Considerations for the Management Strategy Evaluation Program of Work for 2026-2027

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PURPOSE

To provide the Management Strategy Advisory Board (MSAB) with an overview of work topics for the IPHC Management Strategy Evaluation (MSE) in 2026–2027.

1 INTRODUCTION

Items from the MSE Program of Work for 2025-2026 that have been completed are reported in documents IPHC-2025-SRB027-08, IPHC-2025-AM102-11, and IPHC-2026-MSAB022-06. These include examining simulations with autocorrelated recruitment, conducting pilot simulations to determine an appropriate definition of a 'depleted' stock state, examining the effects of productivity on stock size and management outcomes, and preparing the IPHC Harvest Strategy Policy (HSP) for adoption. This document describes items noted by the Commission for the 2026–2027 MSE Program of Work as well as potential additional items noted in past meetings of the MSAB and IPHC Scientific Review Board (SRB).

2 MSE PROGRAM OF WORK FOR 2026–2027

The IPHC HSP (adopted in December 2025) defines a 3-year timeline for the MSE process. The Operating Model (OM) is updated every third year, following the full stock assessment. After updating the OM, management procedures (MPs) are re-evaluated to ensure that they continue to meet the objectives of the Commission. Other tasks, pending the updated OM, are described below.

The Commission noted prioritized topics for the 2026–2027 MSE Program or Work.

> **IPHC-2026-AM102-R, para. 56**. *The Commission NOTED that the 2026 MSE and HSP Program of Work will include the following high priority topics:*
>
> *a) Update and recondition the MSE Operating Model in accordance with the schedule defined in the Harvest Strategy Policy;*
>
> *b) Evaluate a range of SPR values to determine if the optimal reference coastwide fishing intensity is different than the current reference fishing intensity (F43%) defined in the HSP;*
>
> *c) Investigate productivity regimes to determine how the Pacific halibut population and fisheries respond to different productivity regimes, if the optimal reference fishing intensity differs across productivity regimes, and how productivity regimes may be incorporated into a Management Procedure;*

d) Further develop the Depleted concept and identify a limit reference point below which recovery of the Pacific halibut population would be uncertain.

IPHC-2026-AM102-R, para. 57. *The Commission NOTED that the 2026 MSE and HSP Program of Work will include the following low priority topics, which may not be completed before AM103:*

a) Improve the estimation model used in the MSE framework to better characterize the stock assessment in the simulations;

b) Evaluate potential management actions to invoke when approaching a depleted limit reference point;

c) Evaluate additional elements of Management Procedures which may include a triennial assessment frequency, constraints and smoothers on the interannual change in the TCEY, and empirical rules to determine the reference TCEY in years without a stock assessment;

d) Determine reference points using the updated MSE Operating Model (e.g. FMSY and MSY);

e) Develop guidance documents for the Harvest Strategy Policy (e.g. specifications of a rebuilding plan).

IPHC-2026-AM102-R, para. 58. *The Commission NOTED that the 2026 MSE and HSP Program of Work should not include topics related to the distribution of the TCEY, as this is part of the decision-making process and not part of the management procedure, as described in the Harvest Strategy Policy.*

IPHC-2026-AM102-R, para. 59. *The Commission NOTED that outcomes of the 2026 MSE workplan (e.g. an optimal fishing intensity) may be used to update the Harvest Strategy Policy in the future.*

2.1 High priority tasks

The Commission identified four (4) high priority tasks for the MSE Program of Work, which are either defined by the HSP or essential to ensuring that the HSP reflects the current knowledge of the Pacific halibut stock and fisheries.

2.1.1 Condition the MSE Operating Model

Immediately following a full stock assessment, which occurs every three years, the MSE operating model is conditioned using updated data streams, newly estimated parameters from the stock assessment, and improved understanding of processes driving Pacific halibut population dynamics and fisheries. This is also an opportunity to implement improved and updated OM code incorporating current best practices.

The process is time-consuming and involves the following workflow.

