Photo: Francisco Lara

Part 2
Improving Greenfield Development

Part 2: Improving Greenfield Development

It will be difficult for densification policies alone to supply an adequate number of housing units to meet the growing demand for housing in urban areas in most of the world's metropolitan areas. Data on Mexican territorial reserves, analyzed in Appendix F, shows that in many states little land is available in existing urban areas so at least some of the projected new housing demand will need to be met by development on new land (U3). Data on building permits issued in three metropolitan areas in the United States demonstrated that "even in metropolitan areas with successful records of infill development, infill as a percentage of total area growth remains a minor portion of total growth" (Heid 2004, 3). These findings suggest that cities will need to consider alternative practices of sustainable development.

While the previous chapter made the case for densification and for ending urban sprawl, it did not mean to suggest that this is the only type of urban growth that should occur. Greenfield development, or development on previously undeveloped sites, must be an equally important aspect of city-building in the 21st century if urban areas are to properly and adequately house new generations of city-dwellers.

This does not mean, however, that urban expansion should continue as it has in the past. As Table 2.1 shows, there are significant differences between traditional urban sprawl and sustainable greenfield development. Table 2.1 compares the characteristics of sprawl outlined in Part 1 of the report with the features of more sustainable greenfield development. This often requires significant changes to the way urban expansion is planned, permitted, and developed.

Broadly, strategies that governments have used to improve greenfield development can be divided into two groups. First are strategies that ensure public infrastructure, services, and amenities are provided in an adequate and fiscally responsible manner. Second are strategies that ensure new developments, planned communities, and subdivisions built on greenfields are designed in a way to promote economic, environmental, and social sustainability.

Table 2.1 Differences between urban sprawl and sustainable greenfield development

Characteristics of Urban Sprawl	Characteristics of Sustainable Greenfield Development
• Low residential density • Unlimited outward extension of new development • Spatial segregation of different types of land uses through regulations • Leapfrog development (or development that leaps out onto new land, not connected to existing urban areas) • No centralized ownership of land or planning of land development • All transportation dominated by privately owned motor vehicles • Fragmentation of governance authority of land uses among many local governments • Great variation in fiscal capacity of local governments • Widespread commercial strip development along major roadways • Major reliance on filtering process to provide housing for low-income households. Filtering occurs when wealthier people move into new homes and low-income people move into the older and lower-quality houses left behind.	• Higher overall residential density with a variety of housing types, not just single-family houses • Outward extension of development is limited by numerous factors, including municipalities' ability to provide infrastructure and services, open space preservation, and environmental protection considerations, etc. • Land use types are mixed and integrated, with town centers, office parks, and other employment and commercial centers easily accessible from residential areas • Contiguous urban expansion • Land development happens in accordance to well-defined plans or in cooperation among landowners • Infrastructure and development supportive of many modes of transportation are created, including bus, rapid transit, bicycles, and pedestrians • Governance of land use is coordinated among all municipalities in a region • Commercial development is concentrated in nodes or town centers, serviced by a multi-modal transport network, not just roads for automobiles • Affordable housing is provided through a combination of an increased supply of housing, a variety of housing types, government requirements (like inclusionary zoning) and government programs, among others

Adapted from Neuman (2005, 15), citing Burchell et al. (1998).

2.1 Fostering Well-Serviced Additions

Basic services such as roads, sewer, water, schools, parks, shops, and public transportation are key in promoting quality of life. Also important is having housing near jobs.
Photo: Collection of Ann Forsyth

Fostering Well-Serviced Additions

What It Is

- **Infrastructure-rich additions link land use decisions to capital planning.**
- **Such developments allow governments to phase expansion of urban areas to match their ability to pay for and provide services and infrastructure.**

For municipalities responsible for providing infrastructure and services, extensive, low-density growth represents a long-term financial challenge as those residents will eventually demand urban levels of service. Providing adequate services and infrastructure in sprawling areas is not only costly but also inefficient, as fewer people are served per amount of money spent. As a result, municipalities must divert most of their revenue towards infrastructure investments, take on substantial amounts of debt to fund investments, and/or not provide adequate services to some neighborhoods. None of these choices are desirable. Stopping all urban growth is also not desirable. In response to this problem, municipalities have devised ways to manage growth,

timing urban expansion with the adequate and fiscally responsible provision of infrastructure and services.

The following are strategies governments can implement in order to ensure urban expansion is properly and responsibly serviced with infrastructure and other public services:

- Concurrency requirements
- Exactions and impact fees
- Master-planned communities

2.1.1 Concurrency Requirements

What it is: Concurrency requirements are legal requirements to link new development to the provision of public services and infrastructure, ensuring that development does not outpace the ability of municipalities to provide adequate services (Bucher, Willis, and Ratliff Corp. 2006, 1-2).

How it works: While the specifics of concurrency programs differ, in general, they all require municipalities to first adopt minimum level of service (LOS) standards for various types of infrastructure (e.g. roads, water, sewer, electricity) and services (e.g. schools, police, fire, health, recreation). New developments can then be evaluated based on their impacts on the LOS. If the additional people who are projected to live a new development will cause the LOS of the infrastructure and services to drop below an acceptable level, that development will not be allowed until either government builds additional capacity into the system or the developer provides it. Such requirements also give government a greater level of influence as to where new development

In the housing development of Piedra de Agua in Mérida, Yucatán, the developer built branch offices of municipal water and sewage services within the complex. The intention was to provide an extra amenity for residents and as a way of accommodating municipal requirements.
Photo: Nélida Escobedo

will occur since it can decide where new infrastructure and services are built through its capital planning process.

Example: Florida is one of the few states in the United States to use a statewide concurrency program. The program is part of the state's Growth Management Act, passed in 1985 and intended to address the challenges the state faced due to uncontrolled growth, especially with regards to the increasing congestion on Florida roads (Chapin et al. 2007, 3). Specifically, the concurrency policy was "intended to either force governments to provide infrastructure necessary to support growth or to provide a state-sponsored mechanism to allow governments to slow development permitting until infrastructure was in place to service new development" (Chapin et al. 2007, 4). While the policy was ambitious and innovative, it has not been entirely successful.

Local governments struggle to finance the funding of infrastructure projects, many of which are backlogged; the concurrency requirements for transportation have not solved traffic congestion issues; and level of service requirements often make it difficult for developers to do infill and redevelopment projects because in many areas at least some sorts of infrastructure and services are already at capacity (Chapin et al. 2007, 4). To address these issues, several amendments have been made to the Growth Management Act, allowing local governments more flexibility and providing exemptions for some already urban area.

Concurrency policies: Implications for Mexico.

Concurrency policies could be a very useful tool for Mexican municipalities to gain more control over the residential development process. This kind of policy could be particularly useful in greenfield sites, as it would avoid the lack of infrastructure and services that plague more isolated developments and exacerbate housing abandonment. In the Mexican context this will also require the involvement of service agencies, such as metropolitan water agencies, that often supply services to participating municipalities within a metropolitan area and frequently face severe challenges in providing adequate service.

Discretion in applying LOS requirements for services and infrastructure in infill sites and careful consideration in defining LOS measures is key to ensure that developers will not just build in areas where capacity (especially road capacity) is in abundance. Periodic review of requirements is also necessary to verify that the program is yielding the intended results. With strong yet flexible concurrency policies, municipalities, developers, and service agencies alike would be held to higher standards for providing and maintaining infrastructure, creating greater transparency in the urban development process.

