THE PEBBLE ENVIRONMENT

A Scientific Overview of Environmental and Social Data in Southwest Alaska

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Introduction

INTRODUCTION

Alaska has a rich cultural history dating back thousands of years. Alaska's unique history of mineral exploration and discovery began in the late 1800s when gold first attracted adventurers and explorers to the state from all over the world. Later, that same pioneering spirit helped Alaska achieve statehood through the promise that responsible development of the state's natural resources would provide an economic engine of sustainability and independence benefiting all Alaskans. Throughout the years, mineral wealth, along with oil, gas, forestry, fishing and tourism, has played an important role in ensuring Alaska's economic security. As responsible natural resource development has brought new and diverse economies to areas where few other activities have been viable, Alaska residents have enjoyed greater economic opportunity and a higher quality of life.

Later, that same pioneering spirit helped Alaska achieve statehood through the promise that responsible development of the state's natural resources would provide an economic engine of sustainability and independence benefiting all Alaskans.

Today, the Pebble Deposit, one of the largest copper-gold-molybdenum discoveries in the world, offers Alaskans a new opportunity for prosperity. Situated in southwest Alaska on state land designated for mineral exploration and development, the area surrounding the Pebble Deposit was part of an historic land exchange.

In a mutually beneficial agreement between the state of Alaska, the federal government and Cook Inlet Region,

The state of Alaska received more than 500,000 acres of additional land entitlement with which it selected land specifically identified for its mineral development potential, including the area where the Pebble Deposit is located.

Incorporated, the land trade helped complete Lake Clark National Park and Preserve, an area designated for historic, cultural and wilderness preservation. In return, the state of Alaska received more than 500,000 acres of additional land entitlement with which it selected land specifically identified for its mineral development potential, including the area where the Pebble Deposit is located.

Currently, with global demand for copper and other minerals at an all-time high, the Pebble Deposit presents a unique opportunity to help diversify the regional and state economy, both directly and indirectly, as any endeavor of such scope will require human resources from a variety of business sectors: environmental scientists and engineers;

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executive professionals and project managers; construction workers and skilled laborers; and service industry personnel. An opportunity such as this comes at a critical

time for southwest Alaska, where communities face tough economic challenges, including high unemployment, high cost of living and a declining population. Largely due to its geographic remoteness and lack of infrastructure, income opportunities in southwest Alaska are limited, predominantly characterized by public sector jobs, low wages or only seasonal work, rather than the higher-paying, year-round employment experienced in other parts of the state.

With a study area vastly greater than any potential project footprint, and extending some one million acres, the depth and breadth of the research demonstrates the Pebble Partnership's commitment to environmental stewardship.

Communities throughout the state are seeking new ways to increase economic diversity in order to create stability, improve education and enhance their quality of life. From a social perspective, economic diversity in rural Alaska brings something infinitely more valuable: an opportunity to work where you live. Such opportunities can play an important role in helping to preserve cultural ties, while offering the advantage of a stable income in the communities that need it most.

The commitment to economic, cultural and environmental co-existence is not new to Alaska. One of the state's defining characteristics, as outlined in the state's Constitution, is its adherence to the principle that natural resources should be maintained and developed for the benefit of all citizens, and that a stringent regulatory structure should provide environmental and social protection. Continuing in this tradition, the Pebble Limited Partnership has gone to great lengths to study and understand the physical, biological and socioeconomic environment in the area in which the Pebble Project may be developed.