1. Outcomes of each individual model of the ensemble stock assessment are summarized.
2. Parameters and assumptions in each individual model of the OM are linked to each individual model of the ensemble stock assessment and updated to match those in the stock assessment.
3. Mortality and weight-at-age for each fishery is extended to the most recent year.
4. Weight-at-age for the FISS and population is updated and extended to the most recent year.
5. The Pacific Decadal Oscillation (PDO) is updated to the most recent year (and revised for this development cycle based on the new series used in the 2025 stock assessment).
6. An optimized OM executable is compiled and a directory structure for each individual model is created.
7. Parameters for each individual model (e.g. movement, recruitment distribution, average recruitment, initial fishing mortality) are estimated based on fits to stock distribution, regional indices of abundance, age compositions, and the estimated spawning biomass from the linked individual stock assessment model.
8. Individual historical trajectories are created for each individual model of the OM using estimated uncertainty and correlations between parameters.
9. Inputs and outputs for each individual trajectory is saved to the appropriate directory and a reduced set of necessary inputs is saved to GitHub for distribution among computers and for record keeping.

The four individual models of the OM (OM1_longAAF, OM2_shortAAF, OM3_longCW, and OM4_shortCW) were conditioned through step 7 in early 2026 and details are reported in IPHC-2026-MSAB022-06. The variability for each individual model is currently being determined.

Once the OM is conditioned, the process does not need to be repeated until after the next full stock assessment, or an exceptional circumstance occurs (see Section 3.8 of the IPHC HSP). However, after each update stock assessment, mortality, weight-at-age and other data or inputs may be updated to reflect recent realizations (steps 1–5).

2.1.2 Evaluate a range of SPR values

The IPHC HSP defines a reference fishing intensity ($F_{SPR=43\%}$) that was determined to meet the Commission’s objectives using past MSE simulations. With an updated OM, it is useful to ensure that the reference fishing intensity continues to be the optimal fishing intensity to meet those objectives. Therefore, a range of fishing intensities (i.e. SPR values) should be evaluated.

At MSAB022, and recommendation was made to evaluate a range of SPR values.

> **IPHC-2025-MSAB021-R, para. 36**: *The MSAB REQUESTED further evaluations of the following MP elements, after the OM is conditioned following the full 2025 stock assessment:*

a) fishing intensities including, but not limited to, SPRs of 40%, 43%, 46%, 52%, 55%, and 100% (no directed fishing); …

This is a reasonable range to determine an optimal reference fishing intensity.

2.1.3 Investigate productivity regimes

Recent MSE work has involved investigating the effects of low or high productivity on management outcomes (see IPHC-2025-AM102-11 and IPHC-2026-MSAB022-06), and has found that the range of productivity historically observed for Pacific halibut has profound effects on the magnitude of biomass and mortality limits. Weight-at-age and average recruitment are currently identified as the two major components influencing historical productivity. Low and high PDO regimes have been linked to low and high average recruitment, respectively, and are modelled in the OM. PDO regimes are also parameterized to change the distribution of age-0 recruits and movement of all ages in the OM. Environmental or density-dependent linkages have not been determined for weight-at-age, but low, current, and high periods have been identified from historical observations. There are three main concepts to explore when investigating productivity regimes: determine 1) how the Pacific halibut population and fisheries respond to different productivity regimes, 2) if the optimal reference fishing intensity differs across productivity regimes, and 3) how productivity regimes may be incorporated into a Management Procedure. The MSAB has also requested to investigate productivity.

IPHC-2026-MSAB021-R, para 19. *The MSAB AGREED that it would be useful to explore productivity regimes, their effect on the MSE results, and how it may assist in the selection of a management procedure.*

IPHC-2026-MSAB021-R, para 31. *The MSAB NOTED that simulation results with fixed weight-at-age and high or low Pacific Decadal Oscillation (PDO) (i.e. productivity regimes) were helpful to understand the variability, current stock status, and the implication of different MPs under different productivity regimes.*

IPHC-2026-MSAB021-R, para 39. *The MSAB REQUESTED conducting simulations assuming the following productivity regimes with a subset of the MPs from paras. 36 and 37 and all other sources of variability:*

a) low recruitment and low weight-at-age;

b) low recruitment and current weight-at-age;

c) high recruitment and low weight-at-age.

IPHC-2026-MSAB021-R, para 41. *The MSAB REQUESTED presenting dynamic unfished spawning biomass along with simulated spawning biomass, and trace plots (the purple plots in document IPHC-2025-MSAB021-06) with uncertainty for the productivity regimes at MSAB022 for productivity regimes described in para. 39, with SPRs of 43% and 52%.*

Using the newly conditioned OM, productivity regimes will be defined and fixed in the projections. The Secretariat will work with the MSAB to identify the most effective ways to present these results to better understand the effects that changing productivity has on the Pacific halibut population and fisheries. A range of SPR values will be used in these projections to gain an understanding of the effect of productivity on the optimal fishing intensity. Finally, the Secretariat will work with the MSAB, SRB, and Commissioners to identify potential MPs to evaluate that directly incorporate and respond to productivity.

