Alaska Department of Environmental Conservation

Water Quality Standards Section

Nutrient Criteria Development Plan

for submission to the Environmental Protection Agency

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Introduction

Anthropogenic eutrophication of the nation's surface waters from excess nutrient additions, primarily nitrogen and phosphorus, is an ongoing problem in the United States. The United States Environmental Protection Agency (EPA) has been striving to develop national nutrient criteria. The EPA reported in a 1996 national report to Congress that nitrogen and phosphorus are among the leading causes of water quality impairment in the nation. According to the report, 40% of rivers and 51% of lakes have designated use impairments from excess nutrients, which have resulted in excessive algal growth. A Clean Water Action Plan (CWAP) was initiated by EPA in October 1997 to address nutrient over-enrichment in the nation's surface waters. The CWAP includes the development of water quality nutrient criteria as one of its components. EPA recommends the development of region-specific nutrient criteria for different waterbody types, so as to account for the wide natural variation in nutrients that are found around the country.

In a January 2001 Federal Register notice[1], EPA recommended that states develop a nutrient criteria development plan to outline their process for how and when they intend to adopt nutrient criteria into their water quality standards. EPA recommended that states develop the plan by the end of 2001 and adopt criteria by the end of 2004. However, on November 14, 2001[2], Geoffrey Grubbs, the Director for EPA's Office of Science and Technology, distributed a memo to state pollution control administrators providing additional guidance on developing plans, the flexibility available, and new expectations on time frames for plan development and criteria adoption. According to the memo, "states should begin drafting a nutrient criteria plan and discussing the specifics of the plan with EPA in the next few months", and that EPA will evaluate by the end of 2004 the progress of the state and determine how it compares with the schedule in the plan[1]. Nutrient criteria are listed as one of the top priorities in the national WQS strategy. State Nutrient Criteria development plans are viewed as the tool for EPA to monitor each state's progress and resource needs to complete the criteria development.

Purpose

The plan is intended to provide an initial framework for developing nutrient water quality standards for Alaska. The staff of the Water Quality Standards Division Section of the Alaska Department of Environmental Conservation (DEC) will evaluate options for narrative nutrient criteria for consideration by the United States Environmental Protection Agency (EPA) and the public during a triennial revision of 18 AAC 70, The Alaska Water Quality Standards (WQS), possibly in 2007. The plan outlines the work to be performed, description of data collection and analysis, options for criteria development, and time frames for developing and considering nutrient criteria. The information in this plan is preliminary and will be subject to revision as criteria development is reviewed by the DEC, stakeholders, and EPA.

Current Status of Nutrient Regulation in Alaska

Alaska contains within its borders a staggering number of water bodies. Exact numbers are not known, since the National Hydrography Database (NHD) for the state is still a few months away from completion. However, realistic estimates give some indication of the vastness of Alaska's water resources:

- One to three million lakes larger than 20 acres
- Over three thousand rivers and streams, and seven to ten million river and stream miles
- Around 40% of the land area (larger than California and Washington put together) is categorized as wetlands, due to permafrost conditions.
- The coastline is between 30,000 and 45,000 miles long, more than the rest of the nation put together.

It is estimated that only 0.1% of all waters in Alaska have been sampled, and not all of those have been analyzed for nutrients. In addition, many of these waters have only been sampled once.

In Alaska, any probable causes for nutrient pollution are few, and localized. The main causes for nutrient pollution in water bodies are urban runoff and agricultural activity. The only agriculture activity of any significance is within the Matanuska-Susitna (Mat-Su) Valley. Other agriculture in the state is less than half of the small scale, by national standards, found in the Mat-Su Valley. There are approximately 10,500 head of cattle, around 1300 sheep, and 800 pigs in the entire state, with no more than a couple hundred in a single place[3]. The Mat-Su valley is also close to Anchorage and its surrounding suburban communities, the largest urban area in Alaska. Alaska's other large cities, Juneau and Fairbanks, each consist of only a tenth of the population of Anchorage. Therefore, the only area of the state that will be investigated for the purpose of setting nutrient criteria will be the Cook Inlet ecoregion, and includes the Municipality of Anchorage, the Mat-Su Valley and the western parts of the Kenai Peninsula.

