Summary:
This guide summarizes the methodology developed by the World Bank to support the Government of Panama in evaluating the best economic use of several large brownfield sites in the ten-mile wide Panama Canal Zone. The methodology was intended to enable the Government of Panama to bridge the gap between their national development plan and potential land uses by analyzing how these sites could catalyze growth in the context of the Panama Canal expansion. The methodology would be appropriate for any government involved in bringing larger tracts of land to market where there may be tradeoffs between longer-term economic growth and shorter-term financial returns in terms of site use. This methodology analyzes alternatives along three levels: (i) site characteristics and costs for development, (ii) demand for different uses and (iii) economic and strategic benefits.

Key Words: Methodology, strategic, land use, Panama, economy, brownfield, site, redevelopment, alternatives
I. CONTEXT AND OBJECTIVE:¹

This guide summarizes the methodology developed by the World Bank to support the Government of Panama in evaluating the best economic use of several large brownfield sites in the ten-mile wide Panama Canal Zone, which the US transferred to Panama along with the Canal itself in the year 2000. The 77 kilometer Panama Canal is the country’s key economic engine, representing over $2 billion in annual revenue. The Panama Canal Authority holds the concession for Canal administration; however, nearly 1,500 square kilometers of returned land (Areas Revertidas) lies outside of the immediate Canal Zone. Much of this land is reserved in perpetuity as watershed. The Ministry of Economy and Finance (MEF) through the Unidad Administrativa de Bienes Revertidos (UABR) has overall responsibility for the Areas Revertidas.

The objective of the work was to design the tools to allow the Government of Panama to evaluate the best economic use of selected large developable sites in the Areas Revertidas. The methodology was intended to enable the Government of Panama to bridge the gap between their national development plan and potential land uses by analyzing how these sites could catalyze growth in the context of the Panama Canal expansion. This clear, dynamic methodology determines the longer-term economic benefits of different development alternatives compared with simply selling the sites for the highest price based on existing land use and immediate demand.

II. METHODOLOGY

The methodology described here would be appropriate for any government involved in bringing larger tracts of land to market where there may be tradeoffs between longer-term economic growth and shorter-term financial returns in terms of site use. The Bank’s work has followed two paths: 1) sectoral assessments of the potential demand for logistics, maritime services, business services and metropolitan development (including housing, infrastructure and urban services); and 2) specific assessments of environmental conditions, infrastructure access and developability of 6 sites selected by the UABR. Taken together, these assessments will enable UABR to systematically determine how these sites should be developed to achieve national economic development goals, consistent with environmental and social policies.

¹ This guide was prepared by a team of the World Bank’s Latin America and the Caribbean Sustainable Development Department, led by Ellen Hamilton and Jordan Schwartz and comprised of Juan Carlos Belausteguigoitia, Yoonhee Kim, Javier Morales-Sarriera, Aaron Ordower, Chloe Oliver and Valerie Santos.
As the figure illustrates, the process of work was informed by the Government’s Strategic Plan, which articulated a future vision for Panama and identified several economic clusters that can build on the country’s strengths and market opportunities. Since the Advisory work was focused on the reverted areas of the canal, the Bank’s work concentrated on activities that could best be located in the canal area—logistics, maritime services, and housing and urban development.

The Bank’s work proceeded in four steps. First, we conducted macro-level studies of promising economic clusters. The analysis identified 12 specific economic activities that show promise in terms of promoting economic growth within the country and that could be located within the reverted area. Next we conducted site-specific studies of the six parcels proposed by UABR. The studies include: 1) a phase 1 environmental assessment; 2) infrastructure availability; 3) accessibility to maritime and logistic activities, proximity to employment centers; and 4) site characteristics conducive to development.

Building on the work of the work of the first two phases, we next developed a set of criteria for assessing the suitability of each site for development. Second, we prepared a site evaluation matrix, which rated each of the six sites across the 12 activities. Third, to provide more focus, we determined which of the 12 specific economic activities had the best market potential and greatest economic and employment benefits. Using results of the market studies, we have
winnowed these to 6 activities. Finally, using the 6 high potential-high impact activities, we assessed each site’s suitability for accommodating each activity. This provides UABR with a highly focused synthetic decision matrix for developing a strategy for developing these six sites to generate high levels of economic output, employment and the formation of agglomeration economies.

