

Indicators of Sustainability

Workshop #1

**Post-Workshop
Report**

May 10, 1999

Alliance for a Sustainable Atlanta

Center for Urban and Regional Ecology

Georgia Conservancy

Metro Atlanta Chamber of Commerce

Regional Business Coalition

Georgia Environmental Protection Division

Habersham & Cowan

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Overview

At a meeting on March 18, 1999, representatives from the Georgia Conservancy, the Metropolitan Atlanta Chamber of Commerce, the Georgia Environmental Protection Division, the Regional Business Coalition, Habersham & Cowan, and the Center for Urban and Regional Ecology mutually agreed that a common set of indicators are needed to describe, measure, and track the rate of change of “quality of life” in the metropolitan Atlanta region. Although many individuals and organizations already produce or rely on such indicators, it was recognized that there is a lack of consensus or agreement on the definition, acquisition, and interpretation of the metrics. Without a trusted common “language” that describes the region, it is not possible for the community as a whole to develop a shared vision for the future. Thus, it was resolved on March 18 that this group, or “alliance”, would collectively sponsor an initial inquiry into the need to develop a community consensus on a comprehensive and unambiguous set of sustainable indicators. It was further decided that this inquiry should be held as soon as possible to capitalize on the unique political opportunities afforded by the passage of Senate Bill 57 that created the Georgia Regional Transportation Authority.

On May 3, 1999, the Alliance for a Sustainable Atlanta sponsored a three-hour workshop at Georgia State University to solicit comments regarding the need to develop a community consensus on a set of sustainable indicators. The Center for Urban and Regional Ecology (CURE) — a collaboration among Georgia Tech, the University of Georgia, and Georgia State University — agreed to manage the workshop on behalf of the Alliance. Approximately 70 people attended, including representatives from government, business, environmental groups and other non-profits, and academia. At this workshop, the representatives were asked to consider:

- Does Metro Atlanta need a common set of indicators to help decision-makers and others measure and track progress on issues related to land use and land development.
- If so, which indicators would be most valuable in tracking our progress?

Sustainability indicators

“Sustainability indicators” is a term that describes a set of measurements that, taken as a whole, describe an area's human, built and natural conditions — conditions that affect “quality of life.” It is recognized that there are many facets to “quality of life,” and a broad set of indicators is required to adequately represent all aspects. This workshop, however, focused on the variables that are directly affected by land use and land development and the indicators by which we can measure the impact of development. These are the critical issues facing Metro Atlanta at this moment.

The indicators, by themselves, do not suggest which policies should be adopted. But they can be important tools for decision making. For that reason, the sponsors felt it was

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important to develop a community consensus on a comprehensive and unambiguous set of measurements that can guide policy-makers and others in considering possible actions.

Before the workshop, CURE prepared a “strawman” list of indicators, which was shared with participants. These indicators were divided into eight broad categories:

- Air quality
- Transportation
- Water quality and water resources
- Land use
- Population density, demography and diversity
- Economy
- Energy generation and consumption
- Biodiversity

Format of the workshop

The workshop was divided into three parts. First, there were several speakers who welcomed participants, explained how sustainability indicators are developed, and described how CURE developed the strawman list of indicators that were presented on May 3.

Second, a facilitator guided a discussion of indicators in general, and then of the eight categories developed by CURE in particular.

Finally, participants were asked to evaluate the tentative indicators and suggest new ones. To help with the evaluation, participants were asked to place colored dots on the eight categories, which were posted on a nearby wall. The dots (green, yellow, red) signified whether the participant felt that category was:

- "Well served" by the tentative indicators developed by CURE (green).
- Could be well served if selected changes were made to the indicators (yellow).
- Poorly served by the indicators and CURE should rethink its approach (red).

If a participant did not have an opinion about a category -- or did not know enough to evaluate it -- he or she was asked to place no dot on the category.

Participants who placed yellow dots on a category (signifying it could be made acceptable, if changes were made) were asked for additional input. They were given large Post-It notes and asked to suggest specific new indicators for those categories.

Finally, participants were given follow-up evaluation forms and asked for their overall evaluations of the workshop process and additional ideas.

The workshop

The workshop was convened at 8:30 AM at the Urban Life Auditorium on the campus of the Georgia State University. The most important results of the workshop:

- No one in attendance questioned the need for developing indicators nor did anyone question the methodology used by CURE in developing the tentative indicators, although many offered suggestions for new ones, and some questioned specific indicators.
- No one questioned "sustainability" as a legitimate goal for the region.
- Numerous additional indicators were suggested, which CURE's researchers will review in the weeks ahead for importance, objectivity and measurability.
- CURE received evaluations of its eight categories of indicators, which should help guide its efforts in revising the indicators.

Introductory Presentations

Mr. Joel Cowan of Habersham & Cowan welcomed the participants to the workshop, described the need for measures of "quality of life," and introduced several key individuals that may serve the Georgia Regional Transportation Authority now and in the future. Dr. Carl Patton, President of Georgia State University and an influential and active urban planner, welcomed the audience to Georgia State University.

Dr. Anne Steinemann of the City Planning Program at Georgia Tech, and Dr. Bryan Norton of the School of Public Policy at Georgia Tech provided a brief summary of what a sustainable indicator is and what makes a good sustainable indicator. This presentation is included here as *appendix 1*.

Ms. Helen Tapp of the Regional Business Coalition introduced the strawman list of indicators and focused the workshop on the variables that are directly affected by land use and land development, and the indicators by which we can measure the impact of development. The initial strawman list of indicators is included here as *appendix 2*.

Facilitated Discussion

Mr. Otis White of Civic Strategies, Inc. facilitated the remainder of the workshop with the aim of soliciting additional ideas and comments on which indicators should be further investigated. This was the first workshop of its type in Atlanta, bringing together a diverse group of people interested in the subject of sustainability to discuss how sustainability can be measured. It is not surprising that the first half of the workshop was dominated by questions about the workshop's intent, definitions and approaches.

