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论文

复杂性的表达

Representing Complexity

摘要 ……

伊恩·麦克哈格对地图叠加法的改进为地理信息系统（GIS）奠定了基础。他通过叠加地图的方法来说明生态系统之间的各种关系以及景观格局，这可谓是自1413年左右经菲利波·布鲁内莱斯基改良透视画法以来，设计行业中最重要的表现方式和设计手段。除了地图叠加法，麦克哈格还采用了很多其他表现方法来分析景观的复杂性，并说明规划及设计如何与生物物理过程、地质特征相互作用。这些主要用来表现景观复杂性的空间分析手法和表现技法将扩展地理设计的适用性和优越性。善用这些表现技法可以大力推进当前的地理设计，正如地图叠加法加速了GIS的诞生。除了地图叠加法以外，曾经被麦克哈格和他在宾夕法尼亚大学的同事们以及Wallace，McHarg，Roberts及Todd事务所（简称WMRT事务所；现Wallace，Roberts及Todd事务所，简称WRT）所使用过的其他表现方法还包括：地图、断面图、分析图、鸟瞰图、块状图、绘画以及摄影图片。我们将逐一介绍这些表现方法，并讨论其应用于地理设计中的可能性。更全面地探索这些表现技法将有助于推动地理设计的应用，也有助于我们了解麦克哈格在地图叠加法之外的其他贡献。

关键词 ……

景观表现；伊恩·麦克哈格；地理设计；地图叠加法；景观设计

Abstract ...

Ian McHarg helped build the foundation for geographical information systems (GIS) through his refinement of map overlay methods. McHarg's use of map overlays in revealing ecological relationships and landscape patterns is arguably the most important representational tool and strategy for design since Filippo Brunelleschi's refinement of perspective around 1413. In addition to overlays, McHarg employed other representational tools to analyze landscape complexity and to present how planning and design interventions interacted with biophysical processes and geological features. Spatial analytic strategies and representational techniques that focus on landscape complexity can expand the applicability and saliency of geodesign. This expansion could be similar to the influence of overlays to the creation of GIS. The other representational techniques employed by McHarg and his colleagues at the University of Pennsylvania and Wallace, McHarg, Roberts and Todd (now Wallace Roberts & Todd, WRT) include: maps, transects, diagrams, bird's eye perspectives, block diagrams, drawings, and photography. Each of these techniques will be introduced as they were used by McHarg then discussed for potential geodesign applications. A more comprehensive exploration will help expand the potential of geodesign and also acknowledge McHarg's broader contributions beyond map overlays.

Key words ...

Landscape Representation; Ian McHarg; Geodesign; Overlay Mapping; Landscape Architecture

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前言：拓展设计的能力

环境的可视化表达是设计所面临的一个主要挑战，却也是一个优势所在。建筑师和景观设计师如果要构想出建筑和场所的未来，首先应对场地或地块的现存条件进行记录和分析，其中包括社会及自然历史方面；接下来设计师会提出几种不同的设计方案来进行比较；并最终挑选出一个最优方案。为了完成这一系列步骤，建筑师和景观设计师需要利用各种不同的表现方法和分析工具来记录场地、深化设计理念，以及阐明设计方案中的干预措施将会带来哪些影响。

15世纪初期，意大利人菲利波·布鲁内莱斯基对线性透视法的改良彻底影响了建筑设计的方法。布鲁内莱斯基并非透视学的发明者，但是他的改良大力推动了透视学在实践中的应用。地图叠加法是自线性透视法以来最重要的表现方式。伊恩·麦克哈格在20世纪60年代将地图叠加法发展为一种结合生态知识进行设计的工具。和布鲁内莱斯基一样，

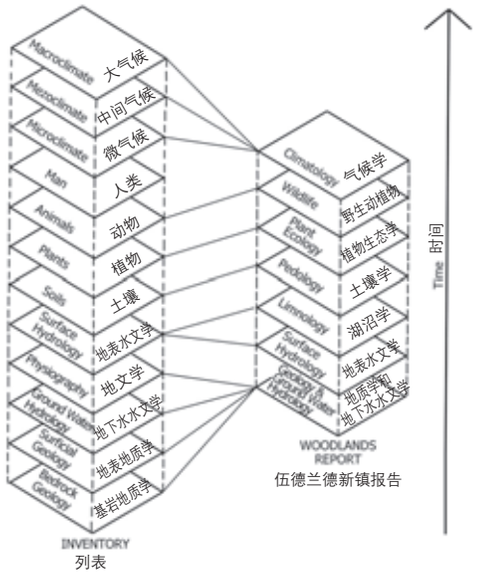
Introduction: Expanding the Capacities for Design

The visual representation of environments is a central challenge and strength of design. The architect and the landscape architect conceive preferred futures for buildings and places. This involves first documenting and analyzing the existing conditions of a place or a parcel, including its social and natural history; second, developing options for the future; and then deciding upon a preferred design. In order to do this, architects and landscape architects use a variety of representational and analytic tools to document the site, to develop design concepts, and to communicate the impact of interventions on preferred futures.

The Italian Filippo Brunelleschi's development of linear perspective in the early 1400s revolutionized how buildings are designed. Brunelleschi did not invent perspective, but advanced its practical application. Map overlaying is the most important representational tool since linear perspective. Ian McHarg developed map overlays as a tool to design with ecological understanding beginning in the 1960s. Like Brunelleschi, McHarg did not invent map overlays. Landscape architects have been using map overlays since at least the 1890s; according to Charles Eliot's accounts of the Olmsted office.[1]~[3] However, McHarg popularized and refined the tool to show opportunities and constraints for development and preservation through suitability analysis.[4][5] McHarg's work coincided with the development of computer mapping techniques including geographic information systems (GIS).

Geodesign is intended to build on GIS and expand the analytic and representational capacities of designers to shape our surroundings. In order to accomplish this expansion, it is important to explore the potentials of other representational methods. Within the broad field of geomatics, this would include cartography, global positioning systems, surveying, photogrammetry, and remote sensing.

Another route of expansion, the path selected here, is to look at McHarg's work and ask how the full range of analytic and representational techniques that he and his colleagues used might be adapted through geodesign. In his professional practice with Wallace, McHarg, Roberts and Todd (WMRT) and his academic work at the University of Pennsylvania, McHarg used maps, transects, diagrams, bird's eye perspectives, block diagrams, drawing, and photography. This more comprehensive exploration of the representation techniques that McHarg employed is novel, as most discussions of his contributions are limited to map overlays. Furthermore, this fuller range of techniques is necessary to develop robust analyses of increasing complex landscapes; detail potential impacts of design interventions on human-nature interactions; and deliver a variety of images, maps, and models into public deliberations out of which preferred futures are identified.



Layer Cake Representation of Phenomena "千层饼"排列方式 1

Moreover, map overlays, like perspective drawings, attempt to abstract complex realities. Social and biophysical systems are inherently complex. This complexity involves phenomena immediately evident to the five senses, as well as things that are not evident. As a result, no single representation medium is capable of capturing the full spectrum of complexity in time or space as well as what is visible and what is not.

Overlay Mapping: the Layer of the Land

The first accounts of map overlays in landscape architecture come from Charles Eliot's autobiography[1], where he described work in the Olmsted office in the

1. 伍德兰德新镇千层饼图（图片来源：参考文献[7]）© WRT
1. The layer cake representation of Woodlands layer cake (Source: Refs. [7]) © WRT

麦克哈格也并非地图叠加法的创始人。查尔斯·艾略特在奥姆斯特德事务所的工作记录表明景观设计师至少从19世纪90年代开始，就已经在使用地图叠加法了。[1]~[3]然而，麦克哈格推广并完善了这种方法，通过适宜性分析，利用叠加地图的表现方式来说明何处适合发展，而何处应该保留。[4][5]麦克哈格的工作契合了包括地理信息系统（GIS）在内的计算机制图技术发展趋势。

地理设计旨在以GIS为基础，拓展设计师塑造周围环境的分析能力及表达能力。为实现这个进步，探索其他表达方式的潜力则变得十分重要。我将在地理信息学的广义领域内进行探讨，制图学、全球定位系统（GPS）、勘测、摄影测量学以及遥感技术都囊括在内。

在这里，我们将通过另一种途径来探讨那些有潜力的表达方式，即通过研究麦克哈格的作品，来探讨麦克哈格和他的同事们所使用的分析和表现技法能否在地理设计中得到全面的应用。在WMRT工作室的职业实践以及宾夕法尼亚大学的学术工作中，麦克哈格曾使用过地图、断面图、分析图、鸟瞰图、块状图、绘画和摄影图片等方式。对麦克哈格使用过的表现方式进行全面分析是一种非常新颖的思路，因为过去大多数关于麦克哈格的讨论都仅限于他在地图叠加法上做出的贡献。此外，我们需要更全面的技术支持来对日益复杂的景观进行可靠的分析；细化设计干预对人与自然的相互作用产生的潜在影响，并利用各种图像、地图和模型来向公众展示优选的设计方案。

不仅如此，地图叠加法与透视图一样，都是对非常复杂的各种实际情况进行抽象。社会和生物物理系统本身具有高度复杂性。这种复杂性不仅存在于五官可即刻感知的现象中，也存在于那些无法察觉的现象中。因此，没有哪一种单一的表现方法可以全方位地表现时间或空间的复杂性，并准确地表达哪些现象是即刻可见的，哪些是隐藏在背后的。

地图叠加法：土地的层级

关于地图叠加法在景观设计中的应用，最早的描述来自于查尔斯·艾略特的自传[1]。自传中，艾略特描述了19世纪90年代，他在奥姆斯特德事务所的工作。地图叠加法在20世纪被景观设计师和规划师不断地完善[3]。麦克哈格在地图叠加法上的贡献是双重的。首先在于理论层面：叠加地图揭示出景观的相互作用模式，从而强化了景观中的生态认知。凯伦·麦克劳斯基将其称之为“进程分析图”[6]。其次在于实践层面：分层地图应该按照时间先后排序，最原始的环境组成部分（例如岩石层）是第一层，接着往上叠加其他的图层（例如水、土壤、植被等）。麦克哈格称这种排列方式为“千层饼”，他在WMRT事务所的多个设计项目中都采用了这种方式，例如位于休斯顿附近的伍德兰德新镇规划项目（图1）。

麦克哈格早期使用的叠加地图均由手绘完成。尽管如此，这些分析仍表明了一些与人类安全问题相关的重大关系和敏感区域。例如在1969年出版的《设计结合自然》一书中，关于史泰登岛适宜性分析的手绘地图就明确地标明了不适合进行城市开发的区域。这些区域与美国联邦紧急事务管理署（FEMA）在2012年的桑迪飓风过后对史泰登岛的评估结果极为类似（图2）。

GIS技术在很大程度上是源于地图叠加法，而GIS技术的发展也显著地改良了这种表现方式。现在，地图叠加法在规划、地理学和许多其他领域都非常普及，但在设计行业的应用普及度还有待提高。GIS的分层图解很多时候都与麦克哈格的千层饼结构图类似（图3），但GIS技术的发展却鲜少归功于麦克哈格。除了广泛的实际应用以外，GIS也推动了许多学科领域内的重要文章和著作的发表[8]。GIS为地理设计提供了坚实的基础，而其他表现方式的应用也将推动地理设计的发展。例如，麦克哈格曾将叠加技术和X射线相比较。现在，放射学领域中很多重要进展也能应用于地理设计。[5]

地图：图形诗歌

除了叠加地图以外，麦克哈格也曾使用单独的地图来传达一些特定的信息。他利用这些地图来说

2. 麦克哈格1968年对史泰登岛的分析图，标明了不适宜城市开发的区域（左图深色部分）；2012年桑迪飓风后美国联邦紧急事务管理署对撤离区域的分析图（右图黄色部分）（图片来源：《设计结合自然》及美国联邦紧急事务管理署）。

2. Areas in Staten Island identified as unsuitable for urban development by Ian McHarg in 1968 (darker areas, left). Areas in Staten Island evacuated after Superstorm Sandy by the Federal Emergency Management Agency in 2012 (orange areas, right). (Sources: *Design with Nature* and the Federal Emergency Management Agency).