The below slide summarizes the phasing and content of the analysis carried out in Panama.

**Figure Two: Site-Specific and National Strategic Analysis for Decision-making**

<table>
<thead>
<tr>
<th>Site Development Strategy</th>
<th>Site Status</th>
<th>National Strategy &amp; Sectoral Analysis</th>
<th>National Legal Framework</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase 1:</strong> Initial Site Diagnostic</td>
<td><strong>Phase 2:</strong> Alternative Use Scenarios</td>
<td><strong>Phase 3:</strong> Preferred Use Strategy</td>
<td></td>
</tr>
<tr>
<td>• Permitted Uses</td>
<td>• Site description (including existing infrastructure)</td>
<td>Sectoral Analysis Based on National Strategic Development Plan Priorities:</td>
<td>• Land use &amp; zoning policies</td>
</tr>
<tr>
<td>• Possible Uses</td>
<td>• Site geology/vegetation</td>
<td>• Maritime Services &amp; Logistics Supply and Demand Analysis</td>
<td>• Environmental regulations &amp; enforcement practices</td>
</tr>
<tr>
<td>• Preliminary Market Sounding</td>
<td>• Drainage and topography</td>
<td>• Housing Supply and Demand Analysis</td>
<td>• Resettlement Policies</td>
</tr>
<tr>
<td>• Preliminary Market Sounding</td>
<td>• Historical site use</td>
<td>• Strategic Environmental / Conservation Needs</td>
<td>• National procurement &amp; contracting framework</td>
</tr>
<tr>
<td>• Current site use</td>
<td>• Current site use</td>
<td>• Economic Impact and Employment Analysis</td>
<td>• Investment promotion practices</td>
</tr>
<tr>
<td>• Pre-feasibility studies</td>
<td>• Site investigation (if needed)</td>
<td>• Urban Development Tools and Strategies</td>
<td></td>
</tr>
<tr>
<td>• Tools for feasibility study</td>
<td></td>
<td>• Other strategic sector needs assessments</td>
<td></td>
</tr>
<tr>
<td>• Public consultations</td>
<td>• Identification of clean-up options and costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Feasibility studies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Master plan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Contract design</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Transaction</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Informed Preferred Site Use

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Those activities listed in bold are those carried out as part of the World Bank - UABR study.
III. SECTOR-LEVEL ECONOMIC ASSESSMENTS

We start with the sectoral assessment activities and then proceed to review work that focused on the six specific sites. In terms of sectoral analysis, the World Bank undertook the following:

- Maritime demand study
- A Labor supply chain analysis of strategic land uses
- Economic impact study of alternative uses in reverted areas (input/output study)
- Housing demand and supply study
- Urban development to foster competitiveness

Below we provide a brief narrative on each of these studies.

Maritime demand study

The maritime demand study used the Government of Panama’s Strategic Plan as a starting point, and developed detailed assessments of the following 11 activities: ship repair, shipyards, fuel storage and supply, repair and maintenance of containers, ship provisioning and auxiliary services, treatment of maritime liquid waste and fuel discharges, logistic services and value added storage, ship dismantling, distribution hub for ship parts, passenger ship terminals, and multi-use bulk terminals. The maritime demand study assessed the relative competitiveness of Panama against other regional ports and gauged the demand for services, assuming canal expansion. The maritime study assessed 28 current canal related activities and using information from the Estudio Impacto Economico de Canal y el Proyecto de Ampliacion en Panama (2006) as well as interviews and other data sources, identified 11 activities with the greatest potential for growth. They are expected to increase by 5.2 and 16.8 percent between 2010 and 2015.

The maritime study then prioritized these 11 activities in terms of their strategic importance, potential future demand, and comparative advantage over other countries in the region. Based on the prioritization, the study identified 5 activities that are particularly attractive possibilities. Table 1 presents rankings for strategic importance, demand potential and competitiveness of the 11 activities, and concludes that activities 1-5 (shown in bold) are the most promising.