2.1.4 Further develop the Depleted concept and identify a limit reference point

The IPHC HSP defines two limit biomass reference points (Figure 1) where going below either is to be avoided with a high probability. The first is a dynamic relative spawning biomass that measures only the effect of fishing. The second, called the Depleted limit reference point, is an absolute spawning biomass that measures the effect of fishing and the environment. The potential for recovery of the population is uncertain if it is below the Depleted limit reference point.

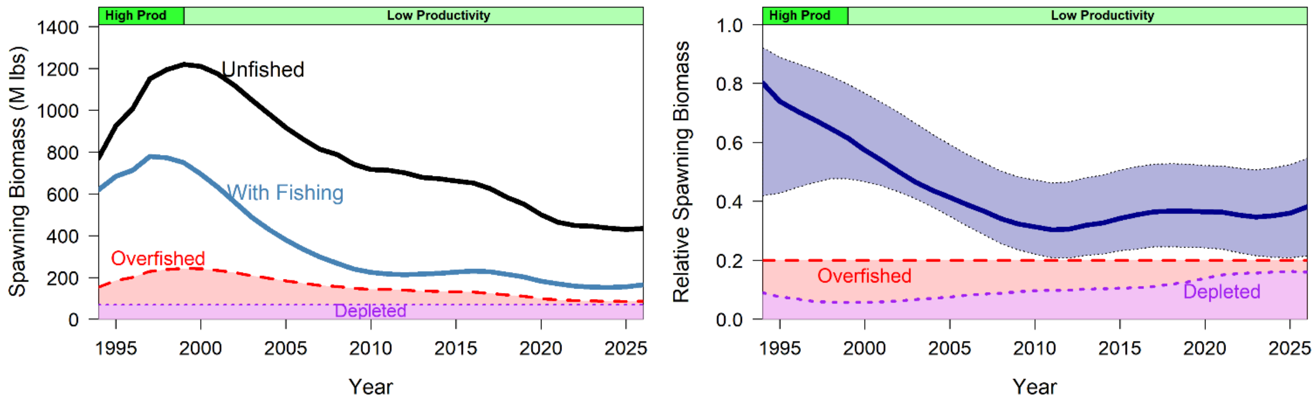

Figure 1. Estimated spawning biomass (left) if fishing had not occurred (unfished) and estimated spawning biomass from the 2025 stock assessment (with fishing). The Overfished threshold of 20% of unfished spawning biomass is shown as a dashed line and changes over time. An example "Depleted" threshold is shown as a straight horizontal line, assuming that it is defined as a constant absolute spawning biomass. The relative spawning biomass ("with fishing" divided by "unfished") is shown on the right with a 95% credible interval (accounting for the covariance in the biomass estimated with and without fishing). The Overfished threshold is shown at 20% and the example Depleted value is shown in purple.

Simulations were conducted in 2025 with the previously conditioned OM (see Section 3 of IPHC-2025-SRB027-08) to determine an absolute biomass below which the potential for recovery would be uncertain. These simulations assumed a 'worst-case' scenario of low productivity and a depensatory spawner-recruit relationship at low spawning biomass. This work was incomplete and will be expanded in 2026 using the newly conditioned OM and further determination of scenarios. The SRB suggested the following.

> **IPHC-2025-SRB027-R. para 23**. *The SRB RECOMMENDED increasing simulation sample sizes to achieve a smooth curve so that a "depleted" threshold can be identified as the lowest spawning stock biomass that results in near 100% probability of recovery.*

Furthermore, the SRB recommended defining an exceptional circumstance if the stock is estimated to be below the Depleted limit reference point because the MP determined from the MSE process should avoid this with high probability and thus would be theoretically unlikely. If the stock was depleted, it may indicate a misspecification within the MSE framework that should be investigated. A definition for this type of exceptional circumstance will be determined with assistance from the MSAB and SRB, and then presented to the Commission for adoption into the IPHC HSP.

> **IPHC-2025-SRB027-R. para 21.** *The SRB RECOMMENDED defining an "exceptional circumstance" if the stock is determined to be "depleted" as this state is unlikely to occur under the circumstances in which the HSP is implemented and may be indicative of a need for model revision*

2.2 Low priority tasks

The Commission, MSAB, and SRB identified additional tasks which are a lower priority than those defined above. These may be possible to complete in 2026 or 2027, but may also be extended into the next MSE Program of Work.

