Section 4
General Planning Methodology

The master plan developed based on the principles of sustainable development and following a strategy of integral planning that included a decision methodology based on the evaluation criteria. This section describes the elements of sustainable development, and the alternatives prioritization methodology.

4.1 Sustainable Development for Master Plan Decision Making

4.1.1 Requirements for Sustainable Development Process

The master plan was developed within a transboundary context, in which funding possibilities from NADBank exist. In order to be eligible for NADBank funding, the master plan would have to be certified by the Border Environment Cooperation Commission (BECC) in conformance with the bi-national approach to develop environmental infrastructure on the Mexican-US border. The BECC has six criteria for certification. One of these criteria is sustainable development.

The master plan incorporated sustainable development using a process developed by the BECC, a petition made by CESPT and the BTC. Sustainable development was incorporated in conformance with the following definition of sustainable development:

> "Conservation oriented social and economic development that emphasizes the protection and sustainable use of resources, while addressing both current and future needs, and present and future impacts of human actions." *(Reference: Project Certification Criteria by the BECC, Ciudad Juarez, Chihuahua Mexico, November 9, 1996)*

The BECC's "*Guidelines for Applying the Sustainable Development Criteria*" (February 1999) defines the process for using sustainable development. The process requires decision making for the construction of infrastructure that more fully integrates and balances social, economic, and environmental needs. The BECC's method uses response or performance indicators of sustainability developed by the stakeholders to identify appropriate solutions. The focus of the master plan was on responses to existing needs and on performance of the response measures. The indicators developed had several uses:

- Provided guidance to data collection and establishing baseline conditions
- Guided the development of infrastructure alternatives
- Acted as criteria for evaluating the alternatives
- Helped define areas of focus for institutional strengthening

- In the future, will be used to monitor actions taken to implement the master plan.

In the BECC process, key indicators become criteria used to evaluate infrastructure alternatives. As explained in the following section, criteria are assigned weights that affect the final ranking of alternatives. Once the alternatives are developed, scales for each criterion are created to represent realistic ranges of performance for the alternatives. Using the weighting for each criterion and the score received by the alternative based on the scales, the alternatives are ranked based on the totals for their weighted scores. Throughout the BECC process, an important element is stakeholder participation. For the master plan, the stakeholders (CESPT and BTC) participated in each step of the decision-making. Using a series of workshops, indicators and criteria were developed through active participation by the public agency stakeholders represented in the BTC.

These and other sustainable development tasks occurred concurrent with the technical tasks of the master plan as shown in Table 4-1.

Table 4-1
Concurrent Technical and Decision Making Tasks for the Master Plan

Master Plan Task	Sustainable Development Task
Collected and interpreted baseline data of infrastructure system and demographics	Workshop 1 – BTC stakeholders developed performance indicators Indicators were compiled and consolidated into a manageable number Indicators were used to guide and interpret data
Conducted integrated planning Developed infrastructure options Combined options and developed integrated alternatives	Refined indicators with BTC stakeholders review and approval Developed evaluation criteria from the indicators Workshops 2, 3, and 4 -- BTC stakeholders weighted the criteria
Selected preferred alternative and completed Mexican and US environmental assessments	Developed scales for each criterion Evaluated alternatives according to the criteria scales Ranked the alternatives and the BTC selected the preferred alternative

The BECC approach was modified for the master plan to accommodate a second process for developing infrastructure alternatives: integrated resources planning. This second process produces infrastructure solutions using a holistic approach. By looking at all systems concurrently, the various water and wastewater options were ultimately integrated into comprehensive alternatives. The weighted criteria developed under the BECC process were applied to these integrated alternatives.

4.1.2 Indicators and Criteria

On March 12, 2002 the BTC conducted an all-day workshop to identify appropriate indicators. The BTC divided into four working groups to address the four divisions of water infrastructure:

- New Water Sources

- Treatment and Distribution of Potable Water
- Wastewater Collection
- Wastewater Treatment, Discharge and Reuse.

The BTC discussed current needs and the groups identified 134 performance indicators. The four groups selected 50 indicators that address the most important issues.

Following the workshop, the lists of indicators were compiled, analyzed, evaluated for compliance with the BECC certification criteria, and grouped by similarities. This regrouping made it possible to aggregate the total number of indicators into a manageable number of key indicators. See Appendix K for the complete list of indicators from the BTC.

