



## CHAPTER 1. INTRODUCTION

The Bristol Bay watershed in southwestern Alaska supports the largest sockeye salmon fishery in the world, is home to 25 federally recognized tribes, and contains abundant natural resources, including significant mineral reserves. Worldwide attention to this watershed has increased because of widespread mineral exploration activities and the discovery of a large ore deposit in the watershed's northeast-central region. The potential for large-scale mining activities has raised concerns about the quality and sustainability of Bristol Bay's world-class fisheries and the future of Alaska Natives who have maintained a salmon-based culture and a subsistence-based way of life for at least 4,000 years.

Public interest in the Bristol Bay watershed has centered on the ecological goods and services provided by the watershed and on potential mining activity. The watershed is most noted for its abundant fish resources. The Bristol Bay watershed supports production of all five species of Pacific salmon found in North America (sockeye, Chinook, chum, coho, and pink), including almost half of the world's commercial sockeye salmon harvest. In 2009, Bristol Bay's ecosystems, which support the watershed's commercial, recreational, and subsistence fisheries, generated \$480 million in direct economic expenditures in the region, and provided employment for over 14,000 full- and part-time workers (Appendix E). This consistently large fish production results from the watershed's high hydrologic diversity and pristine quality, both of which contribute to highly diverse fish populations.

In addition to these biological resources, 16 mine claim blocks have recently been explored in the Bristol Bay's Nushagak and Kvichak River watersheds. Eleven of these claims are associated with porphyry copper deposits, the largest belonging to the Pebble Limited Partnership (PLP). This partnership was created in 2007 by co-owners Northern Dynasty Minerals, Ltd. and Anglo American to design, permit, construct, and operate a long-life mine at the Pebble deposit (PLP 2013) (Anglo American withdrew from the partnership in late 2013). Although PLP has not yet submitted a permit application for a mine, preliminary mine plans have been developed and publicly available information strongly suggests that a

mine at the Pebble deposit has the potential to become one of the largest mining developments in the world.

The Pebble deposit is a large, low-grade deposit containing copper, gold, and molybdenum-bearing minerals. Extraction is expected to require the creation of a large open pit, the production of large amounts of waste rock and mine tailings, the creation of a transportation corridor connecting the deposit area to Cook Inlet, and the development of a deep-water port. Revenues from such a mine have been estimated at between \$300 billion and \$500 billion over the mine's life (Chambers et al. 2012), and more than 2,000 and 1,000 jobs could be created during mine construction and operation, respectively (Ghaffari et al. 2011).

In light of these factors, nine Bristol Bay federally recognized tribes, the Bristol Bay Native Association, the Bristol Bay Native Corporation, other tribal organizations, and many groups and individuals petitioned the U.S. Environmental Protection Agency (USEPA) to use its authorities under Clean Water Act (CWA) Section 404(c) to restrict or prohibit the disposal of dredged or fill material associated with large-scale mining activities in the Bristol Bay watershed. These groups are concerned that large-scale mining could adversely affect the region's valuable natural resources, particularly its fisheries. Four Bristol Bay federally recognized tribes, other tribal organizations, the governor of Alaska, and other groups and individuals, including PLP, have asked USEPA to wait until formal mine permit applications have been submitted and an environmental impact statement has been developed.

USEPA initiated this assessment in response to these competing requests. The assessment's purpose is to characterize the biological and mineral resources of the Bristol Bay watershed, increase understanding of the potential impacts of large-scale mining, in terms of both day-to-day operations and potential accidents and failures, on the region's fish resources, and inform future decisions, by government agencies and others, related to protecting and maintaining the chemical, physical, and biological integrity of the watershed. The assessment represents a review and synthesis of available information to identify and evaluate potential risks of future large-scale mining development on the Bristol Bay watershed's fish habitats and populations and consequent indirect effects on the region's wildlife and Alaska Native cultures.