Takeaways:

- Concurrency requirements can help ensure new development is well-served by infrastructure and services and bolster the amount of control governments can exert over the location of new development.
- Governments need to have a clear way of funding the infrastructure to which developments will be directed; otherwise development backlogs will result, or potential developers or investors will be deterred.

2.1.2 Exactions and Impact Fees

What it is: Exactions and impact fees are two similar strategies which shift the responsibility for paying for and providing the additional infrastructure required to maintain an adequate level of service due to new development away from government and onto private developers. Exactions require developers to provide

infrastructure and services within a project, while impact fees refer to money paid by a developer to government so that the government may make improvements in infrastructure or services elsewhere (Brueckner 1997, 384).

How it works: Exactions and impact fees are levied directly against a developer, usually as a requirement for development permission. They are designed to replace government as the provider of infrastructure and services needed by new development. In theory, by making developers (and by extension, new homebuyers) pay for new infrastructure, government shifts the burden of these investments away from current city residents, who may or may not use the infrastructure, to new residents, who directly benefit from the new infrastructure (Ihlanfeldt and Shaughnessy 2004, 640).

While this does have the effect of raising the prices of new housing, much, if not all, of the increase can be attributed to an increase in home values thanks to the infrastructure investments (Ihlanfeldt and Shaughnessy 2004, 642). When impact fees are levied, they can be determined through a formula or through negotiations between government and developers. Those set by formula are less open to (perceptions of) corruption and thus to be preferred. Overall, the goal is for developers to internalize costs of new projects. This can make development more expensive, slowing the rate at which growth will occur (Brueckner 1997, 385), but it should also encourage more efficient development patterns (Bengston et al. 2004, 276).

Exactions and impact fees: Implications for Mexico.

Exactions and impact fees offer a complement to concurrency policies, and this process has potential in Mexico to ensure that new developments internalize infrastructure costs and do not pass the cost burden onto the wider municipality. This may make local governments more willing to accept development and ensure higher quality of life for new residents with better access to services and infrastructure. The process of determining the fee needs to be logical, fair, and transparent in order to avoid discouraging new development entirely and to prevent corrupt proceedings between developers and municipal authorities. Additionally, higher fees for developers may ultimately imply higher costs borne by the homebuyer and future resident, and thus must be negotiated properly to ensure service implementation without creating barriers for affordability.

Takeaways:

- Exactions and impact fees are important to reducing the expenses of new infrastructure and service provision for local governments, thus making them more willing to accept new development.
- Exactions and impact fees will typically lower longer-term costs to government, who otherwise would have needed to provide the infrastructure themselves. This savings may eventually be passed on to residents in the form of lower taxes.
- When fees are too great, they can act as a deterrent to development. Fees may also raise housing costs at the point of purchase, as developers pass on the additional expenses to homebuyers and renters.
- Determining the levels of exactions and impact fees that sufficiently maintain infrastructure quality without substantially discouraging future development or inflating housing prices is a key area of consideration for government entities. Adjustments in the fee policy will need to be made over time.

2.1.3 Master-Planned Communities

What it is: Master-planned communities are large real estate developments that are comprehensively planned and developed to provide not only housing but infrastructure and services, employment centers, and/or commercial areas.

How it works: The main difference between a master planned community and other real estate developments is the scale. Because these developments are done on large parcels of land, often ranging from 800 hectares upwards (Heid 2004, 16), developers have a much larger degree of control over how they are designed, how infrastructure is placed (especially roads and open space), and how services are provided (like school sites and community amenities, etc.). They can also phase when infrastructure and services are built in line with development. In addition, many master planned communities are mixed-use, allowing the integration of commercial and office land uses into the overall design of the project. This not only allows for jobs and commercial activities to be located closer to residential areas, but also provides the developer with additional sources of revenue with which to finance infrastructure improvements, or pay impact fees and other exactions to government (Heid 2004, 16). This provides both environmental and financial sustainability.

The Woodlands was developed privately, though with an early government land guarantee that means it includes subsidized housing. Its core concept is to protect ecological systems and nestle development in wooded areas screened by vegetation. In recent decades it has developed a higher density town center as well.
Photo: Collection of Ann Forsyth

Example: The Woodlands, a new town style community outside of Houston, Texas, is an example of a large master planned community that has not only been successful, but has also had to provide much of the infrastructure and services used in the development. Pictured here, the Woodlands was developed by George Mitchell, an oil and gas magnate, and opened in the early 1970s. Unlike other planned communities of the time, Mitchell wanted to ensure that his development would not negatively impact the ecological systems that existed on his property. To this end he hired Ian McHarg, a noted landscape architect and author of *Design with Nature*, along with others to design the development (Forsyth 2002, 391). The design focused on protecting the hydrology of the ecosystem, limiting runoff and maximizing the amount of water that could infiltrate back into the aquifer (Forsyth 2002, 391). As a result, the project's design has greatly reduced its need for sewer and drainage infrastructure, relying instead on natural systems. In addition, since the development was located in an unincorporated area of a county that provided low levels of public services, most of these were provided by the developer who also set up private non-profit government entities to provide services such as water (Forsyth 2002, 391). The Woodlands was also federally supported and built with a substantial social housing component.

Master-planned communities: Implications for Mexico.

Mexico has a tradition of larger developments and while many have provided a full complement of services, some have not achieved these aims. New developments could benefit greatly from being held to international standards for master planning, particularly those with a substantial social housing component. To be effectively


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MAXIMA
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Master-planned communities in the State of Hidalgo, Mexico. These developments include commercial areas, housing, school, and other services. *Photo: Collection of Ann Forsyth*

"master planned," new developments would need to better align with ongoing planning efforts at the local level and be more strategic in the commercial or public spaces they provide, ensuring that they are well-located and will be utilized. Existing developments could benefit from attention to retrofitting and re-planning—including larger infrastructure investments such as adding clinics and schools, or smaller initiatives such as repurposing buildings and lots to create commercial areas or programmed public spaces (this repurposing may already happen in an informal way that could be better coordinated). In Mexico, one example of this type of standard-setting and coordination for sustainable, master-planned housing is already taking place through the *Desarrollos Certificados* (DC) program, financed by the *Sociedad Hipotecaria Federal* (SHF) and out of collaboration between CONAVI and SEDATU.

Takeaways:

- Comprehensively planned developments that incorporate multiple uses can provide environments where people can conduct most of their daily activities within the developments, while also linking to a wider municipality.
- Differences exist among the types of master-planned communities. Some are comprehensive, new town style developments. Others are smaller and simpler master-planned communities that may not provide a full complement of uses. Although "new towns" are more difficult to develop, they can have more social benefits.
- Many precedents of master-planned communities incorporate social or environmental goals, like minimal environmental impact.

Benefits and Challenges of Infrastructure-rich Additions

New housing built on vacant lots on the periphery of urban areas does not have access to infrastructure and services unless those are also built. In general, it is the responsibility of local government to provide these services, yet when growth happens too quickly, the public is unable to finance and build adequate infrastructure. The strategies listed in this section offer a number of ways in which governments can either slow the rate of development to a pace that matches their ability to provide infrastructure and services, raise money from new developments to finance the improvements, or encourage developers to contribute to their construction. Some developers in Mexico are providing such infrastructure either as a requirement by government or for marketing purposes.

