INTEGRATING THE PRINCIPLES OF STRATEGIC ENVIRONMENTAL ASSESSMENT INTO LOCAL COMPREHENSIVE LAND USE PLANS IN CALIFORNIA

A Dissertation

by

ZHENGHONG TANG

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

May 2007

Major Subject: Urban and Regional Science

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Approved by:

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ABSTRACT

Integrating the Principles of Strategic Environmental Assessment into Local Comprehensive Land Use Plans in California. (May 2007)

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The lack of early integration with the planning and decision-making process has been a major problem in environmental assessment. Traditional project-based environmental impact assessment has inadequate incentives and capacities to incorporate critical environmental impacts at a broader temporal or spatial scale. While many applications have been geared towards implementing project-level environmental assessments, comparatively little research has been done to determine how to incorporate strategically critical environmental impacts into local planning. Although the principles of strategic environmental assessment (SEA) are not yet required in local planning in the United States, these principles create a theoretical framework for local environmental assessment.

The objective of this study is to examine the ability of local plans to integrate and implement the key SEA principles. This study focuses on increasing the understanding of how and where to integrate environmental impacts into the local planning and decision-making process by converting the principles of SEA into specific planning

tools, policies, and implementation strategies. This study develops a protocol with 112 indicators to measure the strengths and weaknesses of integrating strategic environmental assessment into local comprehensive land use plans. A random sample of 40 California local comprehensive land use plans and associated planning processes is evaluated based on this plan quality evaluation protocol. Statistical analysis and multiple regression models identify the factors affecting the quality of plans with respect to their ability to assess environmental impacts.

The results identify the relative strengths and weaknesses of the ability of local jurisdictions to integrate the SEA principles. The results show that many strategically important environmental issues and tools are rarely adopted by current local plans. The regression analysis results further identify the effects of planning capacity, environmental assessment capacity, public participation and contextual variables on environmental assessment plan quality. The findings extend established planning theory and practice by incorporating strategic environmental considerations into the existing framework of what constitutes a high quality local land use comprehensive plan and suggest ways to improve plan quality.

DEDICATION

To my family

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CHAPTER I

INTRODUCTION

1.1 Research Background

The National Environmental Policy Act (NEPA) of 1969 first established the legislative and programmatic basis for environmental impact assessment (EIA) in the United States. More than 100 countries have followed NEPA to establish their own regulations for EIA (Amir et al., 1997; Briffett et al., 2003; Fisher, 2002; Jacobs & Sadler, 1989; Petts, 1999). However, the traditional EIA has been greatly impaired during the past 30 years because of its inadequate application. Many worldwide experiences have shown that effectiveness of the environmental assessment depends on applying EIA early in the planning and decision-making process (Briffett et al., 2003; CEQ, 1997a; Clark & Canter, 1997). Even with the mandatory introduction of EIA into those counties, agencies actually conduct EIA for projects rather than for the integration of environmental impacts with planning and decision-making. The lack of early integration between EIA and agency planning has been a major problem in its implementation (Randolph, 2004). In many cases, EIA has become an exercise to justify decisions already made, which has resulted in major amounts of paperwork but only minor changes in projects (Keysar & Steinemann, 2002). The cumulative impacts from a single project level cannot be appropriately assessed at trans-boundary scales.

This dissertation follows the style of *Population and Environment*.

In the 1980s, the European Union began to discuss a new approach to strategic environmental assessment (SEA) that would address the environmental impacts of policies, plans, and programs. The implementation of the European Union SEA-Directive 2001/42/EC requires local jurisdictions to conduct SEAs for local plans, programs and projects. Public and private agencies are beginning to take notice and appreciate that what they have feared about strategic assessment may actually benefit them (Underwood & Alton, 2003). SEA is becoming a frontier in the field of environmental assessment (Che et al., 2002). How to transfer the key principles of SEA into the existing policy instrument of planning and environmental assessment is thereby becoming a critical problem for both environmental assessment agencies and planning agencies.

Land use has profoundly impacted environmental resources, species, ecosystem, air, water, human safety, and the ultimately quality of the human environment. In recent years, U.S. federal agencies have become increasingly aware that local comprehensive land use planning has a significant effect on regional and national environment quality (Bonnell & Storey, 2000; Pendall, 1998). Five states, California, New York, Washington, Minnesota and Hawaii, have mandated local jurisdictions to conduct environmental assessment at the local level (Pendall, 1998). Local jurisdictions in California have been encouraged to combine the processes of land use comprehensive planning and strategic environmental analysis (Therivel, 1993). Although the principles of SEA are not yet required in local planning in the United States, these principles create a theoretical framework for local environmental assessment to achieve local sustainable

development. Although some studies began to discuss the SEA effects of comprehensive land use planning (Diaz et al., 2001; Elling, 2000; Keysar & Steinemann, 2002; Noble, 2004a; Onate et al., 2003; Pendall, 1998), little research has been conducted to determine how to convert SEA principles into local tools and how to empirically integrate SEA principles into local comprehensive land use planning. This study will extend the key concepts and principles of SEA by converting them into specific planning tools, policies, and implementation strategies. It will focus on increasing the understanding of how and where to integrate environmental impacts into local planning and decision-making processes. This study will also provide insights into how the SEA principles can be incorporated into local comprehensive land use plans. By understanding the degree to which plans integrate SEA principles, decision makers can be more precise and efficient in their efforts to promote local sustainable development. Identifying the factors affecting the quality of plans with respect to their ability to assess environmental impacts will empirically test key elements of the existing theory on environmental planning.

California is an ideal place to develop a model for environmental assessment for integrating SEA principles with local planning because California, a state with high population density, intense land use demands, and a rapid growing economy, is faced with pressure from population growth, environmental management, and local development in the state. California's economy is the largest of any state in the United States. Its 58 counties will see an estimated population growth of more than 50% within the next 20 years (California Department of Finance, 2001). California ranks first in plant and animal diversity and number of rare species (California Office of Planning and

Research, 2003). As California's population grows, rapid urbanization and extensive land demands are expected to cause numerous conflicts and bring heavy pressure on natural resources and environmental quality. Meanwhile, California has the most restrictive environmental requirements among the 50 states to protect environmental quality in the long term. Since the research setting of this study occurred in the context of a large, complex, diverse, dynamic, and pluralistic state with strict environmental and planning regulations for local land use development, clarifying the internal relationship between local land use comprehensive planning and the California Environmental Quality Assessment (CEQA) is critical. The research settings incorporate the following two aspects:

The first aspect is California local land use comprehensive planning. California local jurisdictions began to adopt master plans in 1937. Local master plans are also called general plans in California or comprehensive plans in general. These terms have similar meanings, thus this study has adopted the most frequently used term: comprehensive plans. The local comprehensive plan should be integrative, long-term and internally consistent and serve as "a 'constitution' for development, the foundation upon which all land use decisions are to be based" (California Office of Planning and Research, 2005). In addition to consistency within the comprehensive plan itself, all principles, goals, objectives, policies, strategies, proposals, programs and projects set forth in a community plan, area plan, or specific plan, must be internally consistent with the overall comprehensive plan. Local planning agencies also tend to consider daily activities such as zoning, subdivision, specific planning and project permits, over

strategic planning in the long term (Harmon, 1972). A long-standing problem in local comprehensive planning is how to balance a long-term, broad planning vision against existing development proposals. A local land use comprehensive plan develops a long-term vision to effectively guide day-to-day land use development decision-making; however, it can often be eroded by short-term, single-project decisions since the consistency of comprehensive plans can be undermined if they are frequently amended for single projects. Thus, integrating environmental consideration into in the planning process as early as possible has been a crucial problem for local planning agencies (Olshansky, 1996).

The second aspect of the research setting is California's environmental assessment. The role of CEQA is unique in California's local development, comprehensive land use planning, and environmental assessment. CEQA mandates all local planning actions relating to comprehensive plan amendments, zoning changes, or conditional use permits. California comprehensive plan preparation is subject to CEQA and a general plan requires an environmental impact report (EIR) as does a comprehensive plan amendment (CEQA, 2006; Olshansky, 1996). Preparation of local general planning is required to perform an initial study or environmental assessment as an amendment to the general plan. CEQA has been identified as a useful environmental assessment tool for both environmental management and local comprehensive land use planning (California Office of Planning and Research, 1987; California Office of Planning and Research, 2005; Catalano and Reich 1977; Olshansky, 1996). CEQA is playing an important role in comprehensive planning as a rational-comprehensive

process by incorporating environmental analysis, public communication, decision-making, information sharing, and alternative scenarios. CEQA can take major responsibility when a local land use comprehensive plan becomes outdated. California has recently paid more attention to the integration of environmental assessment and comprehensive planning processes; for example, San Joaquin County integrated SEA into its comprehensive plan in 1996 (Shepherd & Ortolano, 1996). Integrating environmental assessment into local land use comprehensive planning can change the characteristics of a project-based environmental assessment from an incremental, project-by-project analysis to a comprehensive, systematic, long-range analysis. Integrating environmental assessment with local land use comprehensive planning can improve the performance of local comprehensive planning and thus provide an opportunity for the public to participate in the decision-making process for proposed plans that have significant environmental impacts. Although CEQA emphasizes the integration of environmental assessment and local comprehensive land use planning, many crucial problems are still unsolved in the practice of local comprehensive land use planning and environmental assessment. These include: How should be linked SEA principles to local comprehensive land use planning? What critical components are needed in a local comprehensive land use plan for an effective integration between environmental assessment and local comprehensive land use planning? What obstacles influence the integration of environmental assessment and local comprehensive land use planning? How can an effective integration of environmental assessment and local comprehensive land use plans be promoted?

1.2 Research Objectives

Much effort has been put forward to understand project-level environmental assessment. Research efforts have greatly advanced our understanding for morphology, process, and practice of project-level environmental assessment. While many applications have been directed toward implementing project-level environmental assessment, comparatively little research has been done to determine how to incorporate the principles of SEA into local planning. This study considers the problems facing environmental assessment and local planning in California. The objective of this study is to examine the extent to which local plans integrate and implement of the key principles of SEA. To achieve this objective, a proactive model has been developed to identify the crucial components of existing plans for the integration of SEA principles and local plans. Specifically, this study answers the following research questions: 1) What is a model for a local comprehensive plan that effectively integrates SEA principles? 2) How well do local jurisdictions in California integrate SEA principles into local plans? 3) Which factors promote the integration of SEA principles and local plans? 4) How can local planning process be improved to enhance these integration effects?

There are two reasons for conducting this study. First, the results from this research will have broad implications by advancing our understanding of the relationship between local environmental assessment and the local planning process. The findings can, therefore, provide a more comprehensive and practical picture of local sustainable development and its relation to environmental assessment and local plans. Second, the

results of this study will reduce the existing management gaps between the environmental assessment agencies and planning agencies. This will be done by providing guidance for comprehensive land use planners to minimize environmental loss by designing better planning strategies.

1.3 Dissertation Structure

This dissertation includes seven chapters as follows:

Chapter I is the introduction which identifies the research background and points out the major research problems in environmental assessment. This chapter explains the research objectives and presents the major research questions. The research values are also highlighted.

Chapter II reviews the major literature for environmental assessment, plan quality and plan evaluation, which is the basis for understanding the major principles of SEA and environmental assessment plan components. There are eight parts in this chapter. The first part of this chapter provides a conceptual definition for environmental assessment concepts and development review. The second part introduces the basic six SEA principles. The third part develops SEA principles into local comprehensive land use planning. The fourth part examines the literature on plan quality and plan evaluation. The fifth part explains the plan components with SEA principles. The sixth part of this chapter reviews the factors influencing environmental assessment plan quality. The seventh part states five critical research rationales, and then explains the benefits,

obstacles and promotion methods for integrating SEA principles into local comprehensive land use plans. The eighth provides a chapter summary.

Chapter III presents the conceptual framework for environmental assessment plan quality and identifies the variables in the conceptual model and develops research hypotheses based on the literature review. This chapter then conceptualizes environmental assessment plan quality and develops plan quality evaluation protocol. Finally, this chapter discusses the four sets of independent variables considered to be the main drivers of environmental assessment plan quality.

Chapter IV describes the research design and explains sample selection, data collection, and data analysis methods. This chapter also explains the process of concept measurement for the dependent and independent variables. Reliability test and validity threats are identified at the end of this chapter.

Chapter V characterizes plan quality and interprets the first part of the results of this study. The descriptive results for environmental assessment plan quality are analyzed. Then total plan quality is examined to detect variations in plan quality across jurisdictions. The relative strengths and weaknesses of these jurisdictions on strategic environmental assessment and management are also assessed quantitatively. Additionally, each component of plan quality is explained along with each indicator's breadth and depth scores.

Chapter VI explains the factors influencing environmental assessment plan quality by analyzing the results of regression models for four sets of independent variables: planning capacity, environmental assessment capacity, public participation

capacity and contextual characteristics. A fully specified model is analyzed to make overall statistical conclusions about factors influencing local jurisdictions' environmental assessment plan quality.

Chapter VII summarizes the key findings and presents final conclusions. Theoretical and policy recommendations are made for improving local jurisdictions' strategic environmental assessment and management capacity. Finally, the study's limitations and an agenda for future study are outlined.

CHAPTER II

LITERATURE REVIEW

2.1 Environmental Assessment Concepts

2.1.1 Concepts of Environmental Assessment

Environmental assessment is a useful tool to determine the environmental consequences, or impact, of proposed projects or activities (Jain et al., 2002). Environmental assessment encourages decision-makers to incorporate significant environmental impacts into the planning process. It is a generalized concept for environmental impact assessment, environmental impact statement, environmental impact analysis, environmental impact review, environmental impact report, and strategic environmental assessment. In this study, the term "environmental assessment" includes all of the similar terms that imply the process of determining of the environmental consequences of proposed projects.

Some citied definitions of environmental assessment include: Environmental impact assessment (EIA) is "the process of identifying and evaluating the consequences of human actions on the environment and when appropriate, mitigating those consequences" (Erickson, 1994). Strategic environmental assessment (SEA) is "a systematic process for evaluating the environmental consequences of proposed policy, plan or program initiatives in order to ensure they are fully included and appropriately

addressed at the earliest appropriate stage of decision-making on par with economic and social considerations" (Sadler & Verheem, 1996). SEA is also defined by Therivel (2004) as a process for integrating environmental and sustainability considerations into the strategic decision-making. An environmental impact statement (EIS) is the detailed statement required by NEPA when an agency proposes a major federal action significantly affecting the quality of the human environment. An environmental impact report (EIR) refers to a specific environmental assessment statement in California which evaluates the potential environmental impacts of a project, proposes reasonable alternatives to the project, and identifies mitigation measures necessary to minimize the impacts. The CEQA requires that the agency with primary responsibility for approving a project evaluate the project's potential impacts in an EIR.

2.1.2 Environmental Assessment in the United States

NEPA and its regulations require all federal agencies in the U.S. to consider the environmental consequences of implementing proposed actions in the future. NEPA has been a powerful environmental assessment tool within the U.S. since its procedures compel all federal agencies to consider and report on the environmental effects of proposed actions before making their decisions (Underwood & Alton, 2003). Although there are different interpretations of NEPA's focus and function, the key principles and major elements have been widely recognized. NEPA does not distinguish between policies, plans, and programs (PPPs), but usually refers to actions without distinguishing

between strategic levels and project levels (Fischer, 2002). With respect to triggering NEPA's requirement, a ''federal action'' can be conducted at PPPs levels: policies, plans, programs (Eccleston, 2000). At this point, theoretically, NEPA should be a PPPs-based strategic environmental assessment rather than just a project-based environmental assessment. However, in actuality, most NEPA practices remain at the project-based environmental assessment level rather than promoting a systematic integration strategic environmental assessment into the planning or policy decision-making process (CEQ, 1997a).

The current status of the U.S. 50 states' environmental assessment is illustrated in Table 2.1.

Table 2.1: The Status of Environmental Assessment in the United States

Situations	Numbers	State (Place) Name
Statutes for state actions	15 states	California, Connecticut, Georgia, Hawaii, Indiana, Maryland, Massachusetts, Minnesota, Montana, New York, North Carolina, South Dakota, Virginia, Washington, Wisconsin, District of Columbia, Puerto Rico
Gubernatorial executive orders for state actions	2 states	Michigan, New Jersey
Historical gubernatorial orders for state actions	3 states	New Mexico, Texas, Utah
Statutes for local actions	5 states	California, New York, Washington, Minnesota, Hawaii, District of Columbia, Puerto Rico

Since 1970, fifteen states -- California, Connecticut, Georgia, Hawaii, Indiana, Maryland, Massachusetts, Minnesota, Montana, New York, North Carolina, South Dakota, Virginia, Washington, and Wisconsin -- have established their own environmental assessment statutes for proposed state or local actions (Figure 2.1). Additionally, Michigan and New Jersey have created the gubernatorial executive orders for environmental impact analysis for state proposed actions (Renz, 1984). Moreover, some states historically have state requirements for environmental assessment of state proposed actions. For example, New Mexico, Texas and Utah have had gubernatorial orders or acts, but these requirements have expired (Hart & Enk, 1980; Pendall, 1996).

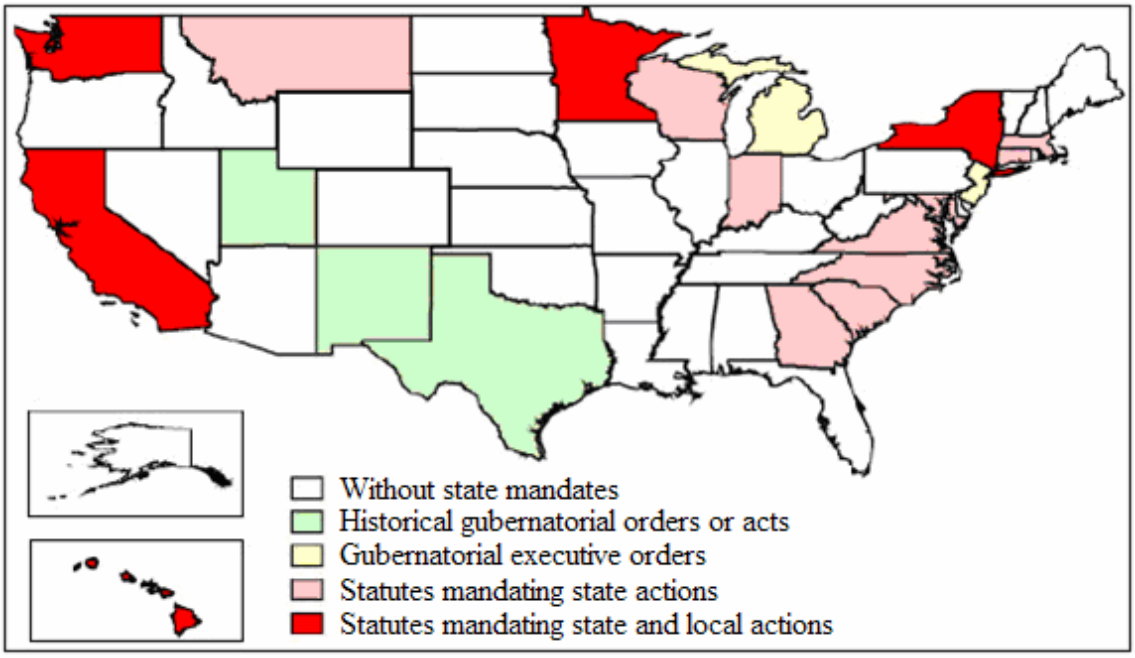

Figure 2.1: Environmental Assessment in the United States (Revised from Pendall, 1998)

In those states with environmental assessment requirements, environmental assessment procedures are playing an important role in state or local environmental quality management. In states without environmental assessment statutes, comprehensive planning acts as a bridge to balance the state's goals of development and conservation. States without local environmental assessment statutes usually adopt stronger planning legislation to ensure environmental quality and control urban sprawl (Pendall, 1996).

Although environmental assessment has been widely used in the U.S., the critical problems of environmental assessment can be summarized as follows:

The first problem for environmental assessment in the U.S. is the lack of early integration between environmental assessment and planning or decision-making processes. Pearlman (1977) found that there is weak integration between planning and environmental assessment and suggests that environmental assessment should be a decision-making tool. Although NEPA is designed to incorporate environmental quality as an essential component of federal policymaking, agencies usually do not fully integrate NEPA into their internal planning processes at an early stage (CEQ, 1997a). Environmental assessment at the state or local levels also lacks an early integration with their internal planning procedures. Most environmental assessment activities focus mainly on site-specific construction, development, or resource extraction projects rather than promoting a systematic integration of environmental assessment into the planning or policy decision-making process. Since environmental assessment has not been fully used as a strategic planning tool, this study attempts to integrate key environmental

assessment principles into local comprehensive land use plans which can provide an alternative way to incorporate environmental considerations into local development decisions.

The second problem is how to assess cumulative impacts and mitigate them. Assessing cumulative impacts is still a challenging issue in environmental assessment (CEQ, 1997b; McCold & Holman 1995; Smit & Spaling, 19995). This problem is still being debated since it is hard to define cumulative effects and reasonably anticipate effects. Some studies have attempted to use new methods to assess cumulative impacts on multiple scales (Smit & Spaling, 1995). In this study, the integration of SEA principles with local comprehensive land use plans can promote local jurisdictions to strategically consider cumulative impacts in local land use decision-making processes.

The third major problem is how to increase public participation in the environmental assessment processes. It is important for an environmental assessment to have a broad representation of key grass-roots, professional, technical, and social groups to ensure recognition of diverse and changing values. The environmental assessment agency should promote participation of these stakeholders to ensure a firm connection to adopted policies and resulting action (Sinclair & Diduck, 2001). To ensure that the methods and data used are accessible to all, the local planning process should include meaningful opportunities for public involvement throughout the environmental assessment process by using mechanisms that are appropriate to the stakeholders. Environmental authorities and the public should be given an early and effective opportunity to express opinions on the draft version of environmental assessment. The

views of the public and relevant jurisdictions should be summarized and considered in the decision-making process. The integration of SEA principles with local comprehensive land use plans can help improve the effectiveness of public participation in environmental issues related to local land use development.

2.1.3 The Main Trend in Environmental Assessment

Before the 1980s, the attention of the EIA process was primarily on the individual project level rather than on policies, plans, and program levels. In the 1980s, the European Union began to discuss a new approach to SEA that would address the environmental impacts of policies, plans, and programs. Some EIA practices were actually extended from a project-oriented assessment to area-wide, regional assessments and policy-level reviews (Jacobs & Sadler, 1990). Programmatic environmental impact statements were used at the strategic decision-making level in the U.S. (Sigal & Webb, 1989). During the early 1990s, growing concern about the effectiveness and efficiency of the existing EIA systems led to the development of environmental assessment processes for earlier and more strategic levels of decision making (Partidario, 2000; Partidario & Clark, 2000; Sadler & Verheem, 1996; Wood & Djeddour, 1992). The European Economic Community issued the first proposal for a directive on the environmental assessment of policies, plans and programs and began the application of environmental assessments at the decision-making level in 1990. Interest has recently shifted towards a cumulative impact analysis of SEA at PPPs levels since 1990s (Bass et

al., 2001; CEQ, 1997b; Irwin & Rodes 1992; McCold & Holman 1995; Smit & Spaling, 1995). Environmental assessment practices in the 1990s reflect the PPPs-oriented SEA. After applying SEA for more than 10 years, the European Parliament and the Council of the European Union adopted an SEA Directive on June 27, 2001. The implementation of a European Union SEA-Directive requires local jurisdictions and related agencies to conduct SEA on PPPs beginning July 2004. More countries have adopted SEA-related legislation as a mandatory procedure at PPPs levels. The milestones in the development of environmental assessment are summarized in the following table (Table 2.2). From these milestones, it is easy to see that the tendency of environmental assessment's development is shifting from EIA to SEA.

Table 2.2: Milestones in the Development of Environmental Assessment

Date	Milestones
1969	National Environmental Policy Act (NEPA) in the U.S.
1978	NEPA regulations in the U.S.
1980s	Environmental assessment at project-levels in many counties
1989	Programmatic environmental impact statement used at the strategic decision-making level in the U.S.
1990s	EIA/SEA debate and SEA applications
2001	SEA adopted by European Union
2004	SEA for local actions in European Union

Based on the previous literature (Arce & Gullon, 2000), the major internal differences between the EIA and SEA are summarized as follows (Table 2.3): First, SEA is intended to be a proactive procedure, whereas EIA is reactive. Second, SEA emphasizes cumulative impacts for sustainable development at PPPs and larger-scale

levels, but EIA mainly considers the direct and indirect impacts even if it began to consider cumulative impacts. Third, SEA provides relatively fewer technical details but has a wider vision of local, regional, or global sustainability while EIA preliminarily considers the direct project-specific impacts at the project level. Fourth, traditional EIA mainly considers the current generation, but SEA emphasizes more inter-generational sustainability and environmental justice. Fifth, traditional EIA mainly considers locally important environmental issues, but SEA is more concerned about strategically critical environmental issues.

Table 2.3: Comparison of EIA and SEA

	Traditional EIA	SEA
Procedure	Reactive	Proactive
Impact	Direct, indirect	Cumulative
Scope	Preliminarily at project-levels	Extending to policies, plans and programs at regional and global levels
Temporal scale	Current generation	Inter-generational sustainability and environmental justice
Elements	Locally important environmental issues	Strategically critical environmental issues

The main purpose of SEA is to facilitate early and systematic consideration of potential environmental impacts in the decision-making process (Sadler, 1996; Therival & Partidário, 1996). The rationales for SEA have been thoroughly discussed by Fischer (2003), Jacobs and Sadler (1990), Lee and Walsh (1992), Partidário & Clark (2000), and Sadler and Verheem (1996). Three critical theoretical rationales for SEA are

summarized as the follows: First is to strengthen project EIA. Second is to integrate environmental and sustainability issues with planning and decision-making. Third is to address cumulative effects on multiple scales. In current practice, SEA has been applied as one conceptual core with multiple forms, names, procedures, and approaches. These include regional environmental assessment, strategic EIA, environmental overview, policy environmental assessment, sectoral environmental assessment, regional sustainability appraisal. A great deal of literature presents SEA principles (IAIA, 2002; Noble, 2000; Partidario, 2000; Therivel, 1993), methodologies (Brown & Therivel, 2000; Kuo et al., 2005; Liou, 2006; Randolph, 2004; Verheem & Tonk, 2000; Wrisberg et al., 2000), procedures (Say & Yucel, 2006), and implementation criteria (Fischer, 2002; Fischer & Gazzola, 2006; IAIA, 2002; Nitz & Brown, 2000; Noble, 2004). Until now SEA has been an approach that is still evolving. SEA has been applied systematically as a vector to integrate the potential environmental impacts and planning in the early stage of decision-making. Furthermore, one of the important aspects for environmental assessment is that it is being increasingly integrated with and performed as a part of comprehensive land use planning at local and regional levels (Randolph, 2004; Therivel & Partidario, 1996). There have been emerging efforts to apply SEA to infrastructure development (Arc & Gullon, 2000), biodiversity (Diaz et al., 2001), regional spatial planning (Elling, 2000), transportation and comprehensive land use planning (Fischer, 2002), energy use (Finnveden et al., 2003; Nilsson et al., 2005), tourism planning (Kuo et al., 2005), industrial planning (Noble, 2004b), and urban development (Shepherd &

Ortolano, 1996). Even if progress with SEA applications has been made, few studies, if any, have been conducted to systematically integrate SEA principles into local plans.

2.1.4 The Framework for Integrating SEA Principles into Local Plans

Based on the literature on environmental assessment and plan quality, Table 2.4 provides a framework for integrating SEA principles into local comprehensive land use plans.

Table 2.4: Integrating the SEA Key Principles into Local Plans

SEA key principles	SEA principles in local planning	Components of local plan quality	Plan quality evaluation protocol
Integrated	Holistic perspective and adequate scope	I. Factual base	31 indicators
Sustainability-led	Sustainable Vision and Goals	II. Goals and objectives	13 indicators
Accountable	Institutional capacity	III. Inter-organizational coordination	9 indicators
Focused	Essential policies and practical tools	IV. Policies, tools and strategies	45 indicators
Participative	Effective communication and participation	IV. Policies, tools and strategies (communication-based)	5 indicators
Iterative	Continuing assessment	V. Implementation and monitoring	9 indicators

There are four steps: First is to identify the SEA key principles. These six key principles were identified by the International Association for Impact Assessment in

2002. Second is to extend the SEA principles into local comprehensive land use planning processes. This study expands the SEA key principles from the environmental assessment field to land use planning field. Third is to define the plan components of land plan quality. Five plan components with the SEA key principles are defined in this study. Fourth is to develop plan quality evaluation protocol. This study develops 112 indicators to measure the integration effects.

Table 2.4 provides an overview for understanding the research framework of this study. This table illustrates the simplified one-to-one correspondence between the SEA principles and the plan quality, but this study also recognizes that the integration of the SEA principles and local comprehensive plans may include many complex interactions among them. The detailed explanations for how to integrating SEA principles into local comprehensive plans are described as the following sections.

2.2 Strategic Environmental Assessment Principles

Research efforts have greatly advanced our understanding of SEA's concepts, morphologies and processes. While many applications have been geared towards implementing SEA, comparatively little progress has been made to incorporate the principles of SEA into local planning. This section explains key SEA principles and illustrates how these principles can apply to the local planning process.

The terms of SEA principles broadly refer to its criteria and definitions. The principles of SEA are designed to assist the planning agencies and other institutions to

implement SEA within certain environmental assessment. According to the International Association for Impact Assessment (IAIA) definitions in 2002, SEA should ideally be integrated, sustainability-led, accountable, focused, participative, and iterative. These six key principles are closely related and guide the concepts, processes, and methods for conducting SEA. These six key principles of SEA can promote a better understanding of the elements for effective environmental assessment and management. The following section explains and extends the meaning of these six principles.

2.2.1 Integrated Principle

The integrated principle means that environmental assessment should have board scope to cover all of the strategically critical environmental issues and impacts. The definition of the integrated principle includes the following aspects: 1) Covering basic environmental elements, issues, and conditions (e.g. water, air, soil, land use); 2) Identifying major environmental problems in the environmental assessment process; 3) Identifying the internal relationships of environmental, social and economic issues; 4) Identifying significant environmental characteristics (e.g. trans-boundary impacts, intergenerational impacts, environmental justice); 5) Identifying cumulative environmental impacts and strategically critical environmental issues (e.g. biodiversity, ecosystems, global warming).

In order to incorporate environmental considerations into a decision-making process, a clear definition of environment must be identified. Environment is “a

combination of our natural and physical surroundings and the relationship of people with these surroundings" (Jain et al., 2002). Environment is also defined by the CEQA as "the physical conditions which exist within the area which will be affected by a proposed project including land, air, water, minerals, flora, fauna, ambient noise, and objects of historical or aesthetic significance" (CEQA, 2006). Bass et al. (2001) uses the term of "human environment" in the NEPA as "the natural and physical environment and the relationship of people with that environment." Based on these definitions, this study identifies the scope of environment as the natural environment, built environment, and human health which does not including socio-economic aspects. This study adopts SEA's scope concentration on the physical environment itself rather than socioeconomic aspects.

Defining the scope of environmental issues is critical to the understanding of the integrated principle. SEA should provide sufficient, reliable and usable information for environmental analysis (Fischer & Gazzola, 2006). There are different opinions as to whether or not further development of SEA should primarily consider environmental impacts or incorporate socio-economic aspects (Fisher, 2002). One school emphasizes that SEA should primarily be an environmental tool, but others suggest that SEA should move toward integrated or sustainability impact assessment (Abaza et al., 2004). In practice, the degree of the integration for environmental and socioeconomic issues is subjected to a particular institutional arrangement.

According to the integrated principle, SEA must include a description of physical environmental conditions from both a local and regional or global perspective. The

integrative environmental setting constitutes the baseline physical conditions to determine whether an environmental impact is significant. The description of the environmental setting is fundamental to an understanding of the significant effects of the proposed policies, plans, programs or projects and their alternatives. Furthermore, SEA must evaluate cumulative impacts which are aggregated from the subsequent effects of an action with other past, present, and reasonably foreseeable future actions. It is more difficult to estimate cumulative impacts precisely since they often occur later, both in time and geographic distance, than primary impacts (CEQ, 1997b; The Interorganization Committee on Principles and Guidelines for Social Impact Assessment, 2003). A more thorough assessment of cumulative effects would involve additions to the main SEA. Greenhouse emissions, ozone depletion, biodiversity, ecosystem protection and other regional or globally important environmental problems may cause cumulative impacts. These issues with cumulative impacts should be identified in the SEA process.

2.2.2 Sustainability-led Principle

The sustainability-led principle emphasizes a sustainable development to meet future generations' needs. The definition of the sustainability-led principle includes the following: 1) Conducting environmental assessment within the context of sustainable development; 2) Ensuring an appropriate decision towards sustainable development; 3) Identifying strategic environmental visions or critical environmental targets; 4)

Developing specific long-term goals for development proposals that contribute to environmentally sustainable development.

Sustainability is defined by the U.N. World Commission on Environment and Development (UNCED) as "to meet the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). SEA allows for a systematic and comprehensive consideration of sustainability principles in the decision-making and planning process (Shepherd & Ortolano, 1996). SEA provides a more sound and holistic framework for planning and decision-making and can help realize sustainability through integrating its principles in decision-making (Arce & Gullon, 2000; Fisher, 2003; Noble, 2000). SEA provides a platform to move the concepts of sustainability from the theoretical level to practical levels. The increasing requirement for SEA can be more directly linked with sustainable development goals. Sustainability principles can be applied through SEA in specific contexts that are interconnected across jurisdictional disciplinary, scalar and generational boundaries. Noble (2000) outlines the links and differences between SEA and sustainability: Sustainable development is not equal to SEA but can be a crucial part of SEA. In addition, SEA is not equally defined by sustainable principles and is not exclusively sustainability-led (Nobel, 2000). SEA requires that its application be set within a broader context of sustainable development and is based on a vision of strategic assessment to promote sustainable development. SEA can incorporate sustainability criteria through considering strategic alternatives and integrating its principles into the decision-making and planning processes to realize sustainable development. Arce and Gullon (2000) summarized the contribution of SEA

towards sustainability as following: First, SEA ensures environmental consideration at the beginning of the decision-making process. Second, SEA can provide a framework for the chain of action. Third, SEA can integrate policy, planning and programs. Fourth, SEA helps detect potential environmental impact at an early stage.

2.2.3 Accountable Principle

The accountable principle measures institutional ability to manage and coordinate environmental assessment issues. The definition of the accountable principle includes the following: 1) Identifying institutional ability undertaken by the leading agency; 2) Identifying inter-organizational cooperation abilities; 3) Defining agency responsibility for the strategic decision to be taken; 4) Identifying stakeholders and their interests; 5) Achieving to professionalism, rigor, fairness, impartiality and balance in the planning process; 6) Creating independent checks and verification.

The accountable principle measures the practice of environmental assessment by asking: whether the environmental assessment is undertaken by the lead agency; do local jurisdictions have necessary capacities for effective inter-organizational coordination; have the responsibilities of the affected agencies for the strategic decision been allocated; have all stakeholder interests been identified. The accountable principle ensures that the environmental assessment process embraces professionalism, rigor, fairness, impartiality and balance. The environmental assessment should include an independent review and verification and indicate how sustainability issues were taken into account in decision-

making. The goal of the accountable principle is to promote inter-organizational coordination and capacities among the stakeholders on multiple scales. To reduce existing and possible conflicts among stakeholders and remove policy gaps on multiple scales. Thus, it is crucial for environmental assessment to enhance the inter-organizational coordination and capacities among the stakeholders. The accountable principle requires that the leading agency to identify all stakeholders and keep strong inter-organizational coordination and capacities among them. The SEA process should be stakeholder-driven, explicitly addressing the public's inputs and concerns (Fischer & Gazzola, 2006). To achieve effective inter-organizational coordination and capacities, it is critical for the leading agency to appropriately identify all stakeholders' interests. SEA should be part of an open and accountable decision-making process by the leading agency and involve all affected stakeholders to promote accountability (Nobel, 2003). SEA should be proactive in identifying the stakeholders and coordinate their interests and values for the proposed policies, plans, programs or projects.