1890s. The technique continued to be developed through the 20th century by landscape architects and planners[3]. McHarg's contributions were twofold. The first was theoretical: ecological understanding of a landscape can be advanced through map overlays in order to reveal patterns of interaction. Karen M'Closkey describes patterns as "diagrams of process"[6]. The second was practical: maps should be organized in temporal sequence with the older components of the environment (for instance, rocks) forming the foundation for subsequent map layers (for instance, water, soils, and vegetation). McHarg called this organization a "layer cake" and it was employed in several WMRT projects, including the plan for The Woodlands new town near Houston (Fig. 1).

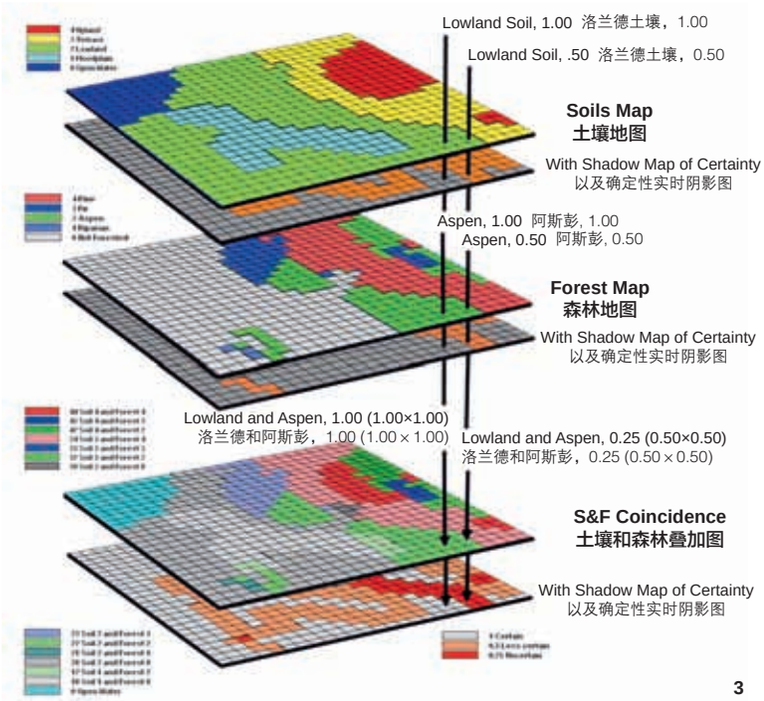
McHarg's early map overlays were hand-drawn. Still, they presented powerful relationships and highlighted areas of human safety concerns. For instance, he published a 1968 suitability analysis of Staten Island in *Design with Nature* (1969). His hand-drawn maps clearly illustrated areas that were unsuited for urban development. These areas are very similar to the Federal Emergency Management Agency (FEMA) evacuated after Superstorm Sandy in 2012 (Fig. 2).

GIS technology is based largely on overlay mapping and has significantly advanced the technique. The technology has become a ubiquitous tool in planning, geography, and many other fields, but less so in design. Frequently, GIS is explained diagrammatically with layer-cake drawings (Fig. 3) similar to McHarg's, but seldom crediting him. In addition to vast practical applications, it has spawned robust literature of articles and books in many academic disciplines[8]. GIS provides a strong foundation for geodesign, but other representation techniques will help advance its potential. For instance, McHarg compared the overlay technique with taking X-rays. Significant advances have occurred in radiology that could be adapted through geodesign.

Maps: Graphic Poetry

In addition to using overlay maps, McHarg used individual maps that focused on specific information. He employed them in cartographic applications, that is, to illustrate spatial phenomena; to highlight certain characteristics; for analysis; and to show possible futures. For instance, in a 1976 WMRT study for the central Toronto waterfront, water quality information is well explained (Fig. 4)[9]. The map and diagrams synthesize data from diverse sources in order to show relationships (for example, between sources of contamination and water pollution) that should be taken into consideration in planning and design for the Toronto waterfront. Original shoreline and historic rivers (now buried in sewers) are shown in blue.

Of course, designers are seduced by beautifully drawn maps. In the recent past, Anuradha Mathur and Dilip da Cunha have produced, arguably, the most original, provocative maps in landscape architecture and planning. The maps in their books help illustrate the diverse landscapes that are complex socio-cultural and bio-physical environments of the Mississippi River Valley[11], the terrain of Bangalore[12], and the Mumbai estuary[13]. Their maps capture temporal change and may be viewed as a kind of change detection approach (Fig. 5). Like McHarg's layer cake, Mathur's maps depict both cultural and ecological processes. Ignacio Bunster-Ossa of WRT calls her maps "graphic poems, something that in content can be absorbed viscerally and



3. GIS "千层饼" 图。来源于约瑟夫•贝瑞编辑的 "超越地图" 系列（www.innovativegis.com/basis/MapAnalysis/）。
3. GIS layer-cake diagram. From Joseph Berry, Beyond Mapping Series (www.innovativegis.com/basis/MapAnalysis/).

明某些空间现象、强调某些特征、进行分析，以及说明可能出现的结果。例如，WMRT事务所在1976年为多伦多市中心滨水区制作的地图就很好地分析了水质情况（图4）[9]。这些地图和分析图综合了不同数据源的信息，总结出多伦多市滨水区的规划和设计中应该予以考虑的关系（如污染源和水体污染之间的关系）。原始的海岸线和河道（现已被掩埋在城市排水管中）在图中用蓝色表示。

当然，设计师们总是能不断地绘制出精美的地图。近年来，阿努拉·马瑟和迪利普·达·库尼亚所绘制的地图可以说是景观和规划行业中最具原创性、最炫目的地图。他们著作中的地图展现了密西西比河谷[11]、班加罗尔地区[12]以及孟买河口[13]复杂的社会文化和生物物理环境下不同的景观类型。这些地图能够捕捉时间的变化，可以被视作一种检测变化的途径（图5）。正如麦克哈格的“千层饼”一样，马瑟的地图描绘了人文和生态过程。WRT事务所的伊格纳西奥·本斯特–奥萨称她的地图为“一首图形诗，地图内容就像诗歌一样娓娓道来，并引人深思。”①

数字技术大大丰富了地图的制作过程及展现的内容。举例来说，埃里克·菲舍尔利用来自照片共享网站Flickr和微博网络Twitter上的数据信息制作了很多城市地图。如图6所示的纽约地图中，红色圆点代表来自Flickr的图片，蓝色圆点代表来自Twitter的图片，白色圆点代表同时来自Flickr和Twitter的照片。地图清晰地展示了街道结构、曼哈顿岛以及包括中央公园在内的主要节点，并纪录了人们在何处使用了网络社交媒体，以及这些地点与包括城市街道和公园在内的基础设施网络之间在地理上的关系。菲舍尔还制作了类似的包括伦敦、巴塞罗那、东京、新奥尔良在内的世界其他城市的地图。

伦敦大学学院巴特利特学院的空间句法实验室在制作这些反应城市空间特征的地图方面取得了许多成就②。空间句法实验室主要研究建筑和城市的空间形态。该实验室的构想最初由比尔·希利尔和他在巴特利特学院的同事们于20世纪80年代提出，现在这些研究成果已经被广泛应用在各种设计领域和社会科学之中[14][15]。

地理设计可以利用数字技术和社交媒体来提高地图制作中设计的可能性。地图可以传达某一特定的信息，如多伦多市滨水区的水文情况或纽约市内Flickr的使用情况。尽管这些信息本身可能非常复杂，但已经远比城市景观中所发生的无数现象简单得多。地理设计有助于在这些复杂的现象和其他地理信息之间建立起联系。

断面：景观的切面

长期以来，地质学家、地理学家、人类学家和生态学家一直利用断面来说明景观各层之间的线性关系。断面包括垂直剖面和纵剖面，可以用来表明诸如土壤、植被等要素在地形上的相互关系。在帕特里克·格迪斯的“山谷横截面”一文中，他提倡利用断面来分析人类居住地，并利用这些信息进行设计和规划。麦克哈格也经常利用断面图来说明问题。在《设计结合自然》一书中，他示范了如何通过断面分析来完善新泽西海岸的规划（图7）。

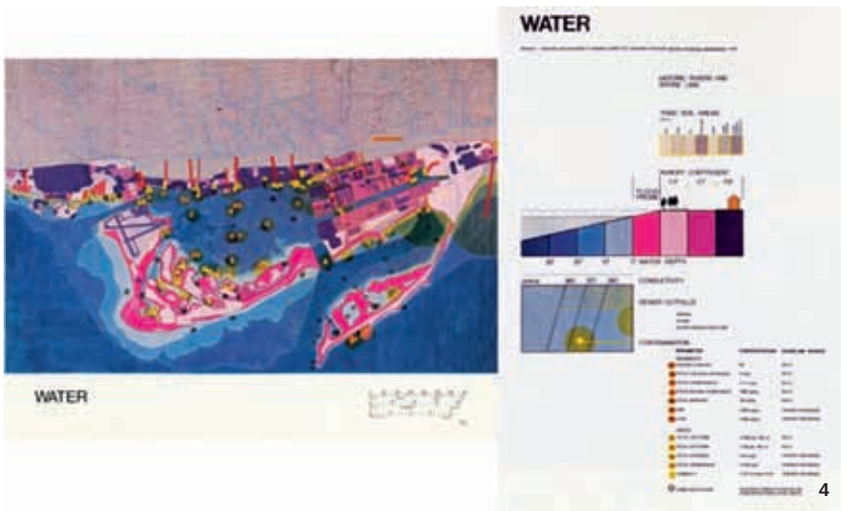
在佛罗里达州的大西洋海岸，位于杰克逊维尔北面的阿米莉亚岛度假社区是贯彻麦克哈格理论的建成范例作品之一。该社区的规划和设计由麦克哈格的合伙人（也是他以前的学生）、WMRT事务所的比尔·罗伯茨负责完成。阿米莉亚岛的断面图显示了岛屿的海滩和沙丘结构（图8）。断面图的左边

4. 地图显示了多伦多海港水资源的相关特质。地图及分析图由纳伦德拉•朱内贾及安妮•惠斯顿•斯本为“多伦多市中心水域环境资源”报告所绘制（图片来源：安妮•惠斯顿•斯本）
5. 阿努•马瑟和迪利普•达•库尼亚所绘制的地图（图片来源：参考文献[12]）。
6. 纽约市Flickr / Twitter使用地图 © Eric Fischer

4. Map showing features related to water resources in Toronto Harbor. Map and diagrams prepared by Narendra Juneja and Anne Whiston Sprin for the Environmental Resources of the Toronto Central Waterfront report (Source: Anne Whiston Spirn)
5. Map produced by Anuradha Mathur and Dilip da Cunha (Source: Refs. [12]).
6. Flickr / Twitter Use Map of New York City © Eric Fischer