The State of Alaska currently has no numerical criteria for nutrients. The priority for developing nutrient criteria has been low, due to Alaska's very small urban and agricultural areas compared with other states with significant algal bloom problems. In response to EPA's request for all states to develop nutrient criteria, a narrative criterion is included in the May, 2003 (approved by EPA in February, 2004) edition of the Water Quality Standards (WQS) in 18 AAC 70. The proposed narrative states that, "There may be no concentrations of toxic substances in water or in shoreline or bottom sediments, that, singly or in combination, cause, or reasonably can be expected to cause, adverse effects on aquatic life or produce undesirable or nuisance aquatic life, except as authorized by this chapter."[4] The narrative is similar to Alaska's antidegradation policy, which protects a water body, for all uses, from degrading beyond its current condition, including nuisance aquatic plants. The narrative criterion will help protect water bodies from nutrient degradation, including excessive growth of nuisance aquatic plants, beyond their current natural conditions until suitable numeric criteria can be established. In addition, the 319 grants issued by Alaska's Nonpoint Source Program encourage total

phosphorus, nitrates, nitrogen and chlorophyll *a* monitoring data collecting as a preliminary indication of areas of possible concern for the 303(d) listings of impaired water bodies.

Scope of Criteria Development

DEC WQS staff will develop and evaluate criteria to address nutrient pollution and/or eutrophication, as well as working with the other Water Program staff to develop implementation guidance. DEC's Nonpoint Source Program will implement complementary approaches towards controlling nutrients as a part of their general reduction best management plans for agricultural and municipal runoff. DEC's Wastewater Permitting Program will subsequently develop procedures to implement the application of criteria to permitting applicable point source discharges. These efforts will be phased over many years.

All waters considered will be in the Level III ecoregion 115 (Cook Inlet Ecoregion), which contains the Mat-Su Valley, the Municipality of Anchorage, and the western half of the Kenai Peninsula. The Cook Inlet ecoregion is approximately 10,800 square miles in size (slightly larger than Maryland). It is comprised of the lowlands tucked between the Alaska, Chugach, and Talkeetna mountain ranges.

DEC WQS staff are exploring different strategies to develop nutrient criteria. Some of the strategies being investigated include:

1) Basing criteria on direct concentrations of nutrients, such as total nitrogen and total phosphorus;
2) Basing criteria on direct indicators of eutrophication - such as chlorophyll *a* or Secchi depth;
3) Developing "translator" procedures that relate concentrations of nitrogen and phosphorus to direct indicators of eutrophication;
4) Relating criteria to protecting water-quality related uses. Since Alaska protects all waters for all uses except in rare cases, and since the nutrient criteria will be tailored to certain categories of lakes, one number will be used to protect all uses contained in the regulations.
5) Basing criteria on various percentiles of ambient concentrations of nutrients and chlorophyll *a* as outlined in the EPA's guidance documents. This option is the least likely to be used by Alaska because it requires more data than is practical to collect within a realistic time frame.

With respect to spatial scales for criteria, DEC intends to explore criteria development according to:

1) Initially, USGS Level III ecoregions for Alaska, as no ecoregions were defined in the EPA guidance documents for nutrient criteria development
2) Categories based on chemical, physical, hydrologic and other characteristics which should result in similar nutrient cycling behavior; and
3) Individual water bodies, if that level of detail is available and/or determined by DEC to be required.

The DEC will provide drafts of criteria and further development procedure versions for EPA review at relevant points during the development process.

Each waterbody type (lakes, streams and rivers, estuaries, and wetlands) will follow the following general steps to develop numeric nutrient criteria for that waterbody type (WBT), including representative sampling planning, new data collection and data evaluation. These steps are outlined in the accompanying flow chart.