2.2.4 Focused Principle

Novel (2003) suggests that a focused SEA should provide an appropriate level of analysis for the policy, plan, or program in question. The focused principle emphasizes developing appropriate approaches and relative policies to address potential environmental impacts. The focused principle reflected in the local planning process mainly involves essential policies and practical tools and defined below: 1)

Concentrating on critical environmental impacts for sustainable development; 2) Analyzing potential magnitude of the impacts at an appropriate level; 3) Providing sufficient, reliable and usable information and related policies, strategies and tools for development planning and decision making; 4) Seeking appropriate policies, tools and strategies to manage environmental issues.

The focused principle identifies potential environmental impacts and suitable policies, tools and strategies to avoid or reduce the adverse effects in environmental assessment processes. IAIA (2002) points out that a focused SEA is customized to the characteristics of the decision-making process. SEA needs to compare the indicator values to targets, reference values, ranges, thresholds, criteria, or development tendency, as appropriate. SEA also needs to determine significance, predicted impacts and find appropriate policies, tools and strategies according to selected environmental criteria and objectives. This principle provides a chance to develop effective policies, tools and strategies through an analysis of the focused issues. In fact, developing effective policies, tools and strategies for environmental assessment is essential to reduce significant environmental impacts from proposed actions.

2.2.5 Participative Principle

The participative principle demands that decisions be made in an open, transparent manner with full public involvement and effective communication. The definition of the participative principle includes the following aspects: 1) Providing

adequate opportunities for public involvement; 2) Informing and involve the affected individuals and organizations throughout the decision making process; 3) Addressing inputs and concerns explicitly in documentation and decision making; 4) Ensuing sufficient access to all relevant information; 5) Providing a channel for equal, transparent, effective communications.

The IAIA suggests that SEA be a participatory process (IAIA, 2002). Public participation is now widely recognized as a crucial component of environmental assessment (Stinchcombe & Gibson, 2001) which can identify key issues to eliminate impacts as well as identify potentially affected groups to provide an opportunity to assess possible impacts (The Interorganization Committee on Principles and Guidelines for Social Impact Assessment, 2003). The participative principle means "active" participation rather than "passive" engagement of stakeholders, including the identification of different stakeholders or interests and particular concerns of minority and disadvantaged communities (Abaza et al., 2004). To protect the interests of affected communities, public participation should pay special attention to the people at risk from environmental change and lifestyle disruption resulting from proposed action (World Bank, 1999). Public participation should emphasize that interested and affected parties can express their views and access the environmental assessment documentation and processes. Moreover, public participation should begin early in the process and continue throughout. Hartley & Wood (2005) has established a set of criteria, including communication, fairness, timing, accessibility, information provision, and influence on

decision-making, competence and interaction, to evaluate public participation effects in environmental assessment processes.

2.2.6 Iterative Principle

The iterative principle indicates that SEA should be part of an ongoing decision cycle and should inspire future planning through the potential amendment of strategic decisions (Fischer & Gazzola, 2006). The iterative principle involves some crucial components in environmental assessment processes: alternatives, mitigation measures, and monitoring processes. The definition of the iterative principle includes the following aspects: 1) Ensuring assessment results in the decision making process and guide future planning; 2) Providing sufficient information to judge whether or not a decision should be amended; 3) Conducting continuous environmental reviews and updates; 4) Developing mitigation measures and monitoring procedures; 5) Identifying and evaluating the effects of the main alternatives; 6) Identifying cost and time effectiveness in a timely and expeditious manner.

Many studies have addressed the criteria of SEA implementation effects (Brown & Therivel, 2000; Kjorven & Lindhjem, 2002; Sadler & Verheem, 1996; Sheate, 1992; Therivel, 1992; Verheem & Tonk, 2000; Zagorianakos, 1999). The iterative principle measures the activities of monitoring, mitigation and alternatives in environmental assessment implementation practices. Monitoring, mitigation and alternatives are three key elements in the SEA implementation process. Monitoring and mitigation link short-

term goals at the project level with long-term goals of sustainable development (Shepherd & Ortolano, 1996). SEA not only assesses impacts, it also identifies the means for mitigating adverse impacts. More importantly, formulating appropriate alternatives in the SEA process is the heart of environmental assessment processes. SEA needs to identify, predict and evaluate the effects of the main alternatives. Expert judgment and scenarios to develop better alternatives, mitigation measures can be built into selected alternative and monitoring systems to ensure the performance of a selected alternative.

In summary, the key SEA principles provide a framework to address environmental assessment and environmental management problems. To completely understand SEA major themes and how they can be captured in a local comprehensive land use plan, it is necessary to look beyond the broad-based work on environmental assessment and closely examine the key literature that supports SEA for local planning processes. Planners must consider these key principles when constructing the framework to address environment-related problems. Since SEA systems are developed in diverse forms, not all SEA principles are equally applicable to all SEA applications.

2.3 SEA Principles in Local Plans

While an increasing number of policy makers are accepting the concept of SEA, there is relatively little research about how the concept can be implemented in practice. There are many studies on the broad goals and scope, but there has been little effort to

understand how the principles, concepts and objectives of SEA can be achieved in practice, particularly at the local level. While the literature on environmental assessment and environmental management provides a foundation for understanding how environmental assessment works (Abaza et al., 2004; Arce & Gullon, 2000; Devuyst & Hens, 1999; Noble, 2003), it does not identify whether or not the environmental impact has been effectively considered in the planning process. The major shortcoming of this literature is that it leaves the strategic, proactive decision-making process out of planning and management. This section will provide insight into integrating the key principles of SEA into local comprehensive land use planning.

The principles of SEA provide a foundation to measure the quality of the integration of environmental assessment into local plans. These principles can be implemented into local comprehensive plans as following: First, the plan must incorporate a holistic perspective and adequate scope. Second, the plan must set strategic goals and sustainable objectives. Third, the plan must consider institutional capacity needs. Fourth, the plan must focus on essential policies and practical tools. Fifth, the plan needs to incorporate an effective mechanism for public participation, communication and information sharing. Finally, the plan must provide for continuous assessment to ensure the implementation of mitigation measures, as needed.

2.3.1 Holistic Perspective and Adequate Scope

The integrated principle of SEA can be translated into the holistic perspective and adequate scope in local planning. The principle of holistic perspective and adequate scope is mainly reflected in the factual base plan component of local comprehensive land use plans. The key points of the holistic perspective and adequate scope include the following: 1) Reviewing the whole environmental system as well as its parts; 2) Considering human impacts on environment at spatial and temporal scales; 3) Assessing cumulative environmental impacts; 4) Identifying major environmental issues; 5) Illustrating the environmental factual base appropriately (e.g. maps, inventories).

A holistic perspective and adequate scope in local comprehensive land use planning considers environmental sub-systems, their state as well as the direction and the rate of change of that state, their component parts, and the interactions between parts. Moreover, local comprehensive land use plans should assess both positive and negative consequences of human activity in a way that reflects the costs and benefits for human and environmental systems. A holistic perspective should review the whole system, the interaction between its parts and consequence of human activity (Duinker & Greig, 2006; Hardi & Zdan, 1997). An adequate scope should adopt a temporal horizon long enough to capture both human and time scales, thus responding to the needs of future generations as well as current short-term decision-making requirements.

The principle of holistic perspective and adequate scope requires consideration for environmental impacts on multiple scales. Local plans should not only consider local

environmental effects but also define the environmental effects across boundaries and build on current conditions to anticipate future conditions. Significant environmental issues may include population, human health, fauna, flora, soil, water, air, climate factors, cultural heritage and working landscape. The interrelationships should be identified and included in the factual base in local comprehensive land use plans. Environmental characteristics of areas likely to be significantly affected should be described and difficulties such as deficiencies in data or methods should be explained in local comprehensive land use plans. The SEA objectives and baseline data collection need to be mutually reinforcing and the methods used to investigate the affected baseline need to be appropriate to the size and complexity of the land use assessment task. The local comprehensive land use plan needs to identify sources of information, including expert judgment and matters of opinion in clear and concise language. Maps and tables are appropriate in local plans. Local plans can contain a non-technical summary covering the overall approach to the SEA and any changes to the plan resulting from the SEA. The principle of holistic perspective and adequate scope in local planning can build an explicit set of categories or an organising framework that links vision and goals to assessment criteria and implementation policies.

2.3.2 Sustainable Vision and Goals

Sustainable vision and goals is a strategic vision with specific goals that the jurisdiction wishes to strive towards in order to achieve its long-term vision of

sustainable development and specific targets within specific time frames. The sustainability-led principle of SEA in local comprehensive plans can be translated into the principle of sustainable vision and goals, which can mainly be reflected in the goals and objectives of local plans. The key points of sustainable vision and goals in local planning process involve the following: 1) Describing an ideal picture for local jurisdictions to product the future; 2) Providing a context for understanding community concerns, prioritizing issues, determining action steps and identifying indicators to measure progress; 3) Selecting appropriate objectives within specific time frames; 4) Providing relative indicators to measure the process of sustainable vision and goals.

The principle of sustainable development is now recognized by planners as a new planning agenda (Beatley & Manning, 1997). However, the road to sustainable development is much more difficult than had been anticipated. Since sustainable development is an abstract concept, it is hard to translate the principle of sustainable development into practice since it can guide planning, but is a difficult concept to apply (Berke & Conroy, 2000; Conroy & Berke, 2004; Jänicke et al., 1997; Stinchcombe & Gibson, 2001). One of the biggest obstacles, among many identified, is the lack of an appropriate methodology for incorporating the criteria of sustainability into the policies of local or regional development. The ultimate goal is to achieve sustainable development through integrating environmental assessment principles into planning and policymaking (Partidario, 1996; Shepherd & Ortolano, 1996). Local jurisdictional comprehensive land use plans provide a bridge to achieve sustainability. When Berke and Conroy (2000) evaluated the effects of 30 comprehensive plans integrating

sustainable development principles, the results show that plans integrating the concept of sustainable development are not significantly different from plans that do not.

Defining a local jurisdiction's vision is an important step in the process of becoming a sustainable community. A local planning vision describes an ideal picture for local jurisdictions to look into the future. A sustainable vision guides local planning's goal-setting, policies and actions. A sustainable vision and relative goals and objectives can provide a context for understanding community concerns, prioritizing issues, determining action and identifying indicators to measure progress. Planners play critical role in promoting a dialogue for integrating sustainable concepts into public policy solutions at the community level (Berke & Conroy, 2000). In local comprehensive land use planning, sustainable visions should be considered in developing objectives and targets. The strategic objectives of sustainable development can be clearly set out and linked to indicators and targets in local land use decision-making processes. For example, two critical environmental issues at the global scale can be used as a measurement of more sustainable land use practices: greenhouse gas emissions and loss of biodiversity (Vitousek et al., 1997).

2.3.3 Institutional Capacity

Institutional capacity measures the capacity of a local plan for environmental assessment and coordination. The accountable principle of SEA described above can be translated into the principle of institutional capacity in local planning and be mainly

reflected in the component of inter-organizational coordination. Iinstitutional capacity includes the following key points: 1) Identifying stakeholders and their interests appropriately in local comprehensive land use planning; 2) Identifying major stakeholders' responsibilities; 3) Enhancing environmental governance, management capacity and organizational effectiveness; 4) Improving human resources, financial resources and external relations for environmental management; 5) Improving inter-organizational coordination; 6) Removing policy gaps between organizations.

The principle of institutional capacity needs to identify stakeholders in local environmental assessment and then work collaboratively with them. A strong institutional capacity needs to identify the stakeholders, involve them and find out where they stand in relation to local environmental quality. A successful local comprehensive land use plan acknowledges and involves the stakeholders who are interested in, who are concerned about, who are affected by, who have a vested interest in, or who are involved in some way with the environmental issues. Since many stakeholders may be involved in local environmental management, inter-organizational coordination is necessary in the local planning process. Inter-organizational coordination among the federal, state government, neighboring jurisdictions, regional agencies, private sectors and other stakeholders is essential for successful plan implementation. Collaboration is a hallmark of successful implementation of the principles, policies, and strategies for local comprehensive land use planning and environmental assessment. Inter-organizational coordination is an integral part of the plan-making process. Institute capacity should clearly assign responsibility and provide ongoing support in the decision-making process

(Hardi & Zdan, 1997). Responsibility should be clearly assigned among various agencies and interested groups whose ongoing support is necessary to promote inter-organizational coordination and capacities. Institutional capacity also involves data collection, maintenance, documentation and conflict resolution. Environmental effects and environmental assessment should be integrated into existing local development planning and decision-making to minimizing disruption to existing inter-organizational arrangements. The principle of inter-organizational coordination and capacities can ensure institutional accountability while inter-organizational coordination and capacities can eliminate policy gaps of multiple scales, multiple organizations, and multiple stakeholders.

2.3.4 Essential Elements and Practical Tools

Essential policies and practical tools identify critical environmental effects and find appropriate approaches. The focused principle of SEA can be translated into essential policies and practical tools for local planning. Essential policies and practical tools can be primarily reflected policies, tools and strategies in local plans. Essential policies and practical tools include the following key points: 1) Identifying the essential environmental policies; 2) Identifying priorities that need to be addressed to achieve local a jurisdiction's vision; 3) Providing environmentally significant thresholds; 4) Transferring goals of sustainable development into a policy instrument; 5) Developing

regulatory policies for comprehensive land use planning and environmental protection; 6) Encourage incentive tools and strategies.

Hardi and Zdan (1997) have identified the critical elements and practical focus for assessment of sustainable development. Determining how to transfer goals of sustainable development in local planning and environmental assessment into a policy instrument is crucial for the implementation of these goals. Identifying essential environmental policies and developing practical tools will thoroughly integrate goals and objectives of local plans into practice. Essential policies and practical tools can help local plans incorporate essential environmental effects and find appropriate policies, tools and strategies. Local planning needs to consider the environmental conditions on which local people depend. The potential effects of economic development and relative planning tools should be considered in the section on policies, tools and strategies. The key issues for environmental protection and economic development should be defined in local plans and focus on significant environmental effects and set reasonable policies, tools and strategies to address these issues. Technical, procedural and other difficulties encountered can be discussed in the preparations of policies, tools and strategies in local planning processes. The uncertainties of environmental impacts should be explained explicitly in the section on policies, tools and strategies so realistic alternatives can be considered and documented. When local plans predict and evaluate relevant environmental effects, the accepted standards, policies, tools, strategies regulations and thresholds should be stated.

2.3.5 Effective Communication and Participation

Effective communication and participation refers to communication's legitimacy, transparency, continuity and efficiency. The participative principle of SEA can be translated into effective communication and participation in local planning. Effective communication and participation can be reflected in the component of policies, tools and strategies. Effective communication and participation includes the following key points: 1) Having a broad representation of key grass-roots, professional, technical, and social groups; 2) Developing an open, equal, efficient, collaborative mechanism; 3) Providing adequate information-sharing channels; 4) Developing appropriate mediation to promote effective communication; 5) Developing multiple channels for communication; 6) Incorporating the public and stakeholders into land use decision-making.

Effective communication and participation is critical in both the environmental assessment and local planning processes (Forester, 1989; Healey, 1992, 1997; Innes, 1995, 1996, 1998; Innes and Booher, 1999; Lawrence, 2000; Sager, 1994, 2002; Sinclair & Diduck, 2001). Effective communication and broad participation between the proponent agency and affected parties will create interactive communication for environmental assessment and become a fundamental component in local land use comprehensive planning. Local plans should be designed to address the needs of the stakeholders and stated in clear language for effective communication. It is important for local planners to have a broad representation of key grass-roots, professional, technical, and social groups to ensure recognition of diverse and changing environmental values.

An open, co-sharing mechanism is necessary to ensure that the methods and data used are accessible to all. The local planning process should include meaningful opportunities for public involvement throughout the environmental assessment process by using mechanisms that are appropriate to the stakeholders. The draft plan should be made available for public comment and all relevant jurisdictions consulted. Environmental authorities and the public should be given an early and effective opportunity within appropriate time frames to express opinions on the draft plan before adoption. Views from the public and relevant jurisdictions should be summarized and responded to in the local planning process. The techniques for effective communication, broad participation and openness include public meetings, advisory panels, open houses, interviews, and other participatory appraisal techniques. Core components to ensure successful stakeholder involvement in local comprehensive land use planning process include adequate information sharing, sufficient time, effective feedback mechanisms, maximum attendance and free exchange of views.

2.3.6 Continuing Assessment

Continuing assessment includes monitoring, evaluation and feedback system using target-based indicators to evaluate progress towards sustainable development and signal the need for changes in the local plan. The iterative principles of SEA can be translated into continuing assessment which can be reflected in the plan component of implementation and monitoring of the local plan. Continuing assessment includes the

following key points: 1) Developing a monitoring, evaluation and feedback system; 2) Ensuring that timely environmental information is provided at the appropriate decision points; 3) Evaluating local planning's progress towards sustainable development; 4) Signaling the need form a local plan's condition to change and regularly updating the plan; 5) Monitoring important projects and environmental condition changes regularly; 6) Developing cumulative effective monitoring and assessment.

Continuing assessment includes mitigation assessment and monitoring procedures and considers mitigating important environmental effects in local planning. Mitigation assessment should then be proposed to prevent, reduce and, as fully as possible, offset any significant adverse effects and optimize environmental and social benefits. Significant adverse impacts should first be addressed in the environmental assessment process where they can be prevented or minimized by reviewing the alternatives. Once significant adverse impacts have been considered, local plans also need to consider mitigating the impacts that are adverse but not considered to be significant. Mitigating adverse impacts is subject to a relevant technical understanding of the impacts and their local circumstances. An actual impact can be rectified through repairing, rehabilitating, restoring, or compensating the affected environment. Explicit procedures should be indicated in local plans with an explanation of the methodology to be used for mitigation.

Continuing assessment ensures that timely environmental information is provided at the appropriate decision points. There must be constant interaction and feedback between the environmental assessment processes and the local planning

processes to ensure that changes can be implemented to avoid or minimize adverse impacts to the maximum extent possible. Local plans should pay more attention to all proposed actions that are likely to have a significant adverse effect on the environment and human health. In a social context for the purpose of environmental justice, particular consideration should be given to vulnerable stakeholders, such as local communities who depend upon the resource base for their sustenance or lifestyle. An iterative, adaptive and responsive system is necessary to promote development of collective learning and feedback to decision-making. Under the principle of continuing assessment, goals, frameworks, and indicators can be adjusted as new insights develop for local sustainable development. Monitoring procedures in local planning should be clear, practicable and linked to the indicators and objectives used in the environmental assessment. During implementation of the plan, regular monitoring can detect baseline information to identify adverse effects at an early stage. Cumulative effective monitoring can be used to monitor some plans and programs that will initiate regional-scale change in environmental stock or critical natural assets (Abaza et al., 2004). Since monitoring environmental impacts is an expensive progress, setting priorities order for monitoring programs will be beneficial for local planning. In fact, mitigation and monitoring should occur on an iterative basis during the whole local planning process.

Integrating SEA principles into local planning can establish a theoretical base for environmental assessment elements in local plans. Based on the key SEA principles, a coherent set of principles in local planning have been developed to capture the major environmental impact themes in plan quality and plan evaluation. The remaining section

discusses the potential, and existing barriers, and possible methods to promote integration of SEA with local comprehensive land use plans.

2.4 Plan Quality and Plan Evaluation

The literature on plan quality and plan evaluation can provide insight into plan components and thus increase the understanding of how and where to integrate environmental impacts into local pans.

2.4.1 The Development of Plan Quality and Plan Evaluation

Since 1960s, some studies have focused on plan quality and plan evaluation (Hill, 1968; Young, 1966). Early evaluation of plan quality concentrated on specific plan components such as land use, housing and employment (Boyce, 1970; Masser, 1983). Peiser (1984) and Tett and Wolfe (1991) emphasize assessing plans' impacts and their hidden meanings. One major advance in plan evaluation was made to develop objective criteria for evaluating plan quality. Although some difficulties still remain in conceptualizing plan quality, major advances have been made. Alexander and Faludi (1989) give five criteria for plan quality comprehensive evaluation: conformity, rational process, optimality ex ante, optimality ex post, and utilization. Kent and Jones (1990) highlight the key characteristics in plan quality measurement: clear policies and strong maps with spatial intent of policies or land-use design. Healy (1993) emphasizes that

normative principles should be consistent with communitywide goals when plan quality is conceptually defined. Berke and French (1994) have adopted an evaluation framework of fact basis, goal, and policy to analyze the influence of state planning mandates on local plan quality. Kaiser et al. (1995) further defines factual basis, goals, and policies as core components of plan quality. In their definition for plan quality, the factual basis should identify existing local conditions and needs related to community physical development. The goals should be clearly articulated and include aspirations, problem abatement, and needs that are premised on shared values. The policies should be appropriately directed to guide decisions and implement the goals. Talen (1996) points out that conceptualizing plan quality is a challenging issue because planning is a complex process. Baer (1997) focuses on a plan as a product or outcome of the planning process as well as a blueprint for future action when he established a conceptual model for plan evaluation. In the mid of 1990s, a series of indicators or checklists were developed to allow planners to make a quantitative assessment and analysis of plan quality. Berke et al. (1997) developed conceptual definition of plan quality by Kaiser et al. (1995) and provided an empirical case study regarding New Zealand's natural hazard plan quality measurement. At that time, many studies focused on the influence of state mandates on hazard mitigation plan quality (Berke and French, 1994; Berke et al., 1996; Burby and Dalton, 1994; Burby and May, 1998). These articles advance our understanding and measurement of hazard mitigation plan quality and provide insight into the factors influencing plan quality. Similar frameworks were used to measure the quality of nature hazards in local planning (Berke et al., 1996; Burby, 1998; Godschalk,

1999). Brody (2003a, 2003b) further extended previous conceptions of plan quality by adding two additional components of inter-jurisdictional coordination and capabilities and implementation to measure the ability of ecosystem management in local plans. This framework developed by Brody (2003a, 2003b) was substantially more systematic than earlier efforts and its protocol can be an example of research and practical plan quality evaluation. Five components can be used to conceptualize plan quality: factual basis; goals and objectives; inter-organizational coordination and capabilities; policies, tools and strategies; and implementation (Brody, 2003a, 2003b). These previous studies have provided a conceptual and methodological foundation for quantitatively assessing plan quality. This study adopts a similar framework, but further develops a conceptual model of plan quality evaluation. For example, monitoring is highlighted in the implementation plan component; the definitions for the factual basis plan component and policies plan component are further extended. My framework for plan quality evaluation includes five plan components: 1) factual basis; 2) goals and objectives; 3) inter-organizational coordination; 4) policies, tools and strategies; 5) implementation and monitoring.

Numerous empirical studies have recently focused on evaluating plan quality of natural hazards (Berke & Beatley, 1992; Brody, 2003c; Burdy, 1998, 2005; Burby et al., 1985; Burby et al., 1988; Burby et al., 1999; Burby et al., 2000; Nelson & French, 2002; Olshansky, 2001), land use pattern (Kent & Jones, 1990), planning mandates (Berke & French, 1994; Berke et al., 1997; Burby, 2005; Burby and Dalton, 1994; Burby et al., 1997; Deyle and Smith, 1998), ecosystem management (Brody, 2003a, 2003d, 2003e; Brody & Highfield, 2005; Brody et al., 2004), sustainability (Berke, 1995a, 1995b, 2002;

Berke & Conroy, 2000; Conroy & Berke, 2004; Laurian et al., 2004), urban sprawl (Brody et al., 2006), public participation (Brody, 2003d, 2003f), intergovernmental collaboration (Burby & May, 1998; Godschalk, 1992, 1994) and plan implementation (Brody & Highfield, 2005; Laurian et al., 2004). Although major achievements were made in previous studies, few studies, if any, have systematically considered environmental impacts and assessed environmental planning quality for local comprehensive land use plans. Furthermore, no empirical model is provided to measure local comprehensive plan quality for strategically environmental management. In recognition of this gap in the existing research a plan quality, this study proposes a proactive model of strategic environmental management to empirically examine local environmental assessment and planning quality.

2.4.2 Major Strengths and Weaknesses for Plan Quality and Plan Evaluation

The strengths of plan quality and plan evaluation in terms of facilitating effective environmental assessment can be summarized as follows: 1) providing a framework to protect important natural resources and environmental values. 2) incorporating systematic thinking to understand and manage environmental quality. 3) providing a proactive approach for environmentally-related planning and development decision-making. 4) providing a chance to implement adaptive environmental management regarding to constantly changing environmental conditions, new knowledge and technologies, or updating regulations, laws and policies. 5) improving inter-

organizational collaboration and capacities on regional or larger scales. 6) identifying possible or potential conflicts in land use or development.

The main weakness of plan quality and plan evaluation in terms of facilitating effective environmental assessment is that the plan evaluation method cannot accurately reflect the entire dynamics of local planning or environmental assessment. Additionally, many external factors such as geographical variations, socioeconomic characteristics, and various policy frameworks also affect final plan quality and plan evaluation results. Finally, a high quality environmental assessment plan does not necessarily result in effective environmental assessment in practice.

2.5 Plan Components with SEA Principles

The major elements of effective comprehensive land use planning regarding environmental assessment should be incorporated in local plan components by directly or indirectly integrating the key principles of SEA. Understanding SEA principles and concepts can lead to a more thorough understanding of what makes effective environmental assessment and what makes a high quality local environmental plan. This section provides a foundation for the theories and concepts of environmental assessment which can identify a local plan that effectively integrates SEA principles. Based on key SEA principles, a coherent set of principles for local planning have been developed to capture the major environmental impact themes in a plan coding protocol.

Based on the literature on plan quality and environmental assessment, this study proposes to measure the ability of local comprehensive plans to incorporate SEA principles that cover essential environmental factors and values. A high quality local comprehensive plan that incorporates environmental factors captures all SEA principles and themes and pulls them together as an integrated whole. A local comprehensive plan must specify existing local conditions and identify needs related to local development as well as represent general aspirations, objectives and needs. Thus, competing missions, objectives, values, physical and socioeconomic conditions are brought together and bound into a local comprehensive plan. More importantly, a high quality local comprehensive plan represents a collaborative vision for strategic environmental management. A strong guide to strategies, policies, standards and criteria of environmental assessment is essential for a local comprehensive plan. Furthermore, a local comprehensive plan needs to indicate how to implement the plan and how to coordinate with others.

By combining existing conceptions of plan quality with the theoretically driven SEA principles, this study develops a framework with five critical components to measure the ability of local comprehensive plans to advance environmental assessment. These components include 1) factual basis, 2) goals and objectives, 3) inter-organizational coordination, 4) policies, tools and strategies and 5) implementation and monitoring.

These five core plan components provide a framework to measure the quality of a local comprehensive plan in environmental assessment. Under this framework, detailed

indicators should be developed within each component to explain the key points that comprise a strong plan. The SEA principles can be translated into local comprehensive plans through these detailed indicators that can be identified, measured, and compared in local comprehensive plan. Therefore, when aggregated, these indicators can be statistically measured and to provide a platform to compare the quality of plans across multiple jurisdictions. The following section will explain each part of the five plan components.

2.5.1 Factual Basis

In this study, the factual basis of a plan refers to an understanding of environmental conditions that are closely related to humans and local development. The SEA's integrated principle requires a holistic perspective and adequate scope in a local plan. On the one hand, this principle will guide the factual basis of environmental assessment in local comprehensive planning; on the other hand, a good environmental assessment plan should reflect the integrated principles to achieve a thorough factual basis.

Understanding the meaning of environment is necessary before this study identifies which factors should be involved in the factual basis of a local plan. Environment is the aggregate of things and conditions that surround or envelop every living and nonliving thing, which also includes humans, and the things, processes, and conditions that pertain to humans (Erickson, 1994). An important purpose of NEPA for

preparing an environmental assessment is to determine whether the proposed action has the potential to significantly affect the quality of the human environment (Bass et al., 2001). According to NEPA regulations, definition of the human environment includes three categories: natural environment, built environment and human health; however, it does not include the effect on economics, social issues, and psychological issues. CEQA defines the environment as "the physical conditions which exist within the area which will be affected by a proposed project including land, air, water, minerals, flora, fauna, ambient noise, and objects of historical or aesthetic significance." Although the CEQA development of the environment includes natural and man-made conditions, in fact, the human environment, which mainly considers human safety and health, is incorporated in many aspects of the California local comprehensive plans. Thus, this study adopts the definitions of NEAP and CEQA to create the scope of factual basis.

The factual basis of environmental assessment in a local plan includes an inventory of existing conditions for the natural environment, built environment and human health within environmental management of the targeted jurisdiction. The factual base for measuring the effects of local plans that integrate SEA principles should involve the following three categories: 1) natural environment, 2) built environment and 3) human health. The factual basis should capture the crucial environmental conditions that significantly affect the quality of the human environment in the local development process rather than just be a thorough checklist.

In general, the natural environment is closely related to natural resources conservation and natural environmental protection; in fact, it provides much of the

scientific background required to understand and implement SEA principles and guidelines. There are three types of important environmental issues to consider in the natural environment. First, a solid factual basis of local comprehensive land use plans must identify local jurisdictions' basic environmental conditions. A local land use comprehensive plan must have geographic comprehensiveness and identify a local jurisdiction's physical setting and sphere of influence which covers the entire planning area and addresses the broad range of issues associated with development. In addition, a local comprehensive plan must recognize the long-term temporal impact from future development. Furthermore, major environmental laws and regulations should be identified as a legal base in local comprehensive land use planning processes. Second, a solid factual basis for local comprehensive land use plans must identify critical local or regional environmental elements including ecosystem, fauna, flora, biodiversity, biological and ecologically critical lands, soil and geology resources, air, and water resources. The connectivity and interaction of these natural systems should also be identified in local plans. Third, a solid factual basis of local comprehensive land use plans must identify critical environmental issues at a global scale such as greenhouse gas emission, ozone layer depletion, climate change and global warming.

Effects on the built environment include considering the environmental values of historic and cultural resources, open spaces, agricultural resources, population and housing impacts, recreation, utilities and public services. Furthermore, an appropriate description of physical constraints and land availability in local development is the foundation of land management.

The effects on human health involve the risk of damage from natural disaster, risk of exposure to hazardous materials, wastes, and activities and risk of contracting diseases. Information about environmental hazards and community safety determines the relative suitability of lands for development. Meanwhile, population growth is a critical issue for local development since it increases the demands for resources that are important to quality of life.

In summary, the foundation for the factual basis is an inventory of critical effects on human environment quality which draws explicitly from the literature on environmental assessment. The factual basis is the descriptive foundation on which policies and decisions within the plan are made and expressed in a written or visual form. A local land use comprehensive plan must contain a written text describing the environmental conditions and elements for development. It must also contain maps, catalogues, and diagrams illustrating the generalized distribution of land uses, natural resources, environmental conditions, and other factual information that can be illustrated.

2.5.2 Goals and Objectives

Goals and objectives guide the implementation of environmental assessment in local comprehensive plans. The sustainability-led principle in SEA seeks a sustainable vision and strategic goals or targets.

The goals and objectives should be a reflection of the needs and desires of the local jurisdictions as well as an indication of the actions required to achieve the

envisioned future for effective environmental assessment. Goals and objectives in comprehensive plans should embody local jurisdictions' vision of what they want to become in the future (Brody, 2003a) and serve as an overall policy guide for local development. Goals are general expression of a local jurisdiction's values and may be abstract in nature. The target objectives are more specific statements of planning activities for environmental assessment required to achieve the goals of local comprehensive planning. Goals should be long-term, challenging, consistent and clear; objectives should be specific, measurable, acceptable, timebound, realistic, extending, and rewarding. Objectives are more specific and measurable actions necessary to move towards these goals; usually multiple objectives have to be achieved before the goal is reached. A general plan is a set of long-term goals and policies that the community uses to guide development decisions. Burby et al. (1997), Burby (2005), and Nelson and French (2002) have found that more thorough, clear, specified goals and objectives can subsequently result in formulating and adopting effective strategies in hazard plans.

In this study, goals for environmental assessment are general statements that describe what a local comprehensive plan wants its overall environmental impact to be. Goals address environmental impact in the context of the local development's overall mission and environmental policy. The goals for environmental assessment can articulate more specific, measurable objectives for environmental performance, therefore, objectives usually are concrete activity statements for environmental assessment elaborating goal statements. The objectives can identify measurable targets for the activities that a local comprehensive plan will take to maintain or improve its

environmental quality within a specific timeframe. Meeting objectives will bring the local development's environmental performance in line with its stated environmental goals. For example, water resource use efficiency is a goal for a local comprehensive plan. One of the targeted objectives can be that reduce this jurisdiction's ground water consumption by 2% per year for the next five years. In summary, the goals and objectives in the plan protocol not only should cover the critical mission in current literature on environmental assessment and management, but more importantly, they should be a commitment to include environmental values and visions in the process of local jurisdiction's development. Based on the literature on environmental assessment, the critical goals in local comprehensive land use plans include protecting natural resources and environmental values, seeking intergenerational sustainability, balancing environmental, social and economic development. In addition, local jurisdictions should seek environmental justice and equity in local development. Additionally, building environmental stewardship is also an important goal for effective environmental assessment. Besides these goals, local jurisdictions must protect critical environmental issues such as ecosystem, biodiversity, water, land, air, open space, energy. Finally, goals of local jurisdictions should protect local jurisdictions' historical and cultural resources and build disaster-resistant, healthy, safe communities.

2.5.3 Inter-Organizational Coordination

Environmental inter-organizational coordination is crucial for environmental assessment since environmental problems are increasingly recognized as a multiple-scale issues rather than impacts only at the local level. The accountable principle in SEA requires adequate institutional capacity in inter-organizational coordination plan component in a local plan.

Inter-organizational coordination identifies the need to coordinate with other agencies, jurisdictions and landowners to make a high quality plan (Brody, 2003b, 2003c). Inter-organizational coordination emphasizes that the environmental problems are complex, cross-boundary, dynamic dispersed and multiple-scale. Therefore, effective environmental assessment and management during the local comprehensive planning process requires a wide range of expertise to understand these environmental problems, and an even wider range of agencies to find and implement a solution. Inter-organizational coordination serves as an umbrella framework for all the agencies providing collaborative services at the local level. Identifying stakeholders and their inter-organizational coordination procedures can help eliminate areas of conflict, identify locations where specific conflicts will occur or attempt to create a mechanism for conflict resolution.

Inter-organizational coordination measures the ability of local jurisdictions to collaborate with neighboring or regional jurisdictions and organizations to manage boundary-spanning environmental problems and is a process for achieving good

development governance, particularly in environmental assessment in this study. Inter-organizational coordination can identify existing or potential conflicts between local planning units and other agencies that are specified in environmental issues. Environmental assessment requires local governments to coordinate their plans with adjacent jurisdictions, regions and other organizations. Planning will be more effective if intergovernmental coordination is taken seriously by local jurisdictions. In summary, inter-organization is a crucial component of plan quality for environmental assessment.

2.5.4 Policies, Tools and Strategies

Policies, tools and strategies can realize the goals and objectives in local comprehensive land use plans. The focused principle in SEA requires that a local comprehensive land use plan provide essential policies and practical tools for essential elements. The participative principle in SEA provides policies, tools and strategies to achieve effective communications and public participation.

Policies, tools and strategies set forth specific principles of land use design and development management (Kaiser et al., 1995) and reflect clear commitments that guide decision-making in local jurisdictions. Policies, tools and strategies are based on comprehensive plan's factual basis and the goals and objectives to ensure that the vision of a local comprehensive plan is met. Policies, tools and strategies should be worded so their progress or achievement can be monitored or measured. Each of the policies, tools

and strategies may pertain to only one particular aspect of a goal or it may be one of several successive steps toward goal achievement.

Policies draw on environmental assessment literature to identify key tools and strategies that protect human environmental quality. Duerksen et al. (1997) summarize the comprehensive land use planning policies and tools for wildlife protection, including regulatory tools, incentive tools, acquisition programs, private-sector initiatives and education policies. A high quality local comprehensive plan for environmental assessment should have the breadth and scope to manage complex environmental systems. Policies, tools and strategies include the following: 1) environmental assessment tools 2) regulatory policies, 3) incentive strategies, 4) land acquisition programs, and 5) communication-based policies.