Benefits of Infrastructure-rich Additions

Growth management: One benefit of these strategies is that they complement the densification strategies listed in the previous chapter. By tying urban growth to infrastructure provision, governments are able to slow the rate of outward urban expansion and limit the areas in which greenfield development might occur. This makes it easier for governments to encourage infill development and redevelopment, especially if development processes are streamlined for infill development. While the strategies to require concurrency or ask for impact fees, etc., can be used to reinforce densification policies, this is not always the case. As will be discussed later, many of these policies have actually discouraged densification and infill development in communities that have adopted them. However, this is due more to the design of the specific policies than their inherent nature. For this reason, it is important to design and implement a comprehensive strategy where such complimentary policies may be designed and coordinated, instead of implementing disparate policies in a piecemeal fashion. While possible, it is much more difficult to coordinate strategies done this way.

Coordinated infrastructure and services: This is essential, since without proper services and infrastructure, housing may remain vacant, be abandoned, or remaining residents will suffer the effects of lack of services. While providing housing for residents is important, municipalities should be sure the growth of housing does not exceed their ability to provide it with proper infrastructure and services. It is also important for government to consider a wide range of infrastructure and services in their concurrency requirements. This is especially true for transportation infrastructure, where government can use concurrency as a powerful tool to ensure that housing is serviced by alternative modes of transportation, such as buses or rapid transit.

Challenges of Infrastructure-rich Additions

Level of service (LOS): Concurrency policies rest on the assumption that the adequacy of a service or infrastructure system can be quantitatively measured and assessed. However, it is not always easy to create appropriate indicators, nor is it easy to create agreement among all governments about what that indicator should be, or to go about the process of coordinating the proper analysis. This is especially true for LOS measures of road networks. Within the United States, states have adopted a number of different measures for concurrency, especially for transportation. Florida, for example, mandates that municipalities use a combination of average travel speeds, traffic density, and road flow rates to determine LOS for every road, regardless of its function (Chapin et al. 2007, 5). If the level of service is too low, housing cannot be built as it would overburden road systems.

The state of Washington, on the other hand, allows local governments to create their own LOS standards, and use a variety of measures such as travel delays, average speeds, and person carrying capacity. In addition, Washington allows municipalities to create different measures for different street types and functional classifications (Bucher, Willis, and Ratliff Corp. 2006, 6). Some amount of standardization in the requirements is important, especially if regional comparisons of impacts are to be made. However, some flexibility allows the overall policy aim to be achieved: developing in well-serviced areas.

Regional/metropolitan impacts: One challenge of LOS standards in concurrency policies is that they are generally calculated without taking into account the regional impacts of development. Residents in a new development in one municipality might use services like schools,

roads, or healthcare in other municipalities or jurisdictions within their region. However, LOS measurements generally only take into account the impacts new development will have within a given municipality. Failure to implement strong concurrency policies in some localities can negate the positive outcomes for communities that do use effective concurrency. A number of concurrency policies in the United States do not consider regional impacts although locations with stronger metropolitan, state, and national planning systems can overcome some of these issues.

One example can be seen in Montgomery County, Maryland. While this county has been very proactive about ensuring that new developments within its jurisdiction do not overburden its public infrastructure and services, surrounding counties in the Washington, D.C. metropolitan area do not have such requirements (Bucher, Willis and Ratliff Corp. 2006, 8-9). As with some of the densification strategies mentioned in the previous chapter, a policy like concurrency works best when done in collaboration with other local governments in a metropolitan area or region, potentially through a formal metropolitan planning agency. Because the effects of development are not confined to one municipality and poor planning in other localities can diminish the benefits of good planning elsewhere, these programs need to be able to work across political boundaries. This suggests the need for a regional planning body to, at the very least, monitor and measure the LOS changes new developments will create in neighboring jurisdictions.

Discouraging infill development: Contrary to the intent, programs like concurrency can actually discourage infill development. This is due to the dependence of these policies on level of service requirements, especially when they are applied evenly across a jurisdiction. Since higher density areas naturally tend to have higher levels of congestion, they also tend to have lower LOS levels than more peripheral areas. This is especially true for roads, which have more unused capacity in peripheral areas than in higher-density urban areas (Chapin et al. 2007, 14). Since there is spare capacity in the periphery, developers are encouraged by concurrency to build there, as it means they will not have to pay for infrastructure and service capacity improvements or wait for local governments to provide it.

In their critique of the transportation requirements of Florida's concurrency program, Chapin et al. (2007) illustrate this challenge well with a hypothetical example. They describe an old warehouse district located near the center of a mid-sized city in Florida. The district has "narrow streets, wide sidewalks, mature trees, and architecturally distinct structures" (Chapin et al. 2007, 1). However, the current LOS for roads in the district is at level D and the new development is forecasted to put the roads at an LOS of F, below the level E threshold required under the concurrency law (in level of service calculations, A is good and F is bad or congested). So while this might seem an ideal site for redevelopment, the developers will need to either pay for expensive upgrades to add road capacity (and potentially destroy the qualities of the district that make it so attractive) or add other modes of transportation (regardless of whether an adequate public transportation network exists in the area) if they want to move forward with the project (Chapin et al. 2007, 1). This challenge highlights the importance of program design. While the Florida concurrency program had a stated goal of preventing suburban sprawl, the requirements set forth in the program actually encouraged it.

Fostering Infrastructure-rich Additions: Conclusions

Ensuring new developments on the urban fringe have adequate services and infrastructure is beneficial to urban areas in a number of

ways, from complementing existing growth management and densification policies to forcing coordination among the many planning processes that governments engage in. However, these policies are not always easy to implement. Often, they have unintended consequences that actually incentivize unwanted development patterns. Monitoring results is key to achieving the potential benefits of the strategies discussed in this section.

To ensure better infrastructure, governments can require developers to contribute to infrastructure provision for new projects, through exactions or impact fees, or government entities themselves can take responsibility for building out the needed infrastructure and services. Infrastructure provision is far easier when development is adjacent to existing built-up areas, although coordinating services and development is a classic problem of new construction, as exemplified by difficulty in defining appropriate level of service (LOS) metrics. Concurrency requirements and densification strategies can help to promote orderly development and infrastructure provision. They must, however, be carefully crafted and monitored to ensure that they are generating the desired outcomes, not contributing to sprawl.

As stated earlier, Mexico's new urban containment boundaries (PCU) are a first step in ensuring that new development is more easily serviced. It is likely that other approaches to providing infrastructure and services, and ensuring better designed developments, will be needed to supplement this approach. While many of these are local concerns, the federal government can help promote such programs by providing model regulations, tying funding to improved local regulations, and providing resources for improved infrastructure and services planning, construction, and maintenance. Given the generally high costs of infrastructure planning and development at the local level, these policies and initiatives may point to a greater role for larger state or federal agencies to assist with level of service analysis. They may also invest in the infrastructure needed to support new housing development and upgrade existing areas experiencing a lack of services.