1. **Index**. An index of the the waterbodies in the ecoregion needs to be developed. All known location information, and any available physical or geological characteristics, will be gathered. The National Hydrography Database project is ongoing in Alaska. The ecoregion 115 area is nearing completion and transferal into the new NHD format.

2. **Categorization**. Each WBT will be categorized by putting the waterbodies in the ecoregion into categories based on chemical, physical, hydrological and other characteristics which should result in similar nutrient cycling behavior. Similarities in land usage should <u>not</u> be considered in this categorization, as this factor is directly related to eutrophication level.

3. **Selection of Priority Category.** Once the waterbodies in the WBT are categorized, a waterbody will be selected using the highest priority ranking on DEC's Nonpoint Source Program's listing of impacted waterbodies or concern for future impact, with respect to nutrient pollution or activity associated with nutrient pollution.

4. **Selection of Reference Waterbody.** A Reference waterbody (or waterbodies) will be selected from the WBT category selected above. The Reference Waterbody will correspond to the high-priority, nutrient-impacted waterbody, as the baseline eutrophic state for the category.

5. **Possible Verification of Reference Waterbody.** The Reference Waterbody (RWB) should be verified as to its perceived reference condition. If EPA guidance exists at the time of the waterbody selection, efforts will be made to verify the reference condition of the RWB.

6. **Sampling and Analysis.** The RWB will be sampled to represent the baseline eutrophication stage for that WBT category. The preliminary list of analyses for each sample includes the following: temperature, pH, conductivity, total nitrogen, nitrate plus nitrite, total phosphorus, orthophosphorus, Secchi disc depths, dissolved oxygen, and chlorophyll *a*. In addition, the technique of estimating phosphorus in water concentration by examining sediment core samples will be investigated to determine feasibility for inclusion in the list. Depending on available funding, other analyses may be added such as habitat assessment, benthic invertebrates, and turbidity measurements.

7. **Criterion Development.** The Alaska Technical Advisory Group will decide on the numeric criteria for the appropriate parameters, according to the data analyzed, and to appropriate EPA Guidance Documents.

Preliminary criteria development activities will focus first on lakes in categories most affected by agriculture and urban runoff. Criteria for the other waterbody types (streams and rivers, estuaries, and wetlands), will subsequently be evaluated in this ecoregion.

Status of Nutrient Monitoring Data and Analysis

Lakes

In ecoregion 115, the USGS has found over 200 lakes which are larger than 20 acres. Many nutrient studies conducted nationwide have included lakes as small as 10 acres. There is interest in the smaller lakes as they are often shallower, and are therefore more sensitive to anthropological impacts. However, USGS index data on smaller lakes in Alaska has not been evaluated in the past year, and there was no data found previously. One literature search[5] in 1987 included almost 600 lakes in this region. Another estimate is that 800-1,000 freshwater lakes are in the region, one-third of which are not named.

Some of the lakes[6,7,8,9] in Ecoregion 115 have been sampled at various times, by several agencies and groups using varying quality control procedures. For instance, reports tested for nitrogen as ammonia, nitrates, or nitrates and nitrites. Other reports did not test for nutrients. The data collected, as a whole, supports the current theory that most areas in Ecoregion 115 have nutrient concentrations which are below the eutropic levels defined by several scientists[6]. Those measurements which exceeded eutrophication levels often occurred in streams during storm flow conditions, or in lakes with high anthropological impacts. This data is available only in individual reports and publications instead of a centralized collection. With little exception, the sampling projects lasted only one year or less. Due to this paucity of both analytical and index data, new data will have to be collected in order to support any nutrient criteria.

In 2000-2001, DEC partnered with the Alaska Department of Fish and Game (DF&G) on a project funded by an EPA section 319 grant to support DEC's development of nutrient controls. Seven lakes in the Mat-Su valley were sampled and analyzed for nutrients, among other analytes[6]. One main factor for choosing the lakes sampled in this study was that they were perceived to have the most human contact, with the most eutrophic potential. All of the lakes sampled were accessible by road, which makes the sampling easier, but is not representative of the lakes in the region. As a result, representative lakes which could be good reference lakes were not sampled. More study needs to be done to improve the quality and representation of the reference lakes.