Environmental assessment tools have been widely discussed by many researchers (Brown & Therivel, 2000; Kuo et al., 2005; Liou, 2006; Munier, 2004; Randolph, 2004; Verheem & Tonk, 2000; Wrisberg et al., 2000). CEQ (1997b) suggested the primary and special methods for analyzing cumulative effects, including questionnaires, interviews and panels, checklists, matrices, networks and system diagrams, modeling, trends analysis, overlay mapping and GIS. Lawrence (2003) makes a summary for environmental assessment methods: network analysis and systems diagrams, modeling, projection and forecasting, backcasting, visioning, scenario writing, story telling, ecological footprint analysis, life-cycle analysis, rapid rural and participatory rural appraisal. Munier (2004) analyzes the environmental appraisal techniques with case studies: GIS, contingent valuation, cost-benefit analysis, cost-effectiveness analysis,

input-output analysis, life cycle analysis, multicriteria analysis, environmental damage appraisal, and risk analysis. Therivel (2004) summarizes the major SEA tools as five types of techniques: 1) qualitative participatory: expert judgment, public participation, quality of life assessment; 2) mapping and simple spatial analysis: overlay maps, land unit partitioning analysis, GIS; 3) impact prediction: network analysis, modeling, scenario or sensitivity analysis; 4) impact evaluation: cost-benefit analysis, multi-criteria analysis, life cycle analysis, vulnerability analysis, carrying capacity, ecological footprints analysis, and risk assessment; and 5) sound planning tools: compatibility assessment. Some of these environmental tools have been widely used in current comprehensive land use planning activities, but some of them are still in the introduction period. Based these literature, this study will develop its own protocol for environmental assessment tools for local comprehensive land use planning.

Regulatory policies have been widely used in comprehensive land use planning practices since the early 1990s. Regulatory policies can make most direct approaches for local land use management and environmental protection. Regulatory policies include land use restrictions, density restrictions, land permits and buffer requirements, zoning, special overlay districts and subdivision review standards (Duerksen et al., 1997).

Incentive strategies are non-mandatory policies which are used to stimulate incentives for effective environmental assessment. The incentive strategies include transfer of development rights (TDR) or purchase of development rights (PDR) away from environmentally sensitive areas, conservation or mitigation banking, and density

bonus. Incentives can sometimes be as more effective than regulatory policies (Duerksen et al., 1997).

Land acquisition programs refer to acquisition of land through the use of bond measures and private donations from land trusts and conservancies. Land acquisition programs often simplify management decisions and can provide a permanent way for land ownership to protection (Duerksen et al., 1997). The major land acquisition programs include fee simple purchase, sellbacks and leasebacks, options and rights of first refusal, easements, land dedications and development impact fees.

Communication-based policies can increase meaningful participation in comprehensive land use planning processes by providing input to decision makers, allowing the public to help set goals and priorities, and encouraging shared commitment. Communication-based policies are increasingly important for effective implementation of complex or controversial environmental issues.

2.5.5 Implementation and Monitoring

The component of implementation and monitoring can measure the ability of a plan to implement the policies, tools, and strategies. The iterative principle needs effective monitoring for environmental effects. The component of implementation and monitoring will reflect the iterative principle and continuing assessment. Each policy must have at least one corresponding implementation measure. The most successful

plans are those that were written from the start with a concern for realistic and well-timed implementation measures.

The component of implementation and monitoring establishes a framework to promote system for environmental assessment and management, to determine how well the plan will be meeting its goals and objectives, and to identify opportunities for improving the performance of environmental assessment actions where needed. The real challenge often comes in translating a local comprehensive plan's vision, goals, policies, tools and strategies into implementation. A comprehensive plan is a long-term visionary document that looks at a long range planning horizon. This does not mean that the plan does not conduct reviewing or updating procedures. In fact, it is highly recommended that effective implementation have on-time monitoring to identify when environmental assessment achieves various goals and objectives. Local jurisdictions should continuously monitor their comprehensive plans to evaluate its success and ensure that the plan remains up to date as the local jurisdiction evolves. Implementation and monitoring can guide public decision-making and determine how it should be monitored and updated.

Plan implementation and monitoring becomes an important element in both the theory of collaborative learning and the practice of adaptive management (Brody, 2005); thus, local comprehensive land use plans need to incorporate effective implementation and monitoring. Policies, tools and strategies can be put into effect through implementation measures such as zoning, land division, and environmental ordinances. Once the proposed policies, tools and strategies are outlined in local comprehensive

plans, it is time to decide how they will be implemented and how to monitor the processes. Effective implementation and on-time monitoring are necessary in order for local comprehensive land use plans to be of value to local jurisdictions. Although a local comprehensive plan is prepared with accuracy, implementation and monitoring is an enduring instrument that eventually ensures regulations, ordinances and cooperation working. Implementation and monitoring are a series of stakeholders' actions that must be initiated when feasible and timely. The component of implementation and monitoring makes it possible for a local comprehensive plan to become reality. Implementation emphasizes making policies, tools and strategies effective, while monitoring focuses on changing conditions and updated standards.

2.6 Factors Influencing Plan Quality

The above section has reviewed the literature on environmental assessment and plan evaluation. The following section reviews the major planning theories related to the factors influencing plan quality and explains which factors are influencing on the plan quality. Drawing on the literature on environmental assessment (Lawrence, 2000; Richardson, 2005) and plan quality, this study presents four sets of factors that are expected to influence local comprehensive land use plans integrated with the principles of SEA: planning capacity, environmental assessment capacity, public participation capacity, and contextual characteristics. The major planning theories and the four sets of factors influencing plan quality are discussed in the followings:

2.6.1 Planning Capacity

The theory of rationality supports to build strong planning capacity for local land use management. The rational planning refers to "the identification of a problem, need, or opportunity; statement of goals, objectives, and criteria; the generation and evaluation of alternatives; and explicit links to implementation" (Lawrence, 2000). The theory of rationality is widely using in local land use comprehensive planning to build strong planning capacity and pursue a simple, explicit, adaptable, logical, consistent, and systematic planning process. Local jurisdictions with strong planning capacity enable have an optimal opportunity to achieve given goals in the planning process. The theory of rational planning has been commonly accepted among most theoreticians and practitioners for both environmental assessment and urban planning since 1960s (Altshuler, 1965; Banfield, 1959; Forester, 1989; Habermas, 1984; Healey, 1992, 1997; Innes, 1995; Lawrence, 2000; Lindblom, 1959). In practice rational planning theory supports using adequate qualified planners, regularly updating plans, and improving technical skills in local comprehensive land use planning.

Planning capacity directly influences local comprehensive land use plan quality through growth management, hazards management, and coastal management (Berke & French, 1994; Dalton & Burby, 1994). Local comprehensive planning is a complex process regarding geographic, social and economic settings, which can be affected by jurisdictional frameworks and planners' values and experiences (Forester 1984; Kent, 1964; Kent & Jones, 1990). Planning capacity can be measured by the number of

planners, plan updates, professional technical skills, and collaborative efforts. Four major plan capacity characteristics are selected in this study.

First is the number of planners. Planners are associated with increased levels of personnel, financial resources, technical expertise, and commitment to build a high quality environmental plan (Brody et al., 2004; Burby & May, 1998). However, jurisdictions with understaffed planning agencies are at a distinct disadvantage when it comes to protecting environmental quality for future development.

The second factor is the most recent plan update. Plan updates are an effective way to improve environmental plan quality. Local land use comprehensive planning is a dynamic process which is based on a snapshot of jurisdictional values, politics, economic, and environmental conditions at a particular planning range. A local land use comprehensive plan should reflect changes and continually monitor the relevance of comprehensive land use plan elements to ensure that they are remain current with their evolving conditions. Local jurisdictions must establish formal procedures for regularly monitoring the effectiveness of their comprehensive land use plans. If monitoring reveals a plan inadequacy, local comprehensive land use plans should be amended, updated, or revised in order to bring it up to date. Although many previous studies provide a conceptual and methodological foundation for quantitatively assessing plan quality, relatively few studies (Brody et al., 2003c) focus on plan quality changes over time. Thus, this study introduces the plan update as an influencing factor on plan quality. Understanding how plan quality can be improved by plan updating may provide important insights strengthening plan quality.

The third factor is professional technical skills. Technical skill has been identified as an important factor to prepare high-quality plans (Berke and French, 1994). Geographical information system (GIS) has been widely recognized as an important planning tool. GIS is an ideal tool to analyze environmental phenomena with spatial and temporal dimensions in analyzing spatial coincidence, adjacency and network through accurate identification, description, quantification and improved evaluation of spatial and temporal variability of the impacts. Local planners can use overlay mapping and GIS analysis to identify areas that would be appropriate or inappropriate for future development that can improve comprehensive land use plan quality.

The fourth factor contributing to planning capacity is collaborative efforts which are required for many local planning activities. California requires local jurisdictions to coordinate the preparation of local comprehensive land use plans with local and intergovernmental agencies. Local jurisdictions must foster collaborative efforts to address issues and promote comprehensive planning and enable various agencies to resolve conflict. In addition, since many environmental issues are not confined to jurisdictional boundaries, collaborative efforts must be made for planning outside the jurisdiction's territory. Environmental management exists in many single-purpose professional agencies that are not designed to address complex and interconnected environmental issues that cut across jurisdictional boundaries; therefore inter-organizational collaboration is increasingly being implemented by various agencies to develop effective regional solutions using an integrative approach. Collaborative planning can guide the orderly and efficient extension of land use development, ensure

the preservation of critical environment and important natural resources, and establish consistent land use patterns for development with adjoining jurisdictions, regional or specific organizations.

2.6.2 Environmental Assessment Capacity

Three planning theories: rationality, socio-ecological idealism and pragmatism, support to build strong environmental assessment capacity in local comprehensive land use planning and environmental assessment.

First, environmental assessment parallels the rational planning process (Lawrence, 2000). Environmental assessment is the process of evaluating and documenting environmental information to facilitate rational planning and decision-making and to managing adverse environmental impacts of proposed plans. Environmental assessment generally has more consideration for important natural resources and environmental issues than the planning process. Meanwhile, rational planning process usually provides more thorough depictions that can benefit environmental assessment. Environmental assessment can be improved through learning from the rational planning process for better problem identification, statement of goals and objectives, generation of alternatives and policies, planning tools, assessment criteria, implementation, and monitoring. Thus, rationality provides a foundation for both comprehensive land use planning and environmental assessment. However, environmental assessment has deficiencies similar to rational planning. Environmental

assessment also is expert-biased with a peripheral role for the public, lack of creativity in communication or weak on implementation (Lawrence, 2000). Recent theory of communicatively rational planning is greatly influenced by environmental assessment activities. For the past 50 years, many experts have debated environmental assessment's approaches and perspectives from its pragmatic, procedural, social, economic, ecological, political aspects. The need to integrate environmental assessment with planning and decision-making is a recurrent theme in environmental assessment literature; therefore, environmental assessment capacity is considered as an important factor influencing environmental assessment plan quality.

Second, the theory of socio-ecological idealism emphasizes integrating social and environmental substance into comprehensive land use planning (Lawrence, 2000). Local comprehensive land use planning should explicitly integrate socio-ecological values, principles and criteria into its decision-making process. Ethics is also a crucial element in the theory of socio-ecological idealism and comprehensive land use planning. Socio-ecological idealism also has significant influence on environmental assessment which incorporates biodiversity, ecosystems, environmental justice, human health, environmental risk, trans-boundary environmental concerns and protection initiatives, and represents a partial integration of comprehensive land use planning and critical environmental substance. This theory also provides fundamental support to build strong environmental assessment capacity in local comprehensive land use plans.

Third, the theory of pragmatism states that "knowledge-based experience should guide planning action to develop an efficient, adaptable, relevant, realistic pragmatic

planning process by establishing census-building, building trust, and reducing resistance to change" (Lawrence, 2000). Thus, there is an increasing voice in environmental assessment for streamlining, harmonization, procedural integration, and scoping, environmental assessment which tends to be similar to pragmatic planning. Besides rationalism and socio-ecological idealism, pragmatism also supports the three factors on environmental assessment capacity: assessment scope, streamlining ability and information management and sharing.

Environmental assessment capacity can be measured by three factors: assessment scope, streamlining ability, information management and sharing. The explanation for these three factors follows:

The first factor is assessment scope. In order to identify particular environmental issues and assess their potential impacts, it is necessary to set the context within which the assessment is to take place by identifying critical environmental issues, or problems to be addressed and the type of SEA to be undertaken and the intended objectives of the assessment for local comprehensive land use planning. Environmental assessment scoping highlights SEA requirements and criteria at the outset and presents an opportunity to identify the relevant stakeholders, identify the availability and quality of data and determine a set of appropriate tools and techniques to address the issue at hand. Integration of SEA principles in a plan should be positive support for strategic environmental management by local land use policies. There are three major types of environmental assessment scopes: master-based, program-based and projected-based environmental assessment. A master environmental assessment should assess the

physical and biological characteristics of an area, air and water quality, open space, the capacities and levels of use of existing services and facilities, and the effects of different development projects. The scope for master environmental assessment is essentially a collection of environmental information which can serve as the foundation of local environmental assessment. The scope of program-based environmental assessment examines broad policies, considers cumulative environmental effects, and contains multiple mitigation measures. The scope for master-plan's environmental assessment is intended to be the foundation for analyzing the environmental effects of subsequent projects. The scope of project-based environmental assessment examines project-specific impacts.

The second factor is streamlining ability which minimizes duplication and overlaps in environmental assessment and planning. Streamlining achieves efficient identification, effective evaluation and timely resolution of environmental and regulatory issues. The streamlining procedure allows documents developed by local comprehensive land use planning agencies, in compliance with environmental assessment, to become a substantial part of the documentation required by other agencies. The advantages of streamlining are manifold: minimizing redundancy, maintaining internal consistency, and integrating functionally-related goals, objectives, and policies. Streamlining procedures also help establish a cooperative environmental assessment process, concurrent reviews and a census-building dispute resolution process. Streamlining can make the local comprehensive land use plan easier to understand and become the vehicle for accomplishing public involvement and providing a focused mechanism to resolve

disputes. Streamlining can also establish "one decision-making process" for land use environmental assessment and planning decision-making.

The third factor is environmental assessment information's management and sharing which is an important part of environmental assessment capacity. Major environmental assessment information includes notice of preparation, an environmental impact report, negative declaration, and other types. If no significant environmental impact is found, a negative declaration can be filed to describe why the comprehensive land use plan will not have a significant environmental impact. Sometimes mitigation measures are needed to ensure that there will be no significant environmental impact. If significant environmental impacts are predicted, then an environmental impact report must be prepared before the plan can be considered by decision makers. Notice of preparation should be made available for public and agency review prior to approval of the plans to allow the public to comment on the contents and adequacy of the documents. When a final environmental assessment document is adopted, a declaration has to be published for public review. Thus, the notice of preparation, environmental impact report, negative declaration, and declaration are all important informational documents. Other types of environmental assessment documents may include a mitigated negative declaration which describes a project that has incorporated changes or mitigation measures to ensure that there will be no significant impacts resulting from the project.

2.6.3 Public Participation Capacity

The theory of collaboration and communication supports strong public participation capacity in local comprehensive land use planning. The theory of communications and collaboration came from the idea of "communicative rationality" (Habermas, 1984). Based a critique of instrumental rationality of planning, planning theorists (Healey, 1997; Sager, 1994) proposed contemporary theories on communicative and collaborative planning. The communications and collaboration theory was developed for "discursive democracy" (Dryzek, 1990) and applied by many planning researchers (Forester, 1989; Healey, 1992, 1997; Innes, 1992; 1995, 1996, 1998, 1999; Lawrence, 2000; Sager, 1994, 2002). The most important facet in the theory of communication and collaboration is creating an environment for planning processes grounded in the principles of free speech and rational argument. This has been recognized as the biggest problem in the theory of rationalism. Communications and collaboration can provide the opportunity to reformulate traditional rational planning. This shift also influences environmental assessment practice. The theory of collaboration and communication emphasizes public participation (Sinclair & Diduck, 2001), collaborative learning (Armitage, 2005; Diduck & Mitchell, 2003; Webler et al., 1995) and adaptive management (Noble, 2000). Environmental assessment as a vehicle for public participation comments on the analysis as a framework for encouraging dialogue between stakeholders and the general public and serves as a communicative rationality for uncertainty, conflict, and a shortage of problem-solving resources. Environmental

assessment is a means for reaching mutual understanding and agreement through communication. Thus, public participation is widely identified as a critical component effective environmental planning by reflecting a commitment to the principles of democratic governance (Arnstein, 1969; Burke, 1979; Day, 1997). Innes (1990) suggests that public participation in planning provides a platform to mutually debate, rationally consider, and reach consensus on public issues relevant to plan decision-making. Public participation seeks collaboration in which the public is given significant roles and degrees of power in local land use decision-making (Day, 1997; Godschalk, 1994; Godschalk et al., 2003; Innes, 1996; Lowry et al., 1997; Wondlleck & Jaffee, 2000).

Three factors selected to analyze public participation capacity include participation formats, public notice channels, and public participation incentives.

The first factor is participation formats which are a critical part of public participation. Berry et al. (1993) point out that successful local participation must include: sufficient breadth and depth. Participation breadth measures who is involved and participation depth measures the extent of involvement. Participation depth means that participants do more than simply show up at public meetings. Public hearings and workshops are the most frequently used public participation methods. According to the Brown Act enacted in 1953**,** local jurisdictions in California must provide advance public notice of hearings and meetings and meetings and hearings must be open to the public if no exceptions apply. California planning laws require that local jurisdictions hold public hearings prior to most planning actions and proposed plans. Advance notice of the place and time of the public hearing must be published in the newspaper and also

mailed directly to involved citizens. The public can be involved in adopting or amending a plan in a variety of ways. The major participation formats include workshops, townhall meetings, public hearings, site tours, and charrettes.

The second factor is public notice channels. Multiple public participation channels can help overcome linguistic, institutional, cultural, economic, and historic barriers to achieve effective communication. Effective public participation should provide notice channels to enable the public discuss the information, opinions and concerns which may be relevant to land use decisions. Multiple public notice channels can thereby increase the accountability and transparency of land use decision-making and contribute to public awareness of environmental issues (Vanderhaegen & Muro, 2005). The most frequently used public notice channels may include the internet, newspapers, radios, television; mail, notices, and community newsletters.

The third factor is public participation incentives. Active public participation should develop incentive strategies that allow for early and meaningful public participation in local comprehensive land use planning by neighborhood organizations, development representatives, business organizations and all other stakeholders. Because many neighborhoods generally lack leadership and resources for public participation, they do not have the same level of influence on the final plan decision-making. Thus, public participation incentives provide a chance for local land use decision-makers to seriously consider public concerns and actually address those concerns. Planners can provide more incentives to foster an exchange of information and an open discussion of ideas in public participation process. With public participation incentives, people have

an opportunity to come together and work to solve possible environmental conflicts in a collaborative spirit that forms community solidarity. Public participation incentives can bring obvious benefits to all stakeholders if it occurs early in the planning cycle and is aimed at achieving consensus for the desired outcome of land use decision-making (Doelle and Sinclair, 2006).

2.6.4 Contextual Characteristics

The theory of political-economic mobilization has a particular concern with social, economic, and environmental justice, unequal power relations, community empowerment, and the need for structural change (Lawrence, 2000). The planning process can be improved through a better understanding of on the insights afforded by the political-economic aspects of planning. The theory of political-economic mobilization is evident in environmental assessment processes which have explicitly considered social and environmental justice, stakeholders' conflicts, social equity and community empowerment. Since comprehensive land use planning is complex, dynamic, and comprehensive, it is always difficult to measure the event of political-economic mobilization on plan quality. To analyze political-economic mobilization, an alternative is to add the contextual characteristics into the factors influencing plan quality.

In this study, five major factors have been used to analyze the contextual influence on plan quality.

The first factor is population which has been identified as an important contextual factor by Brody (2003a) and Burby et al. (1997) in local comprehensive land use planning. Local jurisdictions with larger populations may have more expertise, resources and financial support for local and use planning, but may face more environmental pressure and problems.

The second factor is wealth. Wealthy people often have more time and interest in environmental issues (Scott & Willits, 1994; Van Liere & Dunlap, 1981).

The third factor is education. Education also has been identified as an important factor contributing to environmental issues (Brody et al., 2004; Guagano & Markee, 1995; Howell & Laska, 1992; Raudsepp, 2001). Communities with a more highly educated population can influence the planning process and encourage higher levels of environmental protection.

The fourth factor is population growth. Growth pressures are associated with higher levels of disturbance to environment quality resulting in a greater perceived need to protect the environment (Brody et al., 2004).

The fifth factor is public and conservation lands. Public and conservation lands play a role in open space and natural environment since approximately half of American lands are federally owned. Meanwhile, due to the constraints of public and conservation land ownership and geographic unsuitability, many new land development plans are concentrated in certain areas, especially in the coastal valleys, agricultural lands, and ecologically sensitive foothills which are all critical environmental components.

2.7 Research Rationales

The above sections provide a literature foundation for this study. The following section further summarizes five critical research rationales and explains the benefits, obstacles and improvement approaches for the integration of environmental assessment and local comprehensive land use plans.

2.7.1 Five Research Rationales

The first rationale is environmental values. Integrating SEA principles with local comprehensive planning can provide a systematic way to marshal facts about environmental issues and ensure that environmental values are incorporated into local development decision-making (Onate et al., 2003). Since local comprehensive planning addresses many aspects of a local jurisdiction's physical, social and economic environment, it plays an important role in local development control and guidance mechanisms. To ensure the value of environment and achieve the goals of strategic environmental management, the preferred planning option is to incorporate SEA's principles, visions, concepts, strategies, tools and policies into the existing local comprehensive plan structure. Integrating SEA principles into a local comprehensive plan will, in the long run, result in a greater and more permanent "institutionalization" of environmental assessment into the local jurisdiction's development processes, practices, and patterns (Noble, 2004a). If SEA principles can be effectively incorporated into local

comprehensive planning, the environmental values, initiatives stand a much greater chance of being considered for implementation in practice in the long term. The effective method for fostering and promoting the implementation of environmental assessment principles, concepts, strategies and policies within the community is to completely integrate them into existing elements of the comprehensive plans. Under this scenario, there would not merely be a separate environmental assessment element within the local comprehensive plan. But SEA's principles, strategies, and policies would appear in appropriate places throughout the entire comprehensive land use plan. This method recognizes that environmental assessment is not a separate, optional activity, but rather a necessary activity that must be addressed in each functional element in local comprehensive plans. The potential for greater attention to environmental assessment concepts and implementation and effectiveness of SEA strategies and policies makes this a highly favorable approach for local jurisdictions. Therefore, SEA principles should become integral components of overall local comprehensive planning.

The second rationale is sustainable development. Usually at the local level, the physical environment is often the weakest link to sustainable development because of "not-in-my-backyard" and "locally unwanted-land-use attitudes" (Fischer, 2003). SEA is a tool that may contribute to direct development planning towards sustainability. Linking local comprehensive planning with environmental assessment principles brings a more systematic and wider consideration of effects and alternatives to possible environmental impacts, it can make the whole planning process more efficient and reliable (Ploger, 2001). Integrating SEA's principles into local comprehensive plans can effect desirable

changes and improvements to local land use patterns and socioeconomic development support systems. Thus, it is essential to maintain a strong link between environmental assessment and plans for local or regional sustainability. The integration of SEA and planning can provide a significant contribution to sustainable development and create a better quality of life for future generations. Sustainable development can be achieved by integrating possible environmental impacts into planning processes.

The third rationale is environmental dispute resolution. To maintain local economic development, it is necessary for local jurisdictions to directly confront the conflict between environment and development. An important theoretical argument for integrating SEA into local comprehensive planning is to create a better environment through sustainable decision-making. Applying SEA will displace and defer the conflict between economic development and the environment and create less friction and fewer problems at levels further down the decision making hierarchy (Fischer, 2003; Horton & Memon, 1997). Furthermore, many of today's environmental problems can co-occur because they tend to be regional or global by nature; their co-occurrence requires that integrated assessments take account of cumulative impacts (Wickham et al., 1999). Although almost all governments and agencies know the significance of environment protection, it is hard to resolve the conflicts arising from environmental impacts and planning. This is an ongoing conflict between contingent interests and consistent goals in local and regional development. Incorporating SEA principles into local comprehensive planning can provide a wider scope to resolve environmental impact disputes on multiple scales.

The fourth rationale is environmental collaborative management. Local comprehensive plans help build a platform to coordinate the actions of multiple agencies (Burby, 2005). Due to development occurring at the local level, environmental assessment and environmental management are inherently a local government function. Existing environmental management systems needs a greater responsibility from local jurisdictions. The federal and state governments are playing an important role in the laws and processes governing the use of land and development of property. In addition, federal and state agencies administer a wide variety of programs that affect – either directly or indirectly – the development and use of land. Therefore, a successful implementation of a program to ensure effective environmental assessment must be a joint cooperative effort from the federal, state and local governments. The federal and state governments provide the means for regulating land development, and local governments put that means to use and actually make local development decisions. For local development decision making from comprehensive plans to be effective in improving environmental assessment, local, state and federal actions must be carefully coordinated. Federal and state agencies must ensure, through appropriate legislation and regulations, that local jurisdictions have the necessary means to effectively guide and manage land use change and development. Local governments, in turn, must make high quality comprehensive plans and exercise prudent stewardship. Adequate guidance, oversight, and enforcement at the local level are critically important to successfully implementing the principles of environmental assessment to help ensure that a local development pattern lends itself to more sustainable communities.

The fifth rationale is environmental justice. The essential points in environmental justice are that minority and low-income individuals or communities should be fully represented in the decision-making process and should not be exposed disproportionately to environmental inequality. Environmental justice issues are often related to failures in comprehensive land use planning. During the processes of integrating SEA principles into planning, local jurisdictions may have a chance to create a fair working environment for all people regardless of race, color, national origin, or income. All of the stakeholders, especially potential affected population, can discuss environmental equality with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. This way, environmental justice considerations can be involved in proposed development activities to improve traditional decision making.

2.7.2 Benefits for Integrating SEA with Local Planning

Table 2.5 is a summary of the potential benefits from the integration of SEA principles into local comprehensive land use plans (Fischer, 2003; Keysar & Steinemann, 2002; Noble, 2004a, 2004b; Partida´rio, 1996; Ploger, 2001).

Integrating SEA principles into local comprehensive land use planning can provide a wider scope to resolve environmental impact disputes at multiple scales and help achieve sustainable development by integrating environmental impacts into local comprehensive land use planning decision-making processes. Although the significance

of environment protection has been widely recognized, it is hard to resolve the conflicts arising from environmental impacts and comprehensive land use planning in a dilemma situation. Usually at the local level, the physical environment is often the weakest link due to “not-in-my-backyard” and “locally unwanted-land-use attitudes” (Fischer, 2003).

Table 2.5: Benefits for Integrating SEA Principles and Planning

Benefits for the integration of SEA principles and comprehensive land use planning
Ensuring that environmental values are integrated into planning and decisions
Incorporating environmental goals with a long-term sustainable development mission
Fostering environmental coordination and communication on multiple scales
Reducing environmental disputes and conflicts
Promoting environmental justice
Preventing disruptions in the decision-making/planning/assessment process
Clarifying potentially controversial issues during the planning process
Promoting integrated environment and development decision-making
Informing decision makers and the public of environmental consequences
Wider consideration and prior identification of cumulative impacts at multiple scales
Public involvement in discussions relevant to sustainability on a strategic level
Clearance of strategic issues and information requirements
Concurrent timing of permits and regulatory coordination
Cost savings through tiering
Strengthening project-based environmental assessment

This is an ongoing conflict between contingent interests and consistent goals in local and regional sustainable development. Since integrating SEA into local comprehensive land use planning brings a more systematic and wider consideration of effects and alternatives in possible environmental impacts, it can make the whole planning process more efficient and reliable (Ploger, 2001). Although obvious benefits

are listed, there are still many barriers for the integration of SEA and local comprehensive land use planning as the following section.

2.7.3 Barriers for Integrating SEA with Local Comprehensive Land Use Planning

For an effective integration of SEA principles and local comprehensive land use planning, the barriers in practice come from the following five sources: 1) institutional structure, 2) planning process, 3) implementation process, 4) coordination process, and 5) support system (Clark & Canter, 1997; Finnveden et al., 2003; Keysar and Steinemann, 2002; Noble, 2004a, 2004b; Partidario, 1996).

The obstacles for effectively integrating SEA principles into local comprehensive land use planning may come from the differences in institutional backgrounds. Obstacles for the integration can arise when some agencies cannot understand the benefits of SEA or lack motivation to introduce SEA to the planning process. Shortcomings of the standard environmental assessment process and inadequate mandates for environmental assessment in some jurisdictions reflect the internal deficits of the existing institutional structures. Unfamiliarity with or misperceptions about environmental assessment also can impede the integration of SEA principles and local comprehensive land use planning.

For an effective integration of SEA principles and local comprehensive planning at different regional and decision levels, there needs to be differentiated information-gathering procedures and assessment methodologies. Sometimes there is no adequate flexibility for the SEA process to cope with iterative nature of planning. Some internal

problems in planning procedures cannot resolve the conflicts among environmental objectives at multiple scales or cross-jurisdictions.

The following factors are also influencing the implementation of SEA as well as the integration with planning: unclear statements to implement proposal mitigation, lack of an effective post-project monitoring system, fear of litigation, delays, and increased costs for all stakeholders, lack of methods and expertise for conducting strategic environmental analysis (Keysar & Steinemann, 2002). In fact, it is difficult to make accurate impact predictions at multiple scales when environmental assessment implemented at the project level. For example, it's more challenging to find useful tools for analyzing ecosystem impacts than tools for analyzing emissions of pollutants (Finnveden et al., 2003). Accurate impact predictions are not a sufficient measure of SEA quality performance (Noble, 2004a). An important purpose of environmental assessment is to improve decision-makings rather than just assesses impacts. Furthermore, public participation in SEA is crucial for effective consultation in the whole planning and policy-making process. However, achieving effective public involvement is a major hurdle for the integration of SEA principles and planning.

Ineffective coordination mechanisms greatly impede the integration process. An agency leadership and organizational incentives can influence the integration effects (Keysar & Steinemann, 2002). For example, short-term leadership in SEA or the planning process cannot complete the coordination necessarily. Inadequate communication among stakeholders and detachment of planning agency decision from the SEA process will also cause some problems in coordination. A major problem for

environmental assessment appears to be a lack of dialogue between planners and environmentalists. It is hard for the integration of SEA principles and planning to succeed without an effective coordination process.

An inadequate supporting system for the integration of SEA principles into planning includes the following aspects: lack of a high quality-consulting panel, inadequate funding mechanisms for plans or polices instead of funding only for programs or projects, lack of organizational support for early integration (Keysar & Steinemann, 2002). Currently, there is a lack of certain necessary financial and expert support for the implementation of SEA and the integration with planning. The lack of methodological guidance for SEA is also a barrier to the implementation of SEA and the integration with planning.

2.7.4 Promoting Integration of SEA with Local Comprehensive Land Use Planning

In order to overcome the obstacles, the approaches for promoting the integration of SEA principles and local comprehensive land use planning have been widely discussed in the recent literature (Fischer, 2003; Keysar & Steinemann, 2002; Noble, 2003, 2004a). The following table is a summary for promoting the integration of SEA principles and planning (Table 2.6).

In general, an assessment of the environmental consequences of plans must start at the very beginning of the comprehensive land use planning process. To take advantage of SEA, it must be integrated early into the policy and planning decision-

making process. In addition, a flexible planning oriented approach should be adopted. SEA, as a decision-aiding tool, should be flexible enough to apply at various stages of the policy-making cycle and planning processes (Fischer, 2003).

Table 2.6: Promoting the Integration of SEA Principles and Planning

Promoting the integration of SEA principles and planning
Providing information about the advantages of integration
Integrating strategic concepts or missions into the planning procedure at a very early stage
Developing efficient coordination between environmental and planning agencies
Enhancing organizational strength of environmental sections
Developing a more flexible structure of SEA
Developing more adaptive, practical methodologies
Providing strong technical support
Providing training and education
Improving the quality of comprehensive planning
Sharing data and information
Encouraging public participation

The various provisions of SEA will not overburden administration with the new instrument; also, it is possible to achieve efficient results and not create high costs or long planning durations (Fischer, 2003; Keysar & Steinemann, 2002). SEA approaches should be flexible in order to avoid conflict with the decision process itself; sufficient information must be a basic assumption for SEA application (Fischer, 2003; Keysar & Steinemann, 2002). Some training programs, a dedicated team of specialists and the development of a pilot study will provide an awareness of the significance of integrating of environmental assessment into local comprehensive planning.

2.8 Summary

This chapter builds a theoretical foundation and examines literature support for integrating SEA into local comprehensive land use planning. The conceptual definition of environmental assessment plan quality is defined and the major influences on that plan quality are identified in this chapter. This chapter provides an integrated set of SEA principles derived from various literature supporting strategically environmental management and explains how to understand and translate these principles into the local comprehensive land use planning process. This chapter also lays the groundwork for understanding the theoretical influences on environmental assessment plan quality. The major planning theories are highlighted to support the four influential factors: planning capacity, environmental assessment capacity, public participation capacity, and contextual characteristics. Based on review of the literature, the following chapter will present a conceptual to further define the environmental assessment plan quality through the development of a detailed plan coding protocol, as well as thoroughly examine influence factors.

CHAPTER III

CONCEPTUAL FRAMEWORK

3.1 Conceptual Framework

The literature review of the principles of SEA in local planning provides a theoretical foundation for integrating SEA into local plans. This study will define and measure the ability of local plans to capture the principles of SEA and will identify the main factors influencing the degree to which a local plan integrates SEA principles. From the existing literature, this study can synthesize the major themes of environmental assessment and derive the key principles to guide the integration. The literature review of plan quality is crucial for the development of the conceptual model to evaluate integration effects.

A conceptual definition and a conceptual model are necessary to identify the factors that make a high quality plan that integrates SEA principles (Figure 3.1, Figure 3.2).

Figure 3.1 illustrates the overall conceptual framework and the conceptual definition for integrating SEA principles into local plans in this study. First, this study reviews the major literature on environmental assessment and plan quality evaluation to provide a foundation to support integration of environmental assessment and planning. Second, this study explains the SEA principles and their meanings in local comprehensive land use plans. Third, based on further understanding on local plan

components with SEA principles, this study develops plan quality evaluation coding protocol to evaluate plan quality.

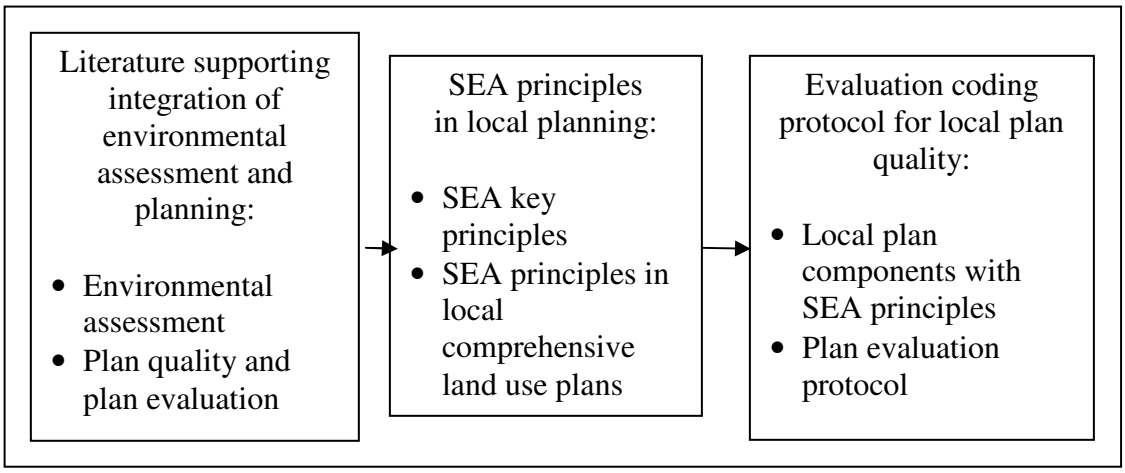

Figure 3.1: A Conceptual Definition for Integrating SEA into Local Plans

Figure 3.2 provides a conceptual model to explain what factors are influencing on local comprehensive land use plan quality. The dependent variable in this study is environmental assessment plan quality which is measured by five plan components. The four sets of independent variables include planning capacity, environmental assessment capacity, public participation capacity, and contextual variables. The detailed descriptions for the dependent variable and independent variables are explained in the sections 3.2 and 3.3.