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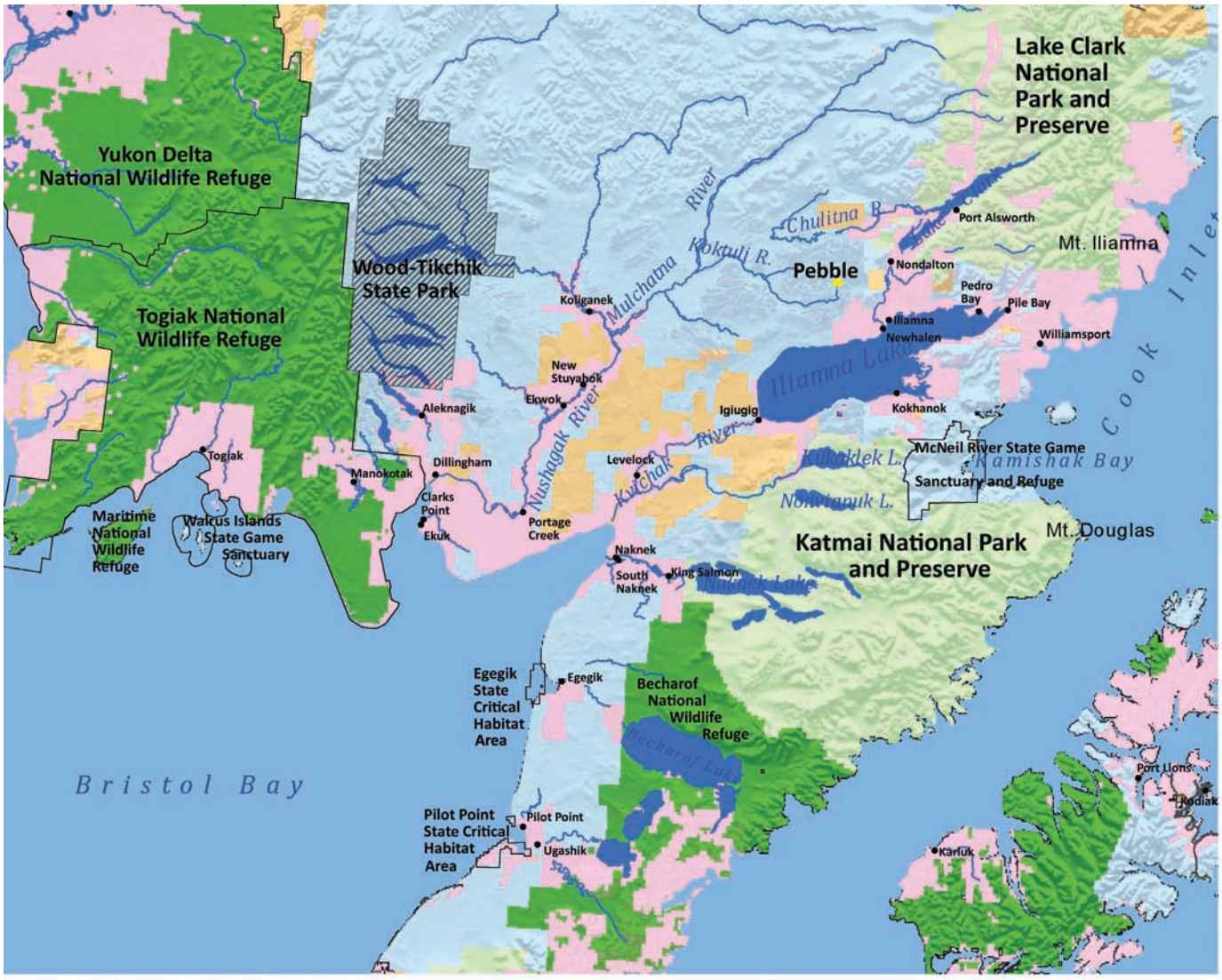
The Pebble Partnership has so far invested more than $120 million in one of the most extensive environmental research study programs ever conducted in the state. With independent research firms gathering and analyzing scientific data throughout a five-year period, the resulting Pebble Environmental Baseline Document (EBD) is a thorough characterization of the existing environmental and social conditions around the Pebble Deposit Area. It is a preliminary but critical step toward responsible development of the Pebble Project. Now, in an advanced exploration stage to determine pre-feasibility and to ensure it is environmentally, technically and financially sound, the Pebble Partnership is poised to contribute to a responsible, sustainable and diversified economy for Alaskans.