Rivers and Streams

The Matanuska, Suisitna, Knik, and Kenai river systems run through the region, as well as many smaller creeks and streams.

Some of the streams[10,11,12] in Ecoregion 115 have been sampled at various times, by several agencies and groups using varying quality control procedures. For instance, reports tested for nitrogen as ammonia, nitrates, or nitrates and nitrites. Other reports did not test for nutrients. The data collected, as a whole, supports the current theory that most areas in Ecoregion 115 have nutrient concentrations which are below the eutropic levels defined by several scientists[6]. Those measurements which exceeded eutrophication levels often occurred in streams during storm flow conditions, or in lakes with high anthropological impacts. This data is available only in individual reports and publications instead of a centralized collection. With little exception, the sampling projects lasted only one year or less. Due to this paucity of both analytical and index data, new data will have to be collected in order to support any nutrient criteria.

A flow chart for nutrient criteria development for rivers and streams would be similar to that for lakes, which accompanies this plan. First, an index of the rivers and streams in the ecoregion needs to be developed. The National Hydrography Database project will be the data source upon its completion of the ecoregion 115 area. After evaluation of available data, the rivers and streams will be classified based on chemical, physical, hydrological and other characteristics which should result in similar nutrient behavior. Similarities in land use should not be considered in this classification, as this factor is directly related to eutrophication level.

Once the rivers and streams are classified, reference reaches corresponding to current nutrient-impacted reaches will be selected, and sampled represent the baseline eutrophication stage of the impacted reach. The preliminary list of analyses for each sample includes the following: temperature, pH, conductivity, total nitrogen, nitrate plus nitrite, total phosphorus, orthophosphorus, Secchi disc depths, dissolved oxygen, and chlorophyll *a*. In addition, the technique of estimating phosphorus in water concentration by examining sediment core samples will be investigated to determine feasibility for inclusion in the list. Depending on available funding, other analyses may be added such as habitat assessment, benthic invertebrates, and turbidity measurements.

Wetlands and Estuaries

These water body types are currently a lower priority, and this plan will be updated as specific plans develop. The approach will probably be similar as to what has already been outlined for the other waterbody types. Some quick facts as to the size of the wetlands and estaries in the Cook Inlet ecoregion:

- Rough estimates are that around 40% of the land areas in the Cook Inlet ecoregion are wetlands.
- Cook Inlet is the ocean inlet for which the region is named, and has one of the largest tide differentials in the world (over 30 feet).

Workgroups

DEC intends to form a technical workgroup for nutrient criteria development in 2004-2005. The workgroup will consist of a small group of individuals knowledgeable in the

response of aquatic systems to nutrients, including representatives, selected by WQS staff, from DEC programs, EPA, and University of Alaska. This workgroup will be tasked with considering options for developing nutrient criteria, providing guidance on options for data evaluation/lake classification, offering suggestions for data needs, and providing input on a more detailed work plan. Currently, representatives from the University of Alaska Fairbanks (UAF) have offered to participate.

After new data is collected, for each waterbody subcategory, it will be reviewed and evaluated by the project manager, with assistance from the workgroup. Several questions need to be answered for each lake category, including:

1. What are the representative indicators of eutrophic condition, based upon the data obtained?
2. What are the goal levels of the chosen indicators for all lakes in the category?
3. What is the maximum concentration level (MCL) at which an indicator can exist without impairing the lake?

DEC, with input from the workgroup, will further define the development of nutrient criteria, and to update the work plan. Draft criteria may be reviewed with stakeholder groups prior to the formal public notice period.