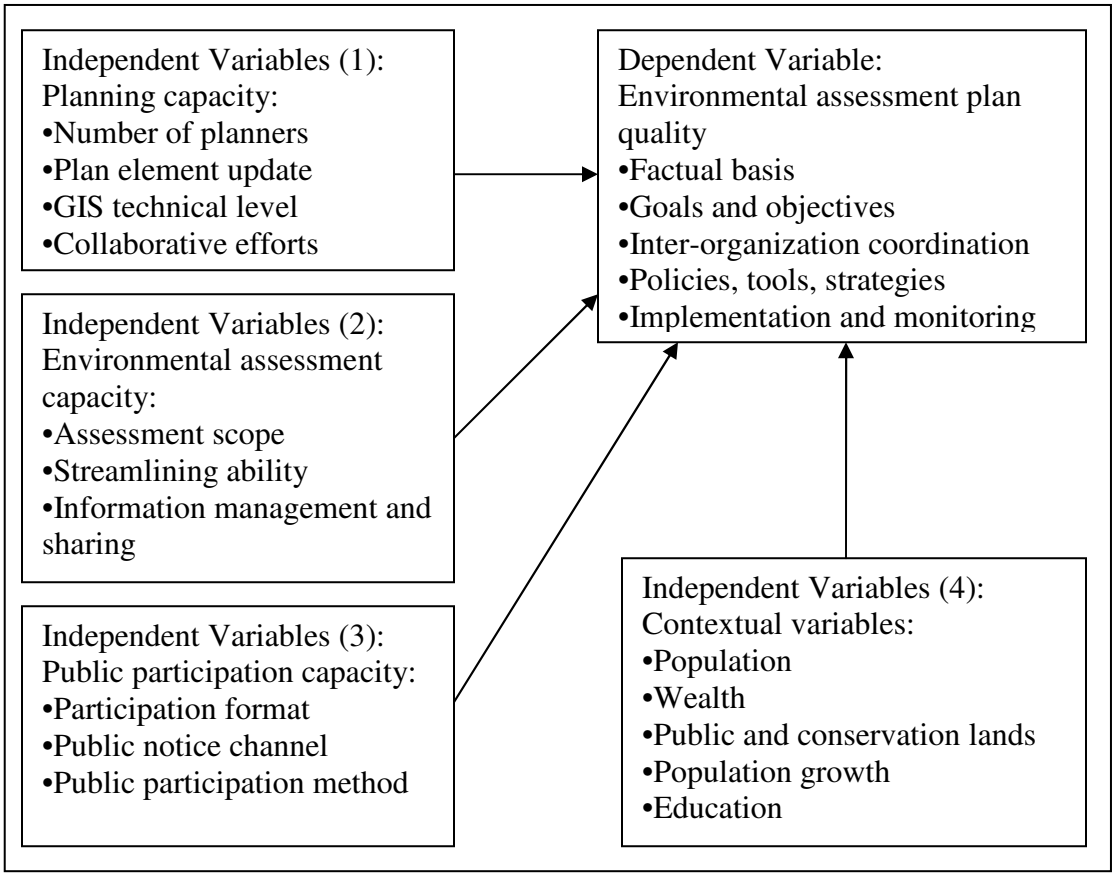

Figure 3.2: A Conceptual Model for Integrating SEA into Local Plans

A high quality local plan captures the key concepts and principles of SEA and pulls them together as an integrated whole. This study extends established theories of environmental assessment to understand what constitutes a high quality plan for environmental assessment. Five components are used to conceptualize plan quality: factual basis; goals and objectives; inter-organizational coordination and capabilities; policies, tools and strategies; implementation and monitoring. These five components measure the ability of local plans to assess and manage the environment. The dependent

variable of this study is the environmental assessment plan quality. The independent variables include planning capacity, environmental assessment capacity, public participation capacity and contextual variables.

A complete protocol is developed to measure local comprehensive plan quality in California (Appendix 1). The plan evaluation protocol can depict complex, multi-faceted and interdependent environmental conditions. The reasons are explained by McCool and Stankey (2004). First, indicators are useful to describing baseline and current conditions and performance of a system. Second, indicators offer a measure of the effectiveness of actions and policies to move a system toward a more sustainable state. Third, indicators might be selected to forecast future changes. The protocol in this study includes 112 indicators to measure the dependent variable: environmental assessment plan quality. Appendix 1 lists the 112 indicators which are used to measure the integration of SEA principles with local comprehensive land use plans. The detailed explanations and measurement for each indicator are described in detail in the Appendix 1, Appendix 2 and Appendix 3.

Based on the above overall research framework and conceptual model of this study, the dependent, independent variables and hypotheses are stated as follows.

3.2 Dependent Variable

The dependent variable of the conceptual model is the environmental assessment plan quality. This study assumes that environmental assessment plan quality is a

reflection of effects for integrating SEA principles into a local land use comprehensive plan. This study uses local comprehensive land use plans to evaluate plan quality that integrates SEA principles since local comprehensive plans provide an ideal bridge to measure environmental assessment capabilities at a local jurisdiction level. The reasons can be stated as the followings: First, a strategic environmental assessment needs a broader vision to look beyond existing local jurisdictional boundaries and collaborate with multiple organizations. The policies in a local comprehensive plan guide a local jurisdiction's environmental protection and natural resource use. Furthermore, this study can measure whether a local plan has intergenerational temporal impacts related to environment because comprehensive plans usually make a relatively long-term planning for local development. Finally, comprehensive plans keep updating with local new conditions or current social development. Thus, local comprehensive plans involve all essential elements of an environmental assessment plan. This study relies on local jurisdiction's comprehensive plans to evaluate the effects that integrate SEA principles.

A high quality environmental assessment plan should capture all SEA principles and elements and pull them together as an integrated whole. As discussed above, local plan quality for integrating SEA principles will be conceptualized and measured through five components: 1). Factual basis; 2) Goals and objectives; 3) Inter-organization coordination; 4) Policies, tools, strategies; 5) Implementation and monitoring. This study will use these five components to describe a local environmental assessment plan quality. The plan protocol for integrating SEA principles into local comprehensive plans has been analyzed in previous statements. A further detailed plan coding protocol is

attached as Appendix 2 and Appendix 3. Based on the plan protocol, 112 indicators have been developed to measure each aspect of environmental assessment plan quality.

Based on an understanding of local comprehensive plan quality, this study has developed a procedure to score each plan component. The criteria for measuring plan quality needed to be developed to score each plan component. The criteria include a series of indicators for scoring each plan component during plan quality measurement.

There are some assumptions in this study for scoring each plan component. First, this study assumes that all indicators apply to effective environmental assessment. The plan may mention some specific indicators in this plan protocol, but they may be used for other purposes. Second, the indicators cover the whole plan contents rather than only in the environment section or other similar section. The evaluation process will scan all plan elements to determine whether the plan has thoroughly considered the quality of the human environment. In the protocol of plan quality measurement, there is a specific score for each indicator. In addition, the page number where the indicators appear and the comments for each indicator are recorded. Chapter IV provides the detailed procedures for scoring each plan component.

In summary, a high quality environmental assessment plan should capture all of the SEA principles and elements and pull them together as an integrated whole. As discussed above, local plan quality for integrating SEA principles will be conceptualized and measured through five components: 1). Factual basis; 2) Goals and objectives; 3) Inter-organization coordination; 4) Policies, tools, strategies; 5) Implementation and monitoring. These five components will be used to describe a local environmental

assessment plan quality. The plan protocol for integrating SEA principles into local comprehensive plans has been analyzed as above. A further detailed plan protocol is attached as Appendix 2 and Appendix 3. Based on the plan protocol, 112 indicators will be used to measure each aspect of environmental assessment plan quality.

3.3 Independent Variables

Chapter II provides the theoretical foundation and literature support for four categories of independent variables in this study: planning capacity; environmental assessment capacity; public participation; contextual characteristics. These independent variables and their hypotheses are explained in the following section.

3.3.1 Planning Capacity

Four indicators are used to describe a local jurisdiction's planning capacity: number of planners; plan update date; GIS technical level; and collaborative efforts.

The first hypothesis concerns number of planners. This study assumes planners are all contributing to the development of the comprehensive plan from various aspects. The more planners involved in a local jurisdiction, the more planning human resources, expertise and personnel are devoted to producing the local comprehensive plan. Thus, more planners may lead to a higher quality local comprehensive plan as well as an environmental assessment plan. Thus, the first hypothesis follows:

H1: Jurisdictions with more numbers of planners will result in higher environmental assessment plan quality.

The second hypothesis involves the timing of plan updates. This study assumes more recent plan updates lead to higher plan quality. An on-time, regular plan update procedure helps a local comprehensive plan stay current with new information, conditions, regulations, and techniques. Thus, this indicator is chosen to describe whether a local jurisdiction has a recent update for its local comprehensive plan. Since the plan element may be updated separately, this study chooses conservation to represent the efforts of environmental assessment and management in a local plan. The conservation element is primarily oriented toward natural resources. The purpose of conservation element is to provide direct information regarding natural resource conservation and environmental protection and establish policies that reconcile conflicting demands on both renewable and nonrenewable resources. The second hypothesis follows:

H2: More recent updating of a local comprehensive plan's elements will result in higher environmental assessment plan quality.

The third hypothesis pertains to technical level of GIS. Today, GIS has become a very important tool in urban planning and environmental assessment activities, and plays an even more important role in providing the capability to perform spatial or cross-boundary analyses for local development or environmental issues. GIS gives planners the ability to organize, store, and analyze spatial information that can visually display information to the public or decision makers. GIS can help planners understand precisely

where critical environmental resources are and the degree to which they are in need of protection and help them make proactive choices about the strategic management of the existing environment. Thus, adopting GIS data in the local comprehensive planning process will increase local plan quality. The third hypothesis follows:

H3: A higher GIS technical level will result in higher environmental assessment plan quality.

The fourth hypothesis concerns collaborative efforts. Collaboration with other jurisdictions or agencies is critical for a local jurisdiction to develop a high quality comprehensive plan for urban planning and environmental assessment because many issues are cross-boundary. Local jurisdiction working together with other organizations can achieve broader goals, help solve current problems, and reduce the potential for disputes in local development as well as environmental management. The fourth hypothesis is as follows:

H4: Increased collaborative efforts in the planning process will result in higher environmental assessment plan quality.

3.3.2 Environmental Assessment Capacity

Environmental assessment capacity includes four aspects: streamlining ability, assessment scope, cost of environmental assessment, data management and sharing.

The fifth hypothesis involves assessment scope. Assessment scope measures what kinds of proposals have been considered in the environmental assessment process.

The most common type is project-based environmental assessment. Other assessment scopes may include a master plan, a program or a proposal. The more contents involved in a local jurisdiction's assessment scope, the stronger environmental assessment and environmental management are expected to be. The fifth hypothesis follows:

H5: Broader assessment scopes will result in higher environmental assessment plan quality.

The sixth hypothesis regards streamlining ability. The streamlining process refers to the process for compliance with environmental laws applicable to a given proposal. Streamlining the environmental review process and minimizing the regulatory burden is important because it means efficient and thorough consideration of proposals, and reduced costs for environmental assessment procedures. Streamlining ability can be measured by the procedures that have been streamlined in local environmental assessment. The most common procedures of environmental assessment for a local jurisdiction include specific plan's environmental review, tiering from prior environmental review, master plan's environmental review, program or project's environmental review, categorical exemptions, statutory exemptions, etc. The more environmental assessment procedures are streamlined, the higher that environmental management capacity can be expected. The sixth hypothesis states:

H6: Stronger streamlining ability for environmental assessment will result in higher environmental assessment plan quality.

The seventh hypothesis measures information management and sharing. A critical element in environmental assessment is for managing the environmental

assessment's information and sharing with government officials, the judiciary, legal practitioners, academia, and the public at large. Web-based information is an effective way to reach the purposes of public access. This indictor is measured by jurisdictions that regularly post environmental assessment documents including a notice of preparation, environmental assessment report, negative declaration and other information. The seventh hypothesis is as follows:

H7: Stronger information management and sharing will result in higher quality environmental plans.

3.3.3 Public Participation Capacity

Public participation in environmental assessment identifies public environmental concerns and issues, provides information and opportunities for the public to formulate and evaluate alternatives, listens to the public, and incorporates public concerns into environmental decision-making. Public participation in environmental assessment creates an open and accessible decision-making process for environmental issues and achieves a goal that is economically feasible, environmentally sound, and human health conscious. Public participation capacity variables will systematically determine whether public participation has contributed to enhance environmental assessment plans. Four items are used to measure public participation capacity: participation formats, public notice channels, public participation incentives, and cost of involvement.

The eighth hypothesis concerns participation formats. Participation formats include workshops, townhall meetings, site tours, charrettes, and other types. This study assumes that with more participation formats, more of the public will be involved and thus develop increased awareness of environmental issues pertinent to local decision-making. The eighth hypothesis follows:

H8: A greater number of participation formats will result in higher environmental assessment plan quality.

The ninth hypothesis is for public notice channels. Public notice channels include internet, newspapers, radio, television, mail, notices, newsletters, and other types. This study assumes that with more public notice channels the public will be more involved and thus, more opportunities provided for public awareness of environmental issues related to local development decision-making. The ninth hypothesis follows:

H9: A greater number of public notice channels will result in higher environmental assessment plan quality.

The tenth hypothesis involves public participation incentives. Public participation incentives include the following: evening meetings, providing daycare at public meetings, providing transportation to public meetings, holding public meetings near the project site, involving youth in community planning exercises, posting minutes or projecting documents on the internet, allowing public comment by e-mail or internet, and using alternative public participation jurisdiction formats. This study assumes that with more public participation incentives, the more the public will be involved and more

opportunities will be provided for public awareness of environmental issues related to local development decision-making. The tenth hypothesis follows:

H10: A greater number of public participation incentives will result in higher environmental assessment plan quality.

3.3.4 Contextual Characteristics

The contextual variables can measure the influence of background information on environmental assessment plan quality. Based on the literature on plan quality measurement, this study chooses population (Berke et al., 1996), wealth (Brody et al., 2004; Fransson & Garling, 1999; Scott & Willits, 1994; Van Liere & Dunlap, 1981), public and conservation lands within a jurisdiction, population growth (Brody et al., 2004), and education (Brody et al., 2004; Guagano & Markee, 1995; Howell & Laska, 1992; Raudsepp, 2001).

The eleventh hypothesis involves population. On the one hand, more population will increase pressure on carrying capacity within a local jurisdiction; thus, more environmental conflicts and problems are expected in the jurisdictions with greater populations. On the other hand, more expertise and resources may be available for environmental assessment. Thus, more population may lead to a higher consideration and stronger capacities on environmental assessment. The eleventh hypothesis follows:

H11: Jurisdictions with more population will produce higher quality environmental assessment plans.

The twelfth hypothesis regards wealth. A wealthier population may have more money, higher awareness, and more interest in environmental issues in its jurisdiction. Wealthier population tends to be well-educated, thus they may be more concerned about environmental protection and pursue a higher environmental quality. Thus, a wealthy jurisdiction will have more financial resources and inner incentives for environmental assessment. A jurisdiction with more wealthy people may lead to a good environmental assessment plan. The twelfth hypothesis follows:

H12: Wealthier jurisdictions will produce higher quality environmental assessment plans.

The thirteenth hypothesis involves public and conservation lands within a jurisdiction. Public and conservation lands are playing important role in local natural resources, open space, ecosystem, biodiversity, recreation and education. Public and conservation lands are usually subjected to a higher standard of environmental protection. More financial resources, personnel, management capacities, and collaborative efforts with multiple organizations are expected for public and conservation lands management. Thus, a jurisdiction with more public and conservation lands will tend to have a higher level of environmental assessment. The thirteenth hypothesis follows:

H13: A jurisdiction with a higher percentage of public and conservation lands will produce a higher quality environmental assessment plan.

The fourteenth hypothesis regards population growth. Rapid population growth has a substantial effect on environmental quality. Population growth may consume more natural resources and built-environment resources; at the same time, it also creates more

waste and pollutions. Potential land use conflicts may increase with population growth resulting in a greater demand for environmental management. The fourteenth hypothesis follows:

H14: A jurisdiction with high population growth will produce a higher quality environmental assessment plan.

The fifteenth hypothesis involves education. A community with a higher education level tends to be more concerns about environmental issues. A community with higher education level tends to have a higher perception of the need for environmental protection and more enthusiasm for participating in environmental management activities. The fifteenth hypothesis follows:

H15: A jurisdiction with a high education level will produce a higher quality environmental assessment plan.

3.4 Statement of Predicted Outcomes

Based on the literature review of environmental assessment plan quality and the conceptual framework for each of the variables described above, this study will test the following main hypothesis: planning capacity, environmental assessment capacity, public participation capacity and contextual characteristics will be associated with an increase in the quality of environmental assessment plan quality.

CHAPTER IV

RESEARCH DESIGN AND METHOD

This study's research design will take a random sample of local jurisdictions in California and test their influences on local environmental assessment plan quality. The research design and methods described in this chapter include the study population and sample selection, data collection techniques and statistical analysis methods.

4.1 Sample Selection

The target population used in this study consists of local jurisdictions in California with comprehensive planning mandates. The samples were obtained from local jurisdictions in California. The sampling strategy involved following (Berke, 1995b; Brody et al., 2004): 1) The sample of local jurisdictions was limited to jurisdictions with a population of 2,500 or more to avoid skewing towards small communities; 2) Large metropolitan areas were excluded from the sample in order to exclude the contextual factors on the samples; this study excludes jurisdictions within Los Angeles, San Diego, and San Francisco; 3) The sample was limited to jurisdictions within 50-mile coastal zone areas (including the coastal bay areas) to maintain a degree of consistency and comparability in terms of the types of environmental conditions assessed.

The first step in sample selection was to choose 20 coastal counties and 297 cities within these counties. The second step was to choose the target cities and counties which satisfied the three above criteria. Based on the three criteria, nine of the cities with less than 2,500 people, 107 of the cities in the three counties located in the large metropolitan areas and 84 of the cities beyond the 50-mile coastal zones were excluded from the sample selection. Thus, 117 local jurisdictions, including cities and counties, satisfied with the three criteria in this study. The third step is to uses SPSS® to produce random numbers and then select 40 samples from the 117 local jurisdictions according to the random numbers. Based on the above procedures, this study took a random sample with 40 local jurisdictions from the whole jurisdictions that satisfied with the above sampling strategy. The selected local jurisdictions include: City of Alameda, City of Arcata, City of Berkeley, City of Burlingame, City of Campbell, City of Carmel, City of Clayton, City of Concord, County of Contra Costa, City of Costa Mesa, City of Cupertino, City of Dana Point, City of Hayward, City of Irvine, City of Lafayette, City of Los Altos, City of Milpitas, City of Moraga, City of Morgan Hill, City of Orange, County of Orange, City of Orinda, City of Oxnard, City of Palo Alto, City of Pinole, City of Redwood City, City of Rohnert Park, City of San Luis Obispo, County of San Luis Obispo, City of San Ramon, County of Santa Barbara, City of Santa Clara, County of Santa Clara, County of Santa Cruz, City of Santa Rosa, City of Sausalito, County of Sonoma, City of Thousand Oaks, City of Tiburon, and City of Ventura. These jurisdictions can be representative of California jurisdictions.

4.2 Data Collection

Data collection techniques involve a combination of existing information and gathering primary data. Most of the local jurisdictions' comprehensive plans are collected from the online service of the California Landuse Planning Information Network or local jurisdictions' planning agency web sites, and in some cases acquisition of plans relied on a mail request. All of the local jurisdictions' comprehensive plans are the most current version. In some circumstances, a mail request was made for the local planning officers to get the most recent changes for jurisdictions in the updating process.

For independent variables, this study use the California Planners' annual survey data from the 2003 and 2005 California Planners' Book of List. The missing items in these two surveys are updated by a webpage survey or emails to local jurisdictions. 2000 census data is used to measure the contextual characteristics. Finally, GIS data came from the California Spatial Information Library.

4.3 Data Analysis

4.3.1 Dependent Variable Measurement

The dependent variable is measured by the five plan components.

First, the factual basis measures the extent to which a jurisdiction understands its existing resources related to natural environment, built environment and human health.

Each indicator in the factual basis will use the score of 0, 1 or 2 to measure its quality. The score of "0" means that this item is not identified, recognized, or considered in the factual basis. The score of "1" refers to the item identified or mentioned but without details. The score of "2" measures the item that is thoroughly considered with details. Since some indicators use maps or visualized characteristics to describe their contents, these items will include more than one coding category to measure their quality. The main categories include described, classified, or visualized items. Described items usually use words to identify their contents. If the item is not described in the plan, it will receive a score of "0." If the item is merely described with little detail, it will receive a score of "1." If the item is described in great details, it will receive a score of "2." Classified items usually explain their contents by using tables or catalogues. If the item is not classified in the plan, it will receive a score of "0." If the item is listed or crudely classified without more detail, it will receive a score of "1." If the item is classified with detailed tables or specific catalogues, it will receive a score of "2." The visualized item illustrates the spatial or temporal contents by using colored GIS-based or scanned maps or photos. If the item is not visualized in the plan, it will receive a score of "0." If the item is crudely visualized which is not friendly read, it will receive a score of "1." If the item is visualized with detailed, high-quality maps, it will receive a score of "2."

Second, a local comprehensive plan is a long-range planning tool used to define a local jurisdiction's vision, goals, and objectives for development. A high-quality comprehensive plan needs to list the goals and objectives which become the basis of the

related policies, tools, and strategies for local environmental assessment. Goals in a strong plan component should be consistent, clear, and detailed. Objectives in a strong plan component should be measurable, realistic and time-bound. Since local comprehensive planning tends to present combined goals and objectives, this study measures goals and objectives as various grouped items. Each indicator in this component of goals and objectives will be scored on a scale of "0," "1," or "2" according to the level of detail and clarity. If an item does not mention the goals or objectives, it will receive a score of "0." If an item presents the goals or objectives, it receives a score of "1." In many cases, if the plan only states an item but does not define it as a specific goal or objective, it will be considered a vague goal or objective and receive a score of "1."

Third, inter-organizational coordination component measures a local jurisdiction's collaborative ability for environmental assessment. Inter-organizational coordination includes collaborative activities across the public and private sectors, various local organizations, cross-boundary jurisdictions, stakeholders, state, regional and federal agencies. In many cases, the indicators of inter-organizational coordination may scatter across the whole plan. However, some plans with strong inter-organizational coordination may have an independent chapter or section to describe the inter-organizational coordination. The quality of inter-organizational coordination can be measured on a scale of "0," "1," or "2" based on the level of detail. If an item does not specifically mention inter-organizational coordination, it will receive a score of "0." If an item specifically includes inter-organizational coordination, it will receive a score of

"1." If detailed procedures of a specific inter-organizational coordination are stated, it will get a score of "2."

Fourth, policies, tools and strategies are the heart of local comprehensive plans. These indicators will be measured based on the level of incorporation by using specific words. If an indicator of policies, tools or strategies is not present, the score will be "0." If an indicator of policies, tools, or strategies has been considered by using the worlds "should," "may," "consider," "intend," "encourage," "prefer," "suggest," it will receive a score of "1." If an indicator of policies, tools, or strategies uses the specific mandatory words such as "mandate", shall", "require", "must" or "will", it will receive the highest score of "2". When a specific policy, tool, or strategy has been adopted in an existing plan, it will be scored as "2." For example, if a tool of tendency analysis has been used to predict a local jurisdiction's population growth or water consumption, it will receive a score of "2." This approach for measuring the word choices in a plan may also be used to score some items of inter-organizational coordination and components of implementation and monitoring. In these components, some items are presented as a style of policies, tools, strategies. This study will use the approach based on specific word choices to score each item in their own component. The method is similar into the approach in policies, tools and strategies, but the scores will be still calculated into the component of inter-organization or the component of implementation and monitoring. If an indicator is not mentioned, it will get a score of "0." If an indicator is at the level of suggestion by using "should," "may," "consider," "intend," "encourage," "prefer,"

"suggest," it will be receive a score of "1." If an indicator reaches the mandatory level, it will get a score of "2."

Fifth, the implementation and monitoring component can measure how well a plan works. In general, a plan should include a paragraph or chapter to describe how the plan will be carried out and how to monitor or update the plan regularly. The quality of the indicators in implementation and monitoring component can be measured based on the level of details. If an indicator is not mentioned, it will receive a score of "0." If an indicator is described without details, it will get a score of "1." If an indicator is thoroughly described with enough detail, it will receive the highest score of "2."

The measurement of plan quality in this study includes the following five steps: The first step was to compute the scores of each indicator for each plan component. The range of the scores is between 0 and 2. The second step was to sum the total of all indicator scores within each plan component. The range of the component scores depended on the number and value of the indicators within each plan component. The third step was to calculate the fractional scores for each plan component by dividing the total of all received scores for each plan component by the total possible score. The range of fractional scores is between 0 and 1. The fourth step was to calculate a standardized score for each component by multiplying the fractional scores by 10. Therefore, the range of the scores for each plan component would be between 0 and 10. The fifth step is to compute the total plan quality scores by adding the five plan components together. The scores in five components was summed, thus the possible total scale for measuring a local comprehensive plan quality is between 0 and 50.

The equations were expressed by Brody (2003c):

$$PC_j = \frac{10}{2m_j}\sum_{i=1}^{m_j} I_i$$

$$TPQ = \sum_{j=1}^{5} PC_j$$

PC_j represents the j^{th} plan component's quality; m_j represents the number of indicators within the j^{th} plan component (scale 0-10); I_i represents the i^{th} indicator's scores (sale 0-2); TPQ is the total scores of a whole plan (scale 0-50).

The concepts of breadth and depth were also introduced to describe plan quality. The concept of breadth measures the level of coverage and whether a plan considers a specific item or a group of items. Indicator breadth score is calculated by the percentage of the plans that address an indicator with the total number of the plans in this study. The concept of depth measures the level of importance and analyzes how much importance is stated in a local comprehensive plan. Indicator depth score is calculated by the percentage of an indicator received scores with the total possible scores from these plans that addressed this indicator. This measurement approach is based on techniques used by (Brody, 2003b, 2003c; Godschalk et al., 1999). The equations for calculating indicator breadth scores and depth scores are listed in the followings:

$$IBS_j = \frac{P_j}{N}$$

$$IDS_j = \frac{\sum_{j=1}^{P_j} I_j}{2P_j}$$

$$ITS_j = IBS_j + IDS_j$$

IBS_j is the j[th] indicator breadth score (scale 0-1); P_j is number of plans that address the j[th] indicator; N is total number of plans in the study; IDS_j is the j[th] indicator depth score (scale 0-1); I_j is the the j[th] indicator received scores (scale 0-2); ITS_j is the j[th] indicator total score (scale 0-2).

4.3.2 Independent Variables Measurement

The descriptive statistics for dependent and independent variables are listed in Table 4.1 to provide an overall view of the data. The scale, mean and standard deviation of each variable is described in the following table.

The independent variables and their measurement are stated as the followings and listed in Appendix 4.

The number of planners is measured by the actual numbers on the 2005 California Planners' Book of List.

The plan elements update is calculated by using the year 2005 minus the actual year of the conservation element. Since comprehensive plans may be updated by each plan element, this study chase the conservation element which incorporated most of the environmental-related information, to represents a plan's status.

Table 4.1: Descriptive Statistics for Dependent and Independent Variables

Variables	Type	Range	Mean	Standard deviation
Environmental assessment plan quality	Dependent	13.32-40.23	23.95	6.84
Number of planners	Independent	1-110	14.35	18.67
Plan updating date	Independent	2-32	10.68	7.99
GIS technical level	Independent	0-16	6.48	2.64
Collaborative efforts	Independent	0-5	4.70	1.66
Assessment scope	Independent	0-5	1.33	0.57
Streamlining ability	Independent	0-7	3.18	1.36
Information management and sharing	Independent	0-6	1.68	0.97
Participation formats	Independent	0-5	2.53	1.11
Public notice channels	Independent	0-7	3.10	1.57
Public participation incentives	Independent	0-8	4.08	1.80
Population	Independent	4,081-2,846,289	223,974	519,742
Population growth	Independent	-1.90-38.00	11.04	9.27
Education level	Independent	13.70-74.40	42.04	15.31
Wealth	Independent	106,611-973,500	380,395	190,405
Public and conservation lands	Independent	1.00-65.54	12.17	14.32

The GIS technical level is measured by the GIS data adopted in the planning process. If one GIS data layer is adopted in the local jurisdiction's planning process, it receives one point. There are 16 types of GIS data layers describing the GIS technical level; thus, creating a scale from 0-16 scales for this variable. The measurable GIS data layers include the following: comprehensive plan land use, zoning designation, parcel lines, jurisdictional boundaries, approved permits, land use code violations, natural hazards, natural resources, roads and other public infrastructure, aerial photos, CEQA

studies or environmental assessments, mitigation monitoring, transportation, health, safety, and others.

Collaborative efforts are measured by the jurisdictions participating in regional collaborative planning efforts. The collaborative activities include other cities, counties, special districts, and regional planning agencies, and others.

Assessment scope is measured by the types of environmental assessment used for the last comprehensive plan update including an environmental assessment for a master EIR, program EIR, project EIR, EIR equivalent, and others.

Streamlining ability is measured by the degree of streamlining environmental assessment including streamlining for specific plan EIR, tiering from prior EIR, master EIR, program EIR, categorical exemptions, statutory exemptions, and others.

Data management and sharing is measured by the documents that jurisdictions regularly post on their websites. The types of data include the notice of preparation, EIR, negative declaration, declaration, other, and description of others. Thus, 0-6 scales were used to describe this item.

Participation formats are measured the types of workshops, townhall meetings, site tours, charrettes, and others.

Public notice channels include the internet, publications in a non-English newspaper, radio/television, mail, notices using community organizations, community newsletters and others.

Public participation incentives include the following: evening meetings, providing daycare at public meetings, providing transportation for public meetings,

holding public meetings near the project site, involving youth in community planning exercises, posting minutes or projecting documents on the internet, allowing public comment by E-mail or internet, and using alternative public participation jurisdiction formats.

Population is measured by the population in 2000 census data. The unit for population is calculated per 1000 people.

Wealth is measured by the median home value in 2000 Census data. The unit for population is calculated per 1000 dollars.

Population growth is measured by population changes from 1990 to 2000; a percentage is used to describe these population changes.

Education is measured by the percentage of people's ages above 25 years with bachelor's degrees or higher in 2000. A percentage is used to represent different education levels.

Public and conservation lands are measured by the actual percentage of public and conservation lands within a jurisdiction. The percentage of public and conservation lands within a jurisdiction is calculated from the GIS data.

4.3.3 Regression Models

The research includes two stages of data analysis:

First, this study uses descriptive statistics to assess the quality of the 40 sampled local plans. Three types of measurements are used to analyze the variation in plan

quality across the sample: indicator breadth, indicator depth and a total score. This part of statistical analysis helps to answer the first two research questions in this study: what is the model for a local comprehensive plan that effectively integrates SEA principles; and how well do local jurisdictions integrate SEA principles into local plans?

Second, this study uses multiple regression analysis to analyze the factors affecting the integration of local plan and environmental impacts. This regression analysis helps to answer the two latter research questions in this study: which factors promote the integration of SEA principles and local plans; and how can the local planning process be improved to enhance integration effects? The ordinary least squares (OLS) technique was introduced into this study to measure what kinds of factors influence local plan quality. As discussed above, four types of independent variables are analyzed to identify which ones influence local environmental assessment plan quality. In total, this study includes 15 independent variables. This number is large when compared to the sample size of 40 local plans. In order to determine how many predictor variables to use in my statistical model, this study has adopted the methods used by Berke and Beatley (1992) and Brody (2003a, 2004). This study divides four blocks including plan capacity variables, environmental capacity variables, public participation variables, and contextual variables. By analyzing regression models for each block, the significance of multiple variables is tested. In each block, Pearson's Product-Moment Correlation Coefficients is produced between the dependent and independent variables to test the degree of association among variables. Then, the F-test is used to determine which variables in each block are statistically significant. Next, a regression analysis

tests the statistical significance of specific variables by interpreting coefficients and testing them at the 0.05 and 0.01 significant levels. If no statistical significance is found in a certain model, this study still uses regression coefficients as references for relative strength and general direction analysis. Based on these test results for the significance of multiple variables, this study chooses the most influential factors for a model that combines the most influential variables in each block. Thus, the number of independent variables in the final regression model was reduced. At the same time, the investigation of factors influencing plan quality was analyzed during the variable selection process.

Based on the above discussion, the following regression models are analyzed in this study.

This first regression model lists planning capacity variables:

$\gamma_{1i} = \beta_{10} + \beta_{11}$ planners $+ \beta_{12}$ plan update date $+ \beta_{13}$ GIS technical levels $+ \beta_{14}$ collaborative efforts $+ \varepsilon_{1i}$

The second regression model lists environmental capacity variables:

$\gamma_{2i} = \beta_{20} + \beta_{21}$ assessment scope $+ \beta_{22}$ streamlining ability $+ \beta_{23}$ information management and sharing $+ \varepsilon_{2i}$

The third regression model lists public participation variables:

$\gamma_{3i} = \beta_{30} + \beta_{31}$ participation formats $+ \beta_{32}$ public notice channels$+ \beta_{33}$ public participation incentives $+ \varepsilon_{3i}$

The fourth regression model lists contextual variables:

$\gamma_{4i} = \beta_{40} + \beta_{41}$ population $+ \beta_{42}$ wealth $+ \beta_{43}$ public and conservation lands$+ \beta_{44}$ population growth $+ \beta_{45}$ education $+ \varepsilon_{4i}$

The final model is a fully specified model comprising those variables which are significant in the previous models:

$\gamma_{5i} = \beta_{50} + \beta_{11}$, planners $+ \beta_{12}$, plan update date $+ \beta_{13}$, GIS technical levels $+ \beta_{14}$, collaborative efforts $+ \beta_{21}$, assessment scope $+ \beta_{22}$, streamlining ability $+ \beta_{23}$, information management and sharing $+ \beta_{31}$, participation formats $+ \beta_{32}$, public notice channels $+ \beta_{33}$, public participation incentives $+ \beta_{41}$, population $+ \beta_{42}$, wealth $+ \beta_{43}$, public and conservation lands $+ \beta_{44}$, population growth $+ \beta_{45}$, education $+ \varepsilon_{5i}$

4.4 Statistical Tests and Diagnostics

The purpose of the statistical tests and diagnostics is to test the reliability of the regression models. Critical issues related to reliability tests have been discussed by many statisticians (Carmines & Zeller, 1979; Hinton, 1995; Kleinman et al., 1988). The reliability tests for regression models help avoid the following types of regression problems: model misspecification, heteroskedasticity, multicollinearity, influential data or outliers, inter-item correlation and scale reliability.

4.4.1 Model Misspecification

Model misspecification means that the true relationship between the two variables is given by one equation with some important variables excluded. Thus, regression estimates from misspecified models is considered scientifically unreliable.

Ramsey regression specification error test (RESET) is used to test the misspecification problem in this study. The RESET results showed no violation of model misspecification in this study.

4.4.2 Heteroskedasticity

Heteroskedasticity means that the residuals have an inconstant variance. Heteroskedasticity may not cause inconsistency, but does present its own set of problems that may keep heteroskedastic regression from being reliable. This study used plots of residuals against the dependent variable to test the regression model's heteroskedasticity problem. The Cook and Weisberg distance test was also used to exam the heteroskedasticity problem. No heteroskedasticity problem is found in this study.

4.4.3 Multicollinearity

Multicollinearity refers to the predictor variables are highly correlated each other in a regression model. If a regression model has collinearity, the variance, standard error, and parameter estimates are all inflated. The variance inflation factor (VIF) is used to detect a regression model's multicollinearity problem in this study. Too many variables in a regression model will increase the risk of multicolinearity which will result in numerically unstable models. This study also needed to seek a balance for maximizing the fit when we trying to avoid the problem of multicolinearity. This study uses

correlation matrix, scatterplot matrix, analysis of residual, variance inflation factor testing (VIF) and tolerance to check the multicollinearity among the independent variables. No multicollinearity is found in these variables.

4.4.4 Influential Data or Outliers

The influential data or outliers represent erroneous data, or sometimes indicate a poorly fitting line in a regression model. If a regression model is routinely applied to data containing outliers or influential data, the obtained estimates can be seriously misleading. These points may have a significant impact on the slope of the regression line. The residual plot or leverage plot or distribution plot can amplify the presence of outliers or influential data. This study drew scatterplots, probability plots, and residual plots of dependent variables versus each of the independent variables and found no seriously influential data or outliers.