①
引用自私人通信。

②
更多信息可参见：http://tinyurl.com/kgucfha。



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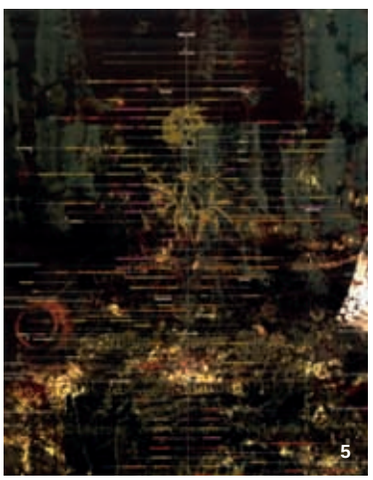
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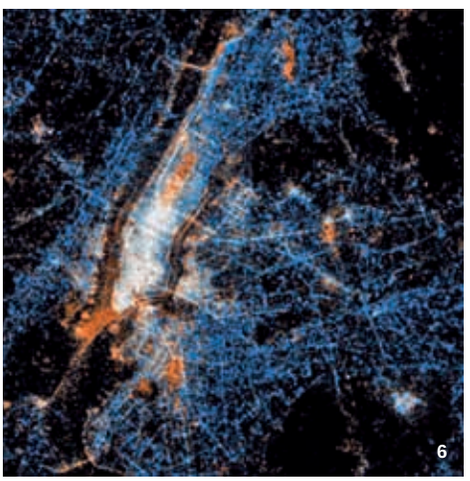
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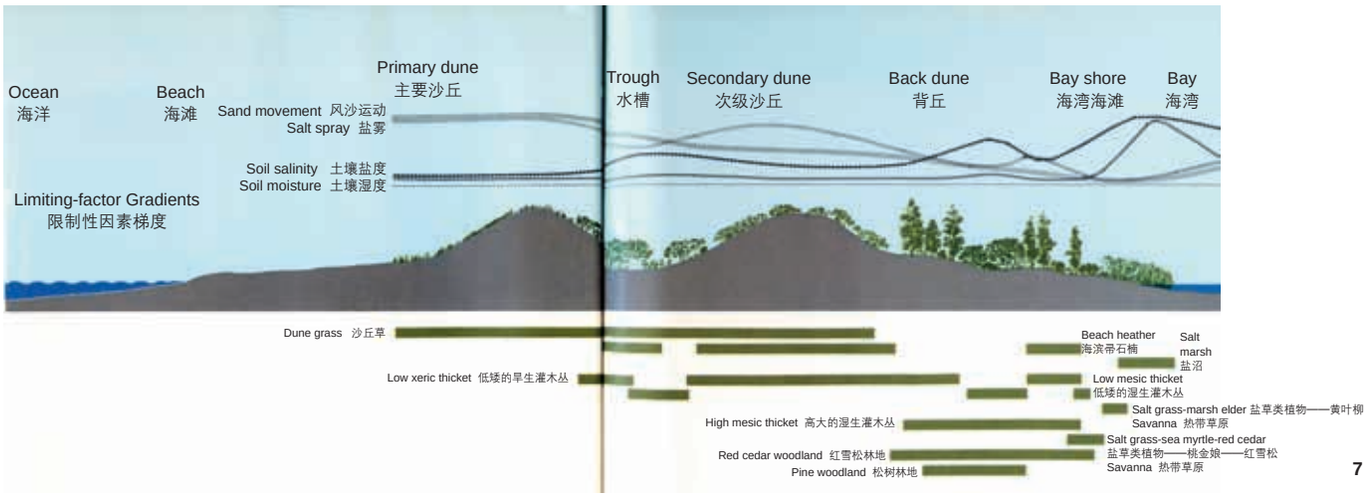


7

didactically.” ①

Digital technology has significantly expanded how maps are produced and what they represent. For instance, Eric Fischer has made maps of cities that combine data from the photo sharing website Flickr and the microblog network Twitter. In Fig. 6 of New York City, the red dots represent Flickr pictures, the blue dots are tweets, and the white dots are both. From the map, one can easily distinguish street structures, Manhattan Island, and key features including Central Park. The map captures where people are using social media to connect and how these geographic locations of intersect with urban infrastructure geographically, including streets and parks. Fischer has produced similar maps for London, Barcelona, Tokyo, and New Orleans, as well as the world.

The Space Syntax Laboratory at the Bartlett School, University College London, has made many advances in map-based graphics that reveal the spatial characteristics of cities②. Space syntax focuses on the spatial configuration of buildings and cities. Originally conceived by Bill Hillier and his Bartlett School colleagues in the 1980s, space syntax has been applied in various design disciplines, as well as the social sciences[14][15].

Geodesign can utilize digital techniques and make use of social media to improve the design possibilities of map making. Maps can help focus on specific information, like the hydrology of the Toronto waterfront or Flickr use in New York City. While this information may be complex in itself, it is less so than the myriad of phenomena that occur in urban landscapes. Geodesign can help make connections between such phenomena and other geographic information.

Transects: Slices Across the Landscape

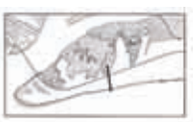
Geologists, geographers, anthropologists, and ecologists have long utilized transects to display relationships linearly across a landscape. Transects are vertical slices or cross sections that can help illustrate the topographic relationships of phenomena like soils and plants. In his “valley section”, Patrick Geddes suggested that human settlement can be analyzed through transects and that this information should be used for design and planning. McHarg frequently employed transects. In *Design with Nature*, he illustrated how coastal planning could be improved through transects of the New Jersey shore (Fig. 7).

On the Florida Atlantic Coast, north of Jacksonville,

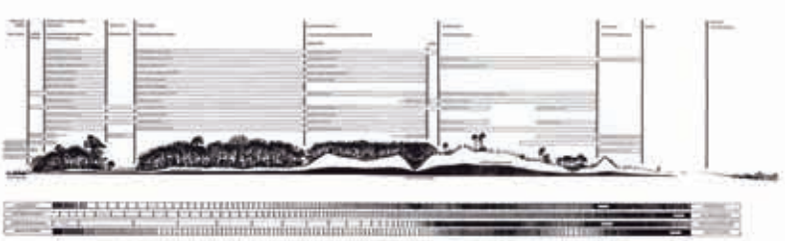
7. 新泽西海岸断面图（图片来源：参考文献[4]）
8. 阿米莉亚岛断面图（图片来源：参考文献[16]）© WRT
7. New Jersey Shore transect (Source: Refs. [4])
8. Amelia Island transect (Source: Refs. [16]) © WRT

① That is referenced from personal communication.

② Please visit http://tinyurl.com/kgucfha.



The above diagram indicate where on the site the vegetation section is taken. Although the vegetation drawing illustrates a narrow transect from the beach to the marsh neck north of Long Point, it shows all of the characteristic formations which make-up Amelia Island’s vegetation. The section also shows the approximate height above sea level of the ground water table.
上图中标出了植被断面在场地中的位置。尽管植被图显示的只是从海滩到位于长角北侧沼泽地的一个狭窄横断面，但它展示出了阿米莉亚岛植被的全部构成特征。该断面图还显示了位于海平面以上的地下水位的大致高度。



8

（位于岛屿的西侧）是一片沼泽。这些湿地、沙丘和海滩对阿米莉亚岛的开发项目的决策非常重要。断面图说明了植物群落和地形之间的关系，并注明了地下水水位、风力强度，以及风暴带来的影响。不仅如此，其中一个剖面图还说明了建筑物应如何与原生树木的林下地形相符合（图9）。WMRT事务所的规划目的之一就是要通过保护沙丘使当地社区免受飓风的侵害。尽管地处常年受强风暴侵袭的佛罗里达，由于这里的沙丘结构被完善保护，当地社区并未受到过强风暴的剧烈破坏。

安德烈斯·杜安尼是近代一位倡导在规划中使用横断面分析图的规划师[17]。他利用断面规划法来推动新都市主义和精明增长原理的发展。他绘制了一个从城市到农村的连续图，用来组织建筑环境的各个组成部分，如建筑、场地、土地利用，以及街道等（图10）。杜安尼和艾米尼·塔尔伦认为“断面是一种基于生态原则的城市规划途径，也是一种‘寻找新发现的’重要分析工具”[17]。

克里斯·里德和他所在的Stoss景观都市主义设计事务所的同事们经常在设计中运用断面和横截面，多用来阐明绿色基础设施[18]。里德的工作涉及到设计新的、适应性的结构。这种结构需要达到一定的性能标准，但同时又应是具有良好适应性的开放性骨架。断面图能够非常有效地表达这些设计原则。例如，他们在台中中央公园的设计中利用了一个横截面来阐释水和人流的循环系统是如何结合在一起的（图11）。

断面图对于设计师而言已是一个非常熟悉的工具，数字技术进一步推动了断面的应用，所以断面图应成为一种强有力的地理设计手段。这些复杂的条状图有助于说明地表之下、之中、之上的各种过程。由此，设计师可以预见到设计方案对诸如地下水和微气候等因素带来的影响。

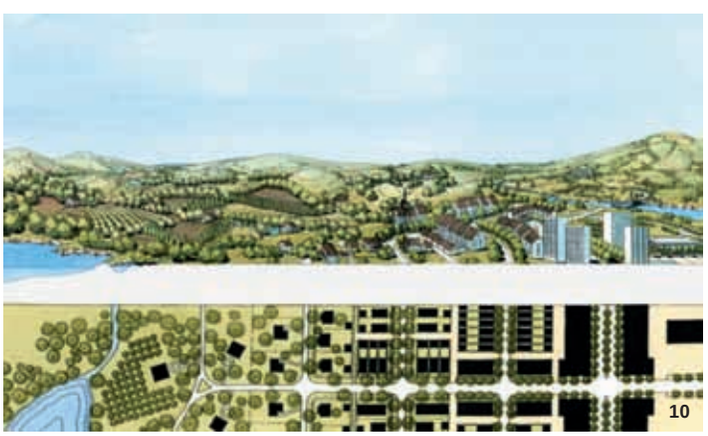
9

分析图：阐明过程

麦克哈格在WMRT事务所的项目很大程度上都是靠分析图来传达项目的设计原则。安妮·斯本当时绘制了很多分析图，多伦多市中心滨水区的项目分析图就出自她之手。斯本在位于德克萨斯州休斯敦附近的伍德兰新镇生态规划项目中也做出了不少贡献。伍德兰新镇是开发商乔治·米切尔在20世纪70年代初委托给WMRT事务所的项目。图12显示了典型的城市化发展对暴雨径流造成的影响，明确地展示出各种负面结果。在这项规划中，麦克哈格成功地说服米切尔放弃常规的雨水管理系统，改用自然排水系统。这不但降低了洪涝风险，为新社区增添绿色设施，还替米切尔节省了不少开发成本，并为他赢得了联邦政府的大力支持[5]。在阿米莉亚岛项目中，分析图被用来说明夏季（图13）和冬季（图14）时节最佳的建筑朝向。这些分析图说明了建筑与日出、正午以及日落时刻太阳位置的相对关系。由于该项目的地理位置靠近海边，图中也注明了夏季微风和冬季的盛行风方向。

当代景观设计师已非常擅长用分析图来表达设计，James Corner Field Operations景观设计事务所为纽约史坦顿岛的清溪垃圾填埋场项目所做的设

9. 阿米莉亚岛住宅景观剖面图（图片来源：参考文献[16]）© WRT
10. 安德烈斯•杜安尼绘制的从城市到农村的剖面图 © Duany Plater-Zyberk & Co.
11. 台中中央公园循环系统剖面图 © Stoss LU
9. Amelia Island Dune Housing perspective section (Source: Refs. [16]) © WRT
10. Urban to Rural transect by Andrés Duany © Duany Plater-Zyberk & Co.
11. Circulation occupation section, Taichung Gateway Park © Stoss LU