2.2.1 Improve the estimation model in the MSE framework

The closed-loop simulations in the MSE framework consist of an OM and an MP (Figure 2). Within the MP there are three subcomponents. The monitoring subcomponent determines what data are sampled and with what precision. The estimation model uses those data to determine outputs necessary for management (e.g. stock status, mortality limits, etc.). The harvest rule consists of other items necessary for the management of Pacific halibut, such as size limits, distribution of the harvest, and control rules.

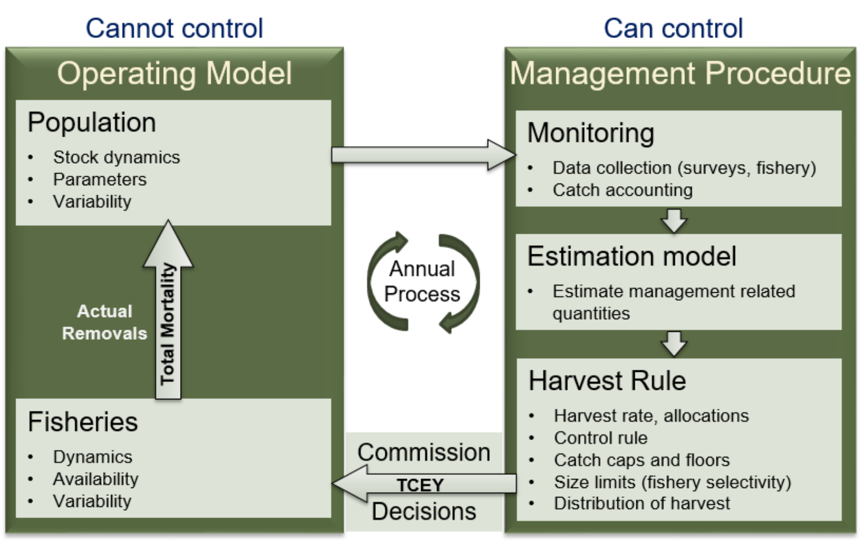

Figure 2. An illustration of the closed-loop simulation within the MSE framework.

Implementing a full ensemble stock assessment in a simulation framework is not technically feasible at this time. Therefore, estimation models in MSE frameworks are typically simplifications of the actual stock assessment to reduce the simulation time but still mimic the behaviours of the stock assessment. The current estimation model mimics the stock assessment with a simple approach of adding correlated random variability to stock status and the mortality limit, which was tuned to outputs of past stock assessments. This method, however, is not capturing potential lags and biases in estimated quantities and cannot simulate different assumptions in the stock assessment. Following an SRB recommendation, work has begun on better mimicking the stock assessment within the MSE framework.

> **IPHC-2025-SRB027-R, para 24.** *The SRB RECOMMENDED considering the development of an assessment model within the MSE framework. This would have multiple benefits including:*
>
> *a) facilitating analysis of the economic consequences of reduced FISS sampling and the associated increased potential for bias in assessment-relevant metrics such as WPUE, the maturity schedule, size-at-age, and age composition.*
>
> *b) Understanding the impacts of uncertainty in natural mortality on management performance.*

2.2.2 Evaluate potential management actions when approaching the depleted limit reference point

Once a depleted limit reference point is determined (see Section 2.1.4), specific management actions to incorporate into a management procedure if this reference point is reached will be evaluated using the MSE framework. This may be a control rule that reduces fishing intensity as the stock approaches a limit reference point to complement the current 30:20 control rule that uses stock status as its operational control points. Other management actions to investigate include adjusting the reference fishing intensity based on the perceived productivity regime.

2.2.3 Evaluate additional elements of Management Procedures

The MSE framework has been used to evaluate many elements of management procedures other than fishing intensity (i.e. SPR). These include constraints or smoothers on the annual change in the TCEY, assessment frequencies other than annual, and alternative control rules. The MSAB has found the investigations useful and has made a number of requests to continue evaluating these as well as new elements.