4.4.5 Inter-item Correlation and Scale Reliability

During the computation of plan quality, a correlation analysis between each indicator and the overall reliability of plan quality is required to test the reliability before the decision for a plan quality is drawn. If the average inter-item correlation is low, Cronbach’s Alpha will be low; otherwise, Cronbach's alpha increases. During the computation of plan quality, a correlation analysis between each indicator and the

overall reliability of plan quality is required to test the reliability before the decision for a plan quality is drawn. The number of indicators also influences the Cronbach's Alpha for scale reliability. The scale reliability can measure the correlations between the individual items that construct the scale, relative to the variances of the items. The Cronbach's Alpha for five plan components and total plan quality is list in Table 4.2, indicating that the inter-item correlation and scale reliability reaches the acceptable level (Nunnaly, 1978).

Table 4.2: Inter-Item Correlation and Scale Reliability

Plan component and total plan quality	Number of Indicators	Cronbach's Alpha
Factual basis	31	0.857
Goals and objectives	13	0.787
Inter-organizational coordination	9	0.676
Policies, tools and strategies	50	0.876
Implementation and monitoring	9	0.661
Total plan quality	112	0.945

In summary, this study conducted related statistical tests for reliability to ensure that the ordinary least squares (OLS) would yield best, linear, and unbiased estimates. The results show that there is no violation of regression assumptions regarding model specification, multicollinearity, heteroskedasticity, errors in the variables, influential data or outliers, or inter-item correlation and scale reliability.

4.5 Validity Threats

Validity refers to the strength of our conclusions, inferences or propositions. This study needed to address four types of validity threats:

4.5.1 Statistical Conclusion Validity

Statistical conclusion validity addresses whether there is a true relationship between the independent variables and dependent variable. In general, a larger sample size would have more chances to avoid conclusion validity threat. This study takes a random sample of 40 local plans that is relatively low to find the statistical significance between the independent variables and dependent variable. The main conclusion validity may come from a relatively low statistical power in the multiple regression models because of the relatively small sample size. In a relatively small sample range, the individual data, especially for some influential data or outliers, can bias the final results. Thus, this study tested each variable's significance and examined the possible influential factors in the regression models. Furthermore, this study groups the variables into four blocks of independent variables to reduce each variable's impact on conclusion validity before the full regression model was given.

4.5.2 Internal Validity

Internal validity addresses whether there is a causal relationship between the independent variables and the dependent variable. The main types of internal validity threats may come from a single factor, multiple factors or social interaction threats. In this study, both local comprehensive planning and environmental assessment are all very complex social management systems affected by numerous natural, socioeconomic, legitimate or institutional factors. For the planning capacity and environmental assessment capacity variables, some factors are unique or important to local environmental assessment plan quality; however, a common protocol or regression model could not identify this impact in this study. For public participation variables, this survey is completed by a local jurisdiction's planning or environmental lead agency rather than the public. The differences between them also cannot be explained in the regression models. For contextual variables, only five items were selected to describe the contextual variations across jurisdictions. The internal regional differences which cross various jurisdictions may influence the regression models. Furthermore, understanding variations for the plan protocol would also be an internal validity threat in this study. Understanding variations can come from personal experience, knowledge, or personality.

Time-related internal validity comes from the local comprehensive plan's dates. The date of the most recent available version of local jurisdictions' comprehensive plan spans more than ten years. Thus, the plan quality reflects different stages of planning or environmental assessment efforts. However, independent variables explain the status of

current or most recent in planning capacity, environmental assessment capacity, public participation or contextual characteristics. Thus, it is difficult for the current 2003's or 2005's planner survey conducted in the California Planners' Book of List to reflect the dynamic processes of planning decision-making or environmental assessment. The biggest challenge for the independent variables is to express a dynamic process of local planning or environmental assessment that actually reflected in final environmental assessment plan quality or integration effects.

4.5.3 Construct Validity

The construct validity refers to whether this study's measured outcome will reflect the construct of variables. Construct validity detects the degree to which inferences can appropriately be made from the variables to the theoretical constructs. Construct validity concerns with the extent to which a particular measure related to other measures in a matter that is consistent with the theoretical concepts. It is critical for a theoretically-based study to establish the fit within the theoretical context and examine theoretical consistency across other measures.

Therefore this study tests whether the aggregating indicators really represented each plan component's plan quality. This study compares the average correlation coefficient of each plan component with other measures. Table 4.3 indicates that the average intra-correlation coefficients of each plan component exceed the average inter-correlation coefficients of other measures. For example, the average intra-correlation

coefficient of the factual basis exceeds the average inter-correlation coefficients between the factual basis and other four plan components. Thus, this study found that five plan components are constructed on a reasonable framework for local environmental assessment plan quality.

Table 4.3: Construct Validity for Five Plan Components

Plan components	I	II	III	IV	V
I. Factual basis	0.22				
II. Goals and objectives	0.15	0.32			
III. Inter-organizational coordination	0.09	0.15	0.31		
IV. Policies, tools, strategies	0.11	0.15	0.13	0.20	
V. Implementation and monitoring	0.15	0.18	0.12	0.13	0.34

4.5.4 External Validity

External validity measures the degree to which this study's outcomes can be generalized to other settings. External validity generalizes this study's outcomes out of the study areas. Geographical variations, socioeconomic characteristics and policy frameworks can be external validity threats to this study. When this study's conclusions are expanded in the rest of California or other states, the above factors should be considered. Moreover, there are various understanding for environmental plan quality and the plan quality evaluation protocol, which can be another external validity. In addition, a higher quality environmental assessment plan does not equal high quality environmental assessment in practice, although the plans were received higher scores.

CHAPTER V

CHARACTERIZING PLAN QUALITY

5.1 Total Plan Quality Overview

5.1.1 Descriptive Statistics for Total Plan Quality and Five Plan Components

The descriptive statistics for each plan component and total plan quality are listed in Table 5.1. The mean score for total environmental assessment plan quality is 23.95 on a scale of 0-50. This low mean for the total plan quality score indicates that the local jurisdictions in this study have a relatively weak capacity to transfer the SEA principles into their local comprehensive land use planning processes.

Table 5.1: Descriptive Statistics for Plan Quality

Plan components and total scores	N	Minimum	Maximum	Mean	Deviation
Factual basis	40	2.26	7.90	4.54	1.41
Goals and objectives	40	2.31	10.00	5.58	1.78
Inter-organizational coordination	40	1.67	9.44	5.84	1.84
Policies, tools and strategies	40	1.90	8.10	4.70	1.33
Implementation and monitoring	40	0.56	7.22	3.29	1.70
Total Plan quality	40	13.32	40.23	23.95	6.83

Inter-organizational coordination plan component has the highest score of the five plan components, demonstrating that local jurisdictions are willing to collaborate with other organizations to manage trans-boundary environmental issues. Goals and objectives receive the second highest score of these five plan components, meaning that jurisdictions have set relatively clear goals to protect local environmental quality. Policies, tools and strategies receive a score of 4.70 indicating relatively weak quality, indicating local jurisdictions still have a long way to go to improve their current assessment tools and planning policies. Factual basis has a score of 4.54 demonstrating a lack of knowledge regarding the existing environmental conditions. Implementation and monitoring is the lowest scoring plan component, indicating weak efforts for implementing environmental assessment through local plans.

5.1.2 Plan Component Scores and Total Scores in Each Jurisdiction

Large variations among the 40 jurisdictions are found in each plan component and the total plan score (Table 5.2). Table 5.2 shows that 62.5% of local jurisdictions receive a final score below 25 points. Only 3 jurisdictions received total scores above 35 points and only one jurisdiction scores above 40. Large variations for each component and total score suggest that local jurisdictions have different capacities to translate the SEA principles into local comprehensive land use planning process.

Table 5.2: Plan Component Scores and Total Scores in Each Jurisdiction

Jurisdictions	Factual basis	Goals	Coordination	Policies	Implementation	Total scores
County of Santa Clara	7.90	9.23	8.89	8.10	6.11	40.23
County of Orange	6.61	9.23	8.33	7.30	7.22	38.70
City of Berkeley	6.45	10.00	7.22	6.40	6.67	36.74
County of Santa Cruz	5.89	8.46	7.78	6.50	6.11	34.74
County of Santa Barbara	6.77	7.31	7.78	7.10	5.56	34.52
County of Contra Costa	6.94	8.08	8.89	6.30	3.89	34.09
City of Los Altos	5.97	6.54	7.78	4.30	5.56	30.14
City of Palo Alto	5.65	7.69	6.11	6.00	3.33	28.78
City of Cupertino	5.89	6.15	6.11	5.00	5.00	28.15
City of Hayward	5.97	6.54	5.56	6.00	3.89	27.95
City of Santa Rosa	5.40	6.54	7.22	4.90	2.78	26.84
City of Ventura	4.11	6.15	6.11	5.30	5.00	26.68
City of Morgan Hill	2.98	6.54	9.44	5.30	2.22	26.49
City of Moraga	3.63	6.15	8.33	5.60	2.22	25.94
County of Sonoma	4.76	5.38	6.67	4.90	3.89	25.60
City of Costa Mesa	5.32	5.77	5.56	4.30	3.89	24.84
City of Lafayette	4.35	6.92	3.89	5.10	4.44	24.71
City of Oxnard	6.13	5.00	4.44	5.40	3.33	24.31
City of Irvine	5.08	4.62	5.56	4.60	4.44	24.30
City of Thousand Oaks	4.19	5.00	7.22	5.00	1.67	23.08
City of Orange	3.47	5.38	7.22	4.20	2.22	22.50
City of Santa Clara	4.35	5.00	5.56	3.90	3.33	22.14
County of San Luis Obispo	4.27	3.46	5.00	4.10	5.00	21.84
City of Carmel	3.71	4.23	6.11	4.50	2.22	20.77
City of San Ramon	3.23	4.23	5.56	4.80	2.78	20.59
City of Sausalito	3.47	4.62	4.44	4.40	3.33	20.26
City of Campbell	4.60	4.62	5.56	3.20	2.22	20.19
City of Tiburon	2.74	3.85	5.56	4.60	2.78	19.52
City of Alameda	3.39	4.62	6.11	3.00	2.22	19.34
City of Rohnert Park	5.56	3.85	4.44	4.20	1.11	19.17
City of San Luis Obispo	3.55	5.77	4.44	4.00	1.11	18.87
City of Dana Point	3.15	4.23	5.00	3.60	2.78	18.75
City of Concord	2.26	5.00	4.44	4.50	2.22	18.42
City of Arcata	3.79	3.85	3.89	3.00	3.33	17.86
City of Orinda	3.31	5.00	3.89	4.10	1.11	17.41
City of Pinole	2.50	2.31	7.22	3.90	1.11	17.04
City of Clayton	3.47	3.85	2.78	3.40	2.22	15.71
City of Redwood City	3.31	5.38	1.67	1.90	1.67	13.92
City of Milpitas	4.84	2.69	2.78	2.30	1.11	13.72
City of Burlingame	2.58	3.85	3.33	3.00	0.56	13.32

The lowest scores are located in the City of Burlingame (13.32 points), City of Milpitas (13.72 points), and City of Redwood City (13.92 points). Jurisdictions with the lower scores are expected to have the weakest planning incentives and capacities to incorporate the principles, policies and tools of strategic environmental management into their comprehensive land use planning process. The highest scores were received by the City of Berkeley (36.74), County of Orange (38.70), and County of Santa Clara (40.23). Higher scores suggest these jurisdictions have stronger capacities and long-term vision to strategically direct and manage local environmental quality.

An interesting result from the t-test for the plan quality total scores between the 7 coastal counties and the 33 coastal cities shows that the plan quality of the counties are significantly higher than those of the cities ($t=2.555$, $p<0.05$). This result indicates that coastal counties may have stronger incentives and capacities than the cities to conduct strategically environmental assessment and management in local planning process.

5.2 Plan Component and Indicator Measurement

This section discusses the quality of each plan component and its indicators which can provide more details on understanding the environmental assessment plan quality.

5.2.1 Factual Basis

The plan component of factual basis has three sub-components: natural environment, built environment and human health. The results for each sub-component are listed in the following indicator scores.

Table 5.3: Natural Environment: Indicator Scores

Indicators	Breadth score	Depth score	Total score
1.01 Local jurisdiction's physical setting	0.80 (80%)	0.67	1.47
1.02 Local environment's sphere of influence	0.75 (75%)	0.78	1.53
1.03 Local environment's temporal impact	0.20 (20%)	0.75	0.95
1.04 Major environmental laws and regulations	0.83 (83%)	0.73	1.56
1.05 Ecosystem's concept, function, process and integrity	0.43 (43%)	0.56	0.98
1.06 Rare, threatened and endangered species	0.65 (65%)	0.66	1.31
1.07 Biodiversity and disturbance and threats	0.30 (30%)	0.54	0.84
1.08 Ecologically important areas	0.90 (90%)	0.70	1.60
1.09 Water consumption and water resources availability	0.90 (90%)	0.66	1.56
1.10 Water quality and point/nonpoint-source pollution	0.88 (88%)	0.64	1.51
1.11 Groundwater supply and aquifer depletion	0.63 (63%)	0.68	1.31
1.12 Hydrological regimes and aquatic environment	0.78 (78%)	0.65	1.42
1.13 Environmentally sensitive lands	0.85 (85%)	0.64	1.49
1.14 Soil quality and soil degradation	0.85 (85%)	0.58	1.43
1.15 Wetland and watershed	0.75 (75%)	0.53	1.28
1.16 Natural/urban vegetation and forestry resources	0.93 (93%)	0.59	1.51
1.17 Local and regional geological settings	0.75 (75%)	0.70	1.45
1.18 Air quality and air pollutants	0.83 (83%)	0.61	1.44
1.19 Greenhouse gas emission	0.13 (13%)	0.70	0.83
1.20 Ozone layer depletion	0.33 (33%)	0.69	1.02
1.21 Climate change and variability	0.18 (18%)	0.57	0.75

Local jurisdictions have identified the physical setting relatively well (80%), indicating they recognize the geographic comprehensiveness of their comprehensive land use plans. Although California Planning Guidance mandates local comprehensive land use plans must identify the sphere of influence, 25% of local jurisdictions still failed to identify the areas outside their planning boundaries to provide a convenient measure of the jurisdiction's region of interest. Although local jurisdictions have good geographic descriptions, relatively very few (20%) of them clearly recognized the temporal impact from their comprehensive land use plans, indicating that local jurisdictions lack an adequate long-term consideration for the environmental impact from their comprehensive land use plans even if the state plan guidance emphasizes a long-term vision for local comprehensive plans. 83% of local plans identified major environmental laws and regulations. This result indicates that the CEQA had significant influence on local comprehensive land use planning. However, the depth score for the indicator is not comparatively high (0.73), suggesting efforts are still needed to enhance local awareness of major environmental laws and regulations. Although ecosystems have been recognized by researchers and planners as an important environmental component, the concept of ecosystem is received little attention by local jurisdictions with a low breadth score of 43%. Biodiversity received a breadth score of only 30% and is, therefore, one of the weakest items in existing factual basis of these local plans. Although two-thirds of local jurisdictions identified rare, threatened and endangered species, the classifications and checklists are generally not given in these plans. Only one-third of them presented a

clear concept of biodiversity. The disturbance and threats to biodiversity have not been adequately recognized in existing local comprehensive land use plans.

In contrast, a majority of local jurisdictions (90%) identify the regions with significant ecological values including wildlife habitat, natural reserves, or protected areas. In general, local jurisdictions receive relatively high scores on the four water-related indicators, indicating that the water issues have a central role in California local environmental planning. The depth of the quality on water consumption and water availability (0.66), water quality and water pollution (0.64) are not very high. 63% of local jurisdictions recognize the problem of groundwater supply and aquifer depletion because a large amount of California water comes from groundwater. The depth of groundwater depletion is still not a high concern. A majority (78%) of local jurisdictions identify hydrological regimes and aquatic environment including rivers, streams, drainages and natural or urban aquatic resources in their comprehensive land use plans. The three land-related indicators have a relatively high breadth but a lower depth score. A majority (85%) of local jurisdictions identify the environmentally sensitive lands which may have negative impacts on environmental quality (e.g. airports; coastal zones; flooding zones, or areas of special environmental significance). Wetlands and watersheds are also recognized with a breadth score of 75% in local comprehensive land use planning, but the depth score (53%) is not very high since the maps and the exact watershed names are generally missing in these plans. Soil quality and soil degradation is identified by a majority (85%) of local comprehensive land use plans, but many of the plans do not list the soil classification or point out the possible threat of soil erosion and

soil contamination. 93% of local jurisdictions identified vegetation and forestry resources, indicating they recognize that nature vegetation and man-made urban forestry are important influences on urban environmental quality. 75% of local jurisdictions illustrated local and regional geological settings in their comprehensive land use plans. Also, air quality and air pollutants are recognized by the majority (83%) of jurisdictions as a critical issue in their comprehensive land use planning. Although local level indicators generally received high scores, the global-scale indicators are weakly identified by local comprehensive land use plans. For example, greenhouse gas emission received the lowest breadth score (13%) in the factual basis plan component. Ozone layer depletion (33%) and climate change (18%) also receive very low scores.

In summary, the natural environment section shows a relatively high percentage of traditional local environmental indicators: ecologically important areas, vegetation and forestry resources, water consumption, water resource, water quality, water pollution, soil quality, and soil degradation. However, at least half of the local jurisdictions failed to identify the concepts of local environment's temporal impact, ecosystem, biodiversity, greenhouse gas emission, ozone and global warming. All of these items are strategically important environmental issues which may have cumulative impacts on the local environment on a long-term scale, but these items were not thoroughly considered in current local comprehensive land use planning activities. Additionally, the indicator depth scores show that many region-wide, global-wide or strategic-level indicators are not well-represented demonstrated by appropriate statements, maps or categories. The lowest total scores were received by indicators of climate change and variability (0.75),

greenhouse gas emission (0.83), biodiversity and disturbance and threats (0.84), temporal impact (0.95), ecosystem (0.98), ozone layer depletion (1.02). Results in this factual basis section demonstrate that local jurisdictions mainly consider environmental issues at the local scale. Local planning agencies may lack incentives and capacities to develop a strategic vision for environmental assessment.

Table 5.4: Built Environment: Indicator Scores

Indicators	Breadth score	Depth score	Total score
1.22 Physical constraints of land development	0.70 (70%)	0.71	1.41
1.23 Land use patterns and land availability	0.93 (93%)	0.64	1.57
1.24 Agricultural resources and working landscape	0.55 (55%)	0.58	1.13
1.25 Description of open space, green space, esthetical or recreational resources	0.98 (98%)	0.76	1.73
1.26 Critical historical and cultural heritage	0.85 (85%)	0.66	1.51

In the built environmental section (Table 5.4), since open space is a mandatory plan element in local comprehensive planning process, almost all of the jurisdictions described the open space, green space and recreational resources. Although a high breadth score (98%) was received for open space, the depth score of the open space indicator is 0.76, which is lower than the breadth score, indicating some jurisdictions do not map the locations of open spaces, green spaces, or recreational resources even if the plans identify them. The conservation of open spaces requires that long-term management be put into place to ensure their viability in the future. 93% of the local plans identified land use patterns and land availability but did not adequately map the

existing land use conditions. Agricultural resources and working landscapes received relatively low coverage (55%) by local jurisdictions because many jurisdictions are highly urbanized with few agriculture lands, farmlands, croplands, grazing lands and timber lands. Approximately 70% of the local plans pointed out the physical constraints of land development and explained the areas where urban expansion was not appropriate or lands that were suited only for a limited range of land uses due to physical topography or environmental hazards. Approximately 85% of the local plans identified cultural heritage in the local development process, but many land plans did not adequately map the cultural heritage resources or point out possible threats from uncoordinated development.

In regard to human health indicators in Table 5.5, most of the local plans identified noise-sensitive areas and main environmental hazards because California planning guidance mandates noise and safety elements in local comprehensive plans. Although local jurisdictions identified the types of main environmental hazards (98%) and risks of hazardous materials, wastes or pollution (85%), further detailed information for vulnerable population and places was very poorly (35%) analyzed in the planning process. The indicator of vulnerable population and places received the lowest total score of 0.90 on a scale of 2 in the human health section. Carrying capacity estimation was rarely analyzed while population growth was well recognized in local jurisdictions' planning process.

Table 5.5: Human Health: Indicator Scores

Indicators	Breadth score	Depth score	Total score
1.27 Population growth and carry capacity estimation	0.78 (78%)	0.56	1.33
1.28 Noise-sensitive areas	0.95 (95%)	0.68	1.63
1.29 Main environmental hazard risks	0.98 (98%)	0.74	1.72
1.30 Social/environment/disaster vulnerable population and places	0.35 (35%)	0.55	0.90
1.31 Risk of exposure to hazardous materials, wastes, pollution	0.85 (85%)	0.61	1.46

5.2.2 Goals and Objectives

As shown in Table 5.6 for the goals and objectives, all of the jurisdictions set goals to protect natural resources and environmental values, build accessible open or green space and a walkable community, and build a disaster-resistant, healthy, safe community. Most jurisdictions (95%) sought clean and plentiful water resources, productive and efficient land use and clear air. All of those goals and objectives related to local community environmental quality received relatively higher scores in both the coverage and the depth quality, indicating that local environmental quality was the major consideration in local development. Approximately 78% of the local jurisdictions set goals to balance development and protect local diversity, distinctiveness, history and culture. Energy conservation and energy alternatives were recognized as an environmental goal by two-thirds of the local jurisdictions.

Table 5.6: Goals and Objectives: Indicator Scores

Indicators	Breadth score	Depth score	Total score
2.01 Protect natural resources and environmental values	1.00 (100%)	0.84	1.84
2.02 Maintain intergenerational sustainability	0.25 (25%)	0.85	1.10
2.03 Balance environmental, social, and economic development	0.78 (78%)	0.76	1.53
2.04 Seek environmental justice and equity	0.10 (10%)	0.63	0.73
2.05 Build up environmental stewardship	0.38 (38%)	0.70	1.08
2.06 Achieve sustainable and healthy ecosystems and protect biodiversity	0.35 (35%)	0.82	1.17
2.07 Seek clean and plentiful water resources	0.95 (95%)	0.92	1.87
2.08 Seek productive and efficient use of land	0.88 (88%)	0.83	1.70
2.09 Seek clear air	0.88 (88%)	0.80	1.68
2.10 Seek energy conservation and energy alternatives	0.65 (65%)	0.73	1.38
2.11 Build accessible open/green space and walkable community	1.00 (100%)	0.78	1.78
2.12 Value and protect diversity and local distinctiveness/history/culture	0.78 (78%)	0.74	1.52
2.13 Build disaster-resistant, healthy, safe community	1.00 (100%)	0.88	1.88

However, relatively few jurisdictions emphasized the goals of intergenerational sustainability (25%), environmental stewardship (38%), biodiversity and ecosystems (35%). Only 10% of the local jurisdictions set goals to seek environmental justice and equity, although environmental justice has been emphasized in NEPA regulations and CEQA guidelines. In summary, local jurisdictions mainly sought the environmental goals highly related to local environmental quality (e.g. air, water, land, open space, safety), whereas some long-term critical environmental goals (e.g. sustainability, ecosystem, biodiversity, environmental justice, and environmental stewardship) were poorly identified in local plans. Environmental justice and equity was the least

understood (10%) of these goals and objectives because it was introduced into the California General Plan Guidelines in 2001.

5.2.3 Inter-Organizational Coordination

More than 90% of local jurisdictions have specific procedures to coordinate with surrounding jurisdictions and regional organizations on environmental issues (Table 5.7).

Table 5.7: Inter-Organizational Coordination: Indicator Scores

Indicators	Breadth score	Depth score	Total score
3.01 Identify public and stakeholder concerns	0.70 (70%)	0.75	1.45
3.02 Inter-organizational coordination within the jurisdiction	0.83 (83%)	0.80	1.63
3.03 Coordination with surrounding jurisdictions	0.93 (93%)	0.95	1.87
3.04 Coordination with regional organizations	0.90 (90%)	0.97	1.87
3.05 Coordination with state or federal agencies	0.78 (78%)	0.87	1.65
3.06 Coordination with private organizations or NGOs	0.70 (70%)	0.88	1.58
3.07 Specify trans-boundary environmental issues	0.70 (70%)	0.82	1.52
3.08 Identify commitment of financial sources for inter-organizational coordination	0.20 (20%)	0.69	0.89
3.09 Specify environmental conflict management and dispute resolution	0.40 (40%)	0.81	1.21

Furthermore, 70% of local jurisdictions also emphasize inter-organization coordination within the jurisdiction and with private organizations or NGOs. Public and stakeholder environmental concerns and the major trans-boundary environmental issues were specified by two-thirds of the local jurisdictions. However, relatively few local

plans commit financial sources (20%), or identify environmental conflict management procedures (40%).

5.2.4 Policies, Tools, and Strategies

Five sub-components are included in the plan component of policies, tools, and strategies (Table 5.8).

Concerning environmental assessment tools, on-site environmental review was most frequently (95%) used in local environmental assessment. The environmental checklist or inventory (90%) is becoming an important environmental tool for local environmental assessment. The major limitation of checklists and matrices is the missing spatial dimension in land use analysis. Additionally, many environmental elements cannot be presented in tabular form. Trends analysis (83%) is widely used to predict population growth, water consumption, or housing demands. The majority (78%) of local jurisdictions adopted land use partitioning analysis and compatibility appraisal to assess existing land use patterns. Since a significant amount of habitat degradation has occurred due to parcelization, the division of land for low-density rural development in open spaces, wetlands, forests and rangelands, land use partitioning analysis helps reduce land parcelization. Land use compatible development is helpful to avoid environmental inequities which disproportionately affect a particular segment of the population or place. 73% of the local jurisdictions set the environmental threshold of significance as an environmental decision-making criterion in local development.

Table 5.8: Assessment Tools: Indicator Scores

Indicators	Breadth score	Depth score	Total score
4.01 On-site environmental review	0.95 (95%)	0.84	1.79
4.02 Environmental threshold of significance for development decision-making	0.73 (73%)	0.62	1.35
4.03 Overlay mapping and GIS analysis	0.53 (53%)	0.79	1.31
4.04 Scenario/sensitivity analysis	0.63 (63%)	0.70	1.33
4.05 Network and system diagram analysis	0.45 (45%)	0.67	1.12
4.06 Trends analysis	0.83 (83%)	0.88	1.70
4.07 Environmental modeling	0.35 (35%)	0.68	1.03
4.08 Ecological footprint analysis/carry capacity	0.15 (15%)	0.67	0.82
4.09 Questionnaires, interviews, panels	0.63 (63%)	0.72	1.35
4.10 Checklists /inventory for environmental items	0.90 (90%)	0.81	1.71
4.11 Matrices for environmental issues	0.68 (68%)	0.78	1.45
4.12 Life cycle analysis	0.05 (5%)	0.50	0.55
4.13 Land use partitioning analysis	0.73 (73%)	0.74	1.47
4.14 Multi-criteria analysis	0.65 (65%)	0.71	1.36
4.15 Compatibility appraisal	0.78 (78%)	0.89	1.66
4.16 Cost-benefit analysis	0.33 (33%)	0.81	1.13
4.17 Risk assessment	0.25 (25%)	0.75	1.00
4.18 Vulnerability analysis	0.08 (8%)	0.67	0.74

More than 60% of jurisdictions have used questionnaires, interviews, expert panels, and matrices to analyze environmental problems. Scenario and sensitivity analysis was used by 63% of local jurisdictions to analyze noise impact, environmental hazards or critical ecological resources. Environmental modeling was relatively less (35%) used to predict water pollution, soil erosion, or air quality. The cost-benefit analysis involves determining and quantifying the environmental benefits and costs and helps decision-makers choose the optimal alternative in comprehensive land use planning, but only one-third of the local jurisdictions adopted cost-benefit analysis to

evaluate the relative merits of a strategic action and incorporate environmental costs into their environmental assessment and review. More important, few jurisdictions have adequate incentives or the capacity to incorporate ecological foot print analysis (15%), life cycle analysis (5%), risk assessment (25%), and vulnerability analysis (8%) as environmental assessment tools. This result is consistent with the findings in the factual basis plan. The combined results demonstrate that local environmental planning lacks details, depth and new approaches.

In regard to regulatory policies (Table 5.9), the total quality of these regulatory policies is higher than other policies, tools, or strategies. All of the jurisdictions have implemented strict regulations on local environmental assessment. Land permit use was adopted by all jurisdictions to protect critical natural resources or environmental areas. More than 90% of the local jurisdictions adopted regulatory policies such as land use restrictions, study zones or conservation zones, disaster-resistant land use and building code in local environmental management. The majority (75%) of local jurisdictions adopted density restrictions or buffer requirements to protect open space or coastal zones. Most local jurisdictions (93%) identified disaster preparedness, mitigation, response and recovery, but the depth of these procedures was relatively low (0.61). Although the state planning office established guidelines for smart growth, policies for controlling urban service and growth boundaries were not highly (63%) adopted by all jurisdictions.

Table 5.9: Regulatory Policies: Indicator Scores

Indicators	Breadth score	Depth score	Total score
4.19 Land use restrictions	0.98 (98%)	0.87	1.85
4.20 Density restrictions in and around environmental sensitive areas	0.75 (75%)	0.78	1.53
4.21 Buffer requirements	0.80 (80%)	0.67	1.47
4.22 Land permitted use	1.00 100%)	0.86	1.86
4.23 Creation of special study zones, conservation zones or protect areas	0.90 (90%)	0.75	1.65
4.24 Sensitive area protection	0.93 (93%)	0.76	1.68
4.25 Control of urban service/growth boundaries	0.63 (63%)	0.80	1.43
4.26 Disaster-resistant land use and building code	0.93 (93%)	0.72	1.64
4.27 Disaster preparedness, mitigation, response and recovery procedures	0.93 (93%)	0.61	1.53
4.28 Other regulatory tools to protect environmental values	0.58 (58%)	0.70	1.27

The incentive policies section (Table 5.10) shows that 90% of local jurisdictions emphasized mixed-use, infill or redevelopment policies and pedestrian or resident-friendly, or bicycle-friendly or transit-oriented policies to solve the problem of limited land supplies. Local community environmental quality was the major concerns in local comprehensive land use planning. Local jurisdictions paid a lot of attention to promoting infill development by rehabilitating, maintaining and improving existing infrastructure to support appropriate reuse and redevelopment of previously developed or underutilized land. 70% of local jurisdictions encouraged clustering development away from environmental sensitive areas. Waste recycling programs are widely (70%) used in local environmental management. To ensure future energy sustainability, energy-efficient land use was encouraged by 68% of jurisdictions to promote efficient and cost-effective use.

Table 5.10: Incentive Tools: Indicator Scores

Indicators	Breadth score	Depth score	Total score
4.29 Transfer of development rights (TDR) or purchase of development rights (PDR) away from the environmental sensitive areas	0.50 (50%)	0.68	1.18
4.30 Land/mitigation banking	0.55 (55%)	0.59	1.14
4.31 Capital improvement program for environmental protection	0.55 (55%)	0.77	1.32
4.32 Density bonus or bonus zoning in charge for environmental protection	0.48 (48%)	0.66	1.13
4.33 Clustering away from the environmental sensitive areas	0.70 (70%)	0.70	1.40
4.34 Mixed-use, infill/ redevelopment	0.90 (90%)	0.79	1.69
4.35 Pedestrian/resident-friendly, bicycle-friendly, transit-oriented community development	0.90 (90%)	0.71	1.61
4.36 Preferential tax treatments to protect environmental values	0.28 (28%)	0.68	0.96
4.37 Waste recycling and management program	0.70 (70%)	0.71	1.41
4.38 Low-impact design for impervious surface	0.25 (25%)	0.80	1.05
4.39 Watershed-based and ecosystem-based land management	0.30 (30%)	0.67	0.97
4.40 Water-conserving land use	0.68 (68%)	0.72	1.40
4.41 Energy-efficient, or alternative-energy land use	0.68 (68%)	0.72	1.40
4.42 Other incentive tools for environmental protection	0.65 (65%)	0.67	1.32

Furthermore, 68% of local jurisdictions emphasized water-conserving land use. Because of the ever-growing demand for water, an unreliable and diminishing supply requires local jurisdictions to look at alternative water policies in comprehensive land use planning. Capital improvement programs were adopted by 55% of the local jurisdictions to provide packages of fiscal and financial incentives along with

appropriate regulatory arrangements and the development of partnerships to achieve environmental protection.

Policies for land or mitigation banking were adopted by more than half of the local jurisdictions to acquire land and hold land for future use. Half of local jurisdictions were using policies to transfer or purchase development rights away from environmental sensitive areas. Less than half (48%) of the local jurisdictions adopted density bonuses or bonus zoning for environmental protection. Relatively few (28%) local jurisdictions have adopted preferential tax treatment for higher tax-producing land uses such as commercial use. Although the benefits of low impact design for impervious surfaces are significant in reducing surface runoff, protecting regular stream flow and watershed hydrology, increasing groundwater recharge and reducing stream sedimentation (Arnold and Gibbons, 1996), this incentive policy has been little emphasized in existing local planning. Few (25%) jurisdictions have encouraged land use design for less impervious surfaces to generate less interference with natural systems and reduce the frequency and severity of floods and pollution. The concepts of watershed and wetland are relatively well identified in the factual basis, but the concepts did not translate as an effective management tools in local planning.

In land acquisition section (Table 5.11), conservation easements are somewhat more widely used than development impact fees. 80% of local jurisdictions have adopted conservation easements agreement between a landowner and a land trust or government agency to permanently limit use of the land and protect its conservation values. 75% of local jurisdictions used development impact fees to acquire land.

Table 5.11: Land Acquisition Programs: Indicator Scores

Indicators	Breadth score	Depth score	Total score
4.43 Development impact fees for environmental protection	0.75 (75%)	0.70	1.45
4.44 Conservation easements	0.80 (80%)	0.72	1.52
4.45 Other land acquisition techniques	0.70 (70%)	0.70	1.40

Local jurisdictions adopted other types of land acquisition techniques including fee simple absolute interests, easement interests, leasing, lease-purchase agreements, purchase and resale or lease, joint acquisition, land swapping, and eminent domain. Since land acquisition allows a public agency or nonprofit land conservation organization purchases the ownership rights to protect environmental values, they are adopted in two-thirds of local comprehensive land use plans. Acquiring a land or conservation easement rather than full ownership ensures that development will be limited and avoids the question of whether regulatory policies limit private property without just compensation. Thus, land acquisition programs including development impact fees for land acquisition and conservation easements have been widely adopted by more than 75% of the plans.

In Table 5.12, communication-based strategies show that public awareness programs such as education and training are most widely used to enhance public awareness for education and training programs. 85% of local jurisdictions provided at least one type of public participation and communication channel. Public meetings are

identified as the most frequent public participation and communication channels; workshops and outreach services were relatively less used by local jurisdictions.

Table 5.12: Communication-Based Strategies: Indicator Scores

Indicators	Breadth score	Depth score	Total score
4.46 Public awareness programs for environmental issues (e.g. education or training)	0.98 (98%)	0.73	1.71
4.47 Multiple public participation and communication channels	0.85 (85%)	0.69	1.54
4.48 Effective information accessibility, notification and dissemination	0.60 (85%)	0.65	1.25
4.49 Public participation in environmental decision-making structure	0.80 (85%)	0.63	1.43
4.50 Emphasizing linking science, technology, and policy	0.50 (85%)	0.55	1.05

60% of the local jurisdictions used at least one type of information availability, notification and dissemination, including mailing lists, toll-free telephone number, newsletters, fact sheets, press releases, exhibits, open-door policy or computer communication. Since state planning guidelines mandate public participation in local planning, 80% of local jurisdictions emphasized public participation in environmental decision-making structure. Only half of jurisdictions emphasize the dialogue and linkage of science, technology and policy which have actually caused inconsistent quality among the five plan components in these plans.

5.2.5 Implementation and Monitoring

In Table 5.13, implementation and monitoring reveals that 90% of the local jurisdictions have identified plan update procedures to evaluate local development status with respect to the comprehensive plan as well as state, regional, and local cooperative planning efforts. A possible explanation for this high score is that the California General Plan Guidance requires that a plan shall contain a program of implementation measures including regulations, programs, public works projects, and financing measures.