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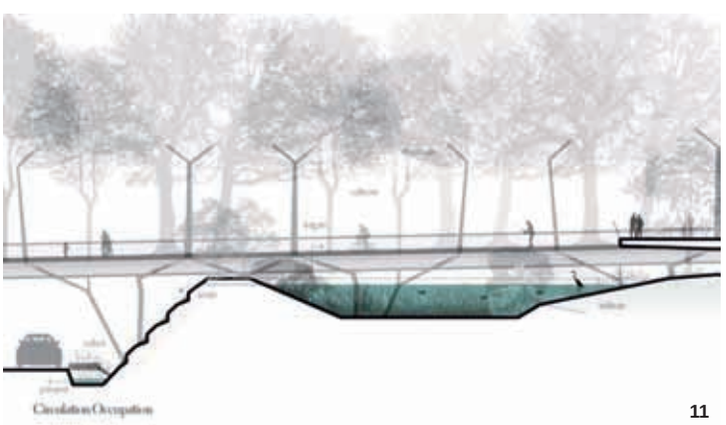

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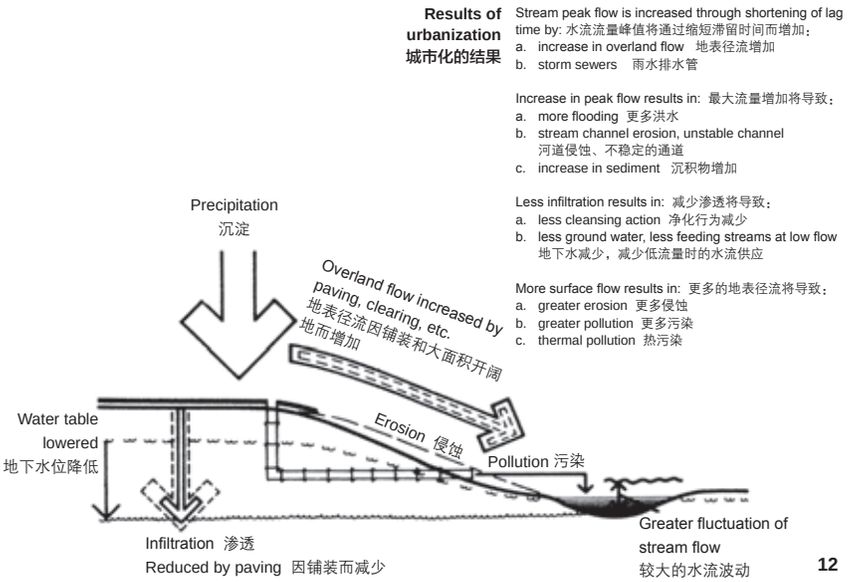
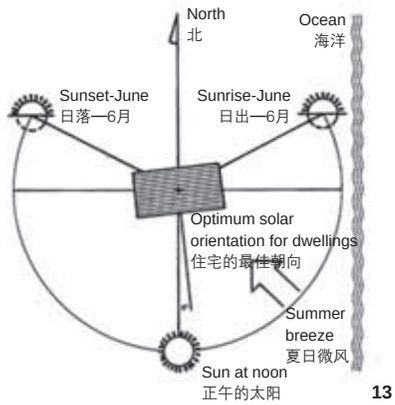
the Amelia Island resort community is one of the best built applications of McHarg's ideas. Its plan and design were led by his partner (and former student) Bill Roberts of WMRT. The Amelia Island transect illustrates the beach and dune structure of the island landscape (Fig. 8). A marsh is located on the left in the transect (the west side of the island). These wetlands, the dunes, and the beach would strongly influence the development plan. Plant communities are shown in relationship to topography. In addition, the transect shows the location of groundwater, wind intensity, and storm impacts. Furthermore, a section drawing illustrated how buildings should fit with the topography below the canopy of the native trees (Fig. 9). One of WMRT's goals was to protect the dunes in order to spare the community from hurricane damage. The dune structure has been preserved and the community has avoided the worst impacts of the strong storms that plague Florida.

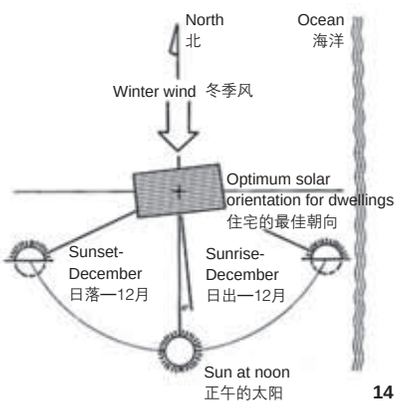
Andrés Duany is a more contemporary advocate of transect planning. Duany uses transect planning to advance New Urbanist and smart growth principles. He developed an urban to rural continuum in order to organize components of the built environment such as buildings, lots, land uses, and streets (Fig. 10). Duany and Emily Talen note that the "transect is an urban planning approach based on ecological principles, but also an important analytical tool" for discovery.

Chris Reed and his Stoss Landscape Urbanism (Stoss LU hereafter) colleagues frequently employ transects and cross-sections in their work, often to illustrate green infrastructure. Reed's work involves the search for new, adaptive structures that are resilient. Such structures are based on performance standards but also open-ended armatures designed for adaptation. Transects are helpful devices in communicating these principles. For example, in their plan for the Taichung Gateway Park in Taiwan, Stoss LU employed a section to illustrate the circulation systems of water and people (Fig. 11).

The use of transects should prove to be a compatible geodesign technique as it is a familiar tool to designers that can be enhanced through digital technology. These slivers of complexity help illustrate processes below, at, and above the surface of the earth. As a result, designers can visualize the ramifications of their designs on factors like groundwater and microclimate.



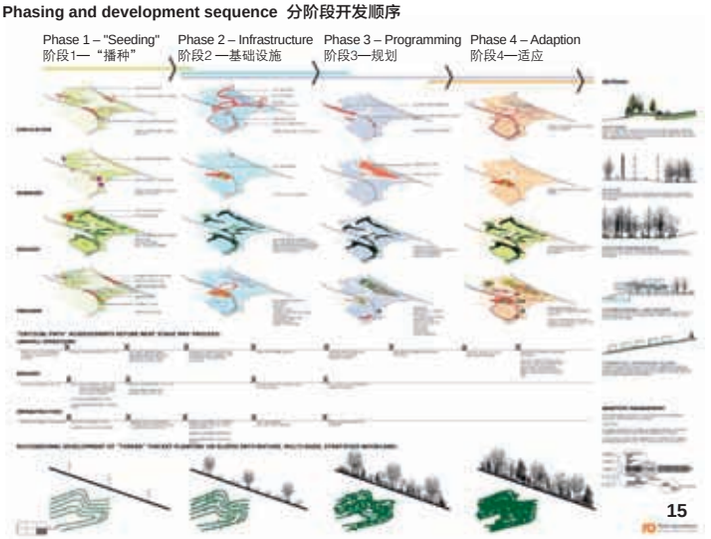




Diagrams: Illustrating Process

McHarg's WMRT plans relied strongly on diagrams to communicate key principles. Anne Sprin contributed much to these diagrams, as the central Toronto waterfront example illustrates. She also created many of the diagrams in the ecological plan for The Woodlands new town near Houston, Texas. The Woodlands plan was prepared for developer George Mitchell in the early 1970s. Figure 12, for example, illustrates the results of typical urbanization on storm runoff, clearly presenting the negative consequences. Through the plan, McHarg was able to convince Mitchell to abandon the conventional stormwater management systems and use natural drainage instead. In addition to reducing flood risks and creating green amenities for the new

12. 典型的城市化对暴雨径流的影响（图片来源：参考文献[7]）
13. 阿米莉亚岛夏季最佳朝向（图片来源：参考文献[16]）
14. 阿米莉亚岛冬季最佳朝向（图片来源：参考文献[16]）
12. Result of stormwater runoff from typical urbanization (Source: Refs. [7])
13. Optimum orientations, summer, Amelia Island (Source: Refs. [16])
14. Optimum orientations, winter, Amelia Island (Source: Refs. [16])



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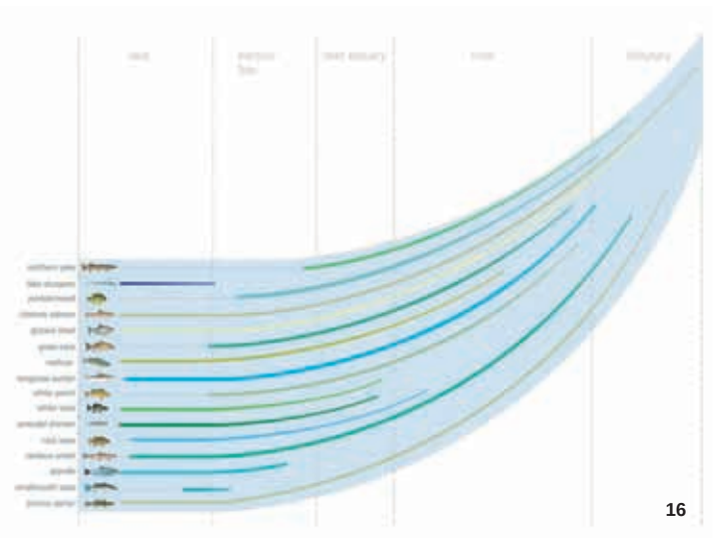


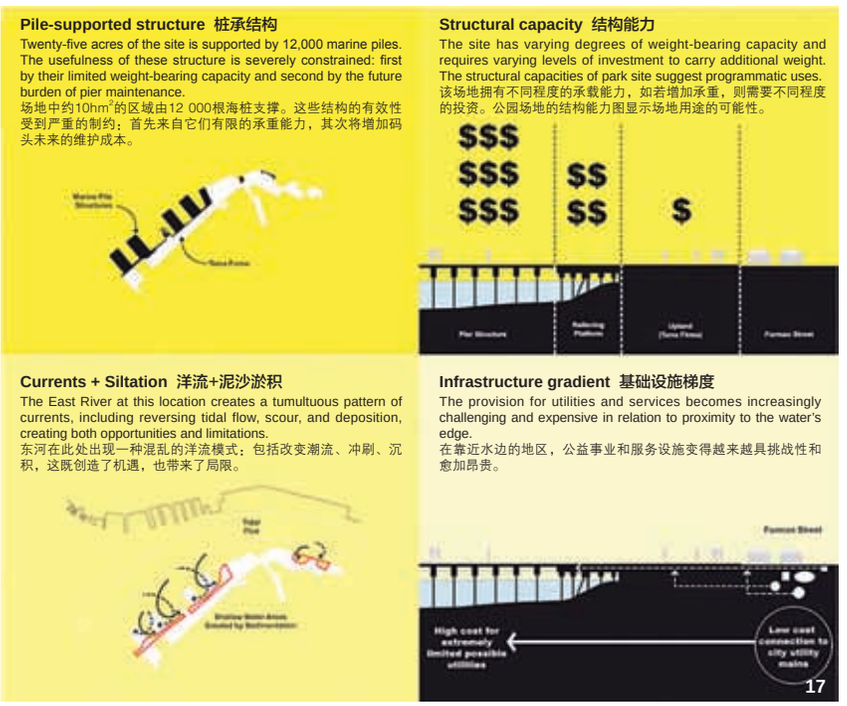
16

计就是其中一个范例。这个巨大的垃圾填埋场占地890hm^2。詹姆斯·科纳的设计是通过长期的生态修复将该污染场地改造成一个公园，命名为清溪公园。他通过分析图对这一过程进行了解释（图15）。分期开发序列图对项目中的4个阶段进行了阐释：播种阶段、基础设施阶段、引进项目阶段和适应阶段。这些阶段与场地的循环、地表条件、生态和项目相对应。设计师需要预测项目在未来将如何发展，而这些分析图恰恰表达出了时间动态的重要性。