OVERVIEW

From the northernmost rainforest to the Arctic tundra – from one of the continent's deepest lakes to its tallest peak – Alaska's terrain is one of the most ecologically diverse in the world. So it is no small endeavor when a group sets out to uncover, understand and document the ecological and socioeconomic environment specific to an area.

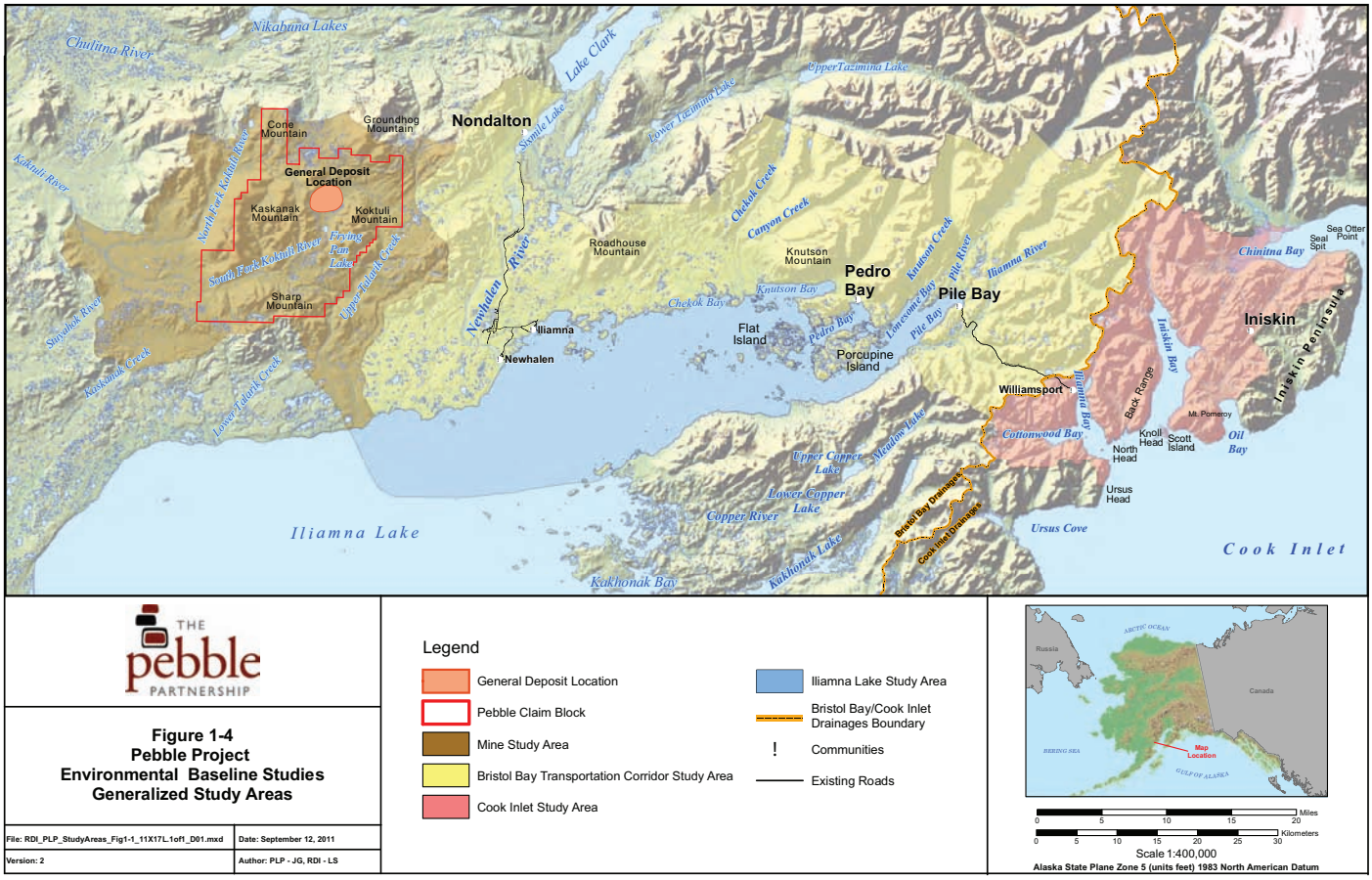
Alaska is celebrated around the world for its abundance of natural resources. Comprising nearly 600,000 square miles, much of it uninhabited wilderness, Alaska is home to more public lands, including national forests, national parks and national wildlife refuges, than any other state in the country. In fact, more than 60 percent of the state, or 222 million acres, is managed by federal agencies. To put that in perspective, federal lands in Alaska alone make up one-third of all federal lands in the United States - larger than the entire state of Texas, bigger than the combination of 15 eastern states stretching from Maine to South Carolina, and larger than Oregon, Washington and California combined.