<table>
<thead>
<tr>
<th>Maritime activities</th>
<th>Strategic importance</th>
<th>Demand potential</th>
<th>Panama’s competitiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1. **Warehousing and added value logistics services**
   - High
   - High
   - High

2. **Hub for ship parts**
   - High
   - High
   - High

3. **Terminal for auxiliary maritime industries**
   - High
   - High
   - High

4. **Passenger terminal**
   - High
   - Medium
   - High

5. **Shipyards for ship repair**
   - High-Medium
   - Medium
   - High-Medium

6. **Multipurpose terminal for bulk storage**
   - Medium
   - Medium
   - Medium

7. **Collection and treatment of bilge water**
   - Medium
   - Medium
   - Medium

8. **Floating repair ship**
   - Medium
   - Medium
   - Medium

9. **Container warehousing and maintenance**
   - Medium
   - Medium
   - Medium

10. **Storage and bunkering of ship fuel**
    - Medium
    - Low
    - Medium

11. **Ship scrapping**
    - Medium
    - High
    - Medium

Source: Analysis of the market demand for maritime services, April 30, 2012.

Implementing these 5 high priority activities will require that the government and private sector provide the financial and project implementation leadership to provide the infrastructure required to expand and/or introduce new activities to the canal area. It also assumes that the labor force is provided with the necessary technical and professional training to provide the capacity to provide the range of services outlined above.

**Labor supply study**

The labor supply study focused on estimating the employment requirements for land use activities that can be attracted to sites within the reverted areas. The employment requirements include both construction phase needs and ongoing operational employment. The study also examined the impacts of new maritime, logistic, residential development and tourism activities on employment at the national level. Importantly, the labor study considered the human resource requirements in terms of training and education and how particular activities might generate employment and income opportunities for the poor. The assessment also considered the extent to which Panama’s labor supply quality might pose constraints for specific maritime, logistics and tourism activities.

An important finding of the labor market study is the high variation in employment generated by specific uses. In the case of storage of ship fuel, (for which little demand was found in the maritime demand study), only 0.1 employees per 100 square meters would be required to operate and maintain such facilities. On the other hand, maritime activities that were considered key for Panama, such as auxiliary maritime industries, are more employment intensive—1.2 persons per 100 square meters. In addition, shipyards would generate between .55 and .6 jobs per 100 square meters of constructed area. Value added warehousing and logistics activities, in turn, would...
generate slightly more than 0.4 workers per 100 square meters. In the case of tourism, the respective number would be higher, with about 1.4 workers per 100 square meters of constructed area.

The labor study also found that skilled and affordable labor was a constraint across all of the sectors examined. Panama’s relatively high labor costs (within the region) are thought to be the result of the country’s labor laws and practices. The study found that the skilled labor market in logistics, maritime services and tourism is shallow and will need to either be deepened through training or expanded through international migration. Labor and total factor productivity in the maritime and logistics sectors is relatively low compared to international standards (ranked 51st in the world). The study suggests that Panama prepare a long-term logistics sector development plan.

Economic input-output study

To gauge the medium term impact of developing these activities on the overall economy, the World Bank prepared an input output study to estimate the direct and induced demand for goods and services. The study examined 10 activities which have the potential to be developed in the reverted areas and then calculated economic output and employment effects. The ten activities incorporated in the input-output model included: Logistics Parks for value-added services, shipyards, auxiliary maritime activities, storage and supply of maritime fuels, cold storage and distribution, tourism in the Panama Canal, passenger terminals and cruises, container maintenance and residential and high rise construction. The model estimates that as of 2010, these activities in the reverted area accounted for 9 percent of Panama’s GDP. However, in terms of employment these reverted area activities accounted for only 3.6 percent of total national employment.

These 10 activities have significant backward linkages into the country’s traditional economic sectors. With multipliers ranging between 1.2 and 1.7, ports and terminals and shipyards, logistics parks for value-added services, passenger terminals are likely to have the significant growth impacts in the future. In terms of employment, the maritime activities are likely to have limited impact on the number of jobs created after an increase in sector demand, while warehousing, cold storage and distribution and high rise residential construction would have a larger direct and indirect employment effects. Nevertheless, since maritime and logistics activities require a more specific set of skills, the jobs created in those sectors are better remunerated, which would counterbalance a smaller employment multiplier in terms of the overall benefit. The economic and employment impacts of these 10 activities are presented in Figure 2 below.