The *San Marcos Desarrollo Certificado* in Mérida, Yucatán, includes a range of housing options and public space amenities provided by developers. *Desarrollos Certificados* has been a strategy devised by the Federal Government to address a lack of adequate infrastructure provision in housing developments.
Photos: Nélida Escobedo

2.2 Sustainable Design for New Developments

Several new developments in Pachuca in the state of Hidalgo feature a number of green building technologies as well as planned open spaces.
Photo: Collection of Ann Forsyth

Sustainable Design for New Developments

What It Is

- **Sustainable design for greenfield development offers alternatives to traditional urban sprawl by advocating compact design, ecological protections, or a combination of the two.**
- **Smart growth, new urbanism, transit-oriented development, conservation subdivisions, and green building and ecosystem services are all approaches that have been suggested as sustainable designs for greenfield developments.**

Sustainability Definition/Concepts

Sustainability is key to current housing and urban development policy in Mexico and has grown to become an important consideration in many aspects of life in the 21st century. While the term and related words (sustainable, sustainable development, green, eco-friendly, etc.) are widely used, there is very little consensus about what they mean or how the concept of sustainability should be defined, analyzed, and operationalized. Indeed, one of the few aspects of sustainability

The compact city approach focuses on saving energy by using attached housing and building around transit lines. Hammarby Sjöstad on a brownfield in Stockholm, Sweden, a showcase development, also features extensive green spaces. *Photo: Collection of Ann Forsyth*

for which there is broad consensus is that the term itself is fuzzy, ambiguous, and broad (Neuman 2005, 17; Parris and Kates 2003, 13.2). In spite of this, sustainability and sustainable development have become central to the goals and objectives of many international organizations, nations, city and local governments, non-governmental organizations, and even corporations (Parris 2003, 13.2). With increasing extreme events and associated social vulnerability these issues are all the more important in the area of social housing**. For further discussion of definitions of sustainability and the evolution of sustainability as a concept, see Appendix C.**

There is no right approach to sustainable design, as it largely depends on how one chooses to define sustainability. However, design that incorporates sustainability will have to make tradeoffs between environmental, economic, and social goals. In general, planners and designers have approached sustainable design in one of two ways: compact development or ecological protection. However, cross-over and hybrids between the two approaches do (and should) exist.

Compact development: Compact development draws on a long planning tradition of walkable villages, towns, and neighborhoods, as well as the history of metropolitan plans based on intensifying development around rail station areas. Its recent incarnation, exemplified best by Smart Growth and the Congress for New Urbanism, advocates for keeping the footprints of development as small and compact as possible. This approach advocates many of the same ideas and design elements as those featured in the compact city model described in the previous chapter (Berke 2008, 400). Specific design elements include higher density buildings, mixed uses, multi-

modal transportation networks, gridded streets (or at least a high degree of connectivity), and the neighborhood as the central organizing feature of a community. It approaches sustainability through the lens of increasing the efficiency with which cities use energy, land, and natural resources (Crewe and Forsyth 2011, 270). Urban form is its main tool for achieving efficiency.

Not all such developments deal with social issues but the compact character and desire for diversity means that the best of them try to provide housing options for a range of incomes or to place lower income housing in prime areas with good public transport access (Jacobsen and Forsyth 2008). They deal with the risks of climate change through a compact footprint.

Ecological protection: Ecological protection, unlike compact development, is not concerned so much with urban form as it is with how urban expansion will affect ecological systems and functions (Berke 2008, 394). In fact, higher density, a cornerstone of compact development, tends to be discouraged by proponents of ecological protection, as it means there will be little space in a neighborhood or development dedicated to open space. In addition, large concentrations of people means that pollutants cannot be processed by natural systems.

One of the benefits of ecological protection is that it tries to bring nature and people as close together as possible, fostering connections to the natural world that can often be lost in urban areas (Crewe and Forsyth 2007, 284). There are many examples of eco-villages that explicitly incorporate principles of ecological protection, such as the Woodlands in Texas or Village Homes in California, illustrated in this report (Crewe

Village Homes in Davis, California, is an example of the lower density ecological protection approach. It features extensive on-site food production, solar energy, and bicycle paths. Rather than strictly protecting pristine nature it integrates people with natural systems.
Photo: Collection of Ann Forsyth

and Forsyth 2007, 269). Socially, many of these developments stress community togetherness and cohesion, particularly the smaller eco-villages.

While there is disagreement between proponents of the compact development and ecological approaches on a theoretical level, actual development projects tend to incorporate aspects from both. It should also be noted that both of these approaches can be useful in addressing environmental and economic aspects of sustainability. If social equity is also to be included (as it should be) in definitions of sustainable development, additional programs and policies by government will need to supplement the mainly design-oriented approaches advocated by compact development and ecological protection. For example, to guarantee long-term affordability, it is generally not enough to merely provide a variety of housing types; rather, government-owned housing or well-crafted regulations protecting affordability are needed.

The following sections describe sustainable design approaches in greater detail:

- **Smart growth**
- **New urbanism**
- **Transit-oriented development**
- **Conservation subdivisions**
- **Green buildings and ecosystem services**

2.2.1 Smart Growth

What it is: The term "smart growth" has been adopted to represent planning and design principles advocating compact development. It emerged out of various growth management policies implemented by governments in the United States starting in the 1970s.

How it works: Smart growth itself is not a planning or design movement, but rather an overarching approach to urban growth under which many movements, such as New Urbanism, may fall. In the United States, smart growth principles are represented by Smart Growth America (smartgrowthamerica.org), a coalition of advocacy groups and non-profits that promotes "building urban, suburban and rural communities with housing and transportation choices near jobs, shops and schools," creating communities with "strong local businesses," "schools and shops nearby and low-cost ways to get around," etc. (Smart Growth America 2014). While these principles are broad and general, the U.S. Environmental Protection Agency (EPA) has created a list of ten principles it considers to embody smart growth:

- Mix land uses
- Take advantage of compact building design
- Create a range of housing opportunities and choices
- Create walkable neighborhoods
- Foster distinctive, attractive communities with a strong sense of place
- Preserve open space, farmland, natural beauty, and critical environmental areas
- Strengthen and direct development towards existing communities
- Provide a variety of transportation choices
- Make development decisions predictable, fair, and cost effective
- Encourage community and stakeholder collaboration in development decisions (EPA 2013).

Example: There are numerous examples of developments with many smart growth features. However, far fewer of these examples combine these features with social equity goals such as providing affordable housing. One such example is the Livable Neighborhoods Code, put into place by the Western Australian Planning

Commission (WAPC) in Perth. The guidelines were implemented to guide future sustainable development and reduce existing urban sprawl in the region through design criteria that considers smarter growth, such as the community context, available public parkland, or urban water management (Curtis and Punter 2004, 40). The guidelines offer alternative design criteria for traditional subdivisions on greenfield sites, enabling developers to create better connected developments with features such as interconnected roadways and intermodal designs (Curtis and Punter 2004, 53). **For further information, see the case study of Western Australian Livable Neighborhoods Code in Appendix D.**

Smart growth: Implications for Mexico.