With few roads and limited access, scientific exploration of such immense geography is not only logistically challenging, but costly. As part of its commitment to responsible development, the Pebble Partnership has brought together more than 100 independent scientists and researchers, all experts in their respective fields, to conduct a rigorous environmental studies program in southwest Alaska. The resulting EBD is a thorough and comprehensive characterization of the existing physical, biological and socioeconomic conditions surrounding the Pebble Deposit.

With a study area vastly greater than any potential project footprint, and extending some one million acres, the depth and breadth of the research demonstrates the Pebble Partnership's commitment to environmental stewardship. Covering a wide range of scientific disciplines from fish, surface and groundwater hydrology and water quality, to seismicity and wildlife, the Pebble EBD is a compilation of the extensive field research and analyses conducted by more than 40 independent, third-party environmental research firms – including many premier Alaska companies. For most study disciplines, only data collected between 2004 and 2008 are provided in the EBD. Several studies are ongoing and their results will be provided in the future as additional baseline documentation.

Providing detailed environmental and social data and characteristics of the area surrounding the Pebble Deposit, the EBD is a preliminary but key element to creating a

STUDY AREAS *Environmental Baseline Document*



future mine design; a critical planning component for engineers to avoid, minimize and mitigate project effects on specific resources. For example, a comprehensive understanding of the current physical geography of the region will provide Pebble engineers the data necessary to integrate reclamation procedures into the overall project plan – a modern mine designed in advance specifically for closure. However, the EBD is not a mining plan, nor is it an environmental management or mitigation plan. It is purely a compilation of baseline scientific research designed to characterize the existing environment.

The goals of the EBD include:

- *Fully characterize and understand the existing environment surrounding the Pebble Deposit*
- *Provide key input for mine planning*
- *Provide baseline characterization information for the project review under the National Environmental Policy Act (NEPA) and subsequent state and federal permitting processes*

  > *Additional studies and analysis will be conducted to further fulfill NEPA and permitting requirements under separate reports*

The benefits of the study are not limited to natural resource development. The study also provides a valuable legacy for the academic community, serving as a vast database of advanced science for the state of Alaska and an important compilation of cultural and natural values for residents of the region. The EBD is a specialized, expert body of work comprising research that employed advanced techniques and technology, as well as documented and proven scientific methods.

SCOPE

A mining project is a complex endeavor. It is a combination of many possible individual components that together have the potential to be developed into a modern working mine – including access roads, a milling complex, tailings storage facilities, housing, power, infrastructure and port facilities, among others. Pebble's environmental baseline study areas were defined to encompass all locations that could possibly be affected by future project components. For research purposes, studies were divided into two primary study areas: the Bristol Bay Drainages and the Cook Inlet Drainages.