The key indicators were then further analyzed for appropriate use as criteria for evaluating the master plan alternatives. Because the master plan focuses on the physical infrastructure only, some of the indicators were better suited for other purposes. As a result, the indicators were grouped into the following three categories:

1. Indicators that act as requirements for all alternatives
2. Indicators used as criteria for alternatives evaluation
3. Indicators for long-term use (post master plan preparation). These indicators address
   a. institutional strengthening necessary for implementing the master plan
   b. monitoring implementation

Overall Requirements

Some indicators were applicable to each alternative and were considered so important that they became requirements to be met by all of the alternatives. These requirements include the programs for developing a water culture, the completion of infrastructure projects to adequately protect human health, and the reduction of impacts to the environment. See Table 4-2. The criteria required for all alternatives cannot be used to differentiate between alternatives, therefore the indicators did not include the criteria, as is explained later in this subsection.

Criteria for Alternatives Evaluation

Eleven key indicators were used as evaluation criteria. The criteria addressed costs, risk, the time required to implement improvements, water sources, ground water use, water losses, water quality, water service, hydraulic capacity, sanitary service

coverage, wastewater treatment, discharges to transboundary waters, sludge management, and reuse. These criteria are shown in Table 4-2.

These criteria, and the manner in which the plan's alternatives abide by them, are described in Section 12. The prioritization of the plan's alternatives is based on these criteria.

Table 4-2
Goals, Criteria, and Components for Evaluation of Alternatives

	Infrastructure Category	Goals for the Master Plan	Criterion (Key Indicator) for Alternatives Evaluation	For Alternatives Comparison	Components	For Evaluation Scale
A	All	Water and wastewater services must be affordable [1]	Cost of alternative	〈	A.1 Present value based on capital and operations and maintenance costs over the planning period	〈
B	All	Reduce environmental impacts	Level of environmental impacts	〈	B.1 Impacts to receiving water quality	〈
					B.2 Nuisance impacts (noise and odors)	
					B.3 Impacts to Sensitive Species and habitat	
					B.4 Construction impacts	
C	All	Protect human health	Adequate water and wastewater infrastructure improvements are made in time to protect human health		C.1 Coverage in 2008. Same for All Alternatives	
					C.2 Coverage in 2013. Same for All Alternatives	
					C.3 Coverage in 2023. Same for All Alternatives	
D	All	Develop a water culture	Number of water culture programs		D.1 Number of water conservation programs. Same for All Alternatives	
					D.2 Number of programs for payment for water services. Same for All Alternatives	
					D.3 Number of programs for appropriate use of the sewer. Same for All Alternatives	
					D.4 Percentage of population receiving educational materials. Same for All Alternatives	
E	All	Alternative has acceptable level of implementation and performance risk	Level of implementation and performance risk (high, medium, or low) [2]	〈	E.1 Political risk, public acceptability, and equity factors	〈
					E.2 Risk of insufficient cost recovery	〈
					E.3 Risk based on uncertainty of land use projections	〈
					E.4 Technical reliability and/or other performance factors	〈
F	Water Supply	Maintain flexible sources of supply	Percent contribution of the largest supply source	〈	F.1 Percent contribution of the largest source of water	〈
					F.2 Number of sources of water	
G	Water Supply	Conserve water and reduce leaks	Percentage of water conserved and reduction in water losses		G.1 Percent reduction in water losses. Same for All Alternatives	
					G.2 Percent conservation in commercial and government buildings. Same for All Alternatives	
H	Water Supply	Sustain ground water extraction	Ratio of ground water extraction to artificial groundwater recharge with water of adequate quality	〈	H.1 Ratio of ground water extraction to artificial groundwater recharge with water of adequate quality	〈
I	Wastewater Collection	Reduce wastewater discharges to transboundary waters	Reduce wastewater discharged to transboundary waters	〈	I.1 Kilometers of trunk sewer pipe installed and replaced	〈
					I.2 Reductions of dry weather flows discharged to transboundary waters (Tijuana and Alamar rivers, river canyons, and the Pacific Ocean)	
J	Wastewater Treatment and Reuse	Eliminate health and environmental risk from wastewater sludge	Efficient sludge management	〈	J.1 Percent of sludge stabilized and disposed or reused safely	〈
K	Wastewater Treatment and Reuse	Maximize wastewater reuse	Percentage of effluent volume reused	〈	K.1 Percentage of effluent volume reused	〈

	This pattern designates indicators constitute important requirements that all alternatives must fulfill equally.
〈	The check mark designates criteria and their components that will be used to evaluate the alternatives. All of the criteria and their components were used to steer the development of all alternatives.