Smart growth principles could serve as an important resource for Mexican municipalities to refer to when developing plans at the local level for encouraging compact development, a wider range of housing types and tenures, ensuring walkability and broadening transportation options, etc. Notably, the federal government's National Urban Development Plan 2014-2018 overlaps in many ways with the principles of smart growth, particularly in its emphasis on containing growth and propelling more compact and vertical development.

Takeaways:

- Smart growth is an umbrella term for a variety of strategies to intensify development while preserving open space and creating an inviting public realm.
- Smart growth frameworks are a useful resource from which local governments can improve their strategies for greenfield development and densification policies.

2.2.2 New Urbanism

What it is: The Congress for the New Urbanism (CNU) is an urban design and planning movement started in the United States in the early 1990s by a number of architects as a way to formalize and coordinate their work in creating "sustainable, walkable, mixed-use neighborhoods that provide for better health and economic outcomes" (CNU 2011). It is similar to other movements internationally including the UK Urban Villages movement (Biddulph 2000).

How it works: Many of the principles of new urbanism are similar to those of smart growth; however the principles of the CNU tend to focus more on urban design and architectural elements of neighborhoods. Their principles are listed in the Charter of the New Urbanism (CNU 2001) and focus on design at different scales. A relevant selection of the 27 principles includes those which go beyond pure urban design:

- Within neighborhoods, a broad range of housing types and price levels can bring people of diverse ages, races, and incomes into daily interaction, strengthening the personal and civic bonds essential to an authentic community.
- Neighborhoods should be compact, pedestrian friendly, and mixed-use.
- Communities should be designed for pedestrian and transit as well as the car.
- Cities and towns should be shaped by physically defined and universally accessible public spaces and community institutions.
- The economic health and harmonious evolution of neighborhoods, districts, and corridors can be improved through graphic urban design codes that serve as predictable guides for change.
- A primary task of all urban architecture and landscape design is the definition of streets and public spaces as places of shared use.

New Urbanist (top three photos) and Urban Village (bottom three photos) developments at Daybreak in Utah and Poundbury in the UK.
Photo: Collection of Ann Forsyth

- Urban places should be framed by architecture and landscape design that celebrate local history, climate, ecology, and building practice.
- The metropolis is made of multiple centers that are cities, towns, and villages, each with its own identifiable center and edges.
- Where appropriate, new development contiguous to urban boundaries should be organized as neighborhoods and districts, and be integrated with the existing urban pattern. Noncontiguous development should be organized as towns and villages with their own urban edges, and planned for a jobs/housing balance, not as bedroom suburbs.

In addition to these principles, the CNU advocates for the use of form-based zoning codes instead of traditional zoning codes as a way to achieve many of the architectural and "placemaking" principles laid out in their charter. Unlike traditional zoning, which emphasizes control of land use, form-based zoning emphasizes the physical forms and buildings in different locations. Form-based zoning often uses design guidelines and architectural standards that aim to create, emulate, or protect a certain architectural or urban design characteristics found in a region.

Example: There are many examples of new urbanist developments, although it is very difficult to conform to all the movement's goals. Kentlands in Maryland is one of the better known examples in the U.S. and is privately developed. In the U.K., Poundbury in Dorchester mixes social and for-sale housing with nostalgic architecture in a development sponsored by the Prince of Wales. Hope VI developments in the U.S., that redeveloped public housing for mixed-income groups, typically used new urbanist design principles.

New urbanism: Implications for Mexico.

Similar to the principles of smart growth, some New Urbanism principles could be well-applied to the Mexican context. New Urbanism's emphasis on effective urban design, accessibility, and integration into the urban fabric are all standards that could be more strictly applied to new housing developments (through clearer standards for developers) to ensure higher quality housing and urban development overall. This could be particularly beneficial for designing social housing developments, such as those sponsored by INFONAVIT, that are often criticized for their use of materials and design that is removed from typical Mexican building styles.

Takeaways:

- New urbanism was developed to emulate the urban forms found in 19th century United States and traditional urban forms in Europe.
- Given this specificity of this form, the applicability to other countries and cities should be carefully considered.
- Form-based codes are one innovative approach to development regulation that new urbanists have advocated but that do not necessarily need to be "new urbanist" in design. The overall aim is to regulate the type and design of building rather than the uses.

2.2.3 Transit-Oriented Development

What it is: Transit-oriented development (or TOD) is a strategy that advocates building dense, mixed-use developments within walking and sometimes cycling distance of transit stations.

How it works: Due to its utility in promoting compact, mixed-use development, TOD is often included in smart growth and new urbanism, although it has a long history dating to the

nineteenth century. The rationale behind the strategy is that creating housing, jobs, and services close to transit stations will increase transit use, as people who live near the station will be more inclined to use transit more frequently. In addition, people who live elsewhere in the city or region will be able to access the jobs and services at the TOD site using public transit. This strategy can be used around existing transit stations, through redevelopment or infill, or as a plan for expanding transit systems.

Example: The Washington Metropolitan Area Transit Authority (WMATA), the owner and operator of public transit services in the Washington, D.C. metropolitan area (Washington, D.C., Virginia, and Maryland), played a major role in encouraging transit-oriented development surrounding the stations of the Washington Metro system

Housing development in Arlington Virginia, takes advantage of closely spaced railway stations for access. *Photo: Collection of Ann Forsyth*

(Metro) (Cervero et al. 2004, 229). WMATA created policies and procedures to form public-private partnerships with developers long before the Metro system opened in the mid-1970s, even creating an internal real estate development department (Cervero et al. 2004, 230). Arlington County in Virginia is known for being one of the most successful examples of TOD in the United States, with numerous large residential and commercial developments serviced by two Metro lines. As of 2004, 26% of the county's residents lived near Metro stations. Of these residents, 39.3% used public transit, the highest rate in the metropolitan area (Cervero et al. 2004, 235). In addition, between 1960 and 2002, 45,998,870 square feet of office space and 4,231,453 square feet of retail were built near Metro stations in Arlington, as well as 35,019 residential units and 14,858 hotel rooms (Cervero et al. 2004, 240; Jacobsen and Forsyth 2008).

TOD: Implications for Mexico.

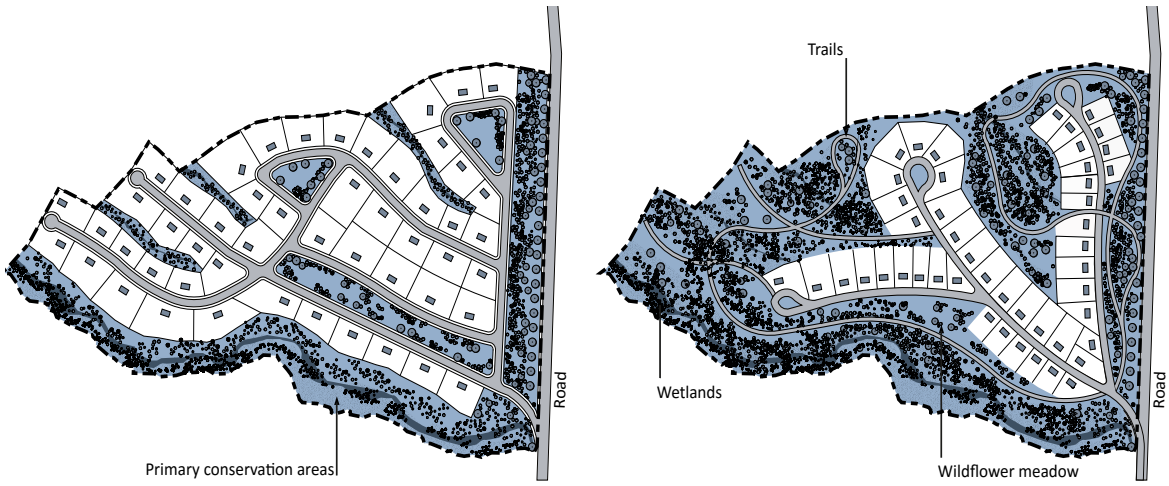
In spite of Mexico's wide variety of transit options, and many important Latin American examples in cities such as Bogota and Curitiba, new development continues to be largely low density and auto-oriented. Transit-oriented development can create a structure of multiple centers (for a train-based system) or high intensity corridors (for a bus-based system). While beneficial, the lack of strong metropolitan planning makes this difficult to implement.