Table 5.13: Implementation and Mentoring: Indicator Scores

Indicators	Breadth score	Depth score	Total score
5.01 Identify each major agency's responsibilities for plan's implementation	0.48 (48%)	0.68	1.16
5.02 Give a clear, reliable time schedule	0.43 (48%)	0.68	1.10
5.03 Provide necessary technical assistance for environmental quality	0.43 (48%)	0.56	0.98
5.04 Identify reliable financial support for plan's implementation	0.48 (48%)	0.61	1.08
5.05 Identify plan update procedures to assess plan effectiveness regularly	0.90 (48%)	0.64	1.54
5.06 Specify environmental monitoring procedures	0.80 (48%)	0.59	1.39
5.07 Specify enforcement of environmental protection	0.23 (48%)	0.56	0.78
5.08 Perform mitigation measurements	0.60 (48%)	0.63	1.23
5.09 Emphasize introducing new knowledge or techniques into implementation process	0.45 (48%)	0.61	1.06

80% of local jurisdictions specified environmental monitoring procedures but relatively little emphasis was given to regular of monitor local jurisdiction's resource use, land development and environmental impacts. 60% of the local jurisdictions identified mitigation measurements to reduce environmental or hazard impacts. Less than half of the local jurisdictions identify major agency's responsibilities (48%), give a clear, reliable time schedule (43%), provide necessary technical assistance (43%), specify enforcement (23%), or introduce new knowledge or techniques in plan implementation (45%). Since the comprehensive plan is a long-term document, it must be regularly refreshed with new knowledge, techniques, or data as they become available in order to ensure that its long-term outlook does not become outdated. Evaluating a local comprehensive plan's effectiveness and making course corrections relies upon the local planning agency's ability to continue introducing new information with new techniques into implementation. However, only 45% local jurisdictions emphasize introducing new knowledge or techniques into implementation process.

CHAPTER VI

FACTORS INFLUENCING PLAN QUALITY

A key question faced by planners trying to plan for strategic environmental assessment is: what can be done in the planning process to influence promotion of environmental planning? The purpose of this chapter is to determine whether dimensions of planning capacity, environmental assessment capacity, public participation capacity and contextual characteristics are related to promoting the concept of environmental assessment in local comprehensive land use plans.

6.1 Correlation Analysis

From the correlation matrix in Appendix 5, five independent variables are significantly correlated with the dependent variable-environmental assessment plan quality where $p<0.05$.

From the correlation matrix, the results are summarized as follows:

First, the number of planners is positively correlated with the plan quality with a correlation coefficient of 0.55 ($p<0.01$). This correlation result suggests that high numbers of planners can bring more human resources, expertise and personnel to local comprehensive planning process. Therefore, more planners may lead to a higher quality local comprehensive plan particularly as it relates to environmental assessment.

Second, the date of plan update has a negative correlation with environmental assessment plan quality ($p<0.05$). Because plan update date is calculated by using the year 2005 minus the actual year of the conservation plan element, the smaller number of the plan update date indicates more recent plans whereas the larger number indicates older plans. An on-time, regular plan element update procedure helps local comprehensive plans keep a breast of existing new information, conditions, regulations, and techniques and leads to higher plan quality.

Third, assessment scope indicates a positive correlation with environmental assessment plan quality ($p<0.01$). This significant statistical relationship suggests that a broader assessment scope can consider more development proposals in the environmental assessment processes, thus, stronger capacities of environmental assessment and environmental management can be expected.

Fourth, information management and sharing is significantly correlated with environmental assessment plan quality ($p<0.01$). Effective environmental assessment critically depends upon information management and sharing capacity to manage the environmental assessment's information resources and share it with government officials, the judiciary, legal practitioners, academia, and the public at large. Local jurisdictions with strong information management and sharing will have a higher quality environmental assessment plan.

Fifth, population is the only contextual factor with a statistically significant correlation with plan quality ($p<0.05$). Local jurisdictions with larger populations may have relatively more expertise and resources to conduct effective environmental

planning and to deal with the possible environmental conflicts in the development process. Thus, population is an important contextual factor in environmental assessment plan quality. This correlation result is consistent with the results in Chapter V. The plan quality of the 7 coastal counties is significantly higher than with the other cities. One contextual characteristic is that the counties in this study generally have a larger population than the cities. Among the contextual characteristics, population growth, wealth, education, public and conservation lands are all not statistically significant is correlated with the plan quality. This study also adopts the median family income, per capita income, and total assessment value (equaling the per capita income multiplied by population) to represent the variable of wealth; however, the results consistently show that wealth does not show significance with the plan quality.

Sixth, regarding planning capacity variables, GIS technical levels and collaborative efforts are not significantly correlated with plan quality, but the association is positive. Environmental assessment capacity variables show that streamlining ability does not have a statistically significant correlation with plan quality. No public participation variables have a statistically significant correlation with plan quality, although numerous previous studies have highlighted the role of public participation in planning process.

Seventh, no significant correlation is found in Appendix 5 for participation formats, public notice channels, public participation incentives, and the plan quality. This result indicates that the more numbers of participation formats, public notice channels, or public participation incentives do not equal to high quality environmental

assessment plans. The combined participation types may mix the negative and positive impacts for plan quality. Brody et al. (2003f) and Godschalk et al. (2003) found that the specific citizen input techniques rather than the number of techniques can influence the plan quality. Public hearings may have a statistically negative impact on planning quality because it is hard to balance all stakeholders' interests in the census-building process, but they found that the workshops and other types of public participation have positive impacts on plan quality. Increased participation could dilute the strength of technical plan elements and powerful diverted stakeholders' interests may also steer plan content away from environmental concerns. Thus, a larger mixed number of public participation does not necessarily mean a higher quality public participation, but specific techniques are what could make the difference (Brody et al., 2003f). To detect the influence of each type of public participation on plan quality, this study further separates the types of participation formats, public notice channels, and public participation incentives to analyze their influences. The correlation results in Table 6.1 show that none of them is statistically significant with the plan quality. The correlation results in Table 6.1 confirm part of the previous studies (Brody et al., 2003f; Godschalk et al., 2003). Although no statistical significance is found in these techniques, the mixed number of public participation techniques may mislead the public participation efforts since these techniques may have opposite impacts on plan quality. Some techniques can reduce the plan quality while others improve it. The correlation results for the public participation capacity variables in Table 6.1 demonstrate that it is a difficult process to incorporate public participation effects into evaluation of local comprehensive land use plans. This

study further analyzes the influence of public participation on environmental assessment plan quality in the following regression analysis section. Furthermore, large sample sizes are needed to further detect the influence of public participation capacity on environmental assessment plan quality in the future study.

Table 6.1: Correlation Results for Public Participation Capacity Variables

Capacity	Techniques	Correlation Coefficient
Participation formats	Workshops	-0.029
	Townhall Meetings	0.088
	Site Tours	0.072
	Charrettes	-0.073
	Other participation formats	0.283
Public notice channels	Internet	-0.051
	Non-English Newspaper	0.010
	Radio or Television	0.068
	Mail	0.191
	Notices using community organizations	0.116
	Community newsletters	-0.078
	Other public notice channels	0.174
Public participation incentives	Evening meetings	-0.058
	Providing daycare at public meetings	-0.111
	Transportation at public meetings	0.016
	Public meetings near the project site	0.123
	Involving youth in community planning exercises	0.052
	Posting minutes or project docs on the internet	0.044
	Allowing public comment by E-mail/ internet	0.241
	Using alternative public participation jurisdiction formats	0.189

Eighth, after the correlation relationships between the dependent variable and 15 independent variables are discussed above, the inter-variable correlation relationships are illustrated as the followings: 1) The number of planners is significantly ($p<0.05$) correlated in a positive direction with the streamling ability, indicating more planning

personnel can devote to the environmental assessment's streamling procedures. In addition, the number of planners is significantly correlated three public participation capacity variables: participation formats, public notice channels, and public participation methods. Jurisdictions with more planners tend to have more planning human resources to organize public participation activities. Furthermore, the number of planners is also correlated with population, and public and conservation lands. Jurisdictions with more population or public and conservation lands generally have more planners to deal with their comprehensive land use planning activities. 2) GIS technical level is significantly correlated in a positive direction with population, education, but it has a negative direction with wealth. The jurisdictions with more population, higher education tend to have higher GIS technical levels to develop the GIS-based environmental information for their comprehensive land use planning. 3) Assessment scope is significantly correlated in a positive direction with participation formats, and population, but it has negative correlation with public participation incentives. Since the population is also correlated with the number of planners, the jurisdictions with larger populations can expand their environmental assessment scopes during their comprehensive land use planning process. 4) For these three public participation capacity variables, participation formats is significantly correlated with public notice channels, and public participation incentives. In addition, public notice channel is significantly correlated with public participation incentives. Jurisdictions with stronger public participation capacity can develop more formats, channels, and incentives for public involvement. In addition, the variable of public participation incentives is significantly correlated with public and

conservation lands. The jurisdictions with larger public and conservation lands tend to have more population as well as more planners to develop public participation incentives. 5) For the contextual variables, education and wealth are significantly correlated with each other. In addition, wealth is also correlated with public and conservation lands. 6) The following variables are only correlated with the plan quality: collaborative efforts, streamling ability, information management and sharing, public participation incentive, population growth.

6.2 Regression Analysis

To further detect the independent variables' influence on plan quality, this section extends the correlation analysis to regression analysis. Since the number of independent variables is relatively large compared to the sample size of this study, the regression analysis group the variables as four blocks: planning capacity variables, environmental assessment capacity variables, public participation variables, and contextual variables. The regression models analyze independent variables in each category as a way to systematically build a fully specified model.

6.2.1 Planning Capacity Variables

In Table 6.2, the results of the regression analysis for the block of planning capacity variables suggest that number of planners and plan update date make a

statistically significant contribution to environmental assessment plan quality. The number of planners has a statistically positive impact on plan quality at the 0.001 level.

Table 6.2: Planning Capacity Variables on Plan Quality

Variable	Coefficient	Standardized Coefficient	Standard Error	T-value	Two-tailed test	One-tailed test
Number of planners	0.190	0.518	0.050	3.819	0.001	0.000
Plan update date	-0.313	-0.366	0.112	-2.803	0.008	0.004
GIS technical level	0.136	0.053	0.363	0.374	0.710	0.355
Collaborative efforts	-0.284	-0.069	0.550	-0.516	0.609	0.304
Constant	25.029		3.992	6.270	0.000	0.000
N	40					
F-Ratio (4,35)	6.605					
Significance	0.000					
Adjusted R-squared	0.365					

By contrast, the plan update date has a statistically negative impact on environmental assessment plan quality (p=0.008). This result demonstrates that more recent updated plans have a statistically higher plan quality than the out-of-date plans on environmental assessment and management. Although the effect is not statistically significant, it would be expected that the GIS technical level would increase the quality of the plan while controlling for other planning capacity variables. Although there are many GIS data layers available related to the California environment at the state and

federal level, many jurisdictions in the study still did not fully take advantage of the large amount of GIS data.

Collaborative efforts were measured by the jurisdictions participating in regional collaborative planning efforts. Although many theories highlighted collaborative efforts in planning quality (Brody, 2003a, 2003b; Brody et al., 2004), this study did not find statistical significance in collaborative efforts on plan quality. Surprisingly, collaborative efforts have a negative impact on environmental assessment plan quality. Effective collaboration may need more planning personnel and funding. Additionally, more collaborative efforts may suggest more environmental conflicts across jurisdictions. Thus, the possible environmental conflicts and related collaborative efforts may distract a planning agency's resources and procedures away from the regular comprehensive planning.

6.2.2 Environmental Assessment Capacity Variables

In Table 6.3, two factors, assessment scope, and information management and sharing make statistically significant contributions to environmental assessment planning quality ($p=0.011$, $p=0.001$ respectively). This result suggests that broader assessment scopes will result in higher environmental assessment plan quality. Scoping is an important step for setting the groundwork for subsequent environmental analyses in local comprehensive land use planning. Broader assessment scopes will lead to more types of environmental assessment for updating a local jurisdiction's comprehensive plan.

Table 6.3: Environmental Assessment Capacity Variables on Plan Quality

Variable	Coefficient	Standardized Coefficient	Standard Error	T-value	Two-tailed test	One-tailed test
Assessment scope	4.171	0.349	1.555	2.682	0.011	0.005
Streamlining ability	1.090	0.216	0.660	1.652	0.107	0.053
Information management and sharing	3.388	0.481	0.926	3.657	0.001	0.000
Constant	9.290		3.518	2.641	0.012	0.006
N	40					
F-Ratio (3,36)	7.899					
Significance	0.000					
Adjusted R-squared	0.347					

If a jurisdiction conducts environmental assessment for master plans, programs, projects or equivalent activities, local comprehensive plans can benefit from these assessment activities. A broader assessment scope can improve the quality of a local comprehensive plan's factual basis, policies, tools and implementation. In addition, information management and sharing are statistically significant contributions to a local jurisdiction's environmental plan quality and can be measured by the lead planning agency's capacity to regularly manage and share environmental assessment documents on its webpage. Local jurisdictions with stronger information management and sharing capacity can regularly maintain environmental documents on their webpage including the notice of preparation, environmental impact reports, negative declaration, declaration, etc. Stronger information management and sharing can increase a local jurisdiction's environmental planning capacity. Although streamlining ability is not statistical

significant (one-tailed p-value=0.053>0.05), it reach a very close level to be significant at the 0.05 statistical level with a positive coefficient between the degree of streamlining ability and plan quality. The future study will increase the sample size in order to further test the significance of streamling ability on plan quality.

6.2.3 Public Participation Capacity Variables

In regard to public participation capacity variables, no variable made a statistically significant contribution to environmental assessment planning quality (Table 6.4). This result is consistent with the correlation results stated in Appendix 5. The significance of this model is not significant (p=0.895), indicating that the public participation capacity does not result in high quality environmental assessment plans. While public participation variables do not have a statistically significant impact on plan quality, these variables make a certain influence on environmental assessment plan quality. Effective public participation with multiple participation formats, public notice channels, and public participation incentives can improve local environmental assessment and management planning quality. Public participation is a difficult issue since it is technically not possible to expect participation from political, economical, technical and wide-ranging sources. Public participation processes frequently are criticized as ineffective by participants, costly, and time consuming, by proponents, and inefficient by governments (Petts, 1999). This regression result shows that effectively translating public participation efforts into practical comprehensive land use plans is

thereby a critical issue for both planning agencies and environmental assessment agencies.

Table 6.4: Public Participation Variables on Plan Quality

Variable	Coefficient	Standardized Coefficient	Standard Error	T-value	Two-tailed test	One-tailed test
Participation formats	0.315	0.051	1.167	0.270	0.788	0.394
Public notice channels	0.067	0.015	0.883	0.076	0.940	0.470
Public participation incentives	0.331	0.087	0.778	0.425	0.674	0.337
Constant	21.603		3.287	6.572	0.000	0.000
N	40					
F-Ratio (3,36)	0.201					
Significance	0.895					
Adjust R-squared	0.065					

As discussed above in the correlation section, various public participation techniques may have different impact on plan quality that increases the complexity to analyze the influence public participation capacity on plan quality. Public participation effects on plan quality will be further discussed in Chapter VII.

6.2.4 Contextual Characteristics Variables

Among the five contextual characteristics variables, only population is statistically significant (p= 0.01) (Table 6.5).

Table 6.5: Contextual Characteristics Variables on Plan Quality

Variable	Coefficient	Standardized Coefficient	Standard Error	T-value	Two-tailed test	One-tailed test
Population	0.008	0.607	0.002	4.312	0.000	0.000
Population growth	0.004	0.005	0.102	0.038	0.970	0.485
Education	0.056	0.126	0.090	0.622	0.538	0.269
Wealth	0.003	0.072	0.007	0.356	0.724	0.362
Public and conservation lands	0.069	0.145	0.070	0.989	0.330	0.165
Constant	17.93		3.586	5.002	0.000	0.000
N	40					
F-Ratio (5,34)	4.872					
Significance	0.002					
Adjusted R-squared	0.332					

This result justifies the hypothesis that jurisdictions with large populations will produce higher environmental assessment plan quality. The jurisdictions with more population often have more environmental pressure and conflicts that result in a need for stronger environmental planning quality since jurisdictions with larger populations tend to have higher levels of disturbance to environment, resulting in a greater perceived need to protect or improve existing environmental quality. Population growth, education, wealth, public and conservation lands all suggest positive relationships with environmental assessment plan quality even if they are not statistically significant. Because none of the remaining variables were statistically significant, it indicates that

future study may need to rethink the inclusion of specific contextual controls or increase the sample size.

6.2.5 Fully Specified Model

Based on the results of regression analysis examining the four types of variables, this study constructs a fully specified model to further examine the influence factors on plan quality. As mentioned previously, this regression blocking technique enabled analysis of numerous independent variables and arrived at a full model specification even with the limitation of a small sample (shown in Table 6.6). The fully specified model includes the number of planners, plan update date, assessment scope, information management and sharing, and population of each jurisdiction in the sample. In this model, assessment scope does not have a statistically significant impact on plan quality when controlling other variables. The number of planners and population still has a positive impact on plan quality ($p=0.011$). Plan update date continues to have a negative impact on plan quality ($p=0.001$). Information management and sharing are statistically significant and contribute to environmental assessment plan quality ($p=0.003$). This result suggests that plan update date, information management and sharing are the most powerful predictor of local environmental assessment capacity. Planning capacity associated with the number of planners also remains a very powerful predictor of local environmental assessment plan quality.

Table 6.6: Fully Specific Model on Plan Quality

Variable	Coefficient	Standardized Coefficient	Standard Error	T-value	Two-tailed test	One-tailed test
Number of planners	0.103	0.281	0.042	2.456	0.019	0.009
Plan update date	-0.295	-0.344	0.085	-3.482	0.001	0.000
Assessment scope	1.066	0.089	1.493	.714	0.480	0.240
Information management and sharing	2.294	0.326	0.719	3.192	0.003	0.015
Population	0.004	0.340	0.002	2.500	0.017	0.008
Constant	19.367		2.589	7.481	0.000	0.000
N	40					
F-Ratio (5,34)	14.942					
Significance	0.000					
Adjusted R-squared	0.641					

6.3 Summary of Results

Based on the correlation and regression analysis above, the following results can be highlighted.

First, for planning capacity variables, both planners and plan update date are critical to environmental assessment plan quality. Since this study assumed all planners are contributing to the development of the comprehensive plan from various aspects, having more qualified planners leads to a higher quality of a local comprehensive plan as well as an environmental assessment plan. Meanwhile, plan updates can help local jurisdictions keep up with the most recent new information, conditions, regulations, and

techniques that can enhance environmental assessment plan quality. However, regional collaborative efforts could not be appropriately reflected in the final plan quality measure, indicating it is still difficult to transfer the regional collaborative concept into the practical planning process to build a high quality local land use comprehensive plan. Thus, the results of this study supported the first and second hypotheses: H1: Jurisdictions with more numbers of planners will result in higher environmental assessment plan quality. H2: More recent updating of a local comprehensive plan's elements will result in higher environmental assessment plan quality. However, the results of this study failed to support the third and fourth hypotheses: H3: A higher GIS technical level will result in higher environmental assessment plan quality. H4: Increased collaborative efforts in the planning process will result in higher environmental assessment plan quality.

Second, for environmental assessment variables, stronger information management and sharing can significantly raise environmental assessment plan quality. Effectively providing and sharing environmental assessment information can improve local jurisdiction's environmental assessment activities. Although assessment scope has a strong positive impact on plan quality, it does not show statistical significance in the final model. Thus, the results of this study failed to support the fifth and sixth hypothesis: H5: Broader assessment scopes will result in higher environmental assessment plan quality. H6: Stronger streamlining ability for environmental assessment will result in higher environmental assessment plan quality. However, it supported the seventh

hypothesis: H7: Stronger information management and sharing will result in higher quality environmental plans.

Third, for public participation variables, although many articles have highlighted public participation's influence on comprehensive land use planning (Brody et al., 2003f; Godschalk et al., 2003), no variable was statistically significant in this study. This study indicated that it is difficult to reflect public participation capacity in local comprehensive land use plans. The jurisdictions with stronger public participation may not have a better local plan; however, public participation is a positive influence on the plan quality. The result identified a gap between public participation efforts and final plan quality. None of the hypotheses related to public participation variables are supported by the results from this study, thus, this study failed to support these three hypotheses: H8: A greater number of participation formats will result in higher environmental assessment plan quality. H9: A greater number of public notice channels will result in higher environmental assessment plan quality. H10: A greater number of public participation incentives will result in higher environmental assessment plan quality.

Fourth, for the contextual variables, population statistically influences plan quality. Other factors have a positive influence but not staying at a statistically significant level. Only the eleventh hypothesis was supported by the results of this study: H11: Jurisdictions with more population will produce higher quality environmental assessment plans. Therefore, the results of this study failed to support these three hypotheses related to contextual characteristics: H13: A jurisdiction with a higher percentage of public and conservation lands will produce a higher quality environmental

assessment plan. H14: A jurisdiction with high population growth will produce a higher quality environmental assessment plan. H15: A jurisdiction with a high education level will produce a higher quality environmental assessment plan.

In summary, the correlation and regression results reveal important insights into the influences of local environmental assessment and management quality. Additionally, these results will be useful for informing local planning and environmental assessment activities. Since this study only analyzed 40 plans, validity of the statistical conclusion may be influenced by a relatively low level of statistical power in the multiple regression models. Thus, this study must be cautious when making final conclusions.

CHAPTER VII

CONCLUSIONS

7.1 Summary of Key Findings and Conclusions

This study measured the ability of local jurisdictions to implement the principles of SEA in local land use comprehensive planning. The model plan evaluation protocol revealed opportunities to strengthen local jurisdictions' strategically environmental management. Identifying the factors influencing plan quality provide insights into how local jurisdictions can produce plans that strategically manage the local environment over the long term. The key findings are summarized as follows:

The first finding from the descriptive analysis is that these local jurisdictions in coastal California have not effectively incorporated the principles of SEA into their existing planning framework. Local jurisdictions in California are still lacking adequate interest and capacity to convert the principles of SEA into their land use comprehensive planning instruments. This study also found that there are large variations in environmental assessment plan quality across local jurisdictions. The average environmental assessment plan quality of these plans is generally weak (23.95 points out of a possible 50), but great variations were found among these plans (range: 13.32-40.23).

The second finding from the descriptive analysis is that local jurisdictions in California have a relatively weak factual basis in local environmental plans, particularly

for the region-wide, global-wide, long-term, cumulative, and strategically critical environmental elements. A weak factual basis indicates that local planning agencies lack incentives and capacities to create detailed inventories for these environmental and resource elements with broader spatial or temporal impacts such as climate change and variability, greenhouse gas emission, biodiversity and disturbance and threats, temporal impact, ecosystem and ozone layer depletion. The local jurisdictions have mainly considered the direct or indirect impacts from their local comprehensive land use plans; however, cumulative effects, originating from the accumulation of a single action or multiple actions, are rarely considered even if they may bring about significant long term environmental change. Since the factual basis works as the foundation of local comprehensive plans, a weak factual basis cannot effectively drive the quality of other plan components. A general plan based upon outdated or inadequate factual basis and projections is not a sound basis for land use decision-making. Effective policy for local environmental assessment is based on a solid factual basis for environmental information. The factual basis provides local jurisdictions with the knowledge about trends, existing conditions, and projections that they need to formulate policy.

The third finding from the descriptive analysis is that implementation and monitoring is the weakest component in the sample of plans. Many local jurisdictions failed to identify major agencies' responsibilities, give a clear, reliable time schedule, provide necessary technical assistance, specify enforcement or introduce new knowledge or techniques in plan implementation and monitoring. Implementation and monitoring is an essential part of the local planning which enables the plans to be a flexible policy

instrument. Implementation and monitoring ensures that a local comprehensive plan can effectively practice adaptive management. Lack of strategic implementation of these programs has placed even greater pressure on open space, ecosystems, habitats, and land use management. A weak implementation on monitoring plan component is of concern because local comprehensive land use plans are meant to provide a general roadmap of strategies to approach implementation and monitoring of goals and policies. Local land use comprehensive planning should be a dynamic process which is based on a snapshot of jurisdiction values, politics, and environmental conditions at a particular planning moment in time. A local comprehensive land use plan should reflect changes and continually monitor the relevance of plan elements to ensure that they remain in touch with evolving conditions. Brody and Highfield (2005) found that plans containing specific implementation plan component are correlated with a greater degree of plan implementation. Local jurisdictions should improve plan performance at the local level and establish a stronger link between plan content and plan implementation to enhance plan's implementation. Local jurisdictions must establish formal procedures for regularly monitoring the effectiveness of their comprehensive plans. When a monitoring program reveals a plan inadequacy, local comprehensive land use plans should be amended, revised in order to bring them up to date. It is not only important to identify critical environmental resources, but also to monitor changes on baseline conditions over time. Monitoring environmental changes or impacts to the environment from development or human activities is an essential part of appropriate policies to avoid degradation of the environment. Not only must local planners have the capacities to

implement the plan's policies, but more importantly, they need to react to constantly changing environmental conditions. Although a majority of local jurisdictions have monitoring programs for air quality and water quality, some strategically important environmental issues such as biodiversity, ecosystem, and ozone layer depletion programs must be incorporated into existing monitoring programs. These monitoring programs can provide powerful information to identify possible changes in environmental conditions before they become irreversible. It is critical for planners to feed information from monitoring programs back into the local planning process. An implementation and monitoring program should ensure that data for comprehensive land use planning can be properly collected, analyzed, and used to adjust management policies and to measure compliance with plan implementation mechanisms.

The fourth finding from the descriptive analysis is that local jurisdictions should expand the planners' toolbox to provide clear policy directives and specific environmental assessment tools. While regulatory policies such as land use permits, land use restrictions and sensitive land protection are most frequently adopted by existing local jurisdictions, incentive tools such as preferential tax treatment, watershed-based and ecosystem-based land management, transfer or purchase of development rights, are often omitted in current plans. These incentives tools can encourage stakeholders to think about and act on the principles of SEA to improve environmental quality rather than force them to protect environment. Also, traditional environmental assessment tools are well adopted by plans; however, most jurisdictions have neither the incentives nor the capacity to incorporate ecological foot print analysis, life cycle analysis, risk

assessment and vulnerability analysis (Kværner et al., 2006) as environmental assessment tools. Although most local jurisdictions identify disaster preparedness, mitigation, response and recovery, the depth of these procedures is relatively low due to lack of details. A central question for local environmental planning thus becomes how to motivate communities to protect critical environment before it is severely impacted by human growth and development. New approaches for environmental protection should be considered in existing comprehensive land use planning. For example, it is difficult to control non-point pollution by using regulatory policies; however, watershed management provides a more holistic approach to managing water and land use within a watershed and preventing pollution. In fact, environmental planning and protection does not exist in a vacuum, and local jurisdictions need to integrate assessment tools, regulatory policies, incentive tools, land acquisition programs and communication-based policies as carefully as a whole toolbox. Other policies, tools and strategies can be used effectively as a supplement to regulations and work together to provide a relatively permanent way to protect the environment.

The fifth finding from the descriptive analysis is that local jurisdictions lack a long-term vision or goals in comprehensive land use planning even though the goals and objectives list may have the highest average score in the five plan components. The vision of the majority of the local jurisdictions is to set goals to protect environment quality, which is closely related to local issues such as local natural resources, environmental values, accessible space, walkable community, and safe community. A high score for goals and objectives indicates that jurisdictions in California intend to

integrate the principles of SEA into their local planning frameworks. Although a local jurisdiction's mission for environmental protection may be clear, some long-term critical environmental goals (e.g. sustainability, ecosystem and biodiversity, environmental justice, environmental stewardship) were omitted in the local plans. Local comprehensive plans focused on SEA need to have clear strategies that develop a road map to sustainability, including some specific targets on energy efficiency, land use efficiency, water quality, biodiversity, ecosystem, and greenhouse gas emissions.

The sixth finding from the descriptive analysis indicates that the need for collaboration on environmental issues is well recognized by local jurisdictions to create a framework at the local level for strategic environmental assessment and management with other organizations. Although considerable efforts for inter-organizational coordination may be made in local comprehensive plans, the effects are not obvious in environmental assessment plan quality even though some local jurisdictions have recognized the importance of inter-organizational coordination and also identified coordination procedures. The biggest problem for inter-organizational coordination arises because existing environmental information, findings, and new approaches in cross-boundary programs are not reflected in current local comprehensive land use plans. Collaborative efforts require more attention to the environmental issues with broader spatial scales or temporal impacts, particularly for ecosystem, biodiversity and global warming. Each local planning agency should take responsibility to coordinate its land use comprehensive plan with other environmental planning efforts as much as possible. Although great efforts have made, regional collaboration for environmental issues is not

yet routine behavior for federal, state and local jurisdictions. The lack of effective collaboration efforts for planning policies and plans can result in poorly planned and inefficient development.

The first finding from the explanatory analysis shows that both the number of planners and the year of plan updates significantly contribute to environmental assessment plan quality by driving the planning capacity. More qualified planners lead to a higher quality local comprehensive plan, particularly as it pertains to technically-driven aspects such as environmental assessment. Meanwhile, plan updates can help local jurisdictions keep up with the most recent new information, conditions, regulations, and techniques to enhance environmental assessment plan quality. Local comprehensive plans must often be amended or updated to reflect long-term jurisdiction needs.

The second finding from the explanatory analysis demonstrates that environmental assessment information management and sharing plays a critical role in raising environmental assessment plan quality. To enhance the capacity for information management and sharing, the following approaches are helpful. First, local jurisdictions need to maximize the use of existing environmental information. Second, local jurisdictions need to remove barriers for sharing environmental assessment information so that all stakeholders can use the spatial data. Third, local jurisdictions need to provide common ways to access information and address the issue of harmonization. The Internet, one of the most important technological opportunities, should give access to the draft version of documents. In addition, although assessment scope does not show statistical significance in the final specific model, it still has a certain positive impact on

plan quality. Broad scopes to assess environmental impacts from master plans, programs or projects can integrate strategic environmental considerations early into the decision-making process.

The third finding from the explanatory analysis reveals that public participation has no significant effect on local plan quality. Although past studies (Forester, 1989; Healey, 1992, 1997) have shown the importance of public participation on local land use planning, this study did not find the statistical evidence to support the hypothesis that stronger public participation can result in higher plan quality. Many past studies (Innes, 1992, Lawrence, 2000; Sager, 1994, 2002) have highlighted that public participation may help cope with uncertainty and conflict and facilitate effective joint participation through identifying stakeholders' interests, building more transparent decision-making processes, more creative dispute solving and greater public involvement, it may result in a longer duration for decision-making and a costly planning process. In addition, different stakeholders have various levels of power and resources to affect the decision-making process by placing unequal impacts on the final comprehensive land use planning. Thus, it is difficult to ensure absolute equity in the distribution of benefits and harm resulting from the comprehensive land use plans and enhance a mutual adjustment in the development process. More importantly, public participants generally pay close attention to their own interests because of "not-in-my-backyard" and "locally unwanted-land-use attitudes" (Fischer, 2003). Public interest tends to focus on more tangible development proposals in local neighborhoods rather than abstract, comprehensive and long-term development proposals (Altshuler, 1965). The general public tends to consider

local issues which are directly related to them rather than region-wide or global-wide issues. Thus, while this study measures how well local plans strategically assess and manage environmental issues; plans with more localized vision may receive relatively lower scores. In addition, both the planning agencies and environmental specialists need to concentrate on how to effectively reflect the opinions of public participants into the final local comprehensive land use plans. Finally, various public participation techniques may have opposite influence on plan quality, thus the mixed number of public participation types cannot appropriately explain the influence of public participation capacity on plan quality.

The findings of this study have initiated the first step in understanding how to convert SEA principles into local land use comprehensive planning. Not only can the results of this study provide guidance for local jurisdictions on environmental policies, but more importantly, they can encourage academics and planners to consider strategically critical environmental management at a broader spatial and temporal scale. This study therefore not only provides insights into strategic approaches for managing the environment in California, but also in other states facing similar environmental issues. The research design used for this study can also be extended because the plan evaluation protocol can easily be applied in other states or regions.

7.2 Theoretical and Policy Implications

7.2.1 Theoretical Implications

The findings of the study expand existing major environmental assessment and planning theories by taking the broad theoretical principles of rationalism, socio-ecological idealism, political-economic mobilization, communications and collaboration and converting them into a model showing how to actually accomplish its objectives at the ground level.

First, this study adds to the theory of rational planning by integrating SEA principles into local comprehensive land use plans to build an idealized model to pursue explicit, adaptable, logical, consistent, and systematic comprehensive land use planning. The plan coding protocol attempts to fill the gap between environmental assessment theories and their implementation for design an environment plan. The plan coding protocol can work as a useful model to quantitatively measure a local jurisdiction's capacity for strategic environmental assessment and management. It is a pioneer study which quantitatively examines how SEA principles can be realized through local land use comprehensive planning. This study extends key SEA principles from the environmental assessment field to local comprehensive land use planning and identifies ways in which these principles can be filtered into local comprehensive plans. The principles were converted into a series of indicators which is the first attempt to capture

the principles of SEA by adding strategic environmental considerations to the existing concept of what makes high quality environmental assessment plan.

Second, the explanatory findings of this study also add to the theory of pragmatism. The number of planners and the frequency of plan updates were found to be critical elements for local planning capacity. Furthermore, this study reveals that information management and sharing significantly affect plan quality. These findings support knowledge-based experience to guide planning action using the theory of pragmatism to develop an efficient, adaptable, relevant, realistic pragmatic local land use comprehensive plan.

Third, the findings of the descriptive analysis further add to the theory of socio-ecological idealism. This study found that cumulative, strategic environmental issues such as biodiversity, ecosystem, sustainability, global warming, environmental justice are rarely identified in existing local comprehensive land use planning, thus, the theory of socio-ecological idealism does not come down to the practice.

Fourth, this finding of the descriptive analysis provide a certain contribution on the theory of political-economic mobilization which has a particular concern with social, economic, and environmental justice, unequal power relations, community empowerment, and the need for structural change (Lawrence, 2000). The planning process can be improved through a better understood on the insights afforded by explicitly considering social and environmental justice, stakeholders' conflicts, social equity and community empowerment. This study found that indicators relating to

environmental justice, environmental or hazard vulnerability, and related tools are listed the lowest scores.

Finally, this study provides the stimulus to rethink the theory of communication and collaboration. The explanatory results show that neither collaboration nor public participation efforts made statistically significant contributions to plan quality. The mixed numbers of participation or coordination techniques may mislead the analysis results because various types of public participation may have opposite effects on plan quality. It is still difficult to know how to effectively translate efforts of collaboration and public participation into the final local use planning and decision-making process. Thus, effectively integrating collaboration and public participation into the planning process is still a critical issue in the theory of communication and collaboration which can be further developed.

7.2.2 Policy Implications and Recommendations

By measuring local comprehensive land use plans, this study provides insights into how to effectively accomplish strategic environmental assessment in California and other states. This study adds to the practice of managing local environment through the following aspects. First, developing a conceptual and measurable model of a local environmental assessment plan moves the field of environmental planning away from qualitative assessment of plan quality toward an evaluative technique that is more precise, defensible and comparable across jurisdictions. Understanding exactly what

makes a high-quality environmental assessment plan provides practitioners with a model against which to test the effectiveness of existing plans and policies. Second, demonstrating the extent to which local jurisdictions are managing strategically important environmental resources in California provides an alternative into how to strengthen existing planning framework. Identifying the relative strengths and weakness in local management across the state helps planners improve plans and policies to more effectively protect the environment in the long term. Third, this study explains the influences on environmental assessment plan quality that can guide local jurisdictions in improving their existing planning activities for future environmental protection. Based on the findings from the explanatory analysis, recommendations are given for local jurisdictions on how to improve the integration of the principles of SEA with local land use comprehensive planning process.