Notes
1 The goal of affordability can be measured once a financial analysis and rate study are conducted.
2 A panel of experts will be assembled to assign a scale for the risk criterion.

Indicators for Institutional Strengthening and Monitoring

Some indicators in this category address institutional issues that must be resolved for successful implementation of the master plan. Other indicators will be used to monitor the effectiveness of the master plan while it is implemented. These indicators address the following topics (see Table 4-3):

- Ongoing community participation
- Industrial discharge compliance
- Reduction of environmental impacts
- Water conservation and system water losses
- Operations and maintenance programs
- Interagency coordination and legal collaboration
- Uncollected revenue.

Table 4-3
Aggregated Indicators for Institutional Strengthening and Monitoring

Aggregated Indicator	Indicators Provided by BTC
1. Percentage of revenue for water service that is uncollected	
	Percentage of water lost (a. actual; b. commercial)
	Indicator of water bills paid
	Percentage of water meters
	Water meter accuracy
	Illegal water connections
	Areas of control
2. Percentage of wastewater discharged from industry that is in compliance with discharge permits	
	Industrial waste volume
	Percentage of industries in compliance
	Control of industrial and commercial discharges
	Number of significant industries
	Number of industries inspected
3. Community Participation	
	Public participation in financing and decision making
	Payment culture
	Number of water rate adjustments
	Water culture
	Water culture programs
	Water conservation culture
	Reuse culture
	Public acceptance
	Replacement of house water laterals
	Rational use of the sanitary sewer
	Private new water works (land developers) and self-financing

Table 4-3 Aggregated Indicators for Institutional Strengthening and Monitoring	
Aggregated Indicator	**Indicators Provided by BTC**
4. Operations and Maintenance Program	
	Preventive maintenance of sanitary sewers
	Corrective maintenance
	Personnel protection equipment
	Training of operating personnel
	Development of operation procedures
	Number of training hours
5. Interagency coordination and legal collaboration	
	Coordination of urban regulation among the three levels of government
	Water rights transfer
	Right-of-way legalization

These indicators could not act as differentiators for the alternatives evaluation, but represent essential components for the successful implementation of the master plan. Some of these components are necessary for BECC certification of projects, such as natural resource conservation (e.g., water) and programs for community participation, operations, and maintenance. The community participation component will be an essential part of any program for water conservation, payment of bills for water service, and other issues related to public behavior.

4.1.3 Weighting the Criteria

In a workshop on May 30, 2002, the BTC met to assign weight to each of the evaluation criteria. Two exercises were used to gather information on the relative importance of the criteria: prioritization and dot budgeting.

The importance of each criteria was defined by the direct prioritization of the BTC members by assigning numbers 1 through 8, according the individual priorities. For example, if the criterion "Percentage of effluent volume reused" is the most important for a particular individual, this criterion will receive number 1.

The dot budgeting method consists in the total number of points (for example 20 points) counted by each member, to be distributed among the different criteria. In this manner, each individual can assign more or less points to each criterion, depending on the importance of the latter. After all members have voted, the total number if points received for each criterion is counted.

The results of the dot budgeting were tallied at the workshop to obtain an initial comparison of the criteria. The weightings from the dot budgeting were compared to the results of the prioritization. A rigorous analysis of the dot budgeting was used to assess the statistical validity of the outcome. The final weights for the criteria are shown in Table 4-4.