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Notes that captured the key comments from the discussion are included here as *appendix 3*. A list of the additional indicators that were suggested by the participants is included here as *appendix 4*. From the discussion came several important points:

- As the regional indicators are being developed, one participant suggested CURE might develop a set of "sub-regional" indicators that can help a county, locality, neighborhood -- or even a corporation or organization -- determine its impact on sustainability.
- Even the best indicators tend to measure the way things were, not how they are or will be. And just as economists have developed a suite of measurements known as "leading economic indicators" to suggest what's ahead, a participant suggested that a set of "leading sustainability indicators" be developed that helps policy-makers determine whether conditions will improve or decline in the future.
- Two new categories were suggested: human or public health, and education.
- Several participants suggested comparing Metro Atlanta's indicators with those of comparable metropolitan areas elsewhere in the country.
- Several participants questioned whether important groups were missing or underrepresented at the workshop. One said that industry, such as Atlanta's automobile manufacturers, were absent.

When specific categories were discussed, most of the discussion was about additional indicators that were needed. But some general observations were made in these categories:

- Air quality: One participant suggested "per household" measurements of emissions that would allow one county or neighborhood to measure its sustainability against others elsewhere in the region.
- Air quality: Another participant questioned how measurements would separate "extra-regional" sources of pollution, such as power plants in Alabama, from sources of pollution generated within the region. Since policy-makers in Atlanta can regulate only local sources of pollution, he said, this may become an important distinction.
- Water quality/resources: One participant suggested that "excess water-supply capacity" -- basically, the amount of water left for future growth -- as a potential "leading sustainability indicator."
- Land use: Several participants suggested a careful definition for "mixed zones" of development. In some jurisdictions, that might mean apartments and single-family houses, while others would define it as businesses, offices and residential. It was important, some said, to be sure the definition included places of employment.
- Biodiversity: One participant said it was important to measure "natural capital," such as uncut forests. Presently, he said, there are only measurements of economic capital.
- Biodiversity: A more descriptive name for this category, participants suggested, might be "Health of the Life-Support System."

Analysis of voting

The "dot voting" gave the Alliance a quick way of evaluating its work to date and deciding where to focus its future efforts.

Here are the highlights of the voting:

- 27 people took part in the evaluation. Participants were more likely to have opinions about transportation, air quality, land use and water quality/resources. They were less likely to have opinions about biodiversity, population, energy generation/consumption and economic indicators.
- Some categories that attracted the least number of votes had the highest percentage of negative votes. For example, fewer people evaluated the energy generation/consumption category, but those who did were more likely to consider its proposed indicators negatively. Another category that received a high percentage of negative votes was biodiversity, although it received an even higher percentage of positive votes.
- Familiar categories tended to have the highest positive votes. Population, economy and air quality -- three categories that have been measured in a variety of ways over the years -- were considered "well served" by their indicators by most participants. (Air quality received no "poorly served" votes.)
- The overwhelming majority of participants wanted specific changes in transportation, land use and biodiversity but thought these categories could be made acceptable with changes.
- Water quality/resources also passed muster. 45% of participants thought the tentative indicators were adequate, 50% suggested specific changes and only 5% (one individual) thought researchers ought to start over.

In summary:

- Four of the eight categories seemed acceptable to participants -- or could be made acceptable with some changes. Those categories were **population, economy, air quality and water quality/resources**.
- Three categories, **transportation, land use and biodiversity**, seemed to participants to require numerous specific changes before they could be made acceptable.
- One category appeared to need major revisions -- **energy generation/consumption**. No other category received more than two red dots (signifying that, in the participant's view, this category was "poorly served" by its indicators). Energy generation/consumption received five red dots.

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**Had an opinion about this
category**

Number of participants voting in
each category

Transportation	27
Air quality	23
Land use	21
Water quality/resources	20
<i>Average</i>	20
Economy	18
Energy	17
generation/consumption	
Population	16
Biodiversity	15

Needs major revision

Percentage voting that indicators "poorly
served" this category

Energy	29%
generation/consumption	
Biodiversity	13%
Economy	11%
Land use	10%
<i>Average</i>	9%
Population	6%
Water quality/resources	5%
Transportation	0%
Air quality	0%

Basically well-served

Percentage voting that this category was "well served"
by indicators

Population	69%
Economy	61%
Air quality	57%
Water quality/resources	45%
<i>Average</i>	37%
Biodiversity	20%
Energy	18%
generation/consumption	
Land use	14%
Transportation	11%

**Can be made acceptable with
changes**

Percentage voting that indicators could serve the
category well, if specific changes were made

Transportation	89%
Land use	76%
Biodiversity	67%
<i>Average</i>	54%
Energy	53%
generation/consumption	
Water quality/resources	50%
Air quality	43%
Economy	28%

Next steps

In the weeks ahead, the steering committee will consider what was said and, in particular, what was suggested to improve the process of developing the indicators. Concurrently, the scientists, engineers, economists, and policy analysts in CURE will meet to evaluate the technical merits of all of the potential indicators, and to begin identifying the resources that will be needed to support this initiative. Based on their input and guidance, CURE will refine the list of indicators and issue a new list, which will be published with accompanying data in printed form and on the Internet. A second workshop is tentatively proposed for early September 1999 to update the community on the status of the indicators, and to address the technical questions concerning data acquisition. It is expected that this will lead to further refinements in the list of indicators. A third workshop is proposed for January 2000 to provide the community an opportunity to preview the application of data to the proposed indicators. Again, it is expected that this

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will lead to a review of the indicators and another round of refinements. Finally, a major conference is proposed for Spring 2000 to unveil the indicators and launch a community-wide discussion on their implications and meanings for the past, present, and future.