In terms of the economic activities identified with high strategic importance to Panama, Logistics Parks for Value-Added Activities which was considered the most strategic sector in the maritime demand study is also significant in terms of economic growth and in terms skilled jobs creation. With regards to other strategic maritime activities, passenger terminal have large economic growth impact, while shipyards and auxiliary maritime activities have lower multipliers because of leakages due to imported inputs. On the other hand, container maintenance and storage and supply of fuels, although they show a large economic growth impact, are of lower strategic value.
Housing demand and supply study

The housing demand and supply study developed estimates of household formation in the reverted areas between 2012 and 2022. Two market areas were defined—the Atlantic, comprised of the Colon District, and the Pacific, defined as the Districts of Panama, Arraijan and La Chorrera. Based on consultations with INEC, we developed two alternative models for estimating population and household formation between 2012 and 2022. Based on our projections, we decided to use a trend model based on 2000-2010 population growth. We added to this the estimated 2010 housing deficit for the two market areas. This backlog includes reducing overcrowding, and the replacement of dilapidated and temporary housing with permanent structures. Table 2 presents our estimate of household formation by district and market area. The table illustrates that most of the housing demand will occur in the Pacific market area, largely covering Panama City.

Table 2: Household formation projections plus housing backlog requirements 2012-2022
<table>
<thead>
<tr>
<th></th>
<th>District</th>
<th>District</th>
<th>District</th>
<th>District</th>
<th>Atlantic</th>
<th>Pacific</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Colon</td>
<td>Panama</td>
<td>Arraijan</td>
<td>La Chorrera</td>
<td>market area</td>
<td>market area</td>
<td>market areas</td>
</tr>
<tr>
<td>2012</td>
<td>58,678</td>
<td>273,966</td>
<td>63,455</td>
<td>48,448</td>
<td>58,678</td>
<td>385,869</td>
<td>444,547</td>
</tr>
<tr>
<td>2015</td>
<td>63,190</td>
<td>297,629</td>
<td>72,413</td>
<td>52,326</td>
<td>63,190</td>
<td>422,368</td>
<td>485,558</td>
</tr>
<tr>
<td>2020</td>
<td>71,494</td>
<td>341,697</td>
<td>90,240</td>
<td>59,492</td>
<td>71,494</td>
<td>491,428</td>
<td>562,922</td>
</tr>
<tr>
<td>2022</td>
<td>86,714</td>
<td>379,328</td>
<td>105,726</td>
<td>67,606</td>
<td>86,714</td>
<td>552,660</td>
<td>639,374</td>
</tr>
<tr>
<td>CAGR 2012-2022</td>
<td>4.0%</td>
<td>3.3%</td>
<td>5.2%</td>
<td>3.4%</td>
<td>4.0%</td>
<td>3.7%</td>
<td>3.7%</td>
</tr>
<tr>
<td>2010-30 increase</td>
<td>28,036</td>
<td>105,362</td>
<td>42,271</td>
<td>19,158</td>
<td>28,036</td>
<td>166,791</td>
<td>194,827</td>
</tr>
</tbody>
</table>

Panama’s housing market has been growing steadily over the past 6 years and while housing construction dropped after the peak in 2008, when it reached 14,600 units in the Panama District. Since then construction activity has been rising and stood at 8,626 in the district of Panama in 2010 and 11,841 units in 2011. Convivienda, an association of residential developers anticipates that construction in 2012 will continue to increase. Construction data from INEC confirms these trends and shows that the market is recovering. Banks have ample liquidity and are eager to lend. Most of the country’s housing construction is located in the Metropolitan area of Panama City, and housing development is moving into the suburban areas of the capital city. Alternatively, the residential real estate market in Colon is relatively anemic.

Most of the country’s private sector housing development is in the price ranges where government subsidies are available—prices up to $120,000 account for 91 percent of market for Convivienda’s members. Only 9 percent of the market is for units over $120,000. This may pose challenges for UABR if it decides to move towards more expensive residential development market segments. It would therefore be prudent to conduct detailed market studies prior to moving in this direction.