## **1.1 Assessment Approach**

This assessment was conducted as an ecological risk assessment (ERA). ERA is a scientific process used to determine whether exposure to one or more stressors may result in adverse ecological effects, the findings of which are used to inform environmental decision making. USEPA routinely uses ERA methods to evaluate the potential impacts of current and future actions when considering management decisions (USEPA 2002a, 2002b, 2002c, 2008, 2011). USEPA is conducting this assessment consistent with its authority under CWA Section 104. CWA Sections 104(a) and (b) provide USEPA with the authority to study the resources of the Bristol Bay watershed, evaluate the effect of pollution from large-scale mining development on those resources, and make such an assessment available to the public. This

assessment is not an environmental impact assessment, an economic or social cost-benefit analysis, or an assessment of any one specific mine proposal.

Risk assessors, decision makers, and community stakeholders determine the topical, spatial, and temporal scope needed to effectively address the decisions the ERA is informing. Within this scope, risk assessments consider the potential effects of an activity and use one or more scenarios, or sets of assumptions, to identify how resources of interest (in this case, fish habitat and populations) could be exposed to stressors generated by some activity (in this case, porphyry copper mining).

Assessment endpoints are explicit expressions of the environmental resources of interest to the risk assessors, decision makers, and stakeholders. We selected fish, and specifically salmon and other salmonids, as our primary assessment endpoint because of their critical importance to stakeholders and future decision making in the watershed. The sustainability of the Bristol Bay fisheries is a concern shared by all Bristol Bay stakeholders—including those who support mining—and the ecological, economic, and cultural importance of the region's commercial, sport and subsistence fisheries has been emphasized consistently by all stakeholders throughout the process. Our preliminary technical consultations with federal, state, and tribal representatives indicated that evaluating the potential risks of large-scale mining on the region's fishery resources was a top priority. During our public engagement efforts, stakeholders consistently emphasized that fish are the crucial resource of concern.

We also considered two key secondary endpoints: wildlife and Alaska Native cultures. Fish-mediated effects on wildlife were considered because fish, particularly salmon, are an important food resource for wildlife, via both direct consumption and as a source of marine-derived nutrients that contribute to the watershed's overall productivity. Fish-mediated effects on Alaska Natives were considered because sustainability of the region's fish populations is critical to the future of Alaska Natives in the Bristol Bay region, and because concern about the region's fishery resources prompted the original requests from Alaska Natives that USEPA examine potential mine development in the Bristol Bay watershed.

Multiple geographic scales are considered in the assessment. Background and characterization information is presented for the entire Bristol Bay watershed. The evaluation of potential large-scale mining impacts focuses on the Nushagak and Kvichak River watersheds. These two watersheds are the most likely to be affected by large-scale mining development, given the location of current mine claims and current federal and state restrictions on development in other portions of the Bristol Bay watershed. These two watersheds are responsible for approximately half of the Bristol Bay sockeye salmon production, and are also home to approximately half of the region's Alaska Native communities and federally recognized tribes. There are 31 federally recognized tribes in the larger Bristol Bay region, and 25 of these tribal communities are within the Bristol Bay watershed boundary defined in this assessment. Fourteen of these communities (13 of which have federally recognized tribes) are within the Nushagak and Kvichak River watersheds.

The assessment also considers smaller geographic scales for risk analysis and characterization. Because the Pebble deposit is the largest known and most explored deposit in the region, we use it as a case study for potential risks. Because none of the parties holding mine claims in the Bristol Bay watershed

has submitted a formal application and mine plan, we developed a set of realistic mine scenarios for the assessment. The foundations for these scenarios are industry documents outlining approaches for mining porphyry copper deposits, as well as specific documents from the PLP outlining a basic, preliminary mine plan for the Pebble deposit. The mine scenarios were used to complete the risk analyses and characterizations in the assessment. Although these mine scenarios were developed for the Pebble deposit, the potential risks evaluated are expected to be qualitatively similar to potential risks associated with any mine of the same resource type (porphyry copper) anywhere in the Nushagak and Kvichak River watersheds.