Schedule

At the time of this draft, no funds have been secured for further sampling and analysis to support nutrient criteria development. National Wildlife Refuge Park or Reserve funding provided to Region 10 has already been appropriated toward projects in Washington, Idaho, and Oregon. Alaska State general funds are not available, and EPA Clean Water Act grant funds have been allocated to support existing programs. Limited Clean Water Act Section 319 funds may be available, but likely insufficient to support a comprehensive sampling and analysis nutrient criteria development program. In short, the limiting factor to nutrient criteria development in Alaska is funding to do the required data collection, analysis, and interpretation. All dates in this schedule will change if appropriate funds cannot be secured for FY 2005.

If funding is obtained, sampling for the first one or two lake categories may occur in the summer of 2005, with possible follow up in 2006, if a second year is needed. DEC expects to produce a report for internal review of the lake study, mentioned above, in spring or summer of 2007. If the data from this study is sufficient for proposing nutrient criteria, then the proposed criteria for the specific lake classification studied within ecoregion 115 will be adopted in the following WQS triennial review, which will begin in 2007. Other lake categories, and eventually river categories, will follow with similar time durations.

This nutrient criteria plan will be reviewed prior to the end of calendar year 2005 to evaluate potential dates to continue nutrient criteria development for other lake classifications, streams and rivers, estuaries, and wetlands. The prioritizing and scheduling development of nutrient criteria will be made based on the realistic potential for anthropogenic nutrient loading in each type of water body within the Cook Inlet

ecoregion. This assessment may include a review of impaired water bodies in the ecoregion that are potentially affected by nutrients, such as those listed for DO or nuisance aquatic life. Although narrative nutrient criteria will be applied statewide, DEC has no plans to develop numeric criteria for regions of the state other than the Cook Inlet ecoregion.

This nutrient criteria development plan is provided to the EPA as a preliminary effort to meet EPA's request[1] of the states to 1) "complete a plan for developing and adopting nutrient criteria into State or Tribal water quality standards" and 2) "States and authorized Tribes should adopt nutrient criteria (either numeric criteria or as procedures to translate a narrative nutrient criteria into a quantified endpoint) for the water body type and ecoregions associated with the section 304(a) water quality criteria that EPA publishes." Since the release of the register, it is evident that the criteria development process is more involved than previously thought, and therefore the scheduled goals of plan completion and criteria adoption have been relaxed somewhat. Although no 304(a) nutrient criteria were published for Alaska, DEC intends to proceed with nutrient criteria development as expediently as funding, personnel, weather, and opportunity exist.

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[1] Environmental Protection Agency, Federal Register, "*Nutrient Criteria Development; Notice of Ecoregional Nutrient Criteria*". January 9, 2001.

[2] Geoffrey Grubbs. Memorandum: Development and Adoption of Nutrient Criteria into Water Quality Standards. November 14, 2001.

[3] B. Benz, M. Roos. *Alaska Agricultural Statistics 2001*. Alaska Agricultural Statistics Service, USDA, 2001.

[4] 18 AAC 70.020.A.11.C and 18 AAC 70.020.B.11.C

[5] M. A. Maurer, P. F. Woods. *Index to Limnological Data for Southcentral Alaska Lakes.* USGS Open File Report 87-529, AK DNR DGGS, 1987.

[6] J. A. Edmundson. Limnological Information Supporting the Development of Regional Nutrient Criteria for Alaskan Lakes: Water Quality Monitoring and Trophic Assessment of Seven Lakes in the Mat-Su Borough. Alaska Department of Fish and Game. Regional Information Report No. 2A03-24, 2002.

[7] P. F. Woods. Limnology of Nine Small Lakes, Matanuska-Sisitna Borough, Alaska, and the Survival and Growth Rates of Rainbow Trout. U.S. Geological Survey Water-Resources Investigations Report 85-4292, 1985.