The overall balance between housing demand and supply is tipped toward undersupply. As we have projected, the four districts are estimated to annually add nearly 19,400 households per year. Of this total, 2,800 households would be generated annually in the Atlantic market area and 16,600 in the Pacific market area. At the same time residential construction (formal permitted units) are approximately 12,000 units per year at the current time in the four districts. This suggests an under provision of housing of 4,600 units per year, leading us to conclude that UABR should not have trouble disposing of its land targeted for residential development.
In terms of housing affordability, the study analyzed household income patterns and determined that the Government’s housing subsidy program works effectively for middle income households but that it does not reach down to the lowest income quartile. Table 3 illustrates housing affordability by income quintile, and shows the limited affordability of households in the bottom two income quintiles. This suggests that UABR might consider alternative approaches to providing affordable housing, by developing housing programs in areas where land is less expensive and development costs would be low. Programs aimed at housing upgrading, infill development and transit oriented residential development would be effective approaches worth considering.

<table>
<thead>
<tr>
<th>Monthly income range</th>
<th>Minimum affordable house price</th>
<th>Maximum affordable house price</th>
<th>Demand per quintile</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 $0-182</td>
<td>0</td>
<td>$21,380</td>
<td>38,965</td>
</tr>
<tr>
<td>2 $183-476</td>
<td>$21,381</td>
<td>$36,132</td>
<td>38,965</td>
</tr>
<tr>
<td>3 $477-811</td>
<td>$36,197</td>
<td>$58,042</td>
<td>38,965</td>
</tr>
<tr>
<td>4 $812-1,417</td>
<td>$58,107</td>
<td>$77,011</td>
<td>38,965</td>
</tr>
<tr>
<td>5 +$1,418</td>
<td>$77,062</td>
<td>Infinite</td>
<td>38,965</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>194,827</strong></td>
</tr>
</tbody>
</table>

*The calculations in this table assume that households utilize MIVOT grants ($5,000) and GoP interest rate subsidies (6.25, 4.00 and 2.00 percent write downs for 15 years) and that households that qualify for MIVOT grants do not make down payments. Following the design of the interest subsidy program, mortgages are amortized over 30 years, although the interest rate subsidy ends after 15 years. The interest rate subsidy program sets maximum purchase prices of up to $35,000 for 0% loans; between $35,001-$65,000 for 2.25% loans; and $60,001-$120,000 for 4.25% loans. Since borrowers are required to obtain life and household insurance we adjust the maximum payment to income percentage from 30 to 25 percent.*
Urban development assessment

In addition to the maritime, input-output and residential market studies, the World Bank also considered the broader question of how to foster urban development that would enhance Panama’s international standing as a world class hub.

While key backbone infrastructure such as the canal, ports, logistics centers, financial districts and airports are critical for achieving the international status of “The Hub of the Americas,” urban development and modernization is needed to improve mobility and accessibility and overall quality of life. The country’s largest metropolitan area, Panama City has an inefficient spatial structure. Its urban footprint is nearly as wide as Sao Paulo, with a tenth of the population. Housing development and supporting commercial services are sprawling along an east-west corridor, and the metropolitan area is moving north. This “T” shaped spatial structure is inefficient and creates serious traffic congestion. Urban development and revitalization efforts should be considered to increase urban densities and to promote transit patronage. Fortunately, the Government is now commencing construction of a new metro that will improve accessibility from the east toward the city center and further to the west. This is an important step that should be complimented by an effort to increase residential densities around transit stations to accommodate increased population growth and to encourage use of the metro.

Panama also needs to consider advancing accessibility across the canal to the west. While, the canal watershed needs protection, there are substantial opportunities for urban development beyond the canal’s watershed that should be exploited. This will require several bridges in addition to the existing Inter-American Highway bridge and the crossings at the northern locks. As mentioned above, the growth in households between 2012 and 2022 will approach 200,000; over 75 percent of this growth is likely to occur in the Panama City metropolitan area. Land and infrastructure requirements will be significant, but necessary in order to achieve the country’s future aspirations.

IV. SITE-SPECIFIC STUDIES

In terms of the site specific studies, the World Bank prepared the following outputs:

- Environmental (phase 1) assessment of sites
- Estimation of infrastructure costs to service sites
- Suitability of locating maritime and residential activities on each of the six sites
- Residential development options for the six sites
- Crowd sourcing survey of stakeholders regarding preferred development of the six sites

Below we provide a brief narrative on each of these studies.

