well-detailed, allowing easy entry. **(F)** Decorative plantings: Indigenous species chosen for visual appeal, ease of maintenance, and dense enough to suppress weeds. Mulch should be low-nutrient material such as gravel to avoid adding nutrients to the grassland. **(G)** Public open space: Generous provision of public open space reduces pressure on adjacent grassland. Grading should serve to maintain existing hydrology. Turf should be native if possible, and secondary grassland (i.e., grassland not officially "conserved" in the grassland itself) should be set aside and used as the basis for the public open space. Turf should be maintained only with minimal herbicide use. **(H)** Trees: All trees should be well back to avoid shading grassland. **(I)** Shared trail: Connectivity, and encouraging engagement, are important. Shared trails can be designed to accommodate maintenance vehicles. Image: Adrian Marshall CC 4.0.

ecosystems in particular, though many will have parallels in other fragmentated ecosystems in human-dominated landscapes.

## Lessons Learned

Support, access to good science, and achieving stakeholder buy-in were key to the project's success. In the fundamental matter of establishing the project's legitimacy, institutional support was vital, with the collaboration of a "green" organization with extensive contacts, including within the scientific community, and a professional organization with complimentary reach within government and the building industry, particularly fortuitous. *SWTG* aimed to be inclusive of all stakeholders but did lack input from developers and more could have been done to bring these stakeholders on board. Communication and collaboration may not always be optimal—some stakeholders will be intransigent, for instance rejecting scientific findings, or rejecting change—but the process will still be valuable. In cases where engagement is compromised, it has to occur by other means, and a substantial body of literature is devoted to how to encourage pro-environmental behavior (e.g., Steg and Vlek, 2009).

*SWTG*'s weakness is in its lack of real economic argument for its design principles. *SWTG* made some arguments for the economic benefits of good design, but most are generalized to larger contexts or scattered throughout the document, and strong counter-arguments often get put forward, especially from developers.

Application of design guidelines must be targeted. At the council level, good design is often seen as costly financially and in time and resources. Retrofitting design solutions into grassland contexts, or rectifying management problems (i.e., weed invasion), may be more expensive than designing appropriate grassland contexts in new development on the urban fringe. Moreover, some guidelines may not be applicable to all grasslands. For instance, there can be considerable resistance

by government authorities to letting people into grasslands that include particularly endangered species over which federal legislation demands due diligence in protection.

At the other end of the spectrum, design principles, if applied poorly, could be considered "greenwashing". For instance, promoting engagement by including a lookout next to a grassland may replace more difficult to achieve but more beneficial interventions.

Overall, the *SWTG* development process would have benefited from having some planned means of measuring its success or otherwise. A survey establishing landscape architects' pre-project and post-project understanding of grasslands and their significance could have been useful, as could a feedback mechanism on the process of the project's development itself. Post-project research is lacking on the exact manner and detail in which *SWTG*'s recommendations were received or are implemented. However, the *SWTG* project was not designed as a research project.

## DISCUSSION

Design focusing on Melbourne's grasslands has had a mixed history. Generally, Melbourne's grasslands have survived through being overlooked rather than being designed into the urban landscape, e.g., on road or rail reserves or rocky areas unsuitable for development. Some grasslands were accidentally designed, being treated as parks prior to being recognized as having indigenous grassland present. Since the 1980s, when the significance of these remnants was realized, a range of more deliberate approaches have been undertaken. The most common of these has been to cheaply fence the grassland, ensure the gate is locked, put up some minimal signage saying "keep out, protected remnant" or similar, and leave it at that, the philosophy being that this vegetation community and the species inhabiting

it are too endangered to be further damaged by visitation. This approach led to resentment and negative attitudes toward native grasslands by many residents. The next level of design shown, perhaps undertaken to assuage bad feeling, is to plant the fenceline with additional native vegetation. Increased design attention has usually been the result of a perceived need to fix bad behaviors: trail bike riding and rubbish dumping in particular; or it arises from tolerating pre-existing users, e.g., a model airplane club. In rare instances, more sophisticated interpretive signage is used, and access encouraged. Grasslands have been rarely integrated into their context (**Figure 4**). At a planning level, earlier subdivisions were built backing onto a grassland (poor engagement), while latter, and less commonly, "master planned communities" had houses facing onto a grassland (better engagement). Master planned communities are generally larger than a simple subdivision, take a whole-of-site approach, and work to embed public open space and incorporate natural systems (Gwyther, 2005) in a manner positive to the development "brand". Offsetting has been another significant means of responding to grasslands in the development process. Offsetting is a process whereby the developer pays to protect a technically determined equivalent of the grassland elsewhere in exchange for being allowed to develop the grassland for housing (DELWP, 2018), a process now generally recognized as creating poor environmental outcomes (Maron et al., 2012).

Biophilic design has been around as long as people have been designing, but was generally not recognized as such. For instance, in instilling the "sublime" in his landscapes, Lancelot "Capability" Brown ensured we engaged with nature at a visceral level (Ross, 2018). And in Central Park, Frederic Law Olmstead made sure wildness was a strong presence (Spirn, 1996). Hydrological interventions such as artificial wetlands, when designed to filter water and retard flows, are biophilic in that humans respond positively to the complexity and wildness they present (Manuel, 2003). Thayer (1976) argued we must make ecology more visible through design in order to emphasize our connection with nature, calling for an aesthetics for a more ecologically aware age.