The first policy recommendation is develop a solid factual basis of environmental assessment in local comprehensive land use plans. In fact, a vast body of information regarding local environmental quality is available at the regional, state and federal level. Local jurisdictions should make the maximum possible effort to use the extensive existing environmental information to update the local comprehensive land use plan's factual basis. For example, regional air quality agencies provide information on air quality trends, growth assumptions, meteorology, and transportation control measures. The Association of Bay Area Governments and the California Geological Survey provide precise information and maps on earthquake faults and other seismic hazards in the San Francisco Bay areas. The Department of Water Resources and the Department of

Conservation provides flood hazard maps. The Department of Fish and Game provides the California Natural Diversity Database which gives location and condition information concerning California's rarest plants, wildlife habitat and networks. The U.S. Geological Survey, U.S. Crops of Engineers, and the U.S. Fish and Wildlife Services provide information on wetlands inventory, watershed inventory, and water resources. The Natural Resources Conservation Service provides detailed information on soil types and soil degradation. In addition, the U.S. Census Bureau provides block-level census information. The Environmental Source Research Institute and other organizations or NGOs also provide very useful environmental information. Environmental assessment data and technical information will can improve environmental planning's factual basis which is generally considered to be the foundation of a plan. In fact, most of this information is free-to-use, web-based, and GIS-based; thus, it is easy to adopt it in local plans. However, this rich information was inadequately used by existing local comprehensive land use plans. At the same time, environmental assessment at the regional, state or federal level has been inappropriately integrated into local comprehensive land use planning. Thus, the most effective, fast and efficient way for local jurisdictions is to "borrow" the extensive environmental information available online to update their factual basis for local comprehensive land use plans. The factual basis can be improved by conducting a more thorough environmental inventory and incorporating available data on existing environmental assessment activities. All critical environmental background information can be appropriately referenced or summarized as technical appendices to enable users of the plan to more easily comprehend the plan's

goals and policies. Effective information sharing with the public can boost planning capacity and significantly raise plan quality. Enhanced environmental assessment information management and sharing can indicate which environmental resources are strategically critical or are being adversely impacted. With a greater understanding of existing environmental quality, local jurisdictions will be more likely to develop appropriate policies for environmental assessment for the long-term. A stronger factual basis will also increase a local jurisdiction's awareness of environmental protection. Having a better understanding of and stronger identification for critical environmental elements and tools will help planners take a more proactive stance to environmental assessment.

The second recommendation suggests an adaptive approach for local comprehensive land use planning and environmental assessment. An adaptive approach has been increasingly recognized as an effective tool for environmental management. May (1992a, 1992b) describes adaptive management as an instrumental form of policy learning in which the planner takes a rational-analytic view to improve designs for reaching existing policy framework. A key finding of this study is that regular plan updates are critical for environmental assessment plan quality. An important issue for local environmental planning thus becomes finding ways to motivate local jurisdictions to protect critical environmental resources before they are lost to development. Adaptive management allows for changes in management policies according to changing environmental conditions and scientific information. Compared with other approaches, regular plan updating is less costly, more efficient and practical. A regular plan update

can improve plan quality by generating more specific goals and policies. Although the plans in this study set relatively clear goals to protect the environment, the specific objectives and related policies were still missing in existing plans. A regular plan update can broaden the range of policies, tools and strategies. Plan updating expands the focus of planners to include more incentive-based policies, rather than only place emphasis on traditional regulatory policies. Incentive policies and strategic planning tools encourage planners to expand their understanding of strategic environmental management. Many of the incentive-based planning tools and strategies embedded in the planning protocol are especially important for enhancing the capability of plans to implement the principles of SEA.

The third recommendation is to educate planners, decision-makers, and general public to know the strategic environmental impacts that can provide a profound way for them to change their behaviors and generate proactive environmental management practices in the long term. This study finds that the long-term, cumulative, and large-scale environmental issues such as biodiversity, ecosystem, global warming, and environment justice are weakly identified in current plans. Local jurisdictions can also increase public awareness to encourage developers and individuals to adopt cost-effective and environmentally efficient practices. In order to make information available, an effective system for environmental information management and sharing should be developed for public access. The environmental awareness and educational programs should enhance environmental information public sharing through effective approaches.

The fourth recommendation is to integrate upper-scale environmental efforts into local land use comprehensive plans. When numerous programs are conducted by the federal, state and regional agencies to protect and conserve environment, inter-organizational collaboration is necessary to achieve success. However, local jurisdictions often do not effectively incorporate these concepts or initiatives into existing local comprehensive land use plans and programs. Relatively higher scores in the coordination indicators indicate stronger procedures exist in current local comprehensive land use plans; however, region-wide or nation-wide environmental assessment was not well incorporated into current plans. Major environmental information, findings, and newly developed policies are generally missing in existing local comprehensive land use plans. The basic information, innovative policies, and tools are not well incorporated into local land use decisions. Actually, regional, state and federal agencies are seldom involved in local land use and development decisions. The gaps between local jurisdiction levels and regional, state or federal levels hamper the capacity of local comprehensive plans to implement SEA techniques. Although the state or federal agencies have strong political will for environmental assessment, their limited authority for local land use and development patterns usually restricts their ability to influence local land use decision-making (Burby, 2005). Even if federal, state government or regional organizations have strong incentives to protect the environment, particularly for strategically critical environmental elements such as biodiversity, ecosystems, watersheds, or ozone depletion, these efforts are weakly incorporated into local plans. Those region-wide, state-wide or federal-level programs are less discussed or supported within existing plan

elements. The initiatives for environmental protection must more efficiently transfer ideas from regional, state or federal agencies to local planning activities in order to implement the principles of SEA at the local level. On the one hand, local jurisdictions must incorporate the policies of regional efforts into local planning actions; on the other hand, regional, state or federal agencies should provide more technical assistance or information sharing with local jurisdictions to ensure that their programs filter down to the local level. Regional approaches should be encouraged for problem-solving through supporting and participating in regional collaborative planning and resource management. When state government plays a leading role in the areas of interagency and regional collaboration, local jurisdictions should partner with adjacent jurisdictions and related upper agencies to develop and implement clearly articulated goals, database, policies and tools for environmental protection. Great efforts are still needed for reconciling redundant and conflicting policies from multiple agencies and local jurisdictions. Particularly, new collaboration efforts should create effective approaches, including new assessment tools, regulatory policies, incentive strategies and other methods, for local jurisdictions. Successful coordination for environmental assessment includes clearly articulated goals, effective policies, reliable financial sources, and unbiased requirements in local comprehensive land use planning. Local jurisdictions must be empowered to coordinate with regional, state, or federal goals and strategies. A local land use comprehensive plan should determine the extent to which the plan's goals, policies, and implementation correspond to regional or adjacent plans. Local

jurisdictions should reexamine and update their own comprehensive land use plans when important changes are made in regional or adjacent plans.

7.3 Study Limitations and Future Study

7.3.1 Study Limitations

This study has several limitations. Although it provides a greater understanding of how to integrate SEA principles into local land use comprehensive planning, it is a primer for research to investigate the topic in California. As previously mentioned in the section of validity threats, a relatively small sample size may lack enough statistical power to extend the conclusions to other jurisdictions. Furthermore, a major limitation of this study is the difficulty in expressing a dynamic process of local land use comprehensive planning that is actually reflected in final environmental assessment plan quality or integration effects. The impact of possible influential data points may also disturb the conclusions of this study. Finally, while this study's results want to be extended to other places, geographical variations, socioeconomic characteristics, and policy framework can be external validity threats. Future study is suggested to unify various jurisdictions' actions towards the preservation of valuable environmental assets.

7.3.2 Future Study

This study is a starting point for understanding how to integrate SEA principles into local land use comprehensive planning. The major direction of future study will extend from SEA principles to practical environmental management efforts. Further study will then mainly focus on the gaps between local comprehensive land use planning and regional programs which may be conducted by regional, state or federal agencies. Regional environmental assessment efforts typically address single issues or have indirect links to local comprehensive land use planning. Many efforts for environmental assessment and management have been made at the regional level for air quality, biodiversity, water quality, wetlands, and watersheds. Even if great advancements have been made from these programs, valuable environmental information and innovative policies have not filtered into existing local comprehensive land use planning; this greatly impairs the effectiveness of these regional programs. However, in the area of environmental protection and land use development, local decision making significantly shapes human environmental quality through local land use decision-making. All local land use decisions are guided by local land use comprehensive plan which set long-range vision and articulate policies and strategies for local development. Thus, integrating valuable information from regional, state, or federal environmental programs into local comprehensive land use planning will be expected to have a significant impact on environmental quality at the local level and regional or larger scales.

Future study will extend the initial study from local jurisdiction's ability to manage regional environmental systems to the regional environmental system. The objectives of future study will investigate ways to protect the regional environment through local comprehensive land use plans and show how local comprehensive land use plans can utilize the findings of regional environmental agencies. Future study will use GIS techniques to examine the aggregate plan quality of each jurisdiction within the 10 bioregions of California. The starting stage for the future study may focus on the Bay-Delta bioregion. Future study will seek a better understanding of ways that local jurisdictions can improve their plans to more effectively integrate region-wide environmental goals and update information, policies and tools into their local comprehensive land use plans.

In particular, the future study will measure whether the recent developed local jurisdictions' comprehensive land use plans have well adopted the state goals, policies, strategies developed in the 2003's California Governor's Environmental Goals and Policy Report. This study will quantitatively measure whether the state environmental management goals and policies have translated into the local plans. Furthermore, if necessary, this study will conduct some interviews with environmental management and planning agencies at the local, regional, state and federal levels to help understand the problems of integrating regional environmental management efforts into local comprehensive land use plans. Finally, future study will increase the sample size to examine local jurisdictions' capacities for strategic environmental assessment and management. Increasing the sample size is an effective way to further examine the

findings of this study and improve statistical power for the previous research questions in this study. An ideal sample size with higher statistical power should examine 80 local comprehensive plans in California. The future study will also develop an approach to systematically measure the degree of collaborative environmental planning across local jurisdictions. The multiple layers of information and policies will be compared and measured in order to find the gaps in the existing local environmental management framework. Thus, theoretically, future study will test whether collaborative environmental planning works well at both the regional and local levels and then identify methods to enhance collaborative environmental planning in the future. The future study will test the spatial scale issue in collaboration to determine whether collaborative environmental planning can be implemented.

The second alternative direction for future study focuses on the gaps between the environmental assessment and local comprehensive land use planning. This study will address whether a high-quality environmental plan equals to a real high-quality in practice. A set of indicators will be developed to physically measure local environmental quality or a specific environmental aspect such as watershed or wetland. Through comparing the plan quality scores and the practical environmental quality scores, the gaps may be found and the influence factors will be deeply analyzed. This future study will explain the gaps between the practical environmental quality and theoretical environmental plan quality and thereby enrich the theories for comprehensive land use planning and environmental assessment.

The third alternative direction for future study will test one more hypothesis: Do the local jurisdictions with state mandates of environmental assessment have stronger capacities for strategic environmental assessment and management than these without state mandates? The further study will provide an insight to decide whether the state mandates of environmental assessment are playing a central role in local environmental management. Examining other states besides California would add a comparative dimension to the research that could provide a more thorough understanding of how to implement the principles of SEA at the local level. Further study will examine and compare the effectiveness of local environmental assessment and local comprehensive plans. In order to reach the objectives of increasing statistical power for the previous research and also complete the new research topic, new funding will be used to expand the sample size to a more reasonable level. An ideal sample size with higher statistical power may be around 160 for total, and 80 plans for each state. In this study, a Chow test will be used to analyze whether or not the two states' samples could be combined without confounding the results.

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APPENDIX 1

Plan Quality Evaluation Protocol

Plan quality evaluation protocol		
I. Factual Basis		
A. Natural Environment		
Local jurisdiction's physical setting	Local environment's sphere of influence	Local environment's temporal impact
Major environmental laws and regulations	Ecosystem's concept, functions and processes	Rare, threatened and endangered species
Biodiversity and possible disturbance and threats	Habitat corridors and network	Water consumption and water resources availability
Water quality and point discharges and non-point-source pollution	Groundwater supply and aquifer depletion	Hydrological regimes and aquatic environment
Environmentally sensitive lands	Soil quality and soil degradation	Wetlands and watershed
Natural/urban vegetation and forestry resources	Local and regional geological conditions	Air quality and air pollutants
Greenhouse gas (or CO_2) emission	Ozone layer depletion	Climate change and variability
B. Built Environment		
Physical constraints of land development	Land use patterns and land availability	Agricultural resources and working landscapes
Open space, green space and recreational resources	Critical historical and cultural heritage	
C. Human Health		
Population growth and carry capacity estimation	Noise-sensitive areas	Main environmental hazard risks
Social/environment/disaster vulnerable population and places	Risk of exposure to hazardous materials, wastes, pollution	
II. Goals and Objectives		
Protect natural resources and environmental values	Maintain intergenerational sustainability	Balance environmental, social, and economic development
Seek environmental justice and equity	Seek to build up environmental stewardship	Achieve sustainable and healthy ecosystems and protect biodiversity

Seek to achieve clean and plentiful water resources	Seek productive and efficient use of land	Seek clear air and climate stability
Seek energy conservation and energy alternatives	Build accessible open/green space and walkable community	Value and protect diversity and local distinctiveness/history/culture
Build disaster-resistant, healthy, safe community		
III. Inter-organizational coordination		
Identify stakeholders and their interests	Inter-organizational coordination within the jurisdiction	Coordination with surrounding jurisdictions
Coordination with regional organizations	Coordination with state or federal agencies	Coordination with private organizations or NGOs
Specify trans-boundary environmental issues	Identify commitment of financial sources for inter-organizational coordination	Specify environmental conflict management and dispute resolution
IV. Policies, tools and strategies		
A. Environmental assessment tools		
On-site environmental review	Environmental threshold of significance for development decision-making	Overlay mapping and GIS analysis
Scenario/sensitivity analysis	Network and system diagram analysis	Trends analysis
Environmental modeling	Ecological footprint analysis	Questionnaires, interviews, expert panels
Checklists for environmental items	Matrices for environmental issues	Life cycle analysis
Land use partitioning analysis	Multi-criteria analysis	Compatibility appraisal
Cost-benefit analysis	Risk assessment	Vulnerability analysis
B. Regulatory Policies, tools and strategies		
Land use restrictions	Density restrictions in and around environmental sensitive areas	Buffer requirements
Land permitted use	Creation of special study zones, conservation zones or protect areas	Sensitive area protection
Control of urban service/growth boundaries	Disaster-resistant land use and building code	Disaster preparedness, mitigation, response and recovery procedures

Other regulatory tools to protect environmental values		
C. Incentive Tools		
Transfer of development rights (TDR) or purchase of development rights (PDR) away from the environmental sensitive areas	Land/mitigation banking	Capital improvement program for environmental protection
Density bonus or bonus zoning in charge for environmental protection	Clustering away from the environmental sensitive areas	Mixed-use, infill/redevelopment
Pedestrian/resident-friendly, bicycle-friendly, transit-oriented community development	Preferential tax treatments to protect environmental values	Waste recycling and management program
Low-impact design for impervious surface	Watershed-based and ecosystem-based land management	Water-conserving land use
Energy-efficient, or alternative-energy land use	Other incentive tools for environmental protection	
D. Land Acquisition Programs		
Development impact fees for environmental protection	Conservation easements	Other land acquisition techniques
E. Communicational- Based Policies, Tools, Strategies		
Public awareness programs for environmental issues	Multiple public participation and communication channels	Effective information accessibility, notification and dissemination
Public participation in environmental decision-making structure	Emphasizing linking science, technology, and policy	
V. Implementation and Monitoring		
Identify each major agency's responsibilities for plan's implementation	Give a clear, reliable time schedule	Provide necessary technical assistance
Identify reliable financial support for plan's implementation	Identify plan update procedures to assess plan effectiveness regularly	Specify environmental monitoring procedures
Specify enforcement of environmental protection	Perform mitigation measurements	Emphasize introducing new knowledge or techniques into implementation process

APPENDIX 2

Indicator Explanations for Plan Protocol

Indicator	Explanations
I. Factual Basis 0: not identified; 1: generally identified; 2: detailed identified M: Mapped; D: Described	
A. Natural Environment	
1.1 Local jurisdiction's physical setting (mapped; described)	Local jurisdiction's physical setting describes its fundamental environmental characteristics that will be a base of local environmental management. This indicator measures whether the most fundamental environmental features have been appropriately described in a local comprehensive plan. If a local jurisdiction's location, boundary, edge or bioregion is generally described and mapped, it will get a score of 1. If the description is based on mapped bioregional units, or watershed boundaries, or actual environmental management region and the maps are produced by GIS or other software, the item can be evaluated by a score of 2. If the local jurisdiction's basic features such as location, boundaries/edges are roughly described, it will be given a score of 1. If a detailed, thorough description is given and the concepts of watershed or bioregions are emphasized, it will be scored as 2.
1.2 Local environment's sphere of influence (described; Mapped)	Local environment's sphere of influence describes its probable service impact as a benchmark for the minimum extent of a local jurisdiction's planning area. California General Plan Guidelines mandates that local General Plan must address the jurisdiction area and those areas with sphere of influence that may beyond the jurisdiction limit. Thus, a local jurisdiction's planning area must include all land within a jurisdiction as well as surrounding unincorporated areas that are within a jurisdiction's sphere of influence. These local jurisdictions may choose to plan for land uses beyond their own sphere when coordinating plans with those of other

	jurisdictions. This indicator measures whether local jurisdiction has a regionally spatial vision rather than a local-level consideration for its environmental issues. If a plan provides a description of a scaling impact from local natural environment on regional environment, it will be scored as 2. If the description stays at a level of several of words, it will be scored as 1.
1.3 Local environment's temporal impact (described)	Local environmental temporal impact is crucial to ensuring long-term natural environmental sustainability in a jurisdiction. This indicator measures whether a local plan incorporates inter-generational impacts or sustainability in its developing process. If a plan emphasizes an inter-generational impact or a concept of sustainability, it will be scored as 2. If the description stays at a level of several of words, it will be scored as 1.
1.4 Major environmental laws and regulations (e.g. CEQA)(described)	Major environmental laws and regulations are the legitimate base for a local jurisdiction's environmental management. This indicator measures whether a local plan provides the major environmental laws or regulations that are highly related to local environmental management. If the local, regional, state or federal key environmental laws, regulations are introduced in a plan, it will be scored as 1. More specifically, if a plan mentions CEQA, it will be scored as 1. If the description of these laws or regulations create a foundation as the legitimate base of environmental management, it will be scored as 2.
1.5 Ecosystem's concept, function, process and integrity (described)	Ecosystem is one of most important concepts in natural environmental management. This indicator measures whether a local jurisdiction introduces a concept of ecosystem and also emphasizes its functions/processes in its natural environmental protection. If an ecosystem's concept is appropriately used and its functions/processes are emphasized, it will get a score of 2. If a plan only mentions the concept or word of ecosystem, it will get a score of 1.
1.6 Rare, threatened and endangered species (mapped;	Rare, threatened and endangered species diagnose whether a local jurisdiction has considered this

catalogued)	keystone item for its flora and fauna protection. This indicator measures whether a local plan lists the rare, threatened or endangered species within its jurisdiction under state or federal law. If the rare, threatened and endangered species are inventoried with Latin names and specific introductions, it will be score as 2. If a plan identifies no rare, threatened and endangered species within its boundary, it is also seen as a high perception with a score of 2 for this item. If the rare, threatened and endangered species are described or listed in a sentence, it will be valued as a score of 1. If the threatened and endangered species are listed in a detailed table with geographical regions and a status of species, it will have a score of 2.
1.7 Biodiversity and possible disturbance and threats (described)	Biodiversity is a critical issue with significant conservation priority on a global scale. The importance of biodiversity has been widely accepted; however, protecting biodiversity in rapidly urbanized areas is still a difficult task. Habitat disturbance or fragmentation can result from the cumulative effects of multiple land clearing activities, including logging, agriculture, urban development, infrastructure construction or changes in land use. Incorporating the concept of biodiversity into a local comprehensive plan is one of the most strategic ways to protect biodiversity in urban areas. This indicator measures whether the concept of biodiversity has been identified in local plans and also measures whether a local jurisdiction has considered possible disturbance and threats from the local development processes. If the concept of biodiversity is identified in a local plan, it will be scored as 1. If possible disturbance and threats on biodiversity, such as habitat fragmentation and loss of habitat network, are given; it will be scored as 2.
1.8 Ecologically important areas (mapped; described)	Ecologically important areas are these regions with significant ecological values. Ecologically important areas include important vegetation, forestry, wildlife habitat wetlands and areas that are adversely affecting by human activities. Ecologically important areas are an important part of natural environment management. This indicator measures whether the areas with significant ecological resources (e.g.

	coastal redwood land, or areas of critical wildlife habitat) have been identified in a local plan. If the areas with significant ecological resources are roughly designated on a map then code it as a score of 1. If the areas having high significant ecological resources are actually located geographically rather than in a rough region, it will be valued as a score of 2. If the areas with important ecological resources are described or listed in a sentence, it will be valued as a score of 1.
1.9 Water consumption and water resources availability (described; catalogued)	Water is critically important to the human environment in California. There are three main resources of water in California: surface water, ground water, and imported supplies. Water is primarily used for urban, agricultural, and environmental purposes. Water-use and availability information can help local jurisdictions to identify trends and competition for limited water resources to prepare for future water safety challenges. Furthermore, water-use and availability information is a key and integral factor for environmental or ecological health of reservoirs, lakes, streams, or aquatic ecosystems. This indicator measures whether a local plan considers appropriate water use and water resource availability in a sustainable use scale. If a plan provides a detailed description for water use and a reasonable analysis for water availability, it will be scored as 2. If the description is presented by rough sentences or draft tables, it will receive a score of 1.
1.10 Water quality and point discharges and non-point-source pollution (described)	Water quality is a critical issue in local planning. Point-source discharges and non-point-source pollution can affect water quality. Apart from point-source discharges, non-point pollutants can affect water quality through urban and agricultural runoff, seepage from landfills, spills on land or water, sediment transport, seepage from underground injection sites, landscape maintenance, building construction or air toxics. Non-point pollution is the major cause of water pollution in California. This indicator measures whether a local plan considers water quality and point-source discharges and non-point-source pollution.

	If a plan provides a detailed description for water quality and pollutants, it will be scored as 2. If the description is presented by rough sentences or draft tables, it will receive a score of 1.
1.11 Groundwater supply and aquifer depletion (described; mapped)	Ground-water depletion refers to long-term water-level declines caused by sustained ground-water pumping. Aquifer depletion is a key issue associated with ground-water use. The negative effects of ground-water depletion include drying up of wells, reduction of water in streams and lakes, deterioration of water quality, increased pumping costs, land subsidence and salt water intrusion in coastal areas. This indicator measures whether local jurisdictions have considered groundwater supply and aquifer depletion. If this item is mentioned, it will be scored as 1. If this item is listed with concrete data, it will be scored as 2.
1.12 Hydrological regimes and aquatic environment (described)	Hydrological regimes and aquatic environment include rivers, streams, drainages and natural or urban aquatic resources. Hydrological regimes and aquatic ecosystem can provide important ecological functions and high amenity values, including transport, flood control, processing of biodegradable wastes and provision of water supply. This indicator measures whether hydrological regimes and aquatic ecosystem have been recognized in local planning. If this item is mentioned, it will be scored as 1. If this item is geographically described, it will be scored as 2. If possible impacts or changes resulting from urban development are emphasized; this indicator will be scored as 2.
1.13 Environmentally sensitive lands (mapped; classified)	Environmentally sensitive lands (e.g. airports; coastal zones; areas susceptible to flooding and geologic or seismic hazards and fires; areas of special biological significance; areas of special cultural significance) are important for local environmental management. This indicator describes a land that is sensitive to potential environmental impacts. For example, a map of lands that are sensitive to possible landslides or coastal erosion illustrates environmentally sensitive areas in a jurisdiction. Usually environmentally sensitive lands include areas of steep slope, jurisdictional wetlands, natural waterways and areas lying within a flood plain, earthquake faults areas and areas prone to

	debris flows, landslides, liquefaction, and rock falls, areas designated as active or potential earthquake fault or landslide areas, wildfire hazards. An environmentally sensitive land map shows sensitive areas overlay which specifies critical areas when proposed for development. Distinguishing elements between a score of 1 or 2 are whether the location of environmental sensitive land is provided, whether site-specific descriptions are presented whether the types of environmental sensitive lands are classified, and whether these lands are well mapped.
1.14 Soil quality and soil degradation (mapped; classified)	Soil is a key component of the earth system. An indicator of soil quality can be measured by soil classification, threat of soil erosion and soil contamination. Soil quality also plays a role in the environmental effects of crop production; soil stability is important for the local built-environment and human safety. Soil quality degradation may be reflected in land capability and suitability, prime land, productivity, erodibility, and vulnerability to leach pesticides and nitrates. Soil quality may result from agricultural activities on excessive gradients, over-harvesting in forests and highway construction. This study chooses soil quality degradation to alter soil's effects on environmental quality. If maps or tables are presented with details of soil associations series, characteristics, and threat of soil erosion, contamination or stability, it will be evaluated as 2. If soil constraints on local development are not mentioned, it will be scored as 1.
1.15 Wetlands and watershed (mapped; described)	Wetlands play a significant role in flood and storm control, wildlife habitat, protection of subsurface water resources, provision of valuable watersheds, recharging ground water supplies, pollution treatment, and erosion control. Wetland loss or wetland function degradation can result from dredging and filling individual tracts of wetlands, toxic sediment contamination and reduced wetland functioning resulting from irrigation and urban runoff. Watershed is essential to evaluation of wetland functions and values and wetland restoration potential. If a plan lists the wetlands within its

	jurisdiction, it will be scored as 1. If site-specific information for these wetlands is given, it will be scored as 2. If the concept of watershed is mentioned, it will be scored as 1. If the names of watersheds are given in a local plan, it will be scored as 2.
1.16 Natural/urban vegetation and forestry resources (mapped; described)	Understanding the intricate link between vegetation/ forestry resources and the urban ecosystem is of critical importance to protecting and maintaining both the natural ecosystem and urban environment. The protection and preservation of vegetation and forestry resources is essential to the wellbeing and health of an ecosystem and without a perception for protecting these resources, ecosystem health and local environment can be severely impacted. Vegetation and forestry resources may include natural vegetation and man-made urban forestry that have important influences on urban environmental quality. If the areas or types of vegetation and forestry resources are roughly designated on a map then code it as a score of 1. If the areas or types of vegetation and forestry resources are actually located geographically rather than in a rough region, it will be valued as a score of 2. If the areas or types of vegetation and forestry resources are described or listed in a sentence, it will be valued as a score of 1. If the areas or types of vegetation and forestry resources are described in detail with geographical regions and a status of species, it will be a score of 2.
1.17 Local and regional geological conditions (mapped; described)	Geological conditions can be the basis for urban development and natural disaster management to measure whether a local plan is well mapped or describes local and regional geological conditions within its jurisdiction. If basic geological conditions are mapped or described with geographical features, it will be scored as 2. If the map or statement only explains regional characteristics without local characteristics, it will be scored as 1.
1.18 Air quality and air pollutants (described; classified)	Air quality is an important indictor of natural environment's quality. This item measures how well a local plan describes air quality. Local plans need to identify the areas that are unsuitable for further development due to potential impacts on health and to

	avoid further deterioration in localized air quality. A good local plan should identify areas where air quality objectives are not met or are at risk. If a location-based map or classification is introduced into a plan, it will be valued as 2. If there is only a general map with some comments on air quality, it will be scored as 1.
1.19 Greenhouse gas (or CO_2) emission (described)	Greenhouse gases are gaseous components of the atmosphere that contribute to the greenhouse effect on global warming. Greenhouse gases include water vapor, carbon dioxide, ozone, methane, nitrous oxide, sulfur hexafluoride, and chlorofluorocarbons. Greenhouse gas or CO_2 emission is a strategic indicator of global warming issues at the local level which measures whether a local jurisdiction considers greenhouse gas or CO_2 emission and global warming. Greenhouse gas emissions are a key challenge for sustainability in the long term. The distinguishing elements between 1 and 2 are whether the data of greenhouse gas or CO_2 emission were listed and whether there is a relationship between emission and global warming. If a local plan perceives the concept of greenhouse gas (or CO_2) emission and global warming, it will be scored as 1. Local jurisdictions should establish achievable targets for greenhouse gas emissions that are incorporated into regulatory programs and reflected in subsequent investments in greenhouse gas reduction.
1.20 Ozone layer depletion (described)	Chlorine and bromine can deplete the stratospheric ozone layer which shields the earth's surface from ultraviolet radiation. Ozone layer depletion has a negative impact on human health, crop yields, natural and built environment. The main resources of man-made chemical for ozone layer depletion come from air conditions, refrigerators, aerosol sprays, foamed plastics and fire extinguishers. If the conception of ozone layer depletion is mentioned, it will be scored as 1. If the sources of main ozone depleting substances and their consequences are discussed, it will be scored as 2.
1.21 Climate change and variability (described)	Climate change and variability can profoundly influence social and natural environments from local level to global level. More specifically, climate

	change and fluctuations can affect agricultural productivity, water supply, energy demand, land and marine ecosystems. Extreme events include droughts, floods, wildfires, heat waves, and hurricanes. Climate change and variability are threatening biodiversity, existing human development and public health. A local comprehensive plan needs to anticipate and plan for potential impacts of climate variability and change. This indicator measures whether a local plan appropriately considers the impacts from significant climate changes or extreme climatic factors. The distinguishing element between 1 and 2 is whether extreme climatic factors are classified. If a plan perceive the concept of climate change and variability, it will be scored as 1.
B. Built Environment	
1.22 Physical constraints of land development (described)	Appropriate descriptions of physical constraints in local development is the foundation of land management. This indicator measures whether a local jurisdiction recognizes physical constraints of land development in its landuse planning process. A local plan needs to identify areas where urban expansion is not appropriate or lands that are suited for only a limited range of land uses. Physical constrains can come from physical topography or hazard-vulnerable areas. Distinguishing elements between a score of 1 or 2 are whether the location of the lands with physical constraints is provided, whether physical constraints are identified and whether site-specific descriptions are presented.
1.23 Land use patterns and land availability (described; mapped)	Identifying land use ownership patterns for land use helps match the ownership gaps in local land management. An inventory of land availability is a basis for local development. If a general percentage is introduced or a rough map is used in a plan to illustrate public/private ownership patterns for landscape or land use situations, it will be scored as 1. If census data or a GIS-based ownership map is used in a plan, it will be viewed as a high-quality with a score of 2. If a strong map is given to illustrate local landscape and land use status, it will be scored as 2. If a GIS-based land use map is given, it

	will be valued as 2. If a detailed inventory is presented to explain landscape or land use types, areas, status, it will get a score of 2. If only a general description is presented, it will be given a score of 1.
1.24 Agricultural resources and working landscapes (described, mapped)	Agricultural resources and working landscapes include farmlands, croplands, grazing lands and timber lands. Their environmental benefits can be seen in scenic open space, flood protection, groundwater recharge, wildlife habitat, recreation, agri-tourism, renewable energy, carbon offsets and climate control. Existing land development patterns and population growth is threatening agricultural resources and working landscapes. Distinguishing elements between a score of 1 or 2 are whether site-specific descriptions are presented, whether the potential pressures of development are mentioned, and whether these lands are well mapped.
1.25 Open space, green space and recreational resources(described; mapped)	The quantity and quality of open space and green space is an important factor for the quality of built environment. Parks, trails, greenbelts and other open space and landscape with locally unique features and areas should be identified as deserving special protection in local planning. This indicator measures whether a local plan completely describes open space or green space. If a plan describes or maps the location of open space, it will get a score of 1. If a plan provides the land designated for a particular quality or amenity value, including publicly accessible land and greenways, recreation ways, scenic and historic routes, ecologically significant natural corridors, greenbelts, and parks, it will get a score of 2.
1.26 Critical historical and cultural heritage(described; mapped)	Identifying cultural heritage in local plans can help local jurisdictions appropriately consider cultural heritage in the local development process. The degradation of historical and cultural heritage can result from land being destroyed, stream bank erosion, construction, plowing and land leveling or fragmentation of historic districts as a result of uncoordinated development. Critical historical and cultural heritage is an important part in local environmental management. If a plan provides a site-specific map for the cultural heritage within its jurisdiction, it will be valuated as

	2. If a plan lists the buildings and archaeological sites at risk or considers potential impacts from local development or emphasizes cultural heritage's importance, it will be scored as 2. If a plan only mentions the cultural heritage with a rough map, it will get a score of 1.
C. Human Health	
1.27 Population growth and carrying capacity estimation (described; Classified/inventoried)	Population growth increases the demands for resources that are important to quality of life. Carrying capacity is an important concept in sustainable development. This indictor measures whether a local plan considers the relationship between human population and carrying capacity. If a plan describes human population growth and rough lists the population construction or status, it will get a score of 1.If carrying capacity is identified and measured or a balance between human population health and the ability of the environment is discussed, it will get a score of 2.
1.28 Noise-sensitive areas (described; mapped)	Noise is an important indicator for living environment's quality and human health. This item measures whether noise types and effects are well described in a local plan. Distinguishing between a score of 2 and 1 is whether site-specified information is given to record noise types and effects.
1.29 Main environmental hazard risks(described; classified)	Identifying main natural disaster risks in a local jurisdiction is necessary to enhance community safety. This indicator measures whether a local plan recognizes possible natural disasters. If main natural disasters and their characteristics are described or inventoried, it will get a score of 2. If only generally described or inventoried, it will get a score of 1. Identifying natural disasters affecting areas is an important step for hazard management and local planning. This indictor measures whether a local plan has mapped or described the potential areas subject to natural disasters.
1.30 Social/environment/hazard vulnerable population and places (described, classified)	Identifying the relationship between environmental vulnerability and affected population is helpful for environmental justice. This indicator measures whether a local plan identifies the relationship between environmental vulnerability and the affected population.

	If a plan mentions the relationship between environmental vulnerability and affected population, it will be scored as 1. If the affected population is classified or mapped, it will be scored as 2. If the potentially affected areas are mapped, it will get a score of 2. If a rough map or only general words are used in a plan, it will be scored as 1.
1.31 Risk of exposure to hazardous materials, wastes, pollution (described; classified)	Hazardous wastes can be liquids, solids, or sludges. The risk of exposure to hazardous materials, wastes, pollution may cause serious long-term effects such as respiratory diseases, nervous system and reproductive problems and cancer. More specially, some hazards of concern include exposure to mercury, lead, and asbestos-containing materials. If hazardous wastes or pollution are not handled properly, they will be a potential risk to people and the environment. This item measures whether a local plan identifies the possible risk of exposure to hazardous materials, wastes, and pollution. If an inventory of the risks is given, it will be scored as 2. If there is only a general statement with short words, it will be scored as 1.
II. Goals and Objectives 0: not identified; 1: general identified; 2: detailed identified	
2.1 Protect natural resources and environmental values	Protecting nature resources and environmental values is the most important purpose of strategic environmental assessment. This indicator measures whether a local jurisdiction has recognized environmental values in its development process.
2.2 Maintain intergenerational sustainability	A local land use comprehensive plan should take a long-term perspective because the general plan affects the welfare of current and future generations. The general plan needs to incorporate a long-term vision for day-to-day decision-making. A lLocal general plan is an ideal vehicle to achieve the goal of intergenerational sustainability because of its comprehensive, integrated, and long-term nature. The principles of sustainable development may also guide the overall goals of the general plan. This indicator measures whether the concept of intergenerational sustainability is rooted in local comprehensive plans.
2.3 Balance development environmental, social and economic considerations	Strategic environmental management relies on the full consideration of social, economic and environmental issues in policy and decision-making. Since the environment, society, and economy are

	interconnected and interdependent, local jurisdictions should holistically take into account environmental, social and economic considerations. This indicator measures the local jurisdiction's goals and objectives in seeking a balance between human use needs, local development and environmental protection.
2.4 Seek environmental justice and equity	Environmental justice is an important goal for strategic environmental management. Local planning may be faced with the inequitable distribution of the benefits and burdens of development. This indicator needs to evaluate a local plan to ensure that a development plan does not result in an unequal environmental burden being placed on low income or minority communities. This indicator measures whether local jurisdictions set a goal for the fair treatment and meaningful involvement of all people regardless of race, color, nationality, or income with respect to local land use development, implementation, and enforcement of environmental laws, regulations, and policies.
2.5 Seek to build up environmental stewardship	Environmental stewardship is the culture of how human or a local jurisdiction cares for and protects natural resources and environmental quality. Environmental stewardship is based on understanding the importance of environmental quality and natural resources to the human race and the cumulative effects of human actions on sustainability. This indicator measures a widely held ethic of stewardship that encourages responsibility by individuals, organizations, institutions, corporations and governments for the environmental consequences of local comprehensive land use plans. This indicator measures whether local jurisdictions set a goal to gather all citizens and groups into environmental protection.
2.6 Achieve sustainable and healthy ecosystems and protect biodiversity	Sustainable and healthy ecosystems and biodiversity protection benefit open space and recreation, tourism, research and education, natural recharge of our air and water, flood protection and soil conservation. The goal of sustainable and healthy ecosystems and protecting biodiversity can promote policies and investments that conserve our natural resources and protect biodiversity for the enjoyment, economic prosperity and quality of life of future generations.