Risk assessments are inherently uncertain, because they must predict the occurrence and consequences of future actions. In this assessment, expressions of uncertainty are treated differently for accidents and failures and for routine operations. Risks of accidents and failures are based on empirical frequencies (summarized in Table 14-1), but we acknowledge the possibility of lower risks due to advances in technology or practices. For example, data concerning risks of culvert failure provide frequencies of 0.3 to 0.6 per culvert. However, risks during operation are simply described as low, because our scenario specifies daily inspections and there are no data quantifying failure rates under such intensive maintenance programs. Risks that effects would occur due to routine operations are not described probabilistically, because they are unintended results of planned actions. However, these risks are uncertain due to lack of knowledge about the receiving environment and its response to mining activities. Those uncertainties are described based on the professional judgment of the authors using ordinary language such as “likely” and, when the evidence allows, in terms of possible deviations from expectations (e.g., thresholds for effects could be at least a factor of 2 lower). The term “likely” is used commonly as an abbreviation for “more likely than not” (>0.5 probability). The risk of a tailings storage facility (TSF) spillway release is different in that it is a hybrid between a failure (TSFs should not overflow during mine operation) and routine operations (spillways are installed to spill excess water, because overflows are a reasonable expectation). No statistics are available on overflow frequencies, but they are judged to be likely over the life of a mine and inevitable afterwards, if water treatment is not continued in perpetuity.

Throughout the assessment, we have reached out to interested parties to ensure transparency of the assessment process (Box 1-1). Through public comment opportunities and by engaging an Intergovernmental Technical Team (IGTT) of federal, state, and tribal representatives, we were able to identify additional information helpful for characterizing the biological and mineral resources of the watershed. These interactions with community members were also helpful in narrowing the scope of the assessment to issues that were most important to stakeholders.

### BOX 1-1. STAKEHOLDER INVOLVEMENT IN THE ASSESSMENT

Meaningful engagement with stakeholders was essential to ensure that the U.S. Environmental Protection Agency (USEPA) heard and understood the full range of perspectives on the assessment and the potential effects of mining in the region. USEPA involved and informed stakeholders throughout the assessment process. Community involvement efforts included a project webpage and listserv to ensure that assessment-related information is shared with the public. Additional ways in which stakeholders and tribal governments were involved in the assessment process are summarized below.

- **Public and stakeholder meetings.** Throughout development of the assessment, USEPA visited many Bristol Bay communities, including Ekwok, Dillingham, Kokhanok, New Stuyahok, Koliganek, Iliamna, Newhalen, Nondalton, Naknek, King Salmon, Igiugig, and Levelock. USEPA also met with representatives from Bristol Bay tribal governments and corporations, as well as organizations representing the mine industry, commercial fishers, seafood processors, hunters and anglers, chefs and restaurant owners, jewelry companies, conservation interests; members of the faith community; and elected officials from Alaska and other states. USEPA heard from hundreds of people at these meetings and from thousands more via phone and email. USEPA was also invited to numerous conferences and meetings to discuss the assessment.
- **Intergovernmental Technical Team (IGTT).** In August 2011, USEPA met with the IGTT, which was established to provide USEPA with input on the structure of the assessment and to identify potential data sources. IGTT participants included tribal representatives from Ekwok, Newhalen, Iliamna, South Naknek, New Koliganek, Curyung, Nondalton, and Levelock and agency representatives from the Alaska Department of Public Health, the Alaska Department of Fish and Game, the National Park Service, the U.S. Fish and Wildlife Service, the National Oceanic and Atmospheric Administration, and the Bureau of Land Management. Feedback from this workshop was used to inform the early stages of problem formulation. USEPA also updated the IGTT on assessment progress in January 2012 via webinar.
- **Tribal consultation.** USEPA's policy is to consult on a government-to-government basis with federally recognized tribal governments when USEPA actions and decisions may affect tribal interests. Consultation is a process of meaningful communication and coordination between USEPA and tribal officials. In February 2011, USEPA invited all 31 federally recognized tribal governments (tribes) of the Bristol Bay region to enter formal consultation on the assessment, to ensure their involvement and to include their concerns and relevant information in the assessment. Throughout development of the assessment there have been numerous opportunities for tribes to participate in the tribal consultation process. Not all tribes elected to participate in consultation. USEPA met with representatives from 20 of the 31 tribes (including all 13 tribes with federally recognized tribal governments in the Nushagak and Kvichak River watersheds), either in person or on the phone, during the consultation process.
- **Alaska Native Claims Settlement Act (ANCSA) engagement.** USEPA provided multiple engagement opportunities for ANCSA Village and Regional Corporations throughout development of the assessment, consistent with Public Law 108-199, Division H, Section 161, and Public Law 108-447, Division H, Title V, Section 518. USEPA representatives traveled to King Salmon, Iliamna, and Anchorage for meetings at the request of multiple ANCSA Corporations, to share information about and receive input on the assessment. Additionally, ANCSA Corporation representatives were invited to participate in a webinar following the release of April 2013 draft of the assessment. Throughout assessment development, ANCSA Corporations have traveled numerous times to meet with USEPA officials in Anchorage, Seattle, and Washington, D.C. Seventeen of the 26 ANCSA Corporations within the Bristol Bay region were engaged through these mechanisms.
- **Public comments.** USEPA released two drafts of the assessment for public comment. Approximately 233,000 and 890,000 comments were submitted to the USEPA docket during the 60-day public comment period for the May 2012 and April 2013 drafts of the assessment, respectively. USEPA also held eight public comment meetings in June 2012, in Dillingham, Naknek, New Stuyahok, Nondalton, Levelock, Igiugig, Anchorage, and Seattle. Approximately 2,000 people attended these meetings. An overview of these meetings was shared via two webinars in July 2012.
- **Public involvement in peer review.** USEPA provided multiple opportunities for stakeholder involvement in the peer review process. In February 2012, the public was invited to nominate qualified scientists as potential peer reviewers; these nominations were submitted to the peer review contractor for consideration. In March 2012, USEPA requested public comments on the questions to be given to peer reviewers, and these questions were revised in response to comments received. In August 2012, the public was invited to participate in the first 2 days of the peer review meeting in Anchorage, to provide oral comments to and observe discussions among the peer reviewers.