Takeaways:

- TOD can help support transit services, reduce dependence on private automobiles, and provide greater accessibility to jobs, services, and housing options.
- Planning efforts must be better aligned with transportation plans in order to designate housing investment in strategic areas, a task that could logically be led by municipal or metropolitan planning authorities. Transit agencies can also play an instrumental role in helping to coordinate transit oriented development.

2.2.4 Conservation Subdivisions

What it is: A conservation subdivision is an alternative to the traditional low-density, American-style subdivision. Instead of exacerbating sprawl, a conservation subdivision preserves open space and other ecologically valuable or sensitive lands by clustering development on a small portion of the land that is to be developed.



Conservation subdivisions cluster development on parts of a parcel in order to protect natural systems, agriculture, and cultural landscapes.
Diagram by Jorge Silva

How it works: The development of a conservation subdivision begins with a detailed examination of the land, in which hydrologic, ecologic, and other environmental features of the site to be conserved are identified. The environmentally sensitive areas are set aside for conservation (Arendt 1996, cited in Allen et al. 2012, 244). Developers then cluster roads, lots, and housing across the remaining land. While specific regulations vary by jurisdiction, most conservation subdivision ordinances are density-neutral, meaning that they allow the developer to build the number of units that zoning allows based on the area of the entire parcel, not just the area that is allowed for development (Allen et al. 2012, 244). Therefore, lots tend to be smaller and housing closer together, but this tradeoff is often seen as acceptable, as residents have easy access to the conservation lands, which also serve as green or open space. For this process to be successful, governments need to provide supportive regulations.

Conservation subdivisions: Implications for Mexico.

Though not as applicable to urban areas, conservation subdivisions are primarily useful in smaller towns and rural areas where there are valuable agricultural areas, historical landscapes, or ecological reserves to protect, a reality confronted in metropolitan areas across Mexico. Rather than unilaterally restricting development in sensitive or vulnerable areas, conservation subdivisions represent a critical compromise that enable responsible and sustainable development, and is consistent with the federal government's increasing support for more compact development.

Takeaways:

- Conservation subdivisions can preserve ecologically and culturally valuable land while allowing for increased development and a variety of housing in designated areas.
- On the other hand, their typically low densities may mean that residents will face long travel times.

2.2.5 Green Buildings and Low-impact Design

What it is: Green design and low-impact design are a cluster of approaches that attempt to minimize the impact human development has on the environment (Berke 2008, 394). By protecting ecosystems, green design and low-impact designs can take advantage of the functions the natural system provides (Berke 2008, 394). In addition, these approaches seek to increase the resource and energy efficiencies of buildings (Crewe and Forsyth 2011, 283).

How it works: There are numerous green design elements and low-impact designs, including:

- Natural drainage systems that allow runoff and storm water to infiltrate into the ground
- Water systems that allow buildings to recycle and reuse potable water as "gray water"
- Rainwater harvesting
- Septic systems and effluent treatment systems that allow for gray water harvesting and reuse
- Solar water heaters (Swilling and Annecke 2006, 323)
- Alternative energy generators, such as solar panels, wind turbines, biogas, etc.
- Use of LEDs and other low energy lighting
- Composting of household waste
- District heating systems (Crewe and Forsyth 2011, 280-283; Swilling and Annecke 2006, 322-324)

Example: The Lynedoch EcoVillage near Cape Town in South Africa is an excellent example of a development that has incorporated many of these green building and ecosystem services strategies, in addition to focusing on economic and social aspects of sustainability. The development, which was led by a non-profit board set up in 2000, had three stated goals: to be a socially mixed community (in terms of race

Green building and low-impact design solutions come in a variety of forms featuring such technologies such as solar energy generation, passive solar design, water infiltration, and water recycling.
Photos: Collection of Ann Forsyth

and class), to be an ecologically designed urban system, and to be financially and economically viable (Swilling and Annecke 2006, 316). The development, which initially was funded through donations and government loans, offered 42 plots of land that were affordable to both middle- and low-income buyers. It incorporated a number of the green building and ecosystem services mentioned previously, and placed a school serving the community's children as the central focus of the development (Swilling and Annecke 2006, 317).

Green buildings: Implications for Mexico.

Green building strategies have been increasingly implemented through INFONAVIT's "Eco-Technologies" and "Green Mortgage" programs, enabling homeowners to gain access to energy and cost saving household appliances such as solar water heaters or water conserving faucets. Particularly given the scale of social housing development in Mexico, these small-scale strategies can help make new developments significantly more environmentally friendly. However, given the impact of large-scale developments and the realities of water scarcity in Mexico, green building strategies must be applied beyond the level of the household to ensure that a development's infrastructure systems (such as energy grids, septic systems, drainage systems, etc.) are sustainable.

Takeaways:

- Green building and green infrastructure approaches can be combined with strategies that explicitly incorporate social and economic goals in order to produce a more fully "sustainable" project.
- While household-scale green building strategies can have important cost savings for families, green infrastructure deserves particular attention to assure that water and sewage is properly and sustainably managed.

Benefits and Challenges of Sustainable Design for New Developments

Benefits of Sustainable Design for New Developments

Cost savings: As with densification strategies, many of the approaches to sustainable greenfield development allow governments to save money when it comes to spending on services, new infrastructure, and maintenance. Using a cost and demand model of public spending in 2,500 Spanish municipalities in 2003, Hortas-Rico and Solé-Ollé (2010) examined the impact of urban sprawl on municipal budgets while controlling for other factors. In this study, sprawl was defined using population density, residential houses per capita, percentage of scattered population per capita, and population centers per capita (Hortas-Rico and Solé-Ollé 2010, 1522). The researchers found that local governments spent more for local police, community facilities, culture and sports, general administration, and grants in lower density developments than they did in higher density ones. (Hortas-Rico and Solé-Ollé 2010, 1536).

New development of any type usually will require government to spend money on new infrastructure and services, or to upgrade existing infrastructure and services. However, evidence suggests that compact, higher density development requires governments to spend less money per capita than low-density sprawl does. **Also see Part 1: Densifying Existing Areas.**

Supports public transit: Increasing public transit ridership can provide lower cost transportation options for low-income people and those too young or too old to drive. Promoting transit ridership is a benefit commonly mentioned by proponents of smart growth, new urbanism, and transit-oriented development. They argue that by increasing building density and creating

more walkable, pedestrian-friendly environments surrounding transit stations, transit ridership will increase, as it is easier to use transit. While there is mixed support for this assertion, these design approaches do create built environments that make it more financially feasible for government to extend transit service, and for people to access transit than in traditional low-density suburbs (Handy 2005, 161).