It is likely that these indicators will change in years to come. That might happen for several reasons:

- New sources of data may become available.
- Policy makers and others may identify new areas of interest.
- Some indicators may be shown over time to be of marginal usefulness.

If so, the Alliance may reconvene from time to time to consider new indicators, and participants in the May 3 workshop may be invited to future forums to consider these new measurements.

Acknowledgement

It is appropriate to recognize and thank the members of the steering committee that helped plan and organize the sustainable indicators workshop. The steering committee consisted of Dr. Michael Chang from the Center for Urban and Regional Ecology, Dr. C.S. Kiang from the School of Earth and Atmospheric Sciences at Georgia Tech, Ms. Ellen Keys formerly of the Georgia Conservancy, Ms. Susan Kidd of the Georgia Conservancy, Ms. Helen Tapp of the Regional Business Coalition, Mr. Jim Durrett of the Metropolitan Atlanta Chamber of Commerce, Mr. David Word of the Georgia Environmental Protection Division, and Mr. Joel Cowan of Habersham and Cowan. This report was prepared by Dr. Michael Chang and Ms. Suzanne Safran of the Center for Urban and Regional Ecology, and Mr. Otis White of Civic Strategies, Inc and was reviewed by all the members of the workshop steering committee.

Attachments

There are five appendices:

- 1) The presentation of "What is an indicator?" and "What is a good indicator?"
- 2) The list of tentative indicators prepared by CURE before the workshop.
- 3) A copy of the notes taken during the discussion.
- 4) The list of additional indicators suggested by participants.
- 5) A list of the participants in the first workshop and their affiliation.

Appendix 1:
What is a Sustainable Indicator?
What is a Good Sustainable Indicator?

Sustainability Indicators

What are sustainability indicators?

Measures that help us understand:

- where we are,
- which way we are going,
- where we want to be, and
- how to get there.

Measures that reflect a community's goals for:

- environmental,
- economic, and
- social well-being.

Types of Sustainability Indicators

- Domain-based
- Issue-based
- Effects-based

Domain-based Indicators (examples)

- Environment
- Economy
- Society
- Transportation
- Land Use
- Population
- Housing

Issue-based Indicators (examples)

- Air Quality
- Traffic Congestion
- Urban Sprawl
- Economic Prosperity
- Quality of Life

Effects-based Indicators (examples)

Sources of Problems

- automobile use, land use decisions, transportation investment decisions, . . .

Problems

- poor air quality, human health problems, urban sprawl, economic losses, . . .

Solutions

- alternative fuel vehicles, alternative transportation options, improved pedestrian accessibility, growth management strategies, . . .

Sustainability Indicators

What makes a good sustainability indicator?

- Goal-Directed
- Useful
- Integrative
- Representative

Choosing Goals--Narrowly or Broadly

How broad should our goals be? Some Examples.

- **Narrow Goals:** “To get out of trouble with the EPA” or “Reducing traffic congestion”
- **Broader Goal:** To re-consider the current direction of development in the Atlanta area, discuss alternatives, and chart a more “sustainable” path toward development.

Defining Sustainability

A choice to pursue sustainability can be thought of as embracing a very broad goal, and initiating a discussion of how to define this broad goal more specifically and more substantively.

Making Decisions to:

- Recognize that decisions today, especially infrastructure decisions, will have impacts and perhaps limit choices (options/opportunities”) for the future
- Accept responsibility to take the future into account in today’s decisions and to avoid choices that unnecessarily reduce opportunities and choices available in the future.

Turning Broad Goals into Action

Step 1: Stakeholder and citizen discussion of the broad social values that characterize the community: Our Greatest Hopes, Our Greatest Fears

Step 2: Articulate broad community goals that have wide acceptance.

Step 3: Choose indicators that track variables associated with our greatest hopes and worst fears.

Criteria for Sustainability Indicators

Scientific Requirements

- Precise as possible
- Reasonably easy to measure.

Political Requirements

- Measure characteristics that are important
- Easily understandable and communicable to concerned parties and to the public.

Appendix 2:
Tentative indicators prepared
for the Sustainable Atlanta Workshop

Air quality

1. GROSS MEASURES
 - a. Number of days per year or percentage of days that the Metro Atlanta Pollution Standard Index (PSI) is in the "good" or "moderate" range
 - b. Atlanta PSI relative to nearby "clean air" location
2. SPECIFIC MEASURES
 - a. Concentrations of ozone
 - b. Concentrations of sulfur dioxide (SO₂) – (fossil fuel burning power plants and industrial boilers)
 - c. Concentrations of carbon monoxide (CO) – (automobile, some industrial process)
 - d. Concentrations of fine particulate matter – (automobiles, wood stoves/fireplaces, power plants)
 - e. Concentrations of lead
 - f. Concentrations of nitrogen dioxide (NO₂) – (automobiles, power plants)
3. FACTORS CONTRIBUTING TO METRO AREA AIR QUALITY
 - a. Nitrogen oxide (NO_x) emissions
 - b. Volatile organic compounds (VOC) emissions
 - c. Carbon monoxide (CO) emissions
 - d. Sulfur dioxide (SO₂) emissions
 - e. Ammonia (NH₄) emissions
 - f. Toxic emissions
4. GREEN HOUSE GASES
 - a. CO₂ emissions (automobile)
 - b. CO₂ emissions per capita
 - c. CO₂ emissions as a percentage of gasoline sales
 - d. CO₂ emissions (industrial)
 - e. CO₂ emissions per unit of Gross Regional Product or Total Regional Income
 - f. Fossil fuel consumption
5. URBAN HEAT ISLAND
 - a. Percentage of land area with tree cover
 - b. Urban heat island index
 - c. Surface reflectivity
6. HUMAN HEALTH
 - a. Number of respiratory problems reported