> **IPHC-2025-MSAB021-R, para 23**. *The MSAB AGREED that a constraint would help to reduce interannual variability in the TCEY when using an annual or triennial assessment frequency.*
>
> **IPHC-2025-MSAB021-R, para 36**. *The MSAB REQUESTED further evaluations of the following MP elements, after the OM is conditioned following the full 2025 stock assessment:*
>
> *a) fishing intensities including, but not limited to, SPRs of 40%, 43%, 46%, 52%, 55%, and 100% (no directed fishing);*
>
> *b) a triennial assessment frequency;*
>
> *c) various empirical rules to determine the reference coastwide TCEY in non-assessment years;*

d) control rules with triggers at higher values than $RSB_{30\%}$ or based on absolute spawning biomass relative to the spawning biomass estimated at the beginning of 2024.

IPHC-2025-MSAB021-R, para 37. *The MSAB REQUESTED evaluating constraints and smoothers, along with MP elements listed in para. 36, that would potentially reduce the interannual variability in the TCEY, including:*

a) a 3-year rolling average (arithmetic or geometric) on the FISS O32 WPUE used in the empirical rule in a triennial stock assessment frequency;

b) constraints applied only to non-assessment years and/or applied only to assessment years;

c) a phase-in approach for the change in TCEY in assessment years;

d) using the trends in fishery CPUE and/or FISS WPUE to determine if a bigger reduction should be taken than suggested by the unconstrained reference TCEY to curtail further reductions in the SB.

The Secretariat will work with the MSAB and SRB to clearly identify candidate MPs incorporating these elements for evaluation.

2.2.4 Update estimates of reference points

The Secretariat last conducted an in-depth analysis of reference points in 2019 and reported the results in IPHC-2019-SRB015-11 Rev_1. That analysis reported estimates of MSY-based reference points that were used in the development of objectives and the definition of overfishing. Since 2019, there have been many updates to the stock assessment and the OM, as well as new data. Repeating this analysis with the updated OM and stock assessment will ensure that the HSP reflects the most up-to-date information.

2.2.5 Develop guidance documents for the Harvest Strategy Policy

The HSP document is a high-level description of the harvest strategy policy that does not describe all concepts in detail. Therefore, the development of supplementary guidance documents describing some concepts in more detail is necessary for the management of Pacific halibut. Supplementary documents to be developed may include

1. Guidelines for developing a rebuilding plan for Pacific halibut that would apply if it was determined to be overfished;
2. Other guideline documents as determined by the Commission.

Guideline documents will be developed and adopted after input from the MSAB, SRB, and Commission.

2.2.6 Incorporate autocorrelated recruitment in projections

The Secretariat reported results of investigations of autocorrelated recruitment for Pacific halibut and its use in the MSE framework in document IPHC-2025-SRB027-08. This was in response to an SRB request.

> **IPHC-2025-SRB026-R , para 24**. *The SRB RECOMMENDED that recruitment projections in the stock assessment and Management Strategy Evaluation (MSE) incorporate a random-walk starting from the most recent reliable recruitment estimate to constrain expected short-term recruitment around recent estimates rather than immediately reverting to the stock-recruitment relationship.*

These results showed some evidence of autocorrelated recruitment that may be useful to model. MSE simulations with and without autocorrelated projected recruitment showed slight differences in performance metrics. The MSE framework is capable of including autocorrelated recruitment and further discussion with the SRB will determine if this is appropriate for testing and selection of MPs.

2.2.7 Update objectives and performance metrics

The three priority Commission objectives are defined in the HSP and additional objectives considered by the MSAB are presented in Appendix A. It is useful to occasionally revisit objectives to clarify them or add new ones. For example, there have been recent discussions regarding the development of an objective related to absolute spawning biomass or a depleted level (see Section 2.1.4).

It is also useful to review the performance metrics related to the objectives. This ensures that MSE results are presented using applicable and understandable metrics. The SRB suggested considering fishery performance metrics.

> **IPHC-2025-SRB027-R, para 22.** *The SRB RECOMMENDED considering some fishery performance indicators that represent metrics directly observable by stakeholders, e.g. fishery CPUE.*

These types of fishery performance indicators would be best associated with general objective 2.2: Provide Directed Fishery Yield (Appendix A).

3 Discussion

Tasks for the 2026–2027 MSE Program of Work are divided into high priority and low priority. High priority tasks are already underway, and some low priority tasks require completion of high priority tasks. A list of all tasks is provided below.