克里斯·里德在顿河下游的竞赛作品中也使用了分析图。例如，图16对不同鱼类与5种栖息地类型（湖、海港/海湾、河口、河流和支流）之间的关系进行了阐释。里德与生态学家、规划师尼娜–玛丽·利斯特共同合作完成了该分析图[19]。

MVVA设计事务所在布鲁克林大桥公园的设计项目中也非常有效地利用了分析图。他们结合地图和分析图来"诊断"场地现状[20]（图17）。他们对场地入口、视觉联系、风、噪音和太阳朝向等因素进行了图解分析。MVVA设计事务所对场地的分析显示出了一些重要的环境要素。例如，布鲁克林河滨不同地段的承重能力各不相同，如要承担更多的荷载，就需要建造不同程度的新结构。如此则能避免在结构造价最昂贵的地段安排项目。此外，设计师们还对从布鲁克林高地眺望曼哈顿进行了视觉分析，并分析了场地中噪音最大的区域位于何处[21]。

在布鲁克林区的另一处，苏珊娜·德雷克和她的dlandstudio事务所的同事们有效地利用分析图发展了"海绵公园"的设计理念。高旺努斯运河建成于1869年，运河水质污染严重。周围的工业区和居住区都经历过衰退。海绵公园的设计理念是要创造一个能够过滤地表水，同时能够提供新的娱乐项目的开放空间系统。dlandstudio事务所通过分析图解释了开放空间和运河之间的关系。例如，图18说明了运河两岸各个市政管辖机构的分布。另一个分析图则说明了水质的改善如何有助于提高野生动物栖息地的质量（图19）。高旺努斯运河是一种复



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community, Mitchell saved money and received significant federal support for The Woodlands[5]. In the Amelia Island plan, diagrams were used to illustrate optimum building orientations during the summer (Fig. 13) and winter (Fig. 14). The diagrams illustrate the buildings in relationship to sunrise and sunset, as well as the midday sun location. Summer breeze and winter wind prevailing directions are also shown as in the location of the ocean.

Contemporary landscape architects possess especially facile skills to diagram design solutions. For example, James Corner Field Operations developed the plan for the Fresh Kills landfill in Staten Island, New York. The vast former landfill covers 2,200 acres (890 hm^2). Corner's design involves long-term restoration to transform the polluted site into a park, called Freshkills Park. He used diagrams to illustrate this process (Fig. 15). The phasing and development sequence diagram includes four phases: seeding, infrastructure, programming, and adaptation. These phases are related to circulation, surface conditions, ecology, and program. These diagrams illustrate the importance of temporal dynamics, as they are projecting how processed should work in the future.

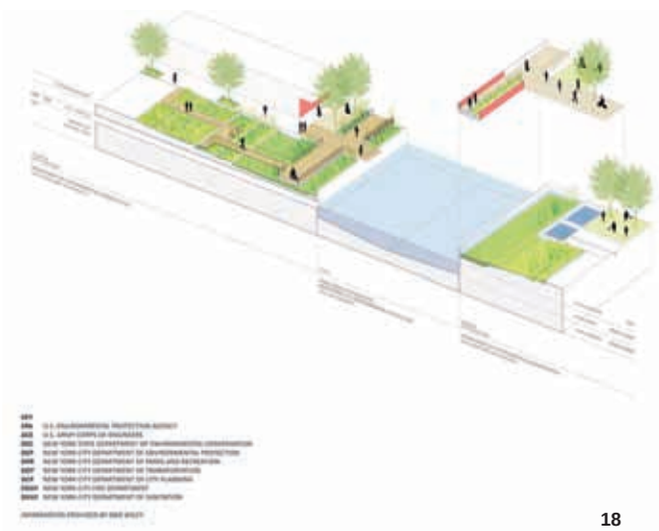
Chris Reed employed diagrams in his Lower Don River competition entry. For instance, Figure 16 illustrates the relationships between several fish species and five habitat types (lake, harbor / bay, river estuary, river, and tributary). Reed worked with ecologist-planner Nina-Marie Lister on this diagram[19].

Michael Van Valkenburgh Associates applied diagrams effectively in their Brooklyn Bridge Park design. They combined maps and diagrams to summarize their site diagnosis[20] (Fig. 17). They illustrated such factors as access, visual connections, wind, noise, and solar orientation. Michael Van Valkenburgh Associates' site diagnosis revealed several helpful factors. For instance, the Brooklyn riverfront site had varying degrees of weight-bearing capacity that required different levels of investment to carry additional weight. This helped direct uses away from the most costly areas. In addition, the designers analyzed how views of Manhattan from the Brooklyn Heights Promenade could be protected and where the highest levels of noise were on the site[21].

Elsewhere in Brooklyn, Susannah Drake and her dlandstudio colleagues have efficiently employed diagrams to advance their Sponge Park concept. Completed in 1869, the Gowanus Canal is an especially polluted water body. The surrounding industrial and residential neighborhoods have experienced decline. The Sponge Park concept creates an open space system that cleans surface water while providing new recreational opportunities. dlandstudio illustrated the concept through drawings explaining the relationship between open spaces and the canal. For instance, Figure 18 was used to diagram the various agencies which have jurisdictional authority along the canal. Another

15. 纽约清溪公园开发时序 © James Corner Field Operations
16. 多伦多顿河下游鱼类生态分析图 © Stoss LU
17. 纽约布鲁克林大桥公园场地分析及项目标准 © Michael Van Valkenburgh Associates
18. 纽约布鲁克林区海绵公园内部机构分布示意图 © dlandstudio
19. 纽约布鲁克林区海绵公园野生动物示意图 © dlandstudio

15. Freshkills Park Phasing and Development Sequence, New York. © James Corner Field Operations
16. Lower Don River Fish Ecology Diagram, Toronto. © Stoss LU
17. Site analysis and project criteria diagram for Brooklyn Bridge Park, New York. © Michael Van Valkenburgh Associates
18. Sponge Park Inter-agency Diagram, Brooklyn, New York. © dlandstudio
19. Sponge Park Wildlife Diagram, Brooklyn, New York. © dlandstudio



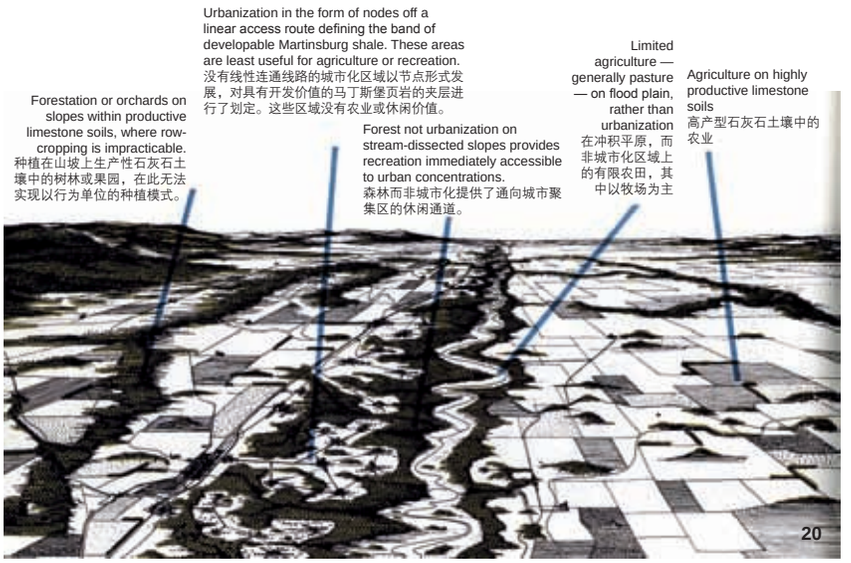
杂的政治生态——能改善人类自身以及其他物种的生活质量。

诸如布鲁克林大桥公园和海绵公园之类的项目很好地示范了分析图在地理设计中的应用。分析图可以有效地传达抽象的、复杂的社会信息，例如政治管辖权；还可以传达特定的基于地理学的信息，如栖息地类型等；分析图还可以说明设计方案将如何创造一个更美好的未来。

鸟瞰透视图：景观全景

从高处俯瞰的优势在于可将全景尽收眼底。在马里兰州巴尔的摩郊外的山谷项目以及其后的波托马克河流域区域规划等项目中，麦克哈格均使用了鸟瞰透视图[22]。麦克哈格在《设计结合自然》一书中展示了波托马克河流域的项目。他结合地图和断面图，从鸟瞰透视的视角来说明哪些地方才是最适宜开发的（图20）。波托马克项目旨在展示该地区所面临的“岌岌可危的未来”，并引导该地区“有序发展”。为了实现这一目标，麦克哈格和他的同事将波托马克河流域划分成5个自然地理区域：阿勒格尼高原、山峰和山谷、大峡谷、皮埃蒙特平原，以及沿海平原。鸟瞰透视图展现了各地区的不同地形，并指出各个区域分别更适合哪一种类型的土地开发。

从合作马萨诸塞州康涅狄格河谷的设计手册起，罗伯特·雅柔、兰德尔·阿伦特和哈利·多德森通过鸟瞰图来表现未经规划和规划开发的后果的手法就令人钦佩[23][24]。他们将现有的景观和传统开发模式下的未来景观以及经过精心设计之后的未来景观并置在一起进行对比（图21）。鸟瞰视角的三联图中整合了地图以及剖面图的信息。



地理设计可以大大加强此类预景。很多未来的场景都可以被模拟出来。这些预景可以在公共会议上根据公众的顾虑和与会者的想法迅速作出相应的调整。通过这种方式，人们可以沟通、评估这些抽象的未来的可能性，公众也能预见设计所带来的结果。

块状图、数字地形模型以及轴测图：模拟三维立体效果

麦克哈格对块状图情有独钟，尤其是在他的教学过程中，他曾大力称赞地理学家这种将地质图与横截面结合使用的方式。这些块状图是对一整块土地的三维立体表现（图22）。块状图可能被看作是景观模型。（模型，尤其是实景模型一直是景观表现技法研究中的一个重要课题。但实景模型不在本

diagram explained how improved water quality would contribute to wildlife habitat (Fig. 19). The Gowanus Canal presents a complex political ecology — but one where improvements could upgrade the lives of species in addition to ourselves.

Projects like the Brooklyn Bridge Park and Sponge Park clearly demonstrate how diagrams can be used in Geodesign. Diagrams can help communicate abstract, complex social information, such as political jurisdictions; specific geographically based information, such as habitat types; and how design can aid in producing better futures.

Bird's Eye Perspectives: Landscape Panoramas

Views from above provide sweeping panoramas of places. McHarg employed bird's eye perspectives in his Plan for the Valley for the countryside outside Baltimore, Maryland, and subsequently for the regional plan for the Potomac River Basin and other projects[22]. McHarg used the Potomac River Basin project in *Design with Nature*, where, in conjunction with maps and transects, he applied bird's eye perspective to illustrate the best places for development to occur (Fig. 20). The goal of the Potomac plan was to lay out the "imperiled future" facing the region and to guide "its orderly development". To accomplish this, McHarg and his colleagues divided the river basin into five physiographic regions: the Allegheny Plateau, the Ridge and Valley, the Great Valley, the Piedmont, and the Coastal Plain. Bird's eye perspectives illustrated the different topographies of each region, pointing out how specific land uses were better suited in certain places.