Transportation

1. TRANSIT

- a. Number of transit rider trips per capita on buses, trains
- b. Mode choice – driving alone, carpooling, public transit, walking or working at home, other
- c. Percentage of people who live within a quarter-mile walk of public transit
- d. Percentage of people who live within a 5 mile radius of public transit (with parking)
- e. Percentage of businesses located within a quarter-mile walk of public transit
- f. Percentage of transit service miles to street miles

1. TRAFFIC CONGESTION

- a. Congestion index
- b. Average speeds on I-85, I-75, I-285, etc.
- c. Vehicle hours of delay
- d. Average commute time between two points (i.e., Interstate 75 between I-285 and intersection with I-85)

3. VEHICLE ACTIVITY

- a. Aggregate measure of daily vehicle-miles traveled per person
- b. Average trip length
- c. Number of vehicle trips per person
- d. Vehicle gasoline sales
- e. Per capita car ownership
- f. Number of alternative-fuel vehicles

4. INFRASTRUCTURE

- a. Percentage of transportation expenditures on transit
- b. Percentage of street miles designated as bike route miles
- c. Miles of road in Atlanta per vehicle mile traveled
- d. Miles of state road in rural county per vehicle mile traveled
- e. Street connectivity
- f. Pedestrian connectivity index
- g. Vehicle miles traveled/pedestrian connectivity index

Water quality and water resources

1. WATER CONSUMPTION

- a. Water use per capita
- b. Water used as percentage of total water resources available
- c. Residential water use as % of total

2. WATER RESOURCES

- a. Number of days water restrictions are in effect
- b. Water supply price

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- c. Percentage of wastewater reused
- 3. WATER QUALITY
 - a. Length of river/creeks in protected natural settings
 - b. Percentage of river/creeks with defined buffer zones
 - c. Number of times water systems are out of compliance with State potable water quality standards
 - d. Number of times water systems are out of compliance with State discharged water quality standards
 - e. Average water quality index rating (based on macroinvertebrate count)
 - f. Water quality based on following criteria:
 - Water temperature
 - PH
 - Dissolved oxygen
 - Turbidity
 - Total alkalinity
 - Nitrate
 - Ortho-phosphate
 - g. Average fecal coliform bacteria count

Land use

- 1. OPEN SPACE
 - a. Acres of "open space" per person
 - b. Acres of land clear cut per year
 - c. Acres of natural forest
 - d. Land areas in parks and wildlife refuges
 - e. Percentage of land in impervious surfaces
 - f. Miles of public trails
- 2. LAND USE
 - a. Land area considered part of the metropolitan Atlanta region
 - b. Population growth compared to metro region land area
 - c. Percentage of land in mixed use zones
 - d. Number of new homes built in metro Atlanta
 - e. Percentage of new housing units going into urban parts of the metro area
 - f. Percentage of people living in multi-family units

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Population density, demography and diversity

1. Population growth
2. Number of households
3. Population density
4. Percentage of population living in urban area
5. Net migration gain and loss (by county)
6. Population age structure (by county)
7. Race and gender (by county or urban vs. suburbs)
8. Population below poverty
9. Percentage of people who live and work within same county
10. Percent of families with two parents in home

Economy

1. BUSINESS
 - a. Number of business establishments
 - b. Value of industrial and commercial property
 - c. Inflation adjusted assessed value of real estate per person
 - d. Retail sales as a percent of personal income
 - e. Dollars spent in locally owned businesses
1. NUMBER OF JOBS
 - a. Total employment
 - b. Number of jobs per household
1. TYPES OF JOBS
 - a. Professional, technical and managerial occupations as percent of total
 - b. Manufacturing wage and salary jobs as percent of total
 - c. Basic industry jobs as percent of total
 - d. Percentage of wage and salary jobs not in five most concentrated industries
 - e. Total number of jobs available
1. WAGES & INCOME
 - a. Percentage of people with average earnings needed to support basic needs
 - b. Per capita personal income
 - c. Total and nonwhite unemployment rates
 - d. Average personal consumer debt/savings ratio
1. BUILDING
 - a. Percentage of building permits issued for new construction in existing urban areas
 - b. Building permits issued for renovations in existing urban areas

Energy generation and consumption

1. Energy supply per unit of Gross Regional Product or Total Regional Income

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2. Energy supply per capita
3. Percentage supply by source (solid fuel, oil, gas, nuclear, other)

Biodiversity

1. AQUATIC BIODIVERSITY
 - a. Index of Biotic Integrity for fish
 - b. Index of Biotic Integrity for macro-invertebrates
1. TERRESTRIAL BIODIVERSITY
 - a. Number of bird species sighted annually within metro Atlanta region
 - b. Human population density per county
 - a. Human population change per county
 - b. Proportion of county area with agriculture and urban landcover
 - c. Road density
 - d. Proportion of total stream length with intact riparian (streamside) forest cover
 - e. Proportion of total stream length with adjacent agricultural landcover
 - f. Proportion of stream length with road within 50 meters
 - g. Density of impoundments
 - h. Percentage of county in forested landcover
 - i. Forest fragmentation
 - j. Forest edge
 - k. Mean forest patch size
 - l. Proportion of the county with minimum forest core areas
 - m. Forest change in watershed