Detailed background characterizations of the watershed's resources are included in the assessment's appendices. We used these characterization studies and input from the IGTT to develop a series of conceptual models illustrating potential linkages between sources and stressors associated with large-scale mining and the assessment endpoints. These models were then used to develop a plan for analyzing and characterizing risks. In the risk analysis, available data were used to assess potential exposures to stressors and potential effects on assessment endpoints stemming from those exposures. In the final phase, results of these analyses were integrated to provide a comprehensive picture of the risks to assessment endpoints within the defined scope of the assessment. The uncertainties and limitations associated with these analyses were also identified.

This assessment has undergone extensive review throughout its development. Two earlier drafts of the assessment, released in May 2012 and April 2013, were subjected to review by 12 independently selected, expert peer reviewers (Box 1-2). Both of these drafts also had 60-day public comment periods, during which interested parties could submit their comments on the assessment to USEPA (Box 1-1).

## 1.2 Uses of the Assessment

This assessment is a scientific investigation. It does not reflect any conclusions or judgments about the need for or scope of possible government action, nor does it offer or analyze options for future decisions. Rather, it is a scientific product intended to provide a characterization of the biological and mineral resources of the Bristol Bay watershed, increase understanding of the potential risks to fish resources from large-scale mining, and inform future government decisions.

USEPA and other stakeholders may use this assessment in several ways. The assessment will inform the public and interested government entities about the resources of the Bristol Bay watershed. Much of the information about these resources was previously found in a variety of sources. In this assessment, we have synthesized and integrated available literature and provided a useful summary characterizing the Bristol Bay watershed's resources.

The assessment also will inform the public and interested government entities about the potential impacts of large-scale mining. USEPA recognizes the high level of interest concerning the impacts of potential mine development on the watershed's ecological resources. That interest originates from Alaska Native communities within the watershed, other Alaska residents, and interested parties throughout the United States. It is expressed both by those interested in protecting the Bristol Bay fishery and by those interested in developing the watershed's extensive mineral resources. This assessment is a scientific and technical resource that is useful to members of the public as they weigh the challenges of both mining and protecting the ecological resources in the Bristol Bay watershed in the years ahead.