In such cases, though, the benefit to nature is secondary to the benefit to humans. This then is the difference between design that happens to be biophilic and biophilic design principles: the latter have benefit to nature embedded in them and considered alongside any benefit to humans. Indeed, at a philosophical level, in biophilic design principles, the distinction between benefit to nature and benefit to humans may be said to be meaningless.

While much biophilic design is occurring, e.g., the greening of Singapore (Newman, 2014), and as a philosophy its literature is plentiful, the scientific evidence base for specific actions is limited, and the rigorous evaluation of biophilic design projects rare. This is a problem common to many urban ecology projects: how to build good science, including establishing pre-design baseline data, into the rapid timelines common to urban development, and then monitor outcomes in a complex and continually changing environment? Indeed, the whole question of how to measure sustainability in nature-based design, is problematic. The concept of ecosystem services may go some way to providing a way forward (Windhager et al., 2010). However,

establishing an evidence base may be a particularly acute problem for biophilic design because of the additional complexities of measuring human psychological response to natural systems.

There is considerable academic literature on what design should encompass: experiences of wildness (Louv, 2008), cues to care (Nassauer, 1995), sustainability and resilience (Ahern, 2013) etc. Much less common in the literature is how to communicate such principles beyond the academic paper. Notable in this regard are calls for transdisciplinary approaches (Brown and Clarke, 2007; Childers et al., 2015; Taylor and Hochuli, 2015) and using design opportunities as sites for experimentation (Felson and Pickett, 2005). In practice, within the design community, communication about biophilic design occurs informally, e.g., though word of mouth, conferences, educational opportunities. In the gray and scientific literature examining biophilic design, the case study is often the "unit" of information, highlighting project(s) that do something well, and other projects that do something else well. However, discussion of case studies is often hampered by a lack of rigor and relevance to the reader's circumstances.

Design is often regarded as a process and used for empowerment. In the United States in the 1960s and 1970s, designers such as Clare Cooper-Marcus used design activism approaches to help create community and empower community members through a design process that included workshops, design charrettes and group construction (Hester and Hester, 2012). Engagement as process not outcome is a core tenant of the way many NGOs operate (Gaventa and Barrett, 2012). We believe biophilic design principles should always include the idea that the process is as important as the outcome. *SWTG* is an example of how *designing the development of the design principles* led to greater engagement and better outcomes that might otherwise have been the case.

## CONCLUSIONS

Good biophilic design outcomes can be achieved in the urban context when a cross-disciplinary approach is taken that allows the evidence-base of specific professions to be taken up by other professions to generate biophilic designs that improve biodiversity outcomes. Broad and inclusive stakeholder engagement allows the complex, overlapping and conflicting interests typical of urban environmental projects to be negotiated in a manner that builds consensus, an audience and future stewardship. Framing document development as an educative campaign process allows synergies to emerge and a broad range of stakeholders to feel valued and included. Legitimacy can be strengthened through organizational partnerships. Case studies, when undertaken well, can provide an excellent basis for discussion, visual communication, community engagement and idea development, and can ground a project in real-world outcomes. Non-experts, when given appropriate expert guidance, can be particularly effective in communicating across a broad range of stakeholders. Communication through non-confrontational, simple language is vital, and appropriate visual communication is essential. Information grounded in academic

**FIGURE 4 |** Well-integrated. Photo taken from a grassland lookout designed to encourage users into the grassland, while encouraging them to stay on a set path to minimize damage from trampling. The entrance is signaled by public art work, housing faces the grassland and the road is used as a firebreak. Image: ©Diana Snape.

discourse but filtered through the knowledge held by other groups of non-academic experts, such as land managers, council staff, and design professionals, is a powerful tool. For instance, the intuitive and powerful "cues to care" concept (Nassauer, 1995), while existing in the literature for 20 years, was new to many of the stakeholders and in feedback was repeatedly referred to as useful.

A well-designed, biophilic urban context for remnant habitats can not only benefit the environment, but benefit urban developments, establishing place identity, increasing the financial value of property, improving residents' well-being, providing connection to nature, and helping to create community. By retaining and highlighting remnant ecosystems using biophilic design principles within new urban areas, developers can free themselves of burdensome processes of offsetting. *SWTG* shows that we can change the way we approach the "problem" of having remnant habitats within a development, and instead frame it as an opportunity. Having a document such as *SWTG* can begin the process of this becoming the first choice, the new normal.

Success, however, is relative. Despite clear changes in attitudes and an improvement in design quality, the decline of south-eastern Australia's grasslands continues. Fundamental problems exist in aligning competing land uses, e.g., the imperative of profit that drives urban development, and recognizing the economic context in which preserving remnant communities takes place. Lack of funds, resources and time hampers the good intentions of many stakeholders and suggests a regulatory framework may be required. There are inherent problems too in protecting a degraded and superficially unattractive ecosystem. Coordination is lacking across multiple interest groups. Current government policies are inadequate for the task of managing remnant communities across multiple jurisdictions and stakeholders.

The task of embedding biophilic design in our urban systems is a large and complex one. Design processes must move well-out from simply protecting remnants, to reimagining the fabric of our suburbs, the selection of street trees and the form of gardens and nature strips and the materiality we choose to build from. The task requires a detailed understanding of the interactions between humans and their environment so that remnant natural habitats can be better integrated into the designed urban landscape.

## AUTHOR CONTRIBUTIONS

AM is the author of *SWTG* and wrote the first draft of the manuscript. NW was a member of the expert panel advising AM for *SWTG* and conceived the idea for this manuscript and wrote sections of the manuscript and edited drafts.

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