Appendix 3:
Notes from the Sustainable Atlanta
Workshop discussion

Preliminary discussion

- Are we talking about goals or indicators or both? Land use policy? Traditional policy or new goals? Response: CURE can address good indicators but not set goals.
- What is the difference between an indicator and a benchmark? Response: An indicator is a measure, a benchmark is a target.
- Definition of sustainability: development that meets the needs of the present without compromising the needs of future generations.
- Question: Is there a set of benchmarks that have been successfully used to determine the sustainability of a city? Response: A number of cities have adopted sustainability indicators and benchmarks in recent years.
- Sustainability can be seen as a general idea; community goals and long-term vision fill in the details.
- The best approach is to determine goals, then select indicators to help us measure our progress toward those goals. In this effort, we are starting with the indicators, but clearly goals must be chosen at some point.
- Comment: Broader metropolitan goals should be broken down to lower levels; i.e., community, organizational, neighborhood, etc.
- Ordinances can be used to measure sustainability, e.g. tree, sign ordinances.
- Comment: Current indicators are snapshots that become outdated; we should look for "leading indicators" that can tell us where we are going -- e.g. land use permits issued, etc.
- Question: Is this group representative? Who is represented? Response: Environmental advocacy groups (10 representatives), business community (9-10), academic (20), government (10-15).
- Community development corporations should have been included.
- Comment: We should separate programmatic indicators from performance indicators; both are worth monitoring, but give distinct views.
- Is there a need for a separate category for waste management, or should it be under land use?
- Suggested category: public health as separate from air quality. Human health integrates many environmental factors...
- Suggested category: education as a long-term indicator of sustainability. Education affects economic base and the ability to communicate complex issues with the public. Choice and use of transportation is also affected by educational attainment.
- Suggested category/indicator: tracking the patterns of change in the tax base.

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- Are there too many indicators? How do we make sense of them all? Response: Indicators must be evaluated as a whole to gain a clear vision; oversimplifying may lead to unintended consequences. Later on, priorities may be determined by GRTA (the Georgia Regional Transportation Authority) and/or others. In the meantime, this process is evolving and will continue beyond today.

Air Quality

- Average citizens are not convinced that air quality is linked more to private transportation than industrial emissions. Could the indicators make those sources more obvious? Response: Indicators do include industrial emissions; state air quality budget includes both sources of emissions; both are important.
- An emissions inventory is necessary but where does the inventory come from? Industry reporting not always accurate, nor are outside observations. Balancing both emissions-based inventory and observation-based inventory is important.
- Possible new indicator: "Per household emissions/pollutants" measurements that compare counties within the region.
- We should be able to differentiate how different parts of the metro area are performing regarding sustainability indicators.
- What about extra-regional sources of pollution, such as power plants in Alabama? How does that fit into the framework? Policy decisions in Metro Atlanta can only affect our region. To understand our present situation, we should know what enters our region from outside.
- Regional sampling can be used to validate emissions inventory.
- It is possible to track the number of emergency room visits related to poor air quality; e.g., elevated levels of asthma attacks during high ozone days, etc.
- On which geographic levels should variables be measured?
- Fleet characteristics are important indicators.
- What about personal energy usage that affects emissions, such as household energy use based on fossil fuels?
- We need supply side and demand side accounting for energy emissions.
- Possible new indicator: Percentage of people in a given area exposed to toxic emissions.

Transportation

- There are no indicators dealing specifically with freight transfer from rail to truck. Tons/mile are a possible indicator.
- Telecommuting should also be measured as an indicator.

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- You may want to consider measuring the reliability and safety of public transit. The image is that MARTA is unsafe and dirty, but the reality is different. It has been ranked among the safest and cleanest transit systems in the country.
- Other possible indicators would be the economic costs of public transit and individual automobile use.
- Possible new indicator: The mean number of intersections per square mile per county. This would help track connectivity and pedestrian friendliness.
- You could measure mode choice: carpooling, telecommuting, etc.
- It is also important to measure the availability of transportation alternatives. In some parts of the region, people have no choice but to use private transportation because there is no public transit. So it's important to measure the difference between modes the region as a whole chooses and those parts of the region where there is an actual choice. Otherwise, you get misleading data.
- We need to measure disincentives to public transit and alternative forms of transit. We could track employer incentives to use public transit/ telecommuting. ARC has a program called Commute Connections which talks to employers about transportation incentive structures.

Water Quality

- Criticism of tentative indicators: Percentage of water used as total -- "kind of mushy" statistic.
- Might want to consider percentage of people using wells and/or septic tanks.
- Should the results of tri-state water resources plan be considered here somewhere? Response: This may be an area where the indicators change, as the details of those negotiations become known.
- Public water consumption is included as a tentative indicator but not industrial or agricultural. Why? Response: Agriculture is not big in Atlanta region.
- We should consider comparing Metro Atlanta's per capita water use to that of other areas. Also, the per capita use of water in different parts of this region.
- May want to consider adding seasonal uses of water, since water consumption rises in the summer, with lawn sprinkling.
- The state already publishes a report about stream quality that can be included here.
- Question about a tentative indicator dealing with defined buffer zones along rivers and creeks: Are we talking about defined policies? The notion of a "buffer zone" needs definition.
- We need to consider storm-water runoff or erosion. Response: If you have a good wastewater system, it should be able to respond to storms. However, if the system is not healthy, it may not be able to respond well. You can measure this through stream discharge

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- Possible new indicators: Miles of stream and river under fish consumption advisory; acres of wetlands lost; acres of lake that exceed standards for swimmability.
- Measurements of storm water generation per acre and/or per capita can be done but is labor intensive.
- Possible new indicator: Excess water supply capacity -- basically, water resources beyond current demands -- could be a leading indicator to help prepare for (or set limits for) growth.

Land Use

- Possible new indicator: Acres of land set aside in easements and/or trusts. These statistics are available.
- We need indicators that can help determine the impact of neighborhood design; i.e., do you need a car to do everything? We should begin linking jobs to neighborhoods.
- How do you measure mixed use zones? Do you look at mixed shopping, living, working or something else? Jurisdictions have different names for the same thing. The critical factor is employment.
- Possible new indicator: Percentage of residences within walking distance of retail. Groups are working on data that would track accessibility to retail areas.
- Rather than looking at the number of new homes built, you may want consider the rate of growth.
- You should look at roads and parking for new building development compared to accommodations for pedestrians.
- A missing category is housing affordability, which is best examined by jurisdiction.
- Possible new indicators: Miles of walking trails, by county; acres that are clear cut each year, by county; acres in nature preserve, by county; acres per capita of parks, by county; miles of rivers and streams protected through easements or ownership, by county; and acres per capita of parks, by county.