Pebble researchers acquired more than 370,000 analytical laboratory results from environmental field samples, intensely studied nearly 20,000 plots to determine whether they were wetland sites, recorded more than 50,000 field photographs and produced roughly 1,000 maps as part of the EBD.

The Bristol Bay Drainages are further divided into secondary study areas: the Mine Study Area, encompassing approximately 230,000 acres immediately surrounding the Pebble Deposit; and the Transportation Corridor Study Area, extending approximately 65 miles eastward to the western coast of Cook Inlet.

Surveying everything from water quality and weather patterns to geochemistry, caribou migration and archeological sites, all information and observations from this encompassing scientific effort have been published for public review well in advance of project permitting.

Recognizing the important role salmon plays in the economic and cultural fabric of the Bristol Bay region and given the Pebble Partnership's stated goal of co-existence with the salmon fishery, studies of water, aquatic habitats and fish were particularly intensive. The research provides data and insight into the nature of all water in the study areas, including surface water, ground water and marine water. This presents a thorough understanding of the role water plays in the environment, its current composition and the factors affecting fish habitats.

Examination of water bodies was vast, spanning the North Fork Koktuli River, South Fork Koktuli River and Upper Talarik Creek, as well as tributaries and off-channel habitats to these rivers and creeks within the Transportation Corridor Study Area, Iliamna Lake and the coastal waters of Cook Inlet. Altogether, thousands of water quality samples were collected for testing and analysis. Additionally, fisheries biologists used nearly 3,000 sampling locations – engaging in snorkeling, electrofishing, dip netting, angling and minnow trapping – to identify fish species by distribution and abundance. Aerial spawning surveys were undertaken to identify

spawning locations for each salmon species, while water flow and temperatures were analyzed in relation to spawning patterns and habitat.

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Throughout the five-year study period, fieldwork for many disciplines took place year-round, with winter temperatures regularly dropping below -10 F. Hydrology data collected on a monthly basis at streams often required digging through deep snow drifts and auguring through several feet of ice to collect samples. Despite the unforgiving climate conditions and isolation, Pebble researchers acquired more than 370,000 analytical laboratory results from environmental

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Additional consideration of census studies, conducted outside of the EBD but applicable in the overall socioeconomic evaluation of the area, show that many rural communities in the state, including southwest Alaska, suffer an unemployment rate of nearly 20

percent. In particular, year-round jobs in southwest Alaska are extremely limited and, according to data provided in the May 2011 edition of *Alaska Economic Trends*, published by the Alaska Department of Labor and Workforce Development, the area carries the distinction of having one of the highest costs of living in the nation.

HOW TO READ THE EBD

The Pebble EBD is composed of 53 chapters. Each chapter of the Pebble EBD includes a table of contents, definition of acronyms and abbreviations, a list of references and a glossary of terms, as well as the given discipline's study objectives and methods, and a discussion of researchers' results complete with tables and figures. A separate technical summary document provides a broad overview of the chapters in each scientific discipline.

Material within the EBD relates to one of the two geographical study areas (Bristol Bay Drainages or Cook Inlet Drainages) where development and reclamation of the Pebble Project could occur. This division was made because the Cook Inlet Drainages Study Area is almost completely defined by the coastal and marine environments of Cook Inlet, which have substantially different characteristics than the interior environments of the study areas within the Bristol Bay Drainages.

The entire printed version of the EBD contains approximately 20,000 pages. Some appendices are available only electronically because of their length. The complete electronic version has approximately 27,000 pages and is available at pebbleresearch.com.

The study disciplines have been organized into three categories: physical environment (e.g., climate, water quality, trace elements); biological environment (e.g., fish and aquatic invertebrates, wildlife and habitat); and socioeconomic environment (e.g., land and water use, subsistence). These categories and the disciplines within are presented in identical order for both the Bristol Bay Drainages and the Cook Inlet Drainages. However, there are a few exceptions, as some of the disciplines (such as marine studies) apply only to the Cook Inlet Drainages.