	This indicator measures the goal of a local plan to protect existing natural environment and key ecosystem's processes and functions. The objectives should be specifically address protection of the processes and functions of hydrology and coastal systems.
2.7 Seek achieve clean and plentiful water resources	The goal of clean and plentiful water resources can promote development practices that improve water quality by protecting the natural functions of watersheds and aquifer recharge areas. This indicator measures whether a local plan seeks clean and plentiful water resources.
2.8 Seek productive and efficient use of land	The alternative to sprawl is development that is compact and uses land efficiently. This indicator measures whether a local jurisdiction seeks a productive and **e**fficient way for land use. Local jurisdictions should encourage efficient development patterns by ensuring that any new land development is compatible with existing land use.
2.9 Seek clear air and climate stability	The goal of clear air can improve air quality by promoting and investing in technology such as renewable energy sources for mobile and stationary purposes, promoting the use of hydrogen and other alternative fuels and low polluting vehicles and encouraging development that supports transportation choice. This indicator measures whether local jurisdictions set a goal to protect air quality and seek climate stability in the long term.
2.10 Seek energy conservation and energy alternatives	The goal of energy conservation and energy alternatives encourages research and development of renewable energy sources to meet an ever-increasing percentage of energy needs, including wind, solar, geothermal, biomass and small hydroelectric. This goal encourages significant reductions, in or elimination of the use of fossil carbon as fuel energy source and establishes achievable targets for greenhouse gas emissions that are incorporated into regulatory programs and reflected in subsequent investments in greenhouse gas reduction. This indicator measures whether local jurisdictions strategically reduce greenhouse gas emissions and measures whether local jurisdictions set a goal to reduce vulnerability to the effects of climate change e.g. flooding and drought.

2.11 Build accessible open/green space and walkable community	This indicator measures the goals and objectives for open space and natural green space protection. This indicator also measures whether local jurisdiction seeks to enhance landscape and built environment's quality. The pressures on open space come from population growth, patterns of urbanization, and changing demographics.
2.12 Value and protect diversity and local distinctiveness/history/culture	This indicator measures whether local jurisdiction protect diversity as well as local distinctiveness.
2.13 Build disaster-resistant, healthy, safe community	This indicator refers to reducing natural disasters and creating a healthy, safe environment in its local jurisdiction.
III. Inter-organizational coordination for environmental management 0: not identified; 1: general identified; 2: detailed identified	
3.1 Identify stakeholders and their interests	This indicator measures whether the key stakeholders, agencies and regions can be identified before a coordination procedure starts. If a plan lists major stakeholders and their interests in environmental management, it will be scored as 2. If only a short sentence or a couple of words are used in this item, it will get a score of 1.
3.2 Inter-organizational coordination within the jurisdiction	The inter-organizational coordination within a local jurisdiction is helpful to identify each responsibility and build a network for local environmental quality. This indicator measures internal coordination capacity among multiple organizations within a jurisdiction.
3.3 Coordination with surrounding jurisdictions	Many environmental problems, particularly for some cross-boundary environmental issues, need effective coordination with adjacent jurisdictions. This indicator measures coordinating capacity of one jurisdiction with adjacent jurisdictions.
3.4 Coordination with regional organizations	This indicator measures whether local jurisdictions coordinate with regional agencies which are organized by natural or graphic features such as watershed, river basin, valley, bays.
3.5 Coordination with state or federal agencies	This indicator measures the ability of local jurisdictions to coordinate with state or federal environmental agencies (EPA, COE, or USGS).
3.6 Coordination with private organizations or NGOs	This indicator measures the ability of local jurisdiction to coordinate with some specific agencies such as NGOs (e.g World Wild life Fund).
3.7 Specify trans-boundary	Specifying trans-boundary environmental issues can

environmental issues	improve coordination or regional efforts to conserve fragile ecosystems while supporting compatible and appropriate economic development to maintain viable and sustainable rural communities. This indicator measures whether trans-boundary environmental issues such as watersheds, groundwater, estuaries, and rivers have been considered in local comprehensive plans.
3.8 Identify commitment of financial sources for inter-organizational coordination	This indictor measures whether a local jurisdiction has guaranteed a certain financial commitment for inter-organizational coordination. If a commitment of financial resources for inter-organizational coordination is given in a plan, it will be scored as 1. If a specific budget or amount is given, it will be scored as 2.
3.9 Specify environmental conflict management and dispute resolution	This indicator measures whether a plan has a specific procedure for environmental conflict management and dispute resolution.
IV. Policies, tools and strategies for environmental management 0: not identified; 1: general identified; 2: detailed identified	
A. Environmental assessment tools	
4.1 On-site environmental review	On-site reviews are designed to review a project to determine if it is complying with federal, state or local environmental regulations and standards.
4.2 Environmental threshold of significance for development decision-making	An environmental threshold of significance is an identifiable quantitative, qualitative or performance level of a particular environmental effect. The threshold of significance is related to potential environmental effects and to compliance with standards. A local jurisdiction formulates its own thresholds of significance to make it easier to ensure local environmental quality.
4.3 Overlay mapping and GIS analysis	Overlay mapping and geographical information system (GIS) have been widely recognized as an important planning tool. GIS is an ideal tool to analyze environmental phenomena with spatial and temporal dimensions. GIS can analyze spatial coincidence, adjacency and connectivity through accurate identification, description, quantification and improved evaluation of spatial and temporal variability of impacts. Local planners can use overlay mapping and GIS analysis to identify areas that would be appropriate or inappropriate for future development. Local plans can use overlay mapping or

	GIS to identify the areas of constraint, areas of importance for landscape, wildlife habitats, or groundwater protection. Overlay mapping and GIS analysis can provide easily understandable results that can be used in decision-making and public participation exercises.
4.4 Scenario/sensitivity analysis	Scenario/sensitivity analysis is a tool to measure uncertainty in a local planning process. This method considers the effect on predictions of changing conditions or more important input values about which there is uncertainty. Scenario/sensitivity analysis can provide more realistic baseline data which reflects uncertainties. This method can be used to improve decision-making process by reducing uncertainties and leading to more robust strategic actions. According to the CEQA Guidelines, environmental assessment for a comprehensive plan must address feasible alternatives that will reduce or avoid one or more of the significant effects associated with the proposed plan. The scenario or sensitivity analysis should help local jurisdictions select the most appropriate plan alternative.
4.5 Network and system diagram analysis	Networks and system diagrams have been recognized as a useful tool to analyze cumulative effects and delineate complex cause-and-effect relationships and establish a reasonable, more understandable framework for environmental management, especially for biodiversity or water resource management. This method helps planners to thoroughly consider the multiple, subsidiary effects of various actions and to identify cumulative or indirect effects to environmental quality that accumulate from direct effects on other actions.
4.6 Trends analysis	Trends analysis is based on a graphic projection of past and current conditions to predict the status of a resource, ecosystem, population, transportation, or land development over time. Trends analysis can assess possible changes in the occurrence or intensity of stressors over the same time period. Trends analysis can provide appropriate environmental baselines for environmental management.
4.7 Environmental modeling	Environmental modeling is a powerful tool for quantifying environmental effects. This method takes the form of mathematical equations or a decision

	making system describing cumulative processes such as soil erosion, air pollution, and water pollution. Environmental modeling is a necessary component of environmental assessment to enhance the quantitative basis for make decisions.
4.8 Ecological footprint analysis	The ecological footprint is a measure of how much land and water is needed to produce the resources and dispose of waste. Ecological footprint analysis can show how the population satisfies their demands by appropriating the environmental carrying capacity. Ecological footprint analysis can identify limits to growth and provide a useful tool for the development of local or regional ecological accounts. Ecological footprint analysis can provide an alternative way to implement the goal of sustainable development by reducing ecological impacts (e.g. providing less surface runoff, sediment load, and water pollution).
4.9 Questionnaires, interviews, expert panels	Questionnaires, interviews, and expert panels are useful methods for gathering a wide range of information on environmental issues. Expert judgment plays a more crucial role in SEA. For some important environmental issues, these methods can help identify important cumulative effects and establish a census building process.
4.10 Checklists for environmental items	Checklists for environmental items are often adopted in SEA because they are relatively simple, and straightforward. Checklists for environmental items can provide a list of important factors on an environmental issue and identify potential cumulative effects as well as provide a shortcut to thorough scoping and conceptualization of cumulative effects problems.
4.11 Matrices for environmental issues	Matrices for environmental issues help identify inter-relationships between human activities and the environment of concern. Matrices for environmental issues usually use a tabular format to combine various factors in the matrix to evaluate cumulative effects.
4.12 Life cycle analysis	Life-cycle analysis is a recently developed analytical environmental management tool which assesses the entire life cycle of a product or an environmental issue, especially used for waste management. Life-cycle analysis considers the entire environmental impact from beginning to end and considers a strategic action's direct impact, indirect impact and

	comprehensive impact from its whole process.
4.13 Land use partitioning analysis	Land use partitioning analysis is to identify, assess and record land use fragmentation resulting from development. Land use partitioning analysis also assesses possible impacts from infrastructure construction or land use changes. The possible effects may include habitat fragmentation, reduction in the scale of landscape, the size of tranquil areas and reduction of people's ability to move from one area to another.
4.14 Multi-criteria analysis	Multi-criteria analysis can assess an environmental issue or compare different alternatives by using various objectives or standards.
4.15 Compatibility appraisal	The purpose of compatibility appraisal is to ensure that different land use types are internally coherent and consistent with other conditions. Local planners should plan ahead to maintain land use compatibility, especially for airports, open spaces, or coastal zones. This indicator measures whether a local plan considers land use compatibility in its development process.
4.16 Cost-benefit analysis	Benefit-cost analysis is a method of evaluating the relative merits of a strategic action in order to achieve efficient allocation of resources. Cost-benefit analysis helps local planners incorporate environmental costs into the environmental assessment and review process. This method can translate environmental costs into a monetary measurement.
4.17 Risk assessment	Risk analysis estimates the probability and consequences of various environmental risks, products, and activities that are detrimental to human health, safety, and ecosystems. Risk assessment determines the potential harm that substances can cause to human health and the environment and then integrates this potential with estimated or actual exposure to the substance. Risk analysis is a probabilistic method to quantify uncertain environmental impacts.
4.18 Vulnerability analysis	Vulnerability analysis can assess different development scenarios to determine how they affect the vulnerability of the receiving environment. Vulnerability assessment needs to answer who and what are vulnerable in a geographic region; at the same time, which kinds of consideration should be

	given to damage and casualties.
B. Regulatory Policies, tools and strategies	
4.19 Land use restrictions (pollution, historical/cultural resources, biodiversity/ecosystem areas)	The policy of use restrictions protects environmentally sensitive areas through prohibiting certain land use types, activities or zoning. For example, commercial or industrial facilities cannot be sited in environmentally sensitive areas with biodiversity.
4.20 Density restrictions in and around environmental sensitive areas	The policy of density restrictions sets a certain density for land development in order to protect environmental quality of environmentally sensitive areas. For example, certain residential or land use density restrictions are used to protect the environmental quality of coastal areas.
4.21 Buffer requirements (for open space, green space or environmentally sensitive areas)	This policy sets certain buffer zones around environmentally sensitive areas to ensure human environmental quality. For example, a 500-meter buffer zone is required along a lake or a 2-kilometer buffer area is set to protect coastal open space.
4.22 Land permitted use (wetland, coastal zone, etc)	The policy of permitted use refers to permiting certain land use types or permit land use in specific areas. For example, a permit is required if a developer wants to use land in a wetland. A waste hazardous permit is required if the hazardous waste management facilities need to be approved to treat, store, and dispose of hazardous wastes.
4.23 Creation of special study zones, conservation zones or protect areas	This policy sets some special zones for particular purposes such as research, education or conservation. The most common purpose of the protected areas is to preserve biodiversity or forests.
4.24 Sensitive area protection (environmental, hazardous)	This policy considers environmentally sensitive areas in local development. All developments proposed within an area determined to be a sensitive area shall be considered a conditional use and shall be reviewed and considered consistent with the procedures for the review of land use regulations.
4.25 Control of urban service/growth boundaries	This indicator measures whether a plan has adopted some form of an urban service or growth boundary—a limit on land development beyond a politically designated area—to curb sprawl, protect open space, or encourage the redevelopment of inner-city neighborhoods.
4.26 Disaster-resistant land use	Many factors determine the resilience of the built

and building code	environment to the effects of these hazards, including appropriate design and location, construction quality and maintenance. An appropriate disaster-resistant land use and building code incorporates a thorough understanding of the forces that natural hazards impose on the area governed by the code. Disaster-resistant land use and building codes help mitigate disasters in the long term. Building or construction codes are standards and guidelines for construction of buildings to ensure a minimum level of safety for the occupants.
4.27 Disaster preparedness, mitigation, response and recovery procedures	Natural disaster management includes preparedness, mitigation, response and recovery procedures. This indicator measures whether a local plan has identified the whole range of these procedures. If the procedures of hazard preparedness, mitigation, response and recovery are all identified or classified in a plan, it will get a score of 2. If only a part is described, it will get a score of 1.
4.28 Other regulatory tools to protect environmental values	Other regulatory tools to protect environmental values
C. Incentive Tools	
4.29 Transfer of development rights (TDR) or purchase of development rights (PDR) away from the environmental sensitive areas	Transfer of development rights refers to a method for protecting land by transferring the "rights to develop" from one area to another. TDR programs do more than preserve farmland, natural resources, and open space; they change the way development occurs in a community. The policy of purchase of development rights involves the sale of that right while leaving all the remaining rights as before. The purchase of development rights is increasingly used in local jurisdictions' land preservation. PDR programs are all voluntary and once a participant sells the development rights to the land, it is permanently protected from land use conversion. PDR can ensure environmental values through these types of land transactions to protect open space, recreational, aesthetic, ecological, agricultural, or historic resources.
4.30 Conservation/mitigation banking	The concept of conservation/mitigation banking has been used in California since the mid-1970s. This policy refers to the practice of acquiring land and holding it for future use. Conservation/mitigation banking may therefore result in considerable savings to a local jurisdiction seeking to preserve open space,

	green space or other purposes A jurisdiction might use this technique to develop a greenbelt or simply to preserve key open space or agricultural tracts. Conservation/mitigation banking has also been defined as wetland restoration, creation, or enhancement to compensate for unavoidable wetland losses in advance of development actions. In some circumstances, wetland compensation is impossible to be achieved at a certain development site or would not be as environmentally beneficial, thus conservation/mitigation banking provides a chance for wetland preservation. Conservation/mitigation typically involves the consolidation of many small wetland mitigation projects into a larger, potentially more ecologically valuable site. The conservation/mitigation bank can provide a permanent endowment for operation of the bank as a wildlife preserve.
4.31 Capital improvement program for environmental protection	Capital improvement programs with financial incentives for environmental protection are supposed to be an effective tool for a certain projects. Local jurisdiction can provide packages of fiscal and financial incentives along with appropriate regulatory arrangements and the development of partnerships to achieve the purposes of environmental protection.
4.32 Density bonus or bonus zoning in charge for environmental protection	The policy of density bonus or bonus zoning allows a higher density than current zoning permits in order to protect environmental values in a certain place. This policy means an increase in developer profits by giving higher densities. Usually, a local jurisdiction holds the rights transferred and a developer in the receiving area obtains a density bonus.
4.33 Clustering away from the environmental sensitive areas	Clustering is a tool to closely group some structures by sharing common walls, floors, ceilings, and roofs as well as other outdoor areas such as recreation and parking facilities. Clustering development allows for the preservation of open space, or environmentally sensitive areas and tends to lead toward a more livable and less environmentally impacting method of land development. Clustering developments are typically placed closer together and targeted away from naturally sensitive features.
4.34 Mixed-use, infill/ redevelopment	A large amount of land exists within urbanized areas that need to be infilled or redeveloped. Infill

	development should be given a high priority in local comprehensive land use planning process. The policies rehabilitate, maintain, and improve existing infrastructure and appropriate reuse and redevelopment of previously developed or underutilized lands. The policy of mixed-use development, infill and redevelopment is an effective way to achieve smart-growth goals and energy efficiency.
4.35 Pedestrian/resident-friendly, bicycle-friendly, transit-oriented community development	Pedestrian/resident-friendly, bicycle-friendly, transit-oriented community development helps build a more active, living-suitable, and energy-conserving built-environment. Cities and counties should promote more livable communities by expanding opportunities for pedestrian/resident-friendly, bicycle-friendly, transit-oriented community development to minimize traffic and pollution impacts from traveling for work, shopping, school, and recreation.
4.36 Preferential tax treatments to protect environmental values	This policy is inclined to give preferential treatment to higher tax-producing land uses such as commercial centers rather than conservation uses. Large lot, low-density residential zones also discourage new development within the urban areas where land values are higher. Preferential assessment programs provide landowners an economic incentive to keep their land in agricultural, timber, open-space, or recreational use. This can help implement land use, open-space, and conservation elements by protecting areas designated for such uses from premature development.
4.37 Waste recycling and management program	A waste recycling and management program should be incorporated into a local land use. The waste recycling and management program assists reuse activities, and waste generation reduction through means that may be effective on a local level.
4.38 Low-impact design for impervious surface	An impervious surface is a surface through which water cannot penetrate, such as a roof, road, sidewalk, or paved parking lot. The amount of impervious surface increases with development and establishes the need for drainage facilities to carry off the increased runoff. Low impact design for impervious surface can reduce large amounts of land with impervious surfaces, improve degradation of water quality, increase surface

	runoff, alter regular stream flow and watershed hydrology, reduce groundwater recharge and reduce flood hazards on a long term scale. Low impact design for impervious surface minimizes impervious surfaces and maximizes open or green space that is consistent with other land use policies such as controlling urban sprawl and promotes efficient land use patterns.
4.39 Watershed-based and ecosystem-based land management	Watershed-based and ecosystem-based land management has been increasingly accepted by planners. This method places more emphasis on planning that provides coordination to reflect regional diversity and values in setting environmental management objectives. Ecosystem-based environmental management has been recognized as a new paradigm for achieving sustainable and healthy development practice.
4.40 Water-conserving land use (agriculture or industry)	Implementing a policy of land reduced taxation for green products, energy-efficient, eco-friendly products or services can preserve environmental values in local development. Water-conserving land use supports new technology and conservation efforts to reduce water usage in the business, agriculture and institutional and residential sectors.
4.41 Energy-efficient, or alternative-energy land use	Local jurisdictions should encourage energy-efficient or alternative-energy land use, especially renewable resources such as solar, wind, hydroelectric, and geothermal resources. Energy-efficient or alternative-energy land use requires incorporating green building principles and materials in planning, construction and operations.
4.42 Other incentive tools for environmental protection	Other incentive tools for environmental protection may include subsidies for environmentally friendly activities, or removal of environmentally harmful subsidies, etc.
D. Land Acquisition Programs	
4.43 Development impact fees for environmental protection	Development impact fees are charges assessed by local governments against new development projects that attempt to recover costs incurred by a local jurisdiction in providing the public facilities required to serve the new development. Impact fees help pay for the cumulative impact of new development through infrastructure improvements and also contribute to local jurisdiction development.

4.44 Conservation easements	A conservation easement is a legal agreement between a landowner and an agency that permanently limits uses of the land in order to protect its conservation values. This is a tool for acquiring open space with less than full-fee purchase, whereby a public agency buys only certain specific rights from the land owner.
4.45 Other land acquisition techniques	Other land acquisition techniques include special taxing districts to enhance land acquisition, or safeguard designated natural areas conservation importance.
E. Communication-based Policies, Tools, Strategies	
4.46 Public awareness programs for environmental issues (e.g. education or training)	Increased environmental awareness has been an important motivation for environmental action. Local jurisdictions can increase public awareness to encourage developers and individuals to adopt cost-effective, environmentally efficient practices. The most common public awareness programs include education, training or workshops.
4.47 Multiple public participation and communication channels (e.g. public meetings, hearings, workshops and services)	Public meetings, hearings, and workshops are an effective communication tools to achieve common environmental values. These types of communication have interactive components to encourage dialogue in local decision making for environmental issues.
4.48 Effective information accessibility, notification and dissemination	To achieve effective public participation in decision-making affecting the local environmental quality, environmental information, data and knowledge must be accessed and disseminated. Effective public participation can increase the accountability and transparency of the local land use decision-making process. To achieve effective public participation the public must have access to environmental data, information, and knowledge. In order to make information available, multiple approaches should be developed to enhance public access and information sharing. This indicator measures whether a local jurisdiction has multiple approaches to enhance public information sharing. The types of information dissemination include mailing lists, toll-free telephone numbers, newsletters, fact sheets, press releases, exhibits, open-door policy, and computer communication. If a plan states more than three of these techniques, it will be scored as 2. If a plan gives only one or two of these techniques, it will be scored

	as 1.
4.49 Public participation in environmental decision-making structure	This policy encourages and ensures public participation in local environmental or development decision-making. Public participation can provide checks and balances on the environmental decision-making of governments and improve the quality of decisions. Moreover, this policy enables advocacy on behalf of certain stockholder's interests such as conservation groups not normally represented. A local jurisdiction should involve the public early in a timely manner before narrowing alternatives or making key decisions.
4.50 Emphasizing linking science, technology, and policy	Linking science, technology and policy can match the gaps in the planning process through building a solid factual basis, implementing capacity with strong technical and scientific support, and making a reasonable policy framework with appropriate goals, objectives, policies, tools, and strategies.
V. Implementation and Monitoring	
5.1 Identify each major agency's responsibilities for plan's implementation	If a plan uses only short sentences or a few words to roughly describe major agencies' responsibilities for the plan's implementation, it will be scored as 1. If each agency's responsibilities are listed or identified, it will be scored as 2.
5.2 Give a clear, reliable time schedule	A clear and reliable time table is helpful for the implementation of the policies in local comprehensive plans. For example, a natural disaster assessment must be conducted by the year 2008.
5.3 Provide necessary technical assistance	If a plan promises to provide necessary technical assistance, it will be scored as 1. If a plan lists possible sources of technical assistance, it will get 2.
5.4 Identify reliable financial support for plan's implementation	If a plan emphasizes using cost-effective methods and identifies reliable financial support for plan implementation, it will be scored as 2.
5.5 Identify plan update procedures to assess plan effectiveness regularly	Local jurisdictions need to monitor development and evaluate its status with respect to the general plan and state, regional, and local cooperative planning efforts. If a plan provides the procedures for updating local comprehensive plans reports, it will get a score of 2. If a plan sets a time or procedure to regularly assess plan effectiveness, it will get a score of 2. If a plan mentions this point with no details, it will be scored as 1.

5.6 Specify environmental monitoring procedures	If a plan specifies certain monitoring procedures for some important environmental areas or issues, it will get a score of 2. For example, a 5-year monitoring plan could be set for changes of biodiversity or air pollution. If it only mentions roughly monitoring procedures, it will be scored as 1. If a plan specifies monitoring procedures to regularly evaluate human resource use, local development and environmental impacts, it will be scored as 2. Usually the results from the monitoring process will provide updating information for factual basis and policy adjustment.
5.7 Specify enforcement of environmental protection	If a plan specifies the enforcement of environmental protection in a plan, it will be scored as 2.
5.8 Perform mitigation measurements	If a plan emphasizes performing regular mitigation measurements, particularly for natural disaster mitigation, it will be scored as 2.
5.9 Emphasize introducing new knowledge or techniques into implementation process	An important aspect of preparing a plan is incorporating new ideas, new knowledge, or techniques. If a plan emphasizes introducing new knowledge (e.g. global warming) or techniques (e.g. GIS, GPS, GIS, wireless networks, DNA water pollution test) into the implementation process, it will be scored as 2. Numerous technologies can be utilized to facilitate sustainable development and decelerate the pace of climate change.

APPENDIX 3

Environmental Assessment Plan Protocol

Data coded: _____

Title of Plan: _____

Jurisdiction: _____

Leading organization: _____

Plan Updated date: _____

Indicator	Score	Page of reference	Comments
I. Factual Basis 0: not identified; 1: Generally identified; 2: Detailed identified M: Mapped; D: Described			
A. Natural Environment			
1.1 Local jurisdiction's physical setting • Mapped • Described			
1.2 Local environment's sphere of influence • General description • Detailed description			
1.3 Local environment's temporal impact • General description • Detailed description			
1.4 Ecosystem's concept, functions and processes • General description • Detailed description			
1.5 Major environmental laws and regulations • General description • Detailed description			

1.6 Rare, threatened and endangered species • Catalogued • mapped			
1.7 Biodiversity and possible disturbance and threats • General description • Detailed description			
1.8 Ecologically important regions • Mapped • Described			
1.9 Water consumption and water resources availability • General description • Detailed description			
1.10 Water quality and point discharges and non-point-source pollution • General description • Detailed description			
1.11 Groundwater supply and aquifer depletion • Mapped • Described			
1.12 Hydrological regimes and aquatic environment • General description • Detailed description			
1.13 Environmentally sensitive lands • Mapped • Classified			
1.14 Soil quality and soil degradation • Mapped • Classified			
1.15 Wetlands and watershed • Mapped • Described			
1.16 Natural/urban vegetation and forestry resources • Mapped • Described			
1.17 Local and regional geological conditions • Mapped • Described			
1.18 Air quality and air pollutants • Described • Classified			
1.19 Greenhouse gas (or CO_2) emission			

• General description • Detailed description			
1.20 Ozone layer depletion • General description • Detailed description			
1.21 Climate change and variability Mapped • General description • Detailed description			
B. Built Environment			
1.22 Physical constraints of land development • General described • Detailed described			
1.23 Land use patterns and land availability • Described • Mapped			
1.24 Agricultural resources and working landscapes • Described • Mapped			
1.25 Open space, green space and recreational resources • Described • Mapped			
1.26 Critical historical and cultural heritage • Described • Mapped			
C. Human Health			
1.27 Human population growth and carry capacity • Described • Classified/inventoried			
1.28 Noise-sensitive areas • Described • Mapped			
1.29 Main environmental hazard risks • Mapped • Described/inventoried			
1.30 Social/environment/hazard vulnerable population and places • Described • Classified			
1.31 Risk of exposure to hazardous materials, wastes, pollution • Described			

• Classified /inventoried			
II. Goals and Objectives 0: not identified; 1: general identified; 2: detailed identified			
2.1 Protect natural resources and environmental values			
2.2 Maintain intergenerational sustainability			
2.3 Balance environmental, social, and economic development			
2.4 Seek environmental justice and equity			
2.5 Seek to build up environmental stewardship			
2.6 Achieve sustainable and healthy ecosystems and protect biodiversity			
2.7 Seek to achieve clean and plentiful water resources			
2.8 Seek productive and efficient use of land			
2.9 Seek clear air and climate stability			
2.10 Seek energy conservation and energy alternatives			
2.11 Build accessible open/green space and walkable community			
2.12 Value and protect diversity and local distinctiveness/history/culture			
2.13 Build disaster-resistant, healthy, safe community			
III. Inter-organizational coordination for environmental management 0: not identified; 1: general identified; 2: detailed identified			
3.1 Identify stakeholders and their interests			
3.2 Inter-organizational coordination within the jurisdiction			
3.3 Coordination with surrounding jurisdictions			
3.4 Coordination with regional organizations			
3.5 Coordination with state or federal agencies			
3.6 Coordination with private organizations or NGOs			
3.7 Specify trans-boundary environmental issues			
3.8 Identify commitment of financial sources for inter-organizational coordination			
3.9 Specify environmental conflict management and dispute resolution			
IV. Policies, tools and strategies for environmental management			

0: not identified; 1: generaly identified; 2: detailed identified			
A. Environmental assessment tools			
4.1 On-site environmental review			
4.2 Environmental threshold of significance for development decision-making			
4.3 Overlay mapping and GIS analysis			
4.4 Scenario/sensitivity analysis			
4.5 Network and system diagram analysis			
4.6 Trends analysis			
4.7 Environmental modeling			
4.8 Ecological footprint analysis			
4.9 Questionnaires, interviews, expert panels			
4.10 Checklists for environmental items			
4.11 Matrices for environmental issues			
4.12 Life cycle analysis			
4.13 Land use partitioning analysis			
4.14 Multi-criteria analysis			
4.15 Compatibility appraisal			
4.16 Cost-benefit analysis			
4.17 Risk assessment			
4.18 Vulnerability analysis			
B. Regulatory Policies, tools and strategies			
4.19 Land use restrictions (pollution, historical/cultural resources, biodiversity/ecosystem areas)			
4.20 Density restrictions in and around environmentally sensitive areas			
4.21 Buffer requirements (for open space, green space or environmentally sensitive areas)			
4.22 Land permitted use (wetland, coastal zone, etc)			
4.23 Creation of special study zones, conservation zones			
4.24 Sensitive area protection (environmental, hazardous)			
4.25 Control of urban service/growth boundaries			
4.26 Disaster-resistant land use and building codes			
4.27 Disaster preparedness, mitigation, response and recovery procedures			
4.28 Other regulatory tools to protect environmental values			
C. Incentive Tools			
4.29 Transfer of development rights (TDR) or			

purchase of development rights (PDR) away from the environmental sensitive areas			
4.30 Land/mitigation banking			
4.31 Capital improvement program for environmental protection			
4.32 Density bonus or bonus zoning for environmental protection			
4.33 Clustering away from environmental sensitive areas			
4.34 Mixed-use, infill/ redevelopment			
4.35 Pedestrian/resident-friendly, bicycle-friendly, transit-oriented community development			
4.36 Preferential tax treatments to protect environmental values			
4.37 Waste recycling and management program			
4.38 Low-impact design for impervious surface			
4.39 Watershed-based and ecosystem-based land management			
4.40 Water-conserving land use (agriculture or industry)			
4.41 Energy-efficient, or alternative-energy land use			
4.42 Other incentive tools for environmental protection			
D. Land Acquisition Programs			
4.43 Development impact fees for environmental protection			
4.44 Conservation easements			
4.45 Other land acquisition techniques			
E. Communication-based Policies, Tools, Strategies			
4.46 Public awareness programs for environmental issues (e.g. education or training)			
4.47 Multiple public participation and communication channels (e.g. public meetings, hearings, workshops and services)			
4.48 Effective information accessibility, notification and dissemination			
4.49 Public participation in environmental decision-making structure			
4.50 Emphasizing linking science, technology, and policy			
V. Implementation and Monitoring			

5.1 Identify each major agency's responsibilities for plan's implementation			
5.2 Give a clear, reliable time schedule			
5.3 Provide necessary technical assistance			
5.4 Identify reliable financial support for plan's implementation			
5.5 Identify plan update procedures to assess plan effectiveness regularly			
5.6 Specify environmental monitoring procedures			
5.7 Specify enforcement of environmental protection			
5.8 Perform mitigation measurements			
5.9 Emphasize introducing new knowledge or techniques into implementation process			

APPENDIX 4

The Dependent and Independent Variables Measurement

Name		Type	Measurement	Scale	Source
Environmental assessment plan quality		Dependent Variable	Sum of five plan components: Factual basis Goals and objectives Inter-organization coordination and capabilities Policies, tools, strategies Implementation and monitoring	Interval: 0-50	Sample of plan
Planning capacity	Number of planners	Independent variable	The actual number of planners	Continuous	data source: California Planners' Book of List, 2005: Planners survey
	Plan element update	Independent variable	2005 minus the actual year of conservation element	Continuous	data source: California Planners' Book of List, 2005: Planners survey
	GIS technical level	Independent variable	GIS data adopted in planning: comprehensive plan land use; zoning designation; parcel lines; jurisdictional boundaries; approved permits; land use/code violations; natural hazards; natural resources; roads and other public infrastructure; aerial photos; CEQA studies/environmental assessments; mitigation monitoring; transportation; health; safety; other	0-16 scales	data source: see California Planners' Book of List, 2003: Planners survey*
	Collaborative efforts	Independent variable	Jurisdictions participating in regional collaborative planning efforts: other cities; counties; special districts; regional planning agencies; other	0-5 scales	data source: California Planners' Book of List, 2003: Planners survey*
Environmental assessment capacity	Assessment scope	Independent variable	Type of environmental assessment used for last comprehensive plan update: master EIR; program EIR; project EIR; EIR equivalent; other	0-5 scales	data source California Planners' Book of List, 2003: Planners

					survey*
	Streamlining ability	Independent variable	Degree of streamlining environmental assessment: specific plan EIR; tiering from prior EIR; master EIR; program EIR; categorical exemptions; statutory exemptions; other	0-7 scales	data source: California Planners' Book of Llist, 2005: Planners survey*
	Data management and sharing	Independent variable	Jurisdictions that regularly post on a website any CEQA document for which it is the Lead Agency: notice of preparation; EIR; negative declaration; declaration; other; description of other	0-6 scales	data source: California Planners' Book of List, 2005: Planners survey and Webpage survey*
Public participation capacity	Participation formats	Independent variable	Workshops; townhall meetings; site tours; charrettes; other	0-5 scales:	data source: California Planners' Book of List, 2003: Planners survey*
	Public notice channel	Independent variable	Internet; publish in a non-English newspaper; radio/television; mail beyond required 300'radius; notices using community organizations; community newsletters; other	0-7 scales	data source: California Planners' Book of List, 2003: Planners survey*
	Public participation method	Independent variable	Evening meetings; provide daycare at public meetings; provide transportation to public meetings; public meetings near the project site; involve youth in community planning exercises; post minutes or project documents on the internet; allow public comment by E-mail/ internet; use alternative public participation jurisdiction formats	0-8 scales	data source: California Planners' Book of List, 2005: Planners survey*
Contextual variables	Population	Independent variable	Population in 2000 census	Continuous	data source: 2000

					census
	Wealth	Independent variable	The median home value	Continuous	data source: 2000 census
	Public and conservation lands	Independent variable	Percentage of public and conservation lands within a jurisdiction	Continuous	data source: California spatial information library
	Population growth	Independent variable	Population change from 1990-2000 within a jurisdiction	percentage	data source: 2000 census
	Education	Independent variable	Percentage of persons whose age is above 25 with bachelor's degree or higher, in 2000	percentage	data source: 2000 census

* The missing items in California planners' surveys were updated by this study's email requests to related local jurisdictions.

APPENDIX 5

Correlation Matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	.55 (**)														
3	-.38 (*)	-.06													
4	.14	.27	.17												
5	.02	.11	-.11	-.24											
6	.39 (*)	.02	-.19	.06	-.16										
7	.13	.32 (*)	.06	.01	-.13	-.04									
8	.48 (**)	.30	.06	.21	-.06	.10	-.15								
9	.09	.36 (*)	-.13	.14	.02	-.31 (*)	.24	.21							
10	.08	.37 (*)	-.04	.20	-.12	-.27	.04	.01	.41 (**)						
11	.12	.40 (**)	-.13	.23	-.06	-.37 (*)	.27	.01	.44 (**)	.54 (**)					
12	.61 (**)	.43 (**)	-.06	.35 (*)	-.11	.56 (**)	.26	.25	-.10	-.13	-.03				
13	.02	-.03	-.15	.15	-.17	.04	.25	-.03	.01	-.03	.22	.12			
14	.01	-.25	-.12	-.33 (*)	-.10	.09	-.18	.05	-.08	-.09	-.19	-.21	-.27		
15	.01	-.25	-.12	-.37 (*)	-.17	.21	-.10	.17	-.02	-.06	-.13	-.17	-.18	.74 (**)	
16	.29	.75 (**)	-.12	.30	.31	.06	.03	.19	.21	.33 (*)	.27	.31 (*)	-.06	-.22	.32 (*)

* Significant $p<0.05$; ** significant $p<0.01$;

1. Plan quality; 2. Number of planners; 3. Plan date; 4. GIS technical level; 5. Collaborative efforts; 6. Assessment scope; 7. Streamlining ability; 8. Information management and sharing; 9. Participation formats; 10. Public notice channels; 11. Public participation incentives; 12. Population; 13. Population growth; 14. Education; 15. Wealth; 16. Public and conservation lands.

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