Population

- Possible new indicators: Measurements of population data in non-attainment areas.

Economy

- You need to pay attention to the percentage of dollars spent in the region that stays in the region.

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Energy

- You should consider all types of energy, not just those connected to energy production.
- Measurements of energy generation in the Atlanta area need to take into consideration the age of Atlanta area power plants. None has been built here in recent decades. Newer plants tend to be outside this region.

Biodiversity

- We need to distinguish among the types of forest in the region.
- There is a problem in evaluating "natural capital." For example, when you cut down trees to build, there is no way at this time to account for loss of natural capital. Can we introduce a broader idea of costs to the system? There is some recent work on placing values on natural resources. This research may be adaptable to a metropolitan area.
- Suggest changing the name of this category to "Health of the Life-Support Systems"

Additional comments

- Many of the stakeholders in environmental issues are not present here, particularly representatives from the business community. Where are representatives, for instance, from Metro Atlanta's automobile manufacturers, Ford and General Motors?

Appendix 4:
New indicators proposed
at the Sustainable Atlanta Workshop

Air quality:

1. Include non-attainment area indicators
2. Include separate indicators for industrial emissions
3. Measure of fleet mix
4. Age of vehicles
5. Sport utility vehicles
6. Global fleet characterization by socio-economic data
7. Percentage of people who live within quarter-mile, one mile and five miles of work
8. Average annual NOx and VOC emissions of vehicles in metro-Atlanta -- this should be achieved by multiplying VMT times a car's average level of emissions. This is important because metro-Atlanta will have a mobile source budget. In the abstract, this would allow us to "ration" emissions per vehicle allowable. For example, if we have a mobile source budget of 300 tons annually and we have 3 million cars, divide 300 tons by 3 million. This is allowable emissions per vehicle.
9. Break down the power plants by type of sector:
 - a) Residential
 - b) Commercial
 - c) Retail
 - d) Industrial
10. CO₂ emissions per capita should include households and buildings
11. Hospital admissions for acute asthma and other respiratory illnesses
12. Population and area exposed to high levels of toxic emissions from cars and industries
13. Mean grams of pollutant type per household by county over time
14. Mean number of cold start trips per household by county (SMARTRAQ)
15. Regional transport of pollutants (both intra- and interstate)
16. Regional emission based inventory
17. Regional observation based inventory

Other comments about air quality:

- The CDC is about to announce results of a study of ozone and respiratory problems

Transportation

1. Include van pooling as a discrete indicator
2. Airport emissions
3. Routine air commuting
4. Noise
5. Telecommuting
 - a) Number of jobs
 - b) Percent of workweek
6. Model split of trips to major activity centers
7. Multimodal level of service
8. Percent of trips of different lengths to major activity centers (1, 2, 3, 5, 10, 15, 20, 30 etc... miles) and mode used
9. Cost by mode, by household
10. Parking: percent free and different cost amounts; total available
11. Safety of bicyclists and walkers: deaths / injuries
12. Leading indicator: location of excess capacity – transit / roads
13. Travel time by mode in major corridors
14. Transit vehicle dwell times for passenger boarding / deboardings
15. Freight movement
 - a) Impact on congestion
 - b) Time of day travel
 - c) Impact of accidents
 - d) Economic impacts
 - e) Intermodal connection
 - f) Hazardous spills
16. Transit – measures of attractiveness
 - a) Safety / incidents per passenger
 - b) Reliability / on time
 - c) Cleanliness
17. Mode split by trip distance
18. People moving capacities of major corridors
19. Transit revenue service hours
20. Regional accessibility index by travel time (all modes)
21. Cold starts per households
22. VMT per household
23. Number of public transit transfers (indicates directness of transit connections)
24. Number of bicycle lanes and sidewalks
25. Transportation time spent traveling by typical households with several households representing differing location and demographic groups
26. Vehicle fleet composition by type and age (suggested by 2)
27. Jobs within “x” time transit ride of high unemployment areas

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28. Transportation system connectivity (measure of intermodalism)
29. Safety: accidents / incidents per person-mile for each mode
30. Transit accessibility index (areas people who can live / work / play without a car)
31. Public policy benchmarks
32. Disincentives: higher motor fuel tax, parking taxes
33. Costs of travel
 - a) Percent of household budget
 - b) Total amount spent on travel by business, family, government
34. Number of alternative fuel fueling stations or supply sources
35. Transit usage: average volume to capacity ratio
36. Transit system congestion, i.e. buses and trains with standing room only
37. Measures of telecommuting / teleworking
38. Percent of funds per mode over time
39. Number of vehicles not subject to emission standards (e.g. SUVs, trucks, etc.)

Other comments about transportation:

- For equity purposes data must be split by incomes, age, race

Water quality and water resources

1. Number of health problems reported due to toxins, etc., in water
2. Non-point river pollution by golf courses that put lots of fertilizer on grass and then it goes into river
3. Change “water consumption” to “water quantity”
4. Volume of storm water runoff
5. Measure of excess public water supply capacity (this measure will show where new growth can occur)
6. Transient pollution events (storm water)
7. System variability
8. Wetlands lost (2 different individuals made this suggestion)
9. Include indicators linked to results of tri-state compact in future
10. Regional emission based inventory
11. Regional observation based inventory
12. Storm water generation per acre or person using satellite analysis of land cover
13. Peaking of stream flow due to storm water flow
14. Percent of population on wells
15. Percent of population on septic tanks
16. Wastewater runoff from newly developed properties (how much “treatment” is a result of run-off or domestic usage).
17. Miles of stream and shoreline under fish consumption advisories
18. Miles of stream / river that do not meet use classification

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19. Acres of lake that exceed fecal coliform standards
20. Total available water supply
21. Change in floodplain
22. Seasonal flow levels in streams and rivers (greater monitoring network is essential).
23. Invertebrate and fish IBI are included in biodiversity. Both are also indicators of water quality. I would include both in the water quality indicators and not just rely on macroinvertebrates.
24. I would add a measurement of the percentage of impervious surface cover in the watershed as a good water quality indicator. It is relatively straightforward to measure, and so many aspects of poor water quality, stream channel instability and altered biological communities can be related to the percentage of impervious surface (which alters hydrology), I would like to see that in there.
25. Another good water quality indicator would be number of fish consumption advisories. Again, something the public can relate to and something that is easily determined from available data.
26. Under water quality indicator 3 b, I would be more specific: Percentage of river/creek length with vegetated buffer zones at least 50 feet wide.
27. Water quality indicator 3g: I guess you need to clarify that you are talking about a geometric mean? Or do you mean "average"?