*Environmental (phase 1) assessment of sites*

A phase I environmental assessment was conducted for each of the 6 sites. The assessment followed standard environmental assessment protocols as outlined by standard E1527-05 of the American Society for Testing and Materials, and what is considered best practice for Brownfield
redevelopment by the U. S. Environmental Protection Agency. Phase I assessments are preliminary assessments which focus on archival research, site visits and interviews with knowledgeable experts to assess likely recognized environmental conditions. Additionally, the environmental assessment team was not able to access sites with dense vegetation or lack of road access. The phase one assessment also includes recommendations for further work in phase two. Phase two includes detailed sampling to identify the extent of contamination. Stage three consists of the physical remediation of environmental contaminants.

Estimation of infrastructure costs to service sites

The World Bank team prepared unit cost estimates of infrastructure service provision that can be applied to each of the sites. While approximate, they provide a metric for estimating infrastructure provision costs as UABR moves its development process forward. Our approach in tabulating these costs was to review World Bank infrastructure investment projects in the region; interviews with private Panama infrastructure contractors; and review of various reports on infrastructure provision in Panama. Infrastructure included:

- Water supply (25.4 cm pipe; 76.2 cm pipe; water treatment plant)
- Sewerage (60.96 cm pipe)
- Drainage (60.96 cm pipe)
- Electricity (230kv double circuit transmission line; 115kv double circuit transmission line; 230 kv single circuit transmission line; and low voltage residential distribution line)
- Roads (6.5 m gravel; 6.5 m asphalt; 7 m. concrete; and 2 lane asphalt)

Suitability of locating logistic, maritime, tourism and residential activities on each of the six sites

In the course of both the maritime and residential demand studies, which together focused on 12 land use activities in the logistics, maritime services, industrial, tourism and residential development sectors, the analysis developed a set of accessibility, infrastructure and site characteristics that would be required to support the development of these services at a particular site. In this section we combine the results of the two studies to lay the ground work for evaluating the development suitability of the six sites. Table 4 provides a listing of the criteria used in both studies. As part of the work, an analysis was made of the of how the importance of each of these criteria vary for each of the 12 activities.
Table 4: Accessibility, infrastructure and physical requirements for locating maritime service activities on the UABR sites

- Access to air transport facilities
- Access to maritime transport facilities
- Access to railway transport facilities
- Access to highways
- Low to moderate traffic congestion
- Access to Public Services (water, sewerage, solid waste, electricity and storm drainage)
- Access to population and labor market
- Suitability for cargo loading and unloading
- Size of the site
- Warehousing facilities
- Proximity to industrial areas
- Proximity to free trade zones
- Ability to expand site area to accommodate increased activities
- Water frontage
- Existence of bulkheads
- Access to ocean
- Wharf and docking facilities
- Environmental quality of the site (absence of pollution, quality of landscape)
- Lack of environmental contamination

We developed several development alternatives for the three sites based on varying assumptions regarding density (we considered both the current Garden City planning norms applied in the reverted areas and the MIVOT urban planning norms used outside the reverted areas. We also considered alternative pricing strategies and alternative mixes of apartments, townhouses and single family units. Table 5 provides a summary of the development options considered for the three sites found to be suitable for residential development. Since there continues to be some ambiguity regarding the gross land areas of the sites, and hence the net developable area, the figures in Table 5 should be viewed as approximations.

Table 5: Gross and net residential developable area, based on Garden City (UABR) and non-reverted area zoning norms

<table>
<thead>
<tr>
<th></th>
<th>Total gross area, hectares</th>
<th>Garden City norms, net residentially developable area, hectares</th>
<th>Non-reverted area norms, net residentially developable area, hectares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Davis and</td>
<td>442</td>
<td>159-199</td>
<td>199-318</td>
</tr>
</tbody>
</table>
Using these planning norms for the three sites, we next considered two alternative development options, one called “balanced” which would provide a mix of middle and upper-income dwellings, and an alternative option which we refer to as “land disposition revenue maximization,” or revenue maximization for short. If UABR follows the garden city planning norms and considers two mixes of residential development, one balanced and the other maximum revenue, it stands to generate between $689 million to $1.025 billion from land sale proceeds. On the other hand if it were to consider increasing densities by shifting to MIVOT’s planning norms, developers could build and sell more housing and would therefore be able to pay more for the land. In the case of UABR shifting to MIVOT’s norms, it could potentially generate between $938 million to $2.293 billion.