Also, researchers must deal with self-selection biases in studies of transit usage and the built environment. This issue contends that people who prefer to use public transit tend to live in neighborhoods where they can do so, making it difficult to assess the degree to which the built environment changes behavior, rather than enabling a specific behavior over another (e.g. using transit over automobiles) (Handy 2005, 162). In a literature review of studies regarding the relationship between transit and smart growth/new urbanism, Handy concludes that the reviewed studies suggest only that the urban designs advocated by these movements "make it easier for those who want to drive less to do so" (Handy 2005, 163). While smart growth, new urbanism, and TOD might not directly change people's behaviors or tendencies, they do allow those who want to use transit to do so. This is significant since traditional low-density greenfield developments usually do not support this option. Policies such as expensive parking fees or congestion charges, which can discourage driving, will only encourage public transit usage when transit use is a viable option for citizens.

Conservation and preservation: Even though all of the sustainable design movements and strategies discussed in this section represent new development on land where none existed before, each one considers land preservation and promotes resource and land conservation. One approach, compact development, preserves land by concentrating development through higher densities. However, it has no formal mechanism for preserving land, relying instead on other government policies and programs or non-profit organizations. In conservation subdivisions, land preservation is an essential part of the subdivision design, and the land, in most cases, is placed under a conservation easement or some other formal legal protection.

Studies focused on specific states or regions (Healy and Rosenberg, 1979; Ketcham and Seigal, 1991; Moore and Nelson, 1994; Nelson, 1999; Shen and Zhang 2007) have found that in these contexts, growth management policies were successful in stopping or slowing urban sprawl. However, many of these studies were anecdotal or lacked conclusive evidence (Anthony 2004, 383). A study of state-level growth management policies (which includes smart growth) in the United States, compared changes in urban land and population densities between 1982 and 1997. Using multiple regression models, Anthony (2004) found that while growth management regulations did seem to have some effect on reducing urban sprawl, the effect was not statistically significant. In this study, states with growth management policies, on average, did not manage to increase urban densities. They were, however, more successful in slowing reductions in population density than states with no statewide growth policies (Anthony 2004, 385, 390).

Growth management, smart growth, and other anti-sprawl measures vary across jurisdictions. Accounts of individual measures in cities or metropolitan areas would suggest, however, that these policies can be effective at preserving land and reducing urban sprawl.

Challenges of Sustainable Design for New Developments

Negative impact on social equity: Sustainable development should be analyzed on its

performance in three areas: economic development, environmental protection, and social equity or development. All of the sustainable development strategies discussed in this section touch upon the economic and environmental aspects of sustainability, but the social dimension, while discussed in theory, is often neglected in practice. Because of the costs associated with sustainable design, it can be challenging to create developments that are truly inclusive of lower-income households, or effectively applied to lower-income housing developments.

New urbanism and smart growth both advocate for socially inclusive and diverse communities of residents from different racial, ethnic, social and economic backgrounds. Proponents, especially of new urbanism, believe that these goals can be achieved through design and without government intervention (Talen 2010, 491), mainly by offering a mix of housing types at higher densities. However, in practice this approach has not been successful. Talen (2010) attributes this to the tendency of new urbanist developments to provide "walkable, well designed, and amenity-rich (i.e. well serviced by stores, transit, and schools)" neighborhoods (Talen 2010, 493). These features and amenities create a high demand to live in such neighborhoods, which in turn causes housing prices to rise (Talen 2010, 493). The issue is that a design approach alone cannot make housing affordable.

This lack of affordability is a concern, as it means that the social mixing and diversity advocated by planners and policymakers (as well as proponents of smart growth and new urbanism) will not be possible using design and free market forces on their own. Government is needed to provide programs, requirements, and incentives to developers to continue to build and provide housing that is affordable and desirable to a wide range of social classes in order to prevent or reverse patterns of spatial segregation that have occurred in many metropolitan areas around the world. There are substantial examples of these approaches used by non-profit and government housing developers that are affordable.

Regulatory barriers: There is little mystery as to why traditional forms of low-density development and urban sprawl have occurred in cities: zoning codes and development regulations that guide development usually make such patterns of development the only legal options. Even when alternative development designs are allowed, such as conservation subdivisions or new urbanist neighborhoods, they are often subjected to additional regulatory requirements that create disincentives for developers to attempt them, as they may be more complicated or more costly than traditional developments.

In an analysis of zoning and subdivision ordinance and interviews with developers in Waukesha County, Wisconsin (U.S.), Göçmen found that in 15 of the 19 jurisdictions reviewed, the permitting process for conservation subdivisions required additional steps and fees, resulting in time and money costs (Göçmen 2013, 126). In interviews with developers conducted by the researcher, almost all said land use regulations prevented them from attempting to build conservation subdivisions in the county (Göçmen 2013, 129). Another study of conservation subdivisions, from North Carolina, also in the United States, found through interviews with developers, planners, designers, real estate agents, and local politicians, that the third highest ranked barrier to conservation subdivisions in the state was a "lack of interest from elected officials to change zoning regulations" (Allen et al. 2012, 246).

Mixed use, another key component of smart growth and new urbanism, is likewise discouraged or prevented by zoning and regulations. Traditional zoning systems that separate

different types of land uses are still used in many jurisdictions. Altering the outcomes of greenfield development requires changing the rules and regulations that govern it. If these new forms of development are to be accepted and adopted by the development community, approvals for sustainable patterns of development must be as easy, or easier, to achieve than traditional ones. At the very least, codes should give developers flexibility to be innovative and creative in the designs of their projects.

Need for regional efforts: Many of the benefits and advantages to smart growth, new urbanism, conservation subdivisions, and other types of sustainable urban designs are hard to prove definitively. This is mostly due to the fact that these benefits can only be achieved if these approaches are adopted regionally. Until entire regions have been transformed to match the visions of each of these approaches, we may never truly know their true benefits (and costs). The transportation benefits are particularly difficult to gauge. Specific developments might make it easier for residents to take public transit by creating walkable and pedestrian friendly environments surrounding transit stations. However, where driving is inexpensive and transit networks are weak, residents will likely continue to drive.

Whether greenfield development is sustainable depends not just on the design of the development, but on how the rest of the city, metropolitan area, or region functions. New development must be complemented by efforts that reform and retrofit existing developments, suburbs, and neighborhoods. The region must be viewed as a whole, not as individual subdivisions, neighborhoods, or cities if its true potential to be sustainable is to be reached.

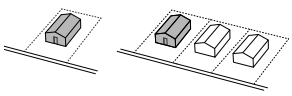
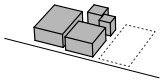
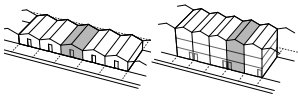
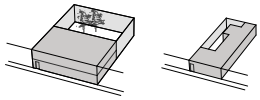
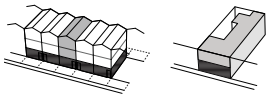
Sustainable Design for New Developments: Conclusions

The benefits of more sustainable approaches to greenfield design are many, as the strategies seek to simultaneously protect the environment while also promoting economic development, social integration, and diversity. However, these benefits are not well understood and can be difficult to quantify.