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In total, the Pebble EBD not only gives a true glimpse of the complex and diverse world around us – it comprehensively, objectively and scientifically characterizes the environmental baseline conditions of the region.

What follows is a high-level overview of the various sections and main disciplines related to the EBD.

II

Social

REGION DEMOGRAPHICS

The social section of the EBD covers a wide breadth of social, economic and demographic information for the region. The studies include a short history of the region, traditional knowledge and subsistence, as well as documentation of the visitor, government and commercial salmon industries as they relate to southwest Alaska.

Like much of rural Alaska, village populations vary greatly from a few dozen to a few hundred residents. In 2009, eight communities nearest the study area (Nondalton, Newhalen, Kokhanok, Port Alsworth, Iliamna, Pedro Bay, Levelock and Igiugig) ranged in population from a low of 48 in Pedro Bay and Igiugig to a high of 186 in Nondalton. These remote communities embody a long history of Alaskan culture, holding steadfast to many traditional ways of life passed between generations. Today, however, declining populations in the region are a reminder of the struggle residents endure to survive with a high cost of living, widespread unemployment and limited infrastructure.

The socioeconomic aspect of the environmental research encompassed an in-depth look into these communities along with research into additional communities throughout the Lake and Peninsula Borough, the Bristol Bay Borough and the Dillingham Census Area. These studies include aspects that range from populations and economic opportunities to quality of life. Extensive research was collected in an effort to understand the realities of life in the communities of southwest Alaska.

The Alaska Native population residing in the Bristol Bay Drainages Study Areas is mostly composed of Central Yup'ik Eskimos and Dena'ina Athabascan Indians, but also includes Alutiiq-speaking people (known as Aleut or Suspiaq) along the coastal area of Bristol Bay. There are no permanent communities within the Iliamna and Iniskin bay areas of the EBD Cook Inlet Drainages Study Area. The Alaska Native population engages in subsistence hunting and fishing, and there is continued emphasis on maintaining Native culture and values, including Native dancing, Native art and Native language. Of all the cultural aspects, retention of Native language has probably been the most affected; as of the 2000 census, Alaska Native languages are now only used on an ongoing basis for two percent of the population in the Bristol Bay Borough, 10 percent of the population throughout the Lake and Peninsula Borough and 34 percent of the population in Dillingham Census Area.

Population trends have spiraled downward in some parts of the study area, most likely due to outmigration of residents. In the Bristol Bay Borough, overall population declined 23 percent from 2000 to 2009; Lake and

Peninsula Borough experienced fairly similar trends with an overall population decline of 15 percent; and Dillingham had a decline of four percent. Likewise, school enrollment drastically declined in most of the study area, decreasing between 1997 and 2010 by 55 percent in the Bristol Bay Borough and 36 percent in the Lake and Peninsula Borough. Dillingham Census Area, based on limited data available for 1999 to 2008, showed an increase of 11 percent. Unemployment and low income are also prevalent in the region. Indeed, in 1999, the number of individuals living below the poverty level was 19 percent in the Lake and Peninsula Borough, 10 percent in the Bristol Bay Borough and 21 percent in the Dillingham Census Area.

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As unemployment increases and job opportunities are scarce, residents look for stable, year-round work elsewhere. However, in rural Alaska, leaving the community to find a job far from home is not a cultural ideal. With a relatively young, able-bodied population (as of 2009, the proportion of the population age 19 or younger was 37 percent in the Lake and Peninsula Borough, 27 percent in the Bristol Bay Borough and 40 percent in Dillingham), many believe the communities in southwest Alaska would benefit greatly from increased economic opportunity within their local areas, thereby keeping these rural communities intact.

REGION ECONOMY

None of the villages in southwest Alaska are connected to Alaska's road system. Because these communities are accessed by airplane or boat, cost of living is high, businesses are few and year-round employment opportunities are limited.