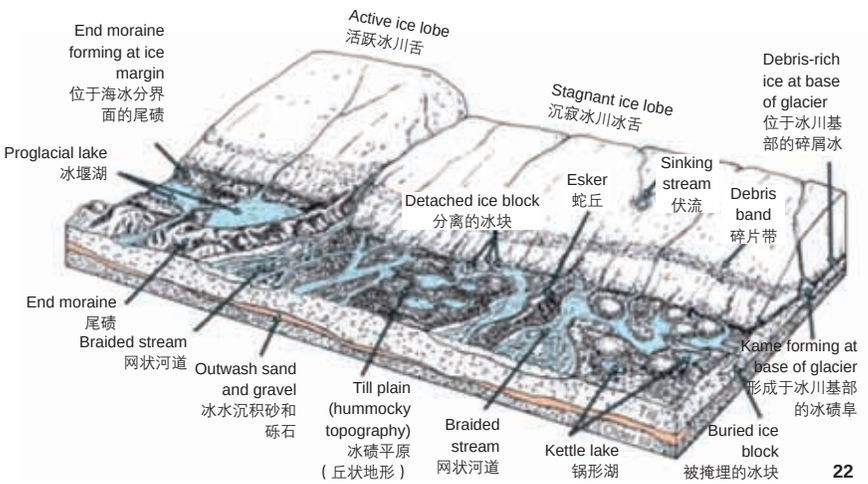
Beginning with their collaboration with a design manual for the Connecticut Valley in Massachusetts, Robert Yaro, Randall Arendt, and Harry Dodson have made impressive use of bird's eye perspectives to show the consequences of both unplanned and planned development[23][24]. Their approach is to show an existing landscape, then contrast what the place would look like with conventional development versus good design (Fig. 21). The bird's eye, triptych drawings are supported by maps and sections.

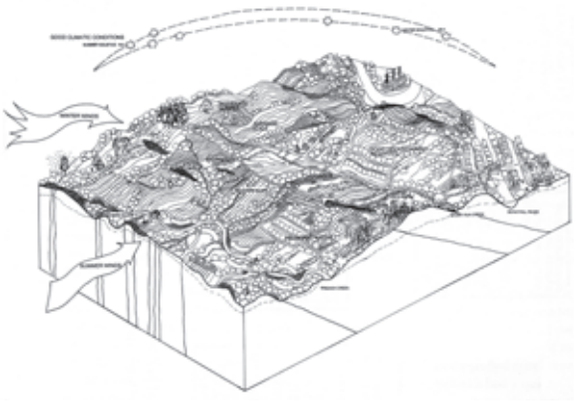
Geodesign can greatly enhance such scenarios. For instance, many future options can be displayed. Scenarios can be adjusted at public meetings to reflect citizen concerns and the ideas expressed by participants in the meetings illustrated quickly. In this way, abstract, potential futures can be communicated and assessed so that the public can understand the consequences of design.

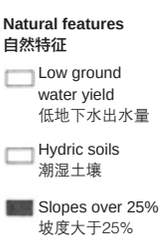
Block Diagrams, Digital Terrain Models, and Axonometric Drawings: Revealing Three Dimensions

Especially in his teaching, McHarg exhibited a special fondness for block diagrams as employed by geologists: combinations of geological maps and cross sections. They are three-dimensional representations of a chunk of the earth (Fig. 22). Block diagrams may be viewed as landscape models. (The topic of models, especially physical models, is an important topic for landscape representation. Physical models are beyond the scope of this paper. [25][26]) At Penn, McHarg forged close alliances with geologists, especially the Bob Giegengack and Art Johnson. McHarg possessed an almost Robert Smithson level of fascination with geology[27]. During McHarg's tenure as chair of Penn's Department of Landscape Architecture and Regional Planning, the construction of a block diagram was one of the early assignments in the introductory graduate studio (called LARP 501). These block diagrams reflected the interests of McHarg, Giegengack, Johnson, and the other Penn faculty. For instance, Figure 23 emphasizes the underlying rock types, as well as topography and

20. 波托马克河流域山谷（图片来源：参考文献[22]）
21. 现有景观、常规发展、良好设计三种模式并置的三联图 © Harry Dodson & Flinker
22. 大陆冰川（图片来源：参考文献[28]）© The Illinois State Geological Survey
20. The Great Valley of the Potomac (Source: Refs. [22])
21. Triptych of existing landscape, conventional development, good design. © Harry Dodson & Flinker
22. Continental Glacier (Source: Refs. [28]) © The Illinois State Geological Survey







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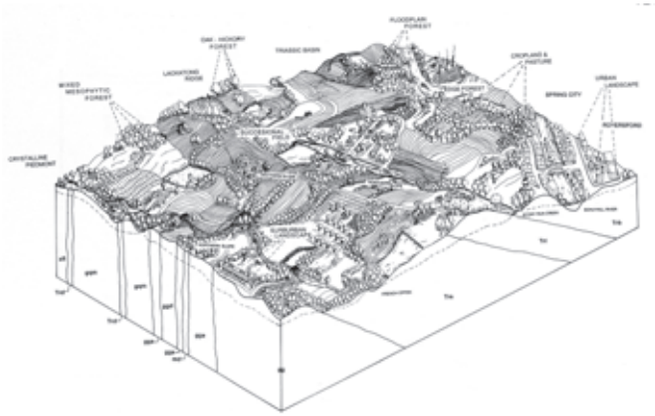

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文所讨论的范围之内。[25][26]）在宾夕法尼亚大学，麦克哈格与很多地质学家紧密地协作，尤其是鲍勃·杰根盖克和阿特·约翰逊。麦克哈格对地理的迷恋程度和罗伯特·史密森不相上下[27]。在麦克哈格担任宾夕法尼亚大学景观和区域规划系系主任期间，块状图的表现技法是研究生院的入门设计课程（课程代码LARP501）。这些块状图反映了麦克哈格、杰根盖克、约翰逊以及其他宾夕法尼亚大学教授对块状图的兴趣。例如，图23侧重于表现地下岩石的类型、地形和植被。另一个版本的块状图（图24）则侧重于表现地下水、气候、土壤以及坡度。总体而言，这些块状图都强调出不同景观类型中的关系和格局。

数字高程模型（DEMs）和块状图类似，但更侧重于表现地表地形。数字高程模型为地形高程提供了数字化的三维表现。美国地质调查局提供了很多景观数字高程模型。麦克哈格在他后期（离开WMRT事务所后）的实践项目中应用了数字高程模型。他发现这些模型能够非常有效地表达地表环境。如今DEMs已被很多景观设计师和建筑师所采用，因此DEMs也是一种可以被很容易地应用于地理设计中的表现方法。

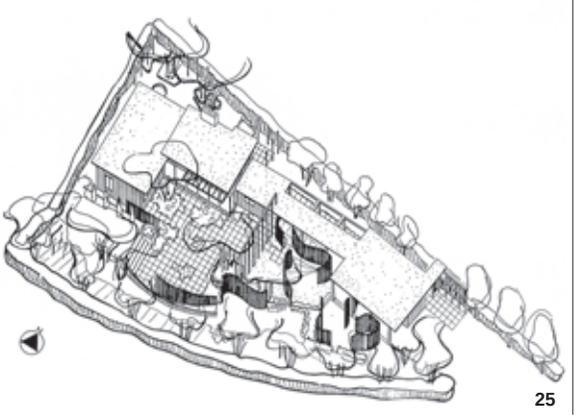
块状图和轴测图非常类似。前者强调表现地表以下的结构，后者总体来说更侧重于表达地表以上的环境。多罗西亚轴·安贝认为轴测图在推动20世纪30年代以后的现代主义景观设计的发展中尤为重要。例如，加勒特·埃克博经常使用轴测图来表现艺术和建筑作品中的各种理念（图25）。

MVVA设计事务所非常擅长在项目中使用轴测图[20]。例如在位于华盛顿特区的美国景观设计师协会的屋顶绿化设计项目中，他们就利用了轴测图来展示该设计方案的各个组成部分（图26）。与此同时，科学家们也已经通过电脑渲染技术改进了块状图的表达效果。例如，美国国家海洋和大气管理局（NOAA）为说明北极原油泄漏事故的风险和危害，通过块状图制作了一个概念模型。该模型显示了原油泄漏对湿地、沿海下游苔原，以及内湖、远洋区、海底生物、浮冰栖息地和食物链顶端的捕食者造成的影响（图27）。

通过地理设计可以尝试各种不同的将块状图和轴测图综合起来的表现技法。这些尝试有助于说明地表和地下结构的关系，也有助于设计出与地质结构紧密联系，以及与地下水系统相符合的方案。

绘画：灵活而全面的表现方式

绘画是设计的一种基本表达方式。像其他景观设计师一样，麦克哈格利用图画来表达他的设计想法。科林·富兰克林是WMRT事务所在20世纪70年代的主绘图师。例如在20世纪70年代中期，麦克哈格和他的WMRT团队被委任在伊朗设计了一个名



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23. 1993年LARP501课程研讨会中所绘制的植被与环境图。© Kim Douglas, Ken Keltai, Lisa Miles, Jeanne Thompson, and Rob Staudt, Department of Landscape Architecture and Regional Planning, University of Pennsylvania
24. 1993年LARP501课程研讨会中所绘制的自然特征与栖居模式图。© Kim Douglas, Ken Keltai, Lisa Miles, Jeanne Thompson, and Rob Staudt, Department of Landscape Architecture and Regional Planning, University of Pennsylvania
25. 加勒特•埃克博1937年绘制的位于旧金山城市中的小型花园。© Marc Treib

23. Vegetation in context, from the fall 1993 LARP 501 studio. © Kim Douglas, Ken Keltai, Lisa Miles, Jeanne Thompson, and Rob Staudt, Department of Landscape Architecture and Regional Planning, University of Pennsylvania
24. Natural features and settlement patterns, from the fall 1993 LARP 501 studio. © Kim Douglas, Ken Keltai, Lisa Miles, Jeanne Thompson, and Rob Staudt, Department of Landscape Architecture and Regional Planning, University of Pennsylvania
25. Small gardens in the city, San Francisco by Garrett Eckbo,1937. © Marc Treib

vegetation. In another version (Fig. 24), groundwater, climate, soils, and slopes are emphasized. Overall, these block diagrams clearly highlight landscape relationships and patterns.

Digital elevation models (DEMs) are similar to block diagrams, but more focused on the surface terrain. DEMs provide digital, three-dimensional representations of the terrain's elevations. In the United States, DEMs of many landscapes are available from the U.S. Geological Survey. Late in his practice (after leaving WMRT), McHarg applied DEMs to his projects. He found them to be helpful in visualizing surface conditions. Many landscape architects and architects use DEMs, too, so it is a tool that can be easily advanced through geodesign.

Block diagrams are similar to axonometric drawings. The former emphasize relationships of things below the surface of the earth, the latter generally focus on the surface upwards. Dorothée Imbert[29] observed that axonometric drawings were especially important in advancing a modernist approach to landscape architecture beginning in the 1930s. For example, Garrett Eckbo frequently utilized axonometric drawings with clear references to broader ideas in art and architecture (Fig. 25).