Other comments about water quality and water supply:

- Can we measure erosion and its adverse effect on water quality and water quantity?
- There are many, many, streams in metro-Atlanta. Too much data. Need to aggregate types of streams, and use that as indicator or pick certain stream segments to use as indicator streams.
- Water quality and related metrics will be difficult because of lack of good monitoring system!
- Which streams? Average across streams? Measure above or below sewer plant?

Land use

1. Number of health problems reported due to toxins in the land
2. Landfill acreage per capita
3. Waste output per capita
4. Percentage of total land in some form of conservation (buffers, parks, conservation easements, etc.)
5. Waste reduction and management (suggested by 2)
6. Measure benefit of mixed land use through reduced trips
7. Percentage of land in impervious surfaces broken down by streets, parking lots, buildings (residential / commercial / retail)
8. Impervious land per capita (suggested by 2)

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9. Per capita consumption of land
10. Housing affordability index per jurisdiction (suggested by 3)
11. Acres zoned in different land uses
12. Number of rezonings by jurisdiction (suggested by 2 -- indicates not following land use plans)
13. Location in region of new development, redevelopment, transportation investments compared to location of existing developed areas.
14. School siting locations compared to location of existing developed areas (leading indicator related to number of kids being schooled in trailers)
15. Acres of farmland
16. Jobs / housing balance; can you work where you live (suggested by 2 – this gives information on the commute trip)
17. “fair share” distribution of low income housing
18. Annual acres of wetlands developed or destroyed or authorized for development by the Corps of Engineers (suggested by 2)
19. Percentage of households within walking distance of jobs, retail, parks, schools, etc... (suggested by 2)
20. Number of government moratoriums on rezonings on apartments
21. Percentage of land in major commercial development (malls)
22. Rate of growth of homebuilding or building permits issued per month
23. Vacant or underutilized land within urbanized area
24. Acres of parkland (private vs. public owned)
25. Percent or amount of housing that is affordable for each income group
26. Amount of food produced locally
27. Annual number of new lots subdivided by jurisdiction
28. Housing locational choice measure, i.e. can you get the type of house or neighborhood where you want to live
29. Parking lot spaces at places of employment
30. Price per parking space at places of employment
31. Parking substitutes
32. Parking lot spaces at shopping centers
33. Neighborhoods within a 10 minute walk of a park, playground, or trail
34. Neighborhoods within a 15 minute walk of retail services
35. Miles of sidewalk which connect neighborhoods, services, and civic life (schools, parks, churches, etc...)

Other comments about land use:

- It is absolutely critical that land use GIS coverages be consistent in categories and collection methodology so that temporal analysis and displays are valid
- Grain of data not clear; should be very small, i.e. parcel or census tract
- Most of data should be expressed as trend or rate to see where we are going

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- Ball fields should be separate from nature preserves

Population density, demography and diversity

1. Percentage of population living in substandard housing
2. Households
 - a) Owned
 - b) Rented
 - c) Subsidized
3. Percent of students eligible for subsidized school lunch
4. Racial segregation: percent of race who live in homogeneous area
5. Annual population growth rate (this measures local government “stress” associated with accommodating new growth – an annual growth rate of 2-3% per year tends to overstress local government systems).
6. Include an indicator that covers nonattainment area now and as it changes in the future

Other comments about population density, demography, and diversity:

- Most of data should be expressed as trend or rate to see where we are going

Economy

1. Per capita income
2. Educational achievement
3. Percent of economic base by facility use (check with BOMA – Building Owners and Management Association):
 - a) Headquarters
 - b) Research and development
 - c) Manufacturing
 - d) Distribution
4. Local taxes per household or person
5. Amount of tax breaks for business
6. Percent of land area that is not taxable (government, church, education) by jurisdiction
7. To (1e) add: percentage of total dollars spent (to get at dollars spent in the region)

Energy generation and consumption

1. Consumption by mode of transportation (a federal transportation act planning requirement)
2. Power plant emissions over past 20 years (compare to change in traffic and vehicles) – power plants are 20 years old however air quality problems more prevalent during last 5 years – mobile sources
3. Energy use per capita

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4. Age of housing stock
5. Energy use per square foot -- commercial and residential (suggested by 2)
6. Percent energy consumption from local sources (we import most of our energy)
7. Sources (types) of energy consumed in region (natural gas, electricity, oil, solid fuel, solar, etc.)