Table 4-4 Criteria Rank and Weights		
Criterion for Alternatives Evaluation	**Rank**	**Weight**
Cost of alternative	1	19%
Percent contribution of the largest supply source	2	18%
Level of environmental impacts	3	14%
Level of implementation and performance risk (high, medium, or low)	4	13%
Percentage of effluent volume reused	5	13%
Reduce wastewater discharged to transboundary waters	6	8.5%
Ratio of ground water extraction to artificial groundwater recharge with water of adequate quality	7	8.5%
Efficient sludge management	8	6%

4.2 Evaluation of Alternatives

Following the development of the alternatives, the master plan team developed scales for each of the criteria. Each alternative was evaluated and provided a score for each criterion. The weighted totals were used by the BTC to rank the alternatives and select the alternative that best fulfills CESPT's objectives. The detailed description of the alternatives analysis is provided in Section 12 and the general evaluation methodology is explained below.

The decision making process during the planning process was facilitated by the use of protocol in the technical evaluation of the alternatives with respect to each one of the established criteria and indicators. Results must be obtained concerning each criterion for every alternative (present value, environmental impact, Percentage of effluent reused, etc. See table 4-2).

In this manner, an initial comparison can be made between alternatives for each criterion individually. This comparison is presented in Section 12. Nonetheless, the alternatives prioritization must be based on the fulfillment of the plan's objectives as a whole. Therefore, the Simple Multiattribute Rate Technique was used.

As part of the methodology, a uniformity scale must be established for each one of the criterions, as observed in the following section, each criterion has different measure units: dollars, percentage, indexes, m^3/s, etc.

The master plan used a scale of 0.00 to 1.00 to normalize the results per alternative for each criterion. The following figure shows two examples of scales for two different criterions:

Value	Cost Measures
1.00	30-40 Millions of Dollars
0.75	41-50 Millions of Dollars
0.50	51-60 Millions of Dollars
0.25	61-70 Millions of Dollars
0.00	70-80 Millions of Dollars

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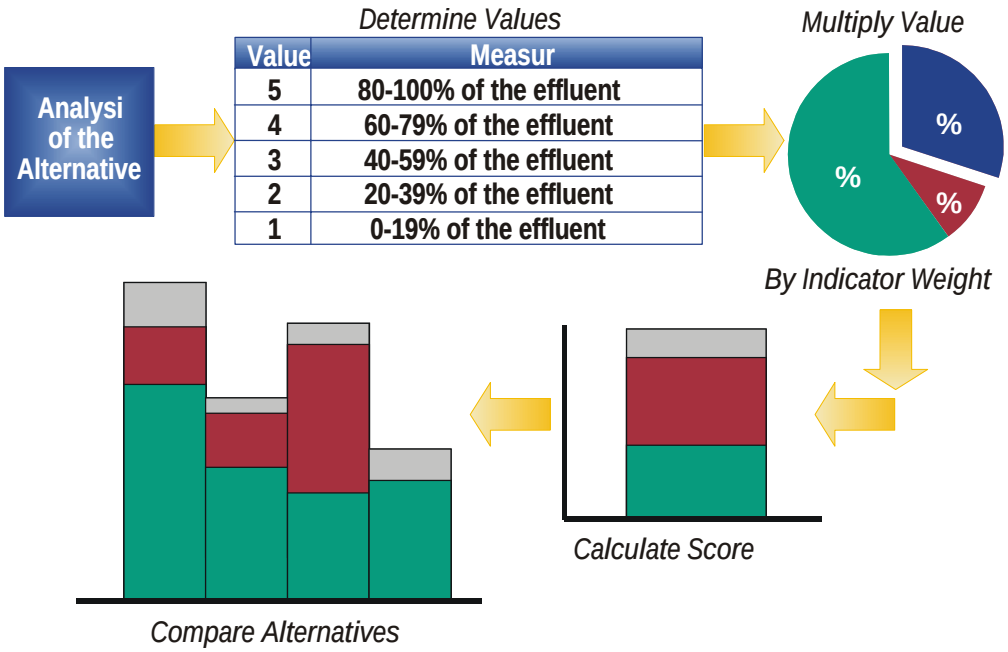

Figure 4-2
Summary of the Alternatives Comparison Process

The application of the decision making process is described in detail in Section 12, which describes the manner in which the alternatives comply with each of the master plan's objectives and presents the global scores of each alternative

It is important to note that because of the steps taken to follow the BECC process, the level of stakeholder involvement, community meetings, and extensive environmental impacts assessment – including transboundary impacts – the master plan project may be eligible to receive high sustainability recognition from the BECC.