The Bristol Bay commercial salmon fishery, followed by the government and visitor industries, dominate the region's economy. Of these three primary economic drivers, only government provides significant year-round employment.

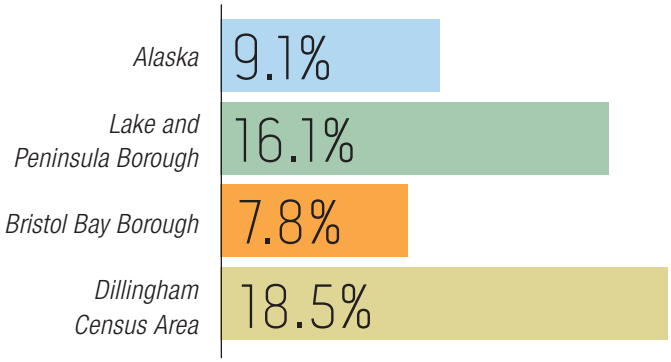
Regional Outmigration

COMMUNITY	Census 2000	Census 2010	10-year change
Bristol Bay Borough	1,258	997	-261
King Salmon	442	374	-68
Naknek	678	544	-134
South Naknek	137	79	-58
Lake and Peninsula Borough	1,823	1,631	-192
Chignik	79	91	12
Chignik Lagoon	103	78	-25
Chignik Lake	145	73	-72
Egegik	116	109	-7
Igiugig	53	50	-3
Iliamna	102	109	7
Ivanof Bay	22	7	-15
Kokhanok	174	170	-4
Levelock	122	69	-53
Newhalen	160	190	30
Nondalton	221	164	-57
Pedro Bay	50	42	-8
Perryville	107	113	6
Pilot Point	100	68	-32
Pope-Vannoy Landing	8	6	-2
Port Alsworth	104	156	55
Port Heiden	119	102	-17
Ugashik	11	0	-11

School Enrollment

COMMUNITY	2000	2010	10-year change
Bristol Bay Borough	491	344	-147
Lake & Peninsula Borough	269	158	-111

Region Poverty Level *2010 U.S. Census*



The overwhelming majority of fishing and visitor industry jobs are seasonal.

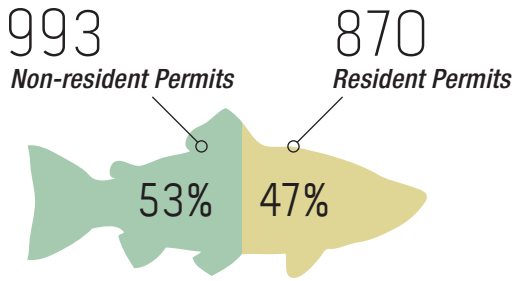
Commercial Fishing

Commercial fishing has been a cornerstone of the Bristol Bay region, particularly the sockeye salmon fishery, which generally accounts for around 91 percent of the salmon catch value and 80 percent of the value for all Bristol Bay commercial fisheries. Also commercially caught in Bristol Bay are smaller numbers of chinook, coho, pink and chum salmon, as well as halibut, cod, pollock, crab and rockfish.

2010 Bristol Bay Commercial Fishing Permit Holders

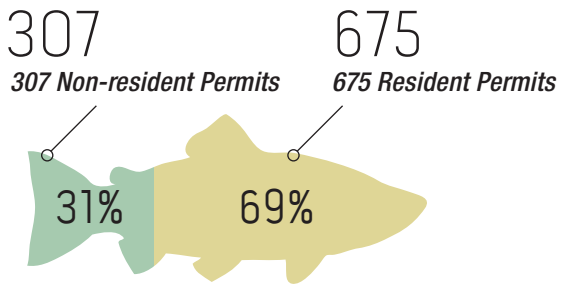
Commercial Fisheries Entry Commission, Alaska's Limited Entry Salmon Fisheries, 2001-2010

Drift Gillnet Permits Issued