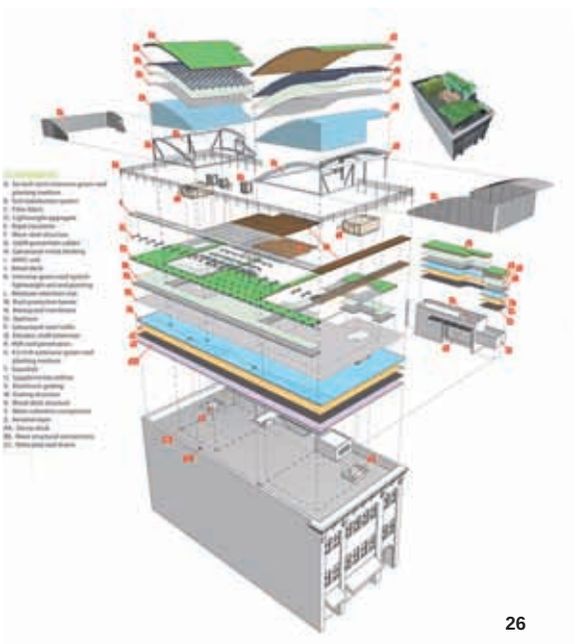
Michael Van Valkenburgh Associates is one firm that effectively employs axonometric drawings[20]. For instance, in their design of the American Society of Landscape Architects' green roof in Washington, D.C., an axonometric drawing displays the various components of the project (Fig. 26). Meanwhile, scientists have advanced block diagrams through computer rendering techniques. For instance, the National Oceanic and Atmospheric Administration (NOAA) prepared a block diagram which provides a conceptual model of Arctic oil spill exposures and injuries. The model displays impacts on wetlands, low coastal tundra, and lagoons; the pelagic zone; the benthos; ice habitat; and top predators (Fig. 27).

Possible syntheses between block diagram and axonometric drawing techniques could be explored through geodesign. Such exploration could help illuminate relationships between surface and ground. This could help enable design and plans that connect to geologic structure and are sensitive to groundwater systems.

Drawings: Sketch Up, Down, and All Around

Drawing is a fundamental skill for design. Like other landscape architects, McHarg relied much on drawings to communicate his ideas. During the 1970s, a chief WMRT illustrator was Colin Franklin. For instance, in the mid-1970s McHarg and his WMRT team were engaged in designing a large zoological park in Iran called Pardisan. McHarg inverted his conventional

26. 位于华盛顿的美国景观设计师协会的绿色屋顶项目。© Michael Van Valkenburgh Associates
27. 由NOAA的凯特•斯维尼绘制的北极原油泄露事故的风险与危害概念模型 © Kate Sweeney
26. American Society of Landscape Architects' Green Roof, Washington, D.C. © Michael Van Valkenburgh Associates
27. Conceptual Model of Arctic Oil Exposures and Injuries, drawn by Kate Sweeney, NOAA © Kate Sweeney



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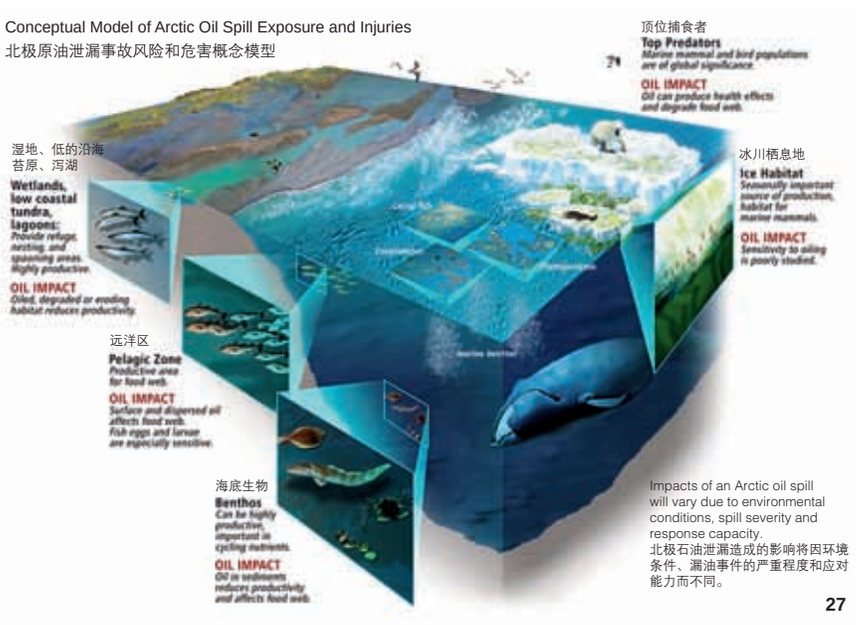

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为帕蒂仙的大型动物园。这次设计，麦克哈格颠倒了他过往进行适应性分析的步骤。通常WMRT事务所都是从研究场地的现有景观开始着手，然后再确定各类土地的开发潜力和制约因素，而这次他们从对动物园每一块物种栖息地所需的环境条件的研究入手。该过程后来被命名为“沉浸式景观”，它彻底地改变了动物园的常规设计手法。爱德华·博耶和科林·富兰克林为帕蒂仙项目绘制的插图展示了动物将如何栖居在这些人为设计的栖息地之中（图28），以及游客与动物之间的互动关系（图29）。

在尼日利亚的新首都阿布贾的城市规划项目中，麦克哈格当时的合伙人汤姆·托德绘制了许多草图[31]。该项目利用了麦克哈格式的生态清单和分析列表来确定各种土地用途。阿布贾有一座非常著名的山，名为阿苏岩，阿布贾项目将阿苏岩定为新城区的主要视觉焦点之一。从托德绘制的草图可以看出，主要建筑物——如国会大厦——都与阿苏岩的轮廓线相一致（图30）。

绘画表达仍是景观设计教育和实践的主流。劳伦斯·欧林是一位技巧高超的绘者，一位很棒的绘画老师，同时他也非常擅长解说自己的图纸。他指出，“绘画过程是一种边绘制边思考的过程，或者说是一种通过动手绘制来进行思考的过程”[33]。如今的设计图纸通常是由计算机软件绘制，也包括手绘。正如欧林所指出的，“不论来自于哪个国家，几乎所有的景观专业毕业生都精通CAD、Photoshop、Illustrator、Form* Z、犀牛，还有无数其他的计算机制图软件”[34]。最后的成图往往是综合使用多种软件制作而成的拼贴图。詹姆斯·科纳是最早改良拼贴图的表现技法，并用拼贴图来解释景观设计的设计师之一[35]。

MVVA设计事务所的沃勒溪设计大赛获奖设计图纸的水平也让人惊叹（图31）。该项目利用地下隧道收集并分流雨水，以降低洪涝风险。范·瓦肯伯格和他的同事们提出利用一系列的公园将沃勒溪与其周围环境连接起来。绘制的效果图帮助他们说明了新公园将如何展示当地的地质结构，并利用本地植被。

手绘图和电脑制图可以通过金美京所称的“混合制图”[36]结合起来。她认为这样的图“模糊了数字与模拟体系之间的界限”[36]。蒙太奇是一种将电脑绘图或手绘图与照片混合叠加起来所产生的合成体。地理设计想要取得进展就必须和各形式的图纸表达接轨，并将它们与现实联系起来。设计师绘制出他们所见与所想的场景。计算机技术提高了绘图表达。地理设计能够进一步补充地理联系的方面。

摄影（视频）：静止的（和流动的）的图像

麦克哈格在WMRT的方案报告中采用了很多黑白照片。这些照片通常是一些遭受城市发展压力的风景优美的田园景观。例如，WMRT事务所为威尔明顿、多佛以及佛蒙特做的生态规划研究中所展示的谷仓、溪流、道路，以及佛蒙特乡间的木材堆的照片[37]。这份报告以及麦克哈格对佛蒙特立法机关充满激情的声明对新的国土利用规划法案的出台产生了强烈影响。20世纪70年代初期WMRT事务所的


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suitability process for the park. Instead of studying the landscape to reveal opportunities and constraints for various land uses, the WMRT-led team began by studying what environmental conditions were necessary for each species' habitat to be included in the zoo. This process, subsequently named "landscape immersion", revolutionized zoo design. Edward Boyer's and Colin Franklin's illustrations for Pardisan showed how the animals would inhabit these designed habitats (Fig. 28) as well as human-animal interactions (Fig. 29).

For the plan for Nigeria's new capital city, Abuja, McHarg's then partner, Tom Todd, did many of the drawings[31]. A McHargian ecological inventory and analysis was used to help structure land uses. For Abuja, a prominent mountain, Aso Rock, was used as a major focal point for the new city. Todd's drawings illustrated how major buildings, such as the Parliament, would be aligned with Aso Rock (Fig. 30).

Drawings remain a mainstay of landscape architecture education and practice. Laurie Olin is a highly skilled illustrator, a wonderful drawing teacher, and an articulate spokesperson for drawing[32]. He notes, "drawing is a way of thinking while acting, or thinking through acting"[33]. Nowadays, drawings are commonly made via computer technology as well as by hand. As Olin observed, "nearly every student coming out of undergraduate and graduate landscape architecture programs around the world is conversant with CAD (computer-aided drafting), Photoshop, Illustrator, Form*Z, Rhino, and a myriad of other computer programs"[34]. Often, the resulting drawings are actually collages. The use of collage drawings to illustrate landscapes was initially advanced by James Corner[35].

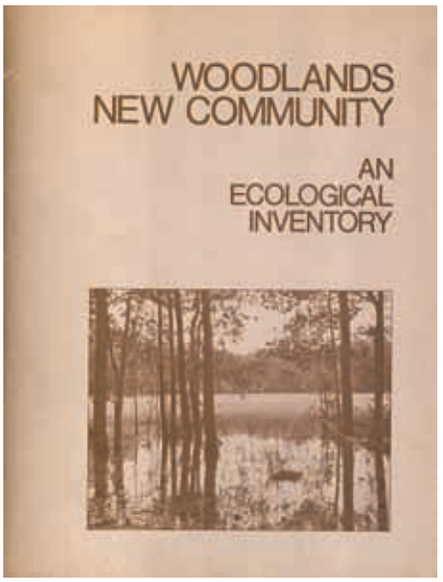
In their winning entry for the Waller Creek Design Competition, Michael Van Valkenburgh produced a series of stunning drawings (Fig. 31). The project was made possible as a result of an underground tunnel that captures and diverts stormwater, reducing flood risk. Van Valkenburgh and his colleagues proposed a series of parks to help the creek corridor make connections to its surroundings. Their drawings helped communicate how the new parks would reveal geologic structure and make use of native flora.

Hand-drawn and digital images can be combined through what Mikyoung Kim calls "hybrid drawings"[36]. She observes such drawings "blur the boundaries between digital and analog systems". Photomontage is a type of hybrid drawing, with images, digital or hand-drawn, overlaid to produce a synthesis. Geodesign must embrace drawing in all forms and connect them to the earth in order to advance. Designers draw both what they see and what they imagine. Computer technology has expanded the possibilities for drawing. Geodesign can contribute the added dimension of strengthening geographical connections.

Photography (and Video): Frozen (and Fluid) Imagery

McHarg's WMRT reports included many black and white photographs. Often, these were rather pretty, bucolic images of rural landscapes under threat of development. For example, in the ecological planning study that WMRT completed for Wilmington and Dover, Vermont there were several images of barns, streams, roads, and stacks of wood in the Vermont countryside[37]. This report as well as McHarg's passionate testimony to the Vermont legislature would strongly influence the state's innovative land-use planning legislation. Anne Spirn took many of the photographs in the early 1970s WMRT plans and reports, such as those on the covers of the various documents produced for *The Woodlands* (Fig. 32). WMRT also used aerial photography in its plans, such as the image in Figure 33 of Amelia Island.