[8] J.P. Koenings, R.D. Burkett, G. B. Kyle, J.A. Edmundson, J.M. Edmundson. *Trophic Level Responses to Glacial Meltwater Intrusion in Alaskan Lakes.* Cold Regions Hydrology Symposium, American Water Resources Association, July 1986.
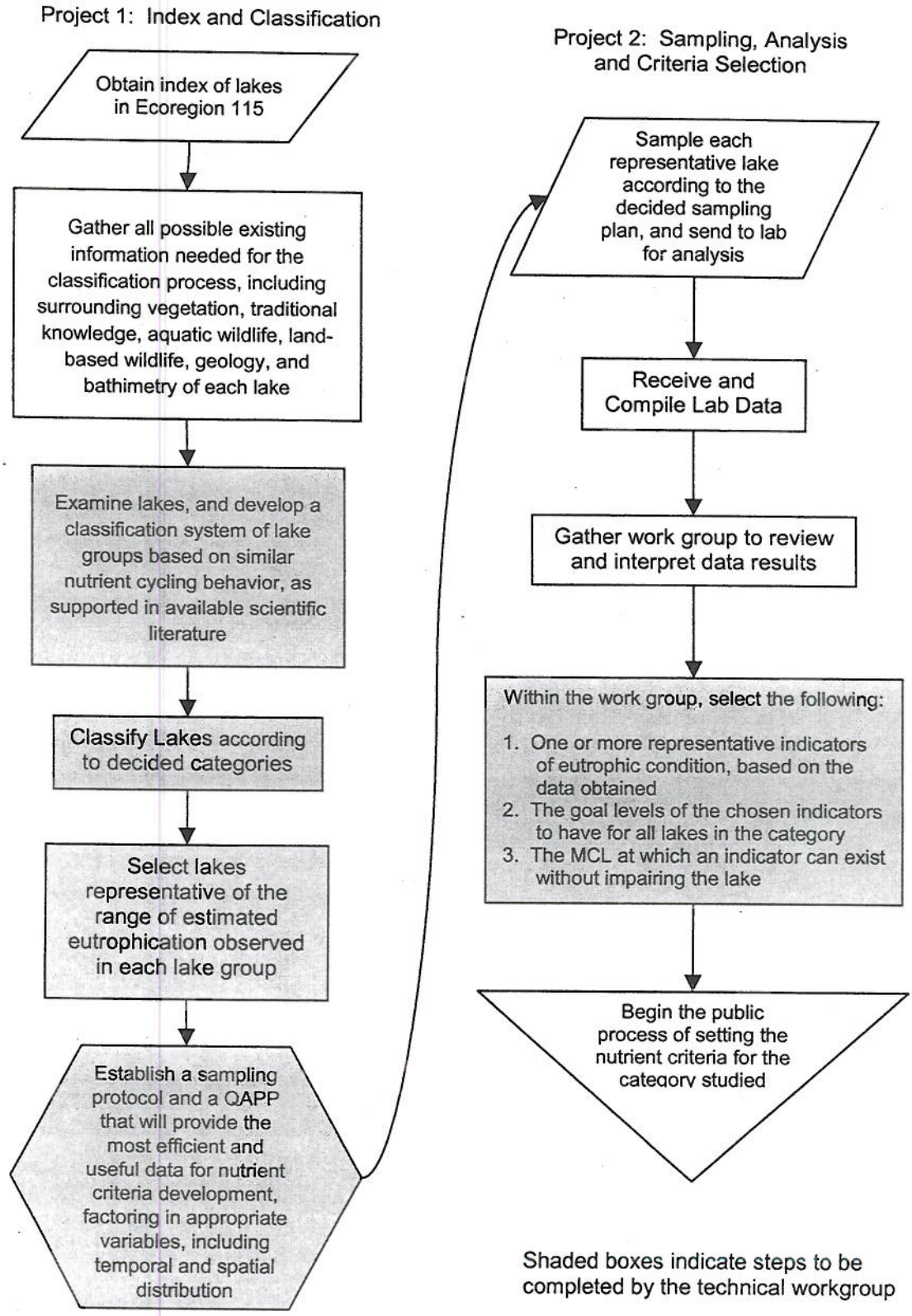
Figure 1. Alaska Nutrient Criteria Development Flowchart