Biodiversity

1. Value of natural capital and the benefits they provide – tree cover, wetlands, pervious land surfaces, etc... (suggested by 2)
2. Percent of pine, mixed, and hardwood forests
3. Availability of corridors and habitat – GAP analysis

Other comments about biodiversity:

- Wetland destruction and relocating wetlands really kills ecosystems. The Corps of Engineers authorizes this as do County Commissioners and City Councils
- The title of this category should be changed to “Health of Life-Support Systems”

Miscellaneous

1. “Pretty factor” – it may be wrong to consider prettiness or “pleasure” factors to be retrofitted activities after data gathering. Prettiness may need a priori status to succeed.
2. Global indicators need to be broken down at least to the county level, perhaps smaller. Rockdale may be making progress, while Gwinnett is moving backward. Overall regional indicators will not capture these distinctions.
3. Need measures of education.
4. Indicators must be related to location in region. For example by county / city variation; by development type: residential / job density; level of mix of different land use; street connectivity
5. Why was industry not present? One from GA Power, one from private consulting firm, and one from large consulting firm were only representatives.
6. There are indicators that address social issues but also relate to the basic categories and that are needed to address the equity piece of sustainability – examples: housing affordability, trip time to work
7. Dream would be to develop healthy county-by-county competition
 - a) Miles of walking trails
 - b) Acres per capita of nature preserves by county
 - c) Acres per capita of total park land
 - d) Miles of rivers and streams protected – easement or ownership
 - e) Every child will live within 5 minute walk of park, trail, or playground

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- f) Safe to swim in the Chattahoochee every where in metro Atlanta
 - g) Miles of sidewalks that connect things, activity centers, and residences
 - h) Homes / neighborhoods within 15 minute walk of retail services
8. Recycling is key, e.g. under water and economy
 9. Need to conceptualize sustainable Atlanta in the future to select indicators (high rises, planned communities, mixed – particularly relevant to land use, population, biodiversity)
 10. Must understand link between economy and population growth
 11. The most integrative category is human resources. Included in this category are:
 - a) Population and demographics
 - b) Public health
 - c) Energy conservation by households
 - d) Education, including public awareness of environmental / sustainability issues
 12. Can we realistically choose a sustainability indicator that threatens the reputation (or track record) of a major state political figure?
 13. Are we making assumptions that we have not specified? For example, we are surely assuming that these indicators will in the future be used to influence and modify public policy. We should state our starting assumptions.

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Appendix 5:
Workshop Participants List

Name	Organization
Ahman, John	GA Dept of Industry, Trade & Tourism
Aifelor, Winnielyn	Student, GA Tech
Bansley, Marcia	Trees Atlanta
Barnes, Brett	Student, GA Tech
Beck, Bruce	Warnell School of Forest Resources, UGA
Brown, Walter	Southface Energy Institute
Burris, Annie Hunt	Board of Regents, University System of Georgia
Carlton, Tim	Student, GA Tech
Chang, Michael	Center for Urban & Regional Ecology, GA Tech
Chapman, Jim	Georgians for Transportation Alternatives
Chen, Tory	School of Industrial & Systems Engineering GA Tech
Clements, Randy	Georgia Municipal Association
Cobb, Verlene	Campion Group
Coombs, Grace	Georgia Regional Transportation Authority
Cowen, Joel	Habersham & Cowan
Cowie, Gail	Fanning Institute, UGA
Cummings, Ron	School of Policy Studies, GSU
Danchez, Frank	GA Department of Transportation
Denton, Doug	DeKalb Citizens for Better Env.
DeVinney, Chris	Association County Commissioners of GA
Dorsey, Hattie	Atlanta Neighborhood Development Partnership, Inc.
Durrett, Jim	Metro Atlanta Chamber of Commerce
Eaton, Pres	Federation of GA Homeowners
Eplan, Leon	Eplan Consulting
Fitzpatrick, Leigh	Communications & Training Technology Branch, GA Tech Research Institute
Frank, Larry	City Planning Program, GA Tech
Franklin, Shirley	Georgia Regional Transportation Authority
French, Steve	City Planning Program, GA Tech
Garner, Teresa	Student, GA Tech
Gleaton, Mike	GA Department of Community Affairs
Griffin, Jerry	Association County Commissioners of GA
Griggs, Lucie	American Forests
Hager, Bryan	Sierra Club
Hanson, Harold	Citizens & Southern Bank (retired)
Hanson, Tonja	Student, GA Tech
Harper, Misty	Student, GA Tech
Ike, Al	Public Service & Outreach, UGA
Jackson, Terry	GA Department of Community Affairs
Kalinski, Art	Atlanta Regional Commission
Kiang, CS	School of Earth & Atmospheric Sciences, GA Tech
Kidd, Susan	Georgia Conservancy
Kundell, Jim	Carl Vinson Institute of Government, UGA
Landesberg, Amy	Nix, Mann, Perkins & Will

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Name	Organization
Lewis, Bart	Atlanta Regional Commission
Liu, Shaw	School of Earth & Atmospheric Sciences, GA Tech
Mills, Sharon	Student, GA Tech
Niederhausen, Michael	Student, GA Tech
Nkosi, Von	Atlanta Neighborhood Development Partnership, Inc.
Norton, Bryan	School of Public Policy, GA Tech
Norton, Lamar	GA Power
Redd, Steve	Centers for Disease Control & Prevention
Rider, Jessica	Student, GA Tech
Rix, Glenn	Georgia Transportation Institute, GA Tech
Roark, Randy	College of Architecture, GA Tech
Ross, Catherine	City Planning Program, GA Tech
Safran, Suzanne	Center for Urban & Regional Ecology, GA Tech
Sattler, Polly	Southface Energy Institute
Sessoms, Walter	BellSouth (retired)
Sibley, John	Georgia Conservancy
Smith, Alicia	Student, GA Tech
Steinemann, Anne	City Planning Program, GA Tech
Stevens, Pat	Atlanta Regional Commission
Tapp, Helen	Regional Business Coalition
Tiedemann, Stephen	Student, GA Tech
Tyler, Jack	GA Department of Community Affairs
Wentworth, Rand	Trust for Public Land
White, Otis	Facilitator, Civic Strategies, Inc.
Woods, Diana	US Environmental Protection Agency Region IV
Woolf, Wes	Southern Environmental Law Center
Word, David	GA Department of Natural Resources, Environmental Protection Division
Wynens, Wesley	Fanning Institute, UGA
Yates, Charlie	Regional Leadership Foundation