1. High priority tasks
    - 1.1. Condition the MSE Operating Model
    - 1.2. Evaluate a range of SPR values
    - 1.3. Investigate productivity regimes
    - 1.4. Further develop the depleted concept and identify a limit reference point
2. Low priority tasks
    - 2.1. Improve the estimation model in the MSE framework
    - 2.2. Evaluate potential management actions when approaching the depleted limit reference point
    - 2.3. Evaluate additional elements of the Management Procedures

2.4. Update estimates of reference points
2.5. Develop guidance documents for the Harvest Strategy Policy
2.6. Incorporate autocorrelated recruitment in projections
2.7. Update objectives and performance metrics

4 RECOMMENDATION/S

That the MSAB:

1) **NOTE** paper IPHC-2026-MSAB022-07 that describes tasks included in the MSE Program of Work for 2026–2027.
2) **REQUEST** additional tasks to be included in the MSE Program of Work for 2026–2027, for consideration by the Commission.

5 APPENDICES

Appendix A: Primary objectives used by the Commission for the MSE evaluations

APPENDIX A
PRIMARY OBJECTIVES USED BY THE COMMISSION FOR THE MSE EVALUATIONS

Table A1. Primary objectives, evaluated over a simulated ten-year period, accepted by the Commission at the 7th Special Session of the Commission (SS07). Objective 1.1 is a biological sustainability (conservation) objective and objectives 2.1, 2.2, and 2.3 are fishery objectives. Priority objectives are shown in green text.

GENERAL OBJECTIVE	MEASURABLE OBJECTIVE	MEASURABLE OUTCOME	TIME-FRAME	TOLERANCE	PERFORMANCE METRIC
1.1. KEEP FEMALE SPAWNING BIOMASS ABOVE A LIMIT TO AVOID CRITICAL STOCK SIZES AND CONSERVE SPATIAL POPULATION STRUCTURE	Maintain the long-term coastwide female relative spawning biomass above a biomass limit reference point ($RSB_{20\%}$) at least 95% of the time	*RSB* < Spawning Biomass Limit (RSB_{Lim}) RSB_{Lim}=20% unfished spawning biomass	Long-term	0.05	$P(RSB < RSB_{Lim})$ Fail if greater than 0.05
	Maintain a defined minimum proportion of female spawning biomass in each Biological Region	$p_{SB,2} > 5\%$ $p_{SB,3} > 33\%$ $p_{SB,4} > 10\%$ $p_{SB,4B} > 2\%$	Long-term	0.05	$P(p_{SB,R} < p_{SB,R,min})$
2.1 MAINTAIN SPAWNING BIOMASS AT OR ABOVE A LEVEL THAT OPTIMIZES FISHING ACTIVITIES	Maintain the long-term coastwide female relative spawning biomass at or above a biomass reference point ($RSB_{36\%}$) 50% or more of the time	*RSB*<Spawning Biomass Reference (RSB_{Thresh}) RSB_{Thresh}=$RSB_{36\%}$ unfished spawning biomass	Long-term	0.50	$P(RSB < RSB_{Thresh})$ Fail if greater than 0.5
2.2. PROVIDE DIRECTED FISHING YIELD	Optimize average coastwide TCEY	Median coastwide TCEY	Short-term		*Median* $\overline{TCEY}$
	Optimize TCEY among Regulatory Areas	Median $TCEY_A$	Short-term		*Median* $\overline{TCEY_A}$
	Optimize the percentage of the coastwide TCEY among Regulatory Areas	Median $\%TCEY_A$	Short-term		*Median* $\left(\overline{\frac{TCEY_A}{TCEY}}\right)$
	Maintain a minimum TCEY for each Regulatory Area	Minimum $TCEY_A$	Short-term		*Median Min(TCEY)*
	Maintain a percentage of the coastwide TCEY for each Regulatory Area	Minimum $\%TCEY_A$	Short-term		*Median Min(%TCEY)*
2.3. LIMIT VARIABILITY IN MORTALITY LIMITS	Limit annual changes in the coastwide TCEY	Annual Change (*AC*) > 15% in any 3 years	Short-term		$P(AC_3 > 15\%)$
		Median coastwide Average Annual Variability (AAV)	Short-term		*Median AAV*
	Limit annual changes in the Regulatory Area TCEY	Annual Change (*AC*) > 15% in any 3 years	Short-term		$P(AC_3 > 15\%)$
		Average AAV by Regulatory Area (AAV_A)	Short-term		*Median* AAV_A

$$AAV_t = \frac{\sum_{t+1}^{t+9}|TCEY_t - TCEY_{t-1}|}{\sum_{t}^{t+9} TCEY_t} \qquad AC_t = \frac{|TCEY_t - TCEY_{t-1}|}{TCEY_{t-1}}$$