However, these estimates do not include costs for environmental remediation such as the removal of unexploded ordinance or removal of contaminated soils or structures. Additionally, while the land revenues do include local infrastructure costs for the residential areas, they do not include the costs of bringing trunk infrastructure to each site. Obviously, the potential revenues will need to be adjusted downward to reflect these costs, which would either be borne by developers (who would lower their land bids accordingly) or by the UABR if it were to finance the provision of infrastructure to each site and pay for any necessary environmental remediation.

However, it should be pointed out that regardless of the ultimate use of the six sites, considerable investment will be required for environmental remediation and the provision of infrastructure. In the case of residential development, environmental remediation is likely to be the most expensive since best practice examples all place a higher clean up standard on residential development. Other more industrial or maritime service activities may need less aggressive remediation. As the UABR moves forward, these cost/risk variations should be systematically assessed. The final part of this section examines the results of a stakeholder survey to gauge their options about how the six sites should be used.

Crowd sourcing survey of stakeholders regarding preferred development of the six sites

In 2011, the World Bank conducted a survey of experts with experience in logistics, maritime services and urban development to consider various land use activities for the six sites. A total of 65 interviews were held and they were roughly evenly distributed between governmental and private sector respondents. The survey asked the respondents about seven land uses: cold storage, housing, tourism, logistic park, shipyard, ship supply facility or maritime fuel storage and supply.

With the analysis completed for a range of 12 activities (11 logistics, maritime, industrial activities and 1 for housing) we can now integrate the sectoral and site-specific results to explore options for connecting land use activities with each of the six sites. Again it merits mentioning, that due to the preliminary nature of the analysis and the fact that more detailed analysis and
strategic thinking will be carried out by the UABR, our discussions outlined in the next section are broadly indicative—they do not make definitive recommendations for action.

An indicative site-by-site analysis is shown in the table below.

| Table 6: Summary of potential suitability for strategic maritime and residential uses |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                                 | Site 1          | Site 2          | Site 3          | Site 4          | Site 5          | Site 6          |
| Warehousing and added-value logistics center | + (E, CA)      |                  | ++ (E, I)       | ++ (E, CA)      |                  |                  |
| Distribution hub for ship parts | + (E, CA)      | + (E)           | ++ (E, I)       | + (E, CA)       | + (E, I, Z, CA) |                  |
| Terminal for auxiliary maritime industries | ++ (E)         |                  |               | + (E, I, Z, CA) |                  |                  |
| Passenger Terminal             | ++ (E)         |                  | ++ (E, I, Z, CA) |                  |                  |                  |
| Shipyard for ship and repair   | ++ (E, CA)     | ++ (E)          | ++ (E, I, Z, CA) |                  | ++ (E, I, Z, A) | ++ (E, I, Z, A) |
| Housing                        | ++ (E, CA)     | ++ (E)          | ++ (E, I, Z, CA) |                  | ++ (E, I, Z, A) | ++ (E, I, Z, A) |

++ = Strong suitability for site
+ = Moderate suitability for site

Additional factors for consideration:
E: Environmental issues with site must be addressed
I: Requires substantial infrastructure investments
Z: Development inconsistent with current zoning
CA: Requires approval of development plan from Canal Authority
A: Terrestrial access only possible by traversing private property
Conclusions

Going forward, UABR needs accurate estimates of environmental remediation of each of the sites that should be based on which use or uses would be located on them. Secondly, UABR needs to prepare engineering cost estimates of providing infrastructure to each of the sites, again according the likely use of the site. Thirdly, UABR needs to estimate the potential land sale revenues that businesses or developers would be willing to pay, given development costs and various risks (environmental, market, construction, etc.). Finally, UABR should consider developing a detailed work program for bringing the sites to market in a manner that achieves its strategic, economic and financial objectives.