28. 由WMRT事务所的爱德华•博耶绘制的帕蒂仙环境公园中的伊朗高原盆地展示区（图片来源：参考文献[30]）
29. 由WMRT事务所的科林•富兰克林绘制的大沙沙漠展示区（图片来源：参考文献[30]）
30. 由汤姆•托德绘制的阿苏岩与新国会大厦之间的关系（图片来源：参考文献[33]）
31. 德克萨斯州奥斯汀市沃勒溪项目 © Michael Van Valkenburgh Associates
28. Plateau Basin of Iran Exhibit, Pardisan Environmental Park, drawn by Edward Boyer, WMRT. (Source: Refs. [30])
29. Great Sandy Desert Exhibit, Pardisan Environmental Park, Tehran, drawn by Colin Franklin, WMRT. (Source: Refs. [30])
30. Aso Rock and New Nigerian Parliament Building, drawn by Tom Todd (Source: Refs. [33])
31. Waller Creek, Austin, Texas. © Michael Van Valkenburgh Associates



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设计项目和方案报告中有很多照片都出自安妮·斯本之手，其中包括伍德兰德项目文本封面上的诸多照片（图32）。WMRT在一些项目规划中还使用过航拍图，如图33所示的阿米莉亚岛。该图展示了阿米莉亚岛的轮廓，以及连接岛屿和内陆的桥梁。图中同样重点展示的还有项目规划中作用至关重大的海滩和湿地。

WMRT的前规划师安妮·斯本曾分别在哈佛大学和宾夕法尼亚大学执教。现为麻省理工大学教授的斯本大力推崇在景观设计中使用摄影照片③[38]。斯本在她最近出版的著作中指出，“视觉是人类了解世界的途径之一，摄影是一种思考问题的媒介，也是探索发现的一种模式”[39]。斯本观察到“视觉思维是一门探索模式的艺术”。例如，在一张拍摄于1989年的澳大利亚悉尼港口费尔莱特游泳池的照片中，她将周围的大环境留在镜头之外，而重点捕捉了游泳池和大海之间的交界面（图34）。

马克·克莱特是一名重要的当代摄影师，他对景观有很深刻的认识。克莱特在获得地质学学位后，曾在美国地质调查局工作过一段时间，随后他又继续深造，学习摄影。克莱特现在是亚利桑那州立大学摄影系的教授，他的摄影作品充分展示了他对地质时间的理解。克莱特使用的技法之一就是通过重新拍摄美国西部景观来说明人类文明的变化。举例来说，他曾与布赖恩·沃尔夫合作拍摄了加利福尼亚州腾亚湖同一段湖岸在4个不同时期4个不同视角的照片（图35）。卡米洛·何塞·维加拉也有着类似的做法。安妮·斯本指出卡米洛在20世纪70年代、80年代和90年代分别拍摄的新泽西州卡姆登城区的照片展示出卡姆登所经历的变化[39]。

俄勒冈大学教授肯尼思·贺普汉则认为摄像“是一种景观表现手法”[41]。他认为电影都是拍摄于特定的地理场所之中，在约翰·福特执导的反映西部的影片以及伍迪·艾伦执导的反映纽约的影片中，景观非常有效地定义了电影的特色和个性。和自然景观一样，电影是动态的，伴随着音效和色彩的不断变化。

布鲁克林数码制片厂曾被委托为纽约市高线公园的设计制作一个筹款视频。“高线之友”组织利用这段视频向观众解释了James Corner Field Operations景观设计事务所和Diller Scofidio+Renfro工作室的设计。布鲁克林数码制片厂为高线项目的前两期制作了一段4分钟的漫游动画，该动画被证实是高线项目募资宣传中最有效的途径④。动画虽然和电影或视频在格式上尚有相似之处，但其与摄影确是截然不同的——完全动态的——由于动画是移动的，所以动画图像是非常有效的媒体模式，它带领我们飞越空间，甚至穿越时间。动画通过动态模式为观众展现出变化过程，能够很好地阐释设计师的构想，而无需多余的解释。

有了电脑增效功能，从电脑模拟到数码摄影，

③
更多信息可参见安妮·斯本的个人网站www.annewhistonsprin.com以及她在2008年出版的有关多罗西亚·兰格的著作。

④
更多信息可参见www.brooklynfoundry.com/our-work/the-high-line。

33

34

The image shows the shape of the island, as well as the bridge connecting it to the mainland. The beaches and wetlands that played a strong role in the plan are evident, as well.

Former WMRT planner and professor at Harvard and Penn, Anne Spirn, now at MIT, is a strong advocate of photography in landscape architecture③[38]. Spirn's most recent book addresses "seeing as a way of knowing and photography as a medium of thought and a mode of discovery."[39] Spirn observes that, "visual thinking is an art of pattern-seeking". For instance, in a 1989 photograph of Fairlight Pool in Sydney Harbor, Australia, she focuses on the interface between the pool and the sea, editing out the larger context (Fig. 34).

Mark Klett is an important contemporary photographer with a profound understanding of landscapes. After earning a degree in geology, he worked for the U.S. Geological Survey before studying photography. A photography professor at Arizona State University, Klett brings an understanding of geological time to his work. One technique applied by Klett is re-photographing Western American landscapes to illustrate cultural change over time. For instance, working with Bryan Wolfe, he produced four views from four times of one shoreline along Lake Tenaya in California (Fig. 35). In a similar vein, Anne Spirn points to the rephotographic work of Camilo José Vergara who has focused on changes to urban Camden, New Jersey, in the 1970s, 1980s, and 1990s[39].

University of Oregon Professor Kenneth Helphand has explored film "as a medium of landscape representation"[41]. He argues that films are geographically situated. In the Westerns by directors like John Ford, as well as the New York City films by Woody Allen, landscapes play an especially strong role in defining character and identity. Like landscapes, films move and are accompanied by sounds and colors.

The Brooklyn Digital Foundry was commissioned to produce a fundraising video of the design of the High Line. The video helped the Friends of the High Line to explain James Corner Field Operations and Diller Scofidio+Renfro's design. The Brooklyn Digital Foundry produced a four-minute, fly-through animation of the first two phases of the project, which proved to be most effective in helping to generate support for the project④. Although they may appear similar in film or video formats, animation is something entirely different from photography — literally animated — and animated images are powerful because they move, they take us through the space and even through time periods. Animations can capture processes in a dynamic way that eases up on the need for words to explain what is envisioned.

From analog to digital photography, from film to video with computer enhancements and manipulations, much can be contributed to designs that are geographically based. Certainly, the photography of Sprin and Klett possesses strength through its geological and ecological grounding. The Brooklyn Digital Foundry's video visualization of the High Line is a high-tech rendition of the design but with explicit geographic references.

Moving Forward, Seeking Patterns

Human environments are complex to understand and to represent. Geodesign presents an opportunity for landscape architects, architects, and planners to better understand and represent the complexity of human places. To realize this potential, it is useful to advance the range of representation techniques that design employ. The tools used by Ian McHarg and his collaborators suggest a starting point.

Two persistent criticisms of McHarg are that he was a positivist and his method was deterministic[42]. McHarg, in fact, called his approach "ecological determinism". His critics use his overlay method to reinforce their view. As this paper illustrates, McHarg employed many other techniques besides overlay mapping, though he was certainly an advocate for GIS and map overlays. Furthermore, he purposely used "ecological" rather than "environmental" determinism to emphasize complex, dynamic interactions instead of merely surroundings. Like Paul Sears, McHarg viewed ecology as a "subversive science"[43]. That is, natural and cultural systems are inherently disruptive and the study of such systems inevitably leads to results that can disrupt the status quo.

For geodesign to advance, a variety of representation

③ Please see her website: www.annewhistonspirn.com, as well as her 2008 book about Dorothea Lange.

④ Please visit www.brooklynfoundry.com/our-work/the-high-line.

32. 《伍德兰德生态清单》封面（图片来源：参考文献[7]）© WRT
33. 阿米莉亚岛航拍图（图片来源：参考文献[16]）© WRT
34. 澳大利亚悉尼港口费尔莱特游泳池 © Anne Spirn
32. Cover of *The Woodlands Ecological Inventory* (Source: Refs. [7]) © WRT
33. Aerial photograph of Amelia Island (Source: Refs. [16]) © WRT
34. Fairlight Pool, Sydney Harbor, Australia. © Anne Spirn

从电影到视频，这些基于地理学的表达技法都能有助于设计。当然，斯本和克莱特的摄影作品的优势源自作品背后强大的地质认识和生态认识的支持。布鲁克林数码制片厂的视频将高线公园的设计可视化，是一项高科技的设计，但也有着明确的地理学上的参考。

进步，寻找新的模式

对于人文环境的理解和表达都非常复杂。地理设计为景观设计师、建筑师和规划师提供了一个很好的机会，它能够帮助设计师更好地理解和表达这些人类场所的复杂性。要想发掘地理设计的潜力，就需要丰富设计的表现技法。伊恩·麦克哈格和他的同事们所使用的表现方法就是一个很好的出发点。

一直以来，对麦克哈格的评论主要集中于两点：他是一个实证主义者，他所采用的方法是决定性的[42]。实际上麦克哈格称自己的设计手法为“生态决定论”。这些评论人士通过分析麦克哈格的叠加技法来论证他们的观点。正如本文所示，尽管麦克哈格热衷于GIS技术和地图叠加技法，他仍然使用了地图叠加之外的很多其他表现方法。而且他特意采用“生态”而非“环境”决定论，以此来强调复杂的、动态的相互作用，而不仅仅是指周围环境这么简单。和保罗·西尔斯一样，麦克哈格也认为生态学是一个“颠覆性的科学”[43]。他认为自然系统和人文系统本质上就是混乱的，对这些系统的研究将不可避免地导向打破现状。

地理设计想要取得进步，就需要使用各种表现技法来展现景观的复杂性。只有积累了一定的生态素养，我们才能科学地应用这些表现技法。这就需要彻底改变我们看待环境以及表达环境的方式。我们需要超越（很多人所钟爱的）英式田园美学和奥姆斯特德式的景观设计；超越现代主义的简单几何图形（尽管这是一个很受追捧的社会性议题，但主要是受建筑师青睐，其他大部分人并不那么热衷）；超越后现代主义，用计算机生成的流线型建筑（由于形式灵活而受到许多设计学院的喜爱，但仍不被大多数其他人接受）。我们必须摒弃过去认为生态学是实证主义，是绝对的观念；而应将生态学看作一种设计的开放力量，在这个过程中，开始重视生态，包括其中的人、建筑，以及混乱的、不断在新陈代谢的生物物理过程，并意识到这些生物物理过程并不总是绿色的，它也包括其他颜色，如灰色和棕色。

地理设计要成为一个行之有效的表现平台，必须能够使用各种表现方法来展现生态的复杂性。地理设计要成为一个改革的表现平台，就必须能够使用各类表现方法来整合各种观点和结论。**LAF**

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35. 马克•克莱特与布赖恩•沃尔夫合作拍摄的加利福尼亚州腾亚湖 © Mark Klett

35. Lake Tenaya, California, by Mark Klett and Bryan Wolfe © Mark Klett

techniques are necessary to represent the complexity of landscapes. Ecological literacy is necessary to apply those techniques with knowledge. This will necessitate a fundamental shift in how we view and represent our surroundings. We need to move beyond the pastoral aesthetic of English gardens and the Olmsteds (which many are quite fond of), beyond the clean geometries of modernism (so endeared by architects and less so by most others in spite of an initially admirable social agenda), beyond the postmodern, computer-enabled blobs (favored by many in the design academy because of their formal dexterity, but they remain unfathomable to most everyone else). We need to challenge the perspective that ecology is positivist and deterministic and embrace it as a liberating force for design and, in the process, begin to appreciate the ecological which includes people, buildings, and the biophysical process that is messy, generative, and full of decay, which is green but full of other colors too, including the greys and the browns.

To be effective as a representational platform, geodesign must be able to capture this complexity through a variety of techniques. To be transformative as a representational platform, geodesign must help advance the integration of ideas and conclusions across types of representation. **LAF**

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