While greenfield development extends urban areas outward, it can be done in a way that coordinates development, services, and infrastructure and uses more innovative and sustainable urban designs. This requires more planning capacity at all levels of government, as well as regional coordination, particularly for transit planning. Regulatory reforms and requirements or incentives for developers to take more comprehensive approaches are also needed to facilitate environmentally friendly design. It is important to explicitly consider measures to promote social equality, as these can become lost when focusing intensively on sustainable features.

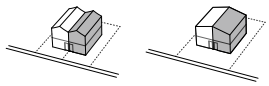
While infill is an appealing approach to consolidating urban areas in Mexico, well-designed new development adjacent to existing areas can perform an important function in supplying housing. Given the diversity of circumstances in metropolitan areas in Mexico, multiple strategies will be needed to fit local needs and practices. Table 2.2 lists the variety of housing types present in Mexican residential developments. This analysis examines the relationship between form, density and location of each type.

Table 2.2 Housing types

One-Family Housing (individual access to the unit)			
Detached			
GARDEN HOUSE 	1 unit/building Floors: 1-3 Floors Bedrooms: 1-6 bedrooms/unit Area: 557.42m2 land area/family* Location: CONAVI perimeter: U2, U3, outside U3; Urban core, periphery, rural		
FRAGMENTED 	3-5 building/unit 1 Floor, 1 shared-bedroom/unit Area: 557.42m2 land area/family Location: CONAVI perimeter: outside U3 Rural		
Attached			
ROWHOUSE 	4-20 units/building 1-3 Floors, 2-4 bedrooms/unit Area: 222.97m2 land area/family Location: CONAVI perimeter: U3, outside U3; Periphery		
DOWNTOWN 	4-10 units/building 1-2 Floors , 3-5 bedrooms/unit Area: 371.61m2 land area/family Location: CONAVI perimeter: U1, U2; Historic Urban Core, Urban Core		
Mixed-Use			
	4-20 units/building 1-3 Floors, 2-5 bedrooms/unit Area: 222.97- 371.61m2 land area/family Location: CONAVI perimeter: U1, U2, U3, outside U3; Historic Urban Core, Urban Core Additional uses: Retail, Parking		

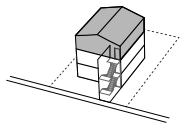
Two-Family and Three-Family Housing (Individual access to each unit)

DUPLEX



2 units/building
1-2 floors, 2-4 bedrooms/unit
Area: 222.97m2 land area/family
Location: CONAVI perimeter: U2, U3, outside U3; Urban core, periphery

TRIPLEX

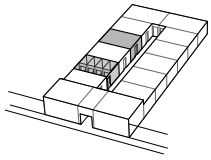


3 units/building
1-2 floors, 2-3 bedrooms/unit
Area: 136.10-222.97m2 land area/family
Location: CONAVI perimeter: U2, U3, outside U3; Urban core, periphery

Multi-Family Housing (Shared access to units)

Shared-Sanitary Facilities

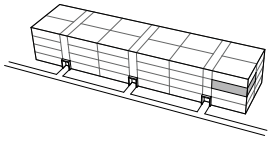
VECINDAD



10-25 units/building
1-2 Floors, 1 bedroom/unit (flexible use), bathrooms and laundry shared by occupants
Area: 136.10-91.51m2 land area/family
Location: CONAVI perimeter: U1, U2; Historic Urban Core

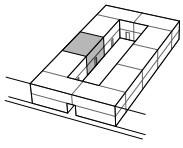
Low-Rise

DETACHED



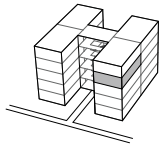
6-40 units/building
3-5 floors, 1-3 bedroom/unit
Area: 136.10-72.24m2 land area/family
Location: CONAVI perimeter: U1, U2, U3, outside U3; Urban Core, periphery, rural

ATTACHED



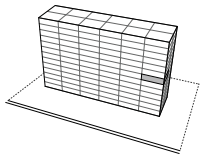
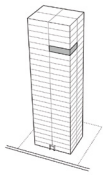
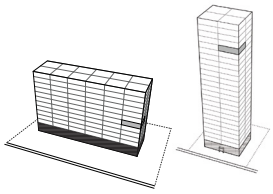
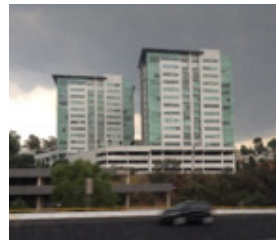
6-40 units/building
3-5 floors, 1-3 bedroom/unit
Area: 136.10-72.24m2 land area/family
Location: CONAVI perimeter: U1, U2, U3, outside U3; Urban Core

MIXED-USE



6-40 units/building
3-5 floors, 1-3 bedroom/unit
Area: 136.10-72.24m2 land area/family
Location: CONAVI perimeter: U1, U2, U3, outside U3; Historic Urban Core, Urban Core
Additional Uses: Office Space, Retail, Recreational Amenities, Services

Mid-Rise & High-Rise

MID-RISE 	10-60 units/building 5-15 floors, 1-3 bedroom/unit Area: 72.24-36.81 m2 land area/family Location: CONAVI perimeter: U1, U2, U3, outside U3; Urban Core, Periphery		
HIGH-RISE 	Over 60 units/building 15 or more floors, 1-3 bedroom/unit Area: 41.81 m2 land area/family or less Location: CONAVI perimeter: U1, U2, U3, outside U3		
MIXED-USE 	10 TO over 60 units/building 15 or more floors, 1-3 bedroom/unit Area: 41.81 m2 land area/family or less Location: CONAVI perimeter: U1, U2, U3, outside U3 Additional Uses: Parking, Office Space, Retail, Recreational Amenities, Services		

** Sources for areas for buildings below 13 floors, De Chaira et al. 1995, 20-21; drawing on other similar typologies e.g. Metropolitan Design Center n.d.*

Photos: (left to right, top to bottom): Nélida Escobedo; Nélida Escobedo; Dennis Jarvis 2010; El Federalista; Ann Forsyth; Ann Forsyth; Nélida Escobedo; Ann Forsyth; Ann Forsyth; Ann Forsyth; Grupo Sadasi 2013b; Grupo Sadasi 2013a; Grupo Sadasi 2013c; Nélida Escobedo ; Ismael villafranco 2011; Henryficar 2014; Nélida Escobedo; Nélida Escobedo; Ann Forsyth; Ann Forsyth; Antoine Hubert 2006; Ann Forsyth; Ann Forsyth; Ann Forsyth; Dëni Fotografía 2009; Abbaner 2010; Erwin Morales 2009; Raul Pacheco-Vega 2014;

Sources: De Chiara, J. et. L 1995, 21; Kliment, S.A., et al. 2010, 39-119; Metropolitan Design Center 2005; Sánchez Corral, J. 2012; Secretaría de Desarrollo Urbano y Vivienda 2015; Torres Zarate, G. 2003.