**BOX 1-2. OVERVIEW OF THE ASSESSMENT'S PEER REVIEW PROCESS**

The peer review process is designed to provide a documented, independent, and critical review of a draft assessment. Its purpose is to identify any problems, errors, or necessary improvements to a document prior to it being published or otherwise released as a final document. To this end, the U.S. Environmental Protection Agency (USEPA) tasked Versar, an independent contractor, with coordinating an external peer review of the May 2012 draft assessment. Versar assembled 12 independent experts to serve as peer reviewers. These reviewers were selected from a pool of candidates that included those suggested during a public nomination process. In assembling the peer reviewers, Versar evaluated the qualifications of each peer review candidate and conducted a thorough conflict of interest screening process.

The peer reviewers were asked to evaluate and provide a written review of the May 2012 draft of the assessment (the main report and its appendices) by responding to 14 questions developed by USEPA with input from public commenters. Peer reviewers were charged only with evaluating the quality of the science included in the draft assessment and were not charged with making any regulatory recommendations, commenting on any policy implications of USEPA's role or mine development in the region, or reaching consensus in either their deliberations (during the peer review meeting, see below) or their written comments. Peer reviewers were provided with a summary of public comments submitted during the 60-day public comment period for the May 2012 draft and were given access to the public comments themselves.

A 3-day peer review meeting, coordinated by Versar, was held in Anchorage, Alaska, on August 7 through 9, 2012. On the first day of the meeting, peer reviewers heard testimony from approximately 100 members of the public. Peer reviewers deliberated among themselves on the second and third days of the meeting; these deliberations were open to the public on the second but not the third day.

Following the public peer review meeting, peer reviewers were given additional time to complete their individual written reviews. Versar provided these final written comments to USEPA in their *Final Peer Review Meeting Summary Report* for the May 2012 draft, which USEPA released to the public in November 2012. USEPA considered these peer review comments, as well as comments received during the 60-day public comment period, as they revised the May 2012 draft of the assessment.

In April 2013, USEPA released a revised draft of the assessment. The same 12 peer reviewers were asked to conduct a follow-on peer review to evaluate whether the April 2013 draft of the assessment was responsive to their original comments. USEPA provided reviewers with a draft response to comments document, in which USEPA responses to peer review comments on the May 2012 draft assessment were added to the *Final Peer Review Meeting Summary Report* submitted by Versar.

In the follow-on review, peer reviewers were asked to go through their comments on the May 2012 draft, review USEPA's draft responses to their original comments, and evaluate whether their original review comments had been addressed sufficiently and whether appropriate changes had been incorporated into the April 2013 draft. USEPA received these follow-on peer review comments directly from the 12 peer reviewers in August to September 2013. Again, USEPA considered these peer review comments, as well as comments received during the 60-day public comment period, as they revised the April 2013 draft of the assessment.

All drafts of the assessment (May 2012, April 2013, and final), as well as the peer review comments on the May 2012 and April 2013 drafts and USEPA's responses to those comments, are available online.

Our findings concerning the potential impacts of large-scale mining will help to inform future government decisions regarding mine development in the Bristol Bay watershed and potential actions to protect and maintain the integrity of the watershed's aquatic resources. One of the initiators for the assessment was the multiple petitions to USEPA to use its authority under CWA Section 404(c). It is expected that the assessment will provide an important base of information for any agency decision about whether or not to use Section 404(c), either now or in the future, and will facilitate a thoughtful decision regarding whether application of this authority is or is not warranted.

The assessment may also assist federal and state scientists and resource managers involved in the evaluation of future mine permit applications submitted for the deposits in the Bristol Bay watershed. It is likely that future mines in the watershed would require the filling of streams and wetlands and thus would require a Section 404 permit from the U.S. Army Corps of Engineers. USEPA reviews and comments on proposed Section 404 permit applications, and this assessment will be a valuable resource in the development and review of such permit applications.

If a Section 404 permit or other major federal action is required for a future mine in the watershed, it would trigger review of the proposed mine under the National Environmental Policy Act. This assessment, particularly in terms of its identification and analysis of potential direct, indirect, and cumulative effects of large-scale mining, will be a valuable resource in the development and review of any future environmental assessment related to mining in the Bristol Bay watershed.

Perhaps the most important use of this assessment is to better inform dialogues among interested stakeholders concerning the resources in the Bristol Bay watershed and the potential impacts of large-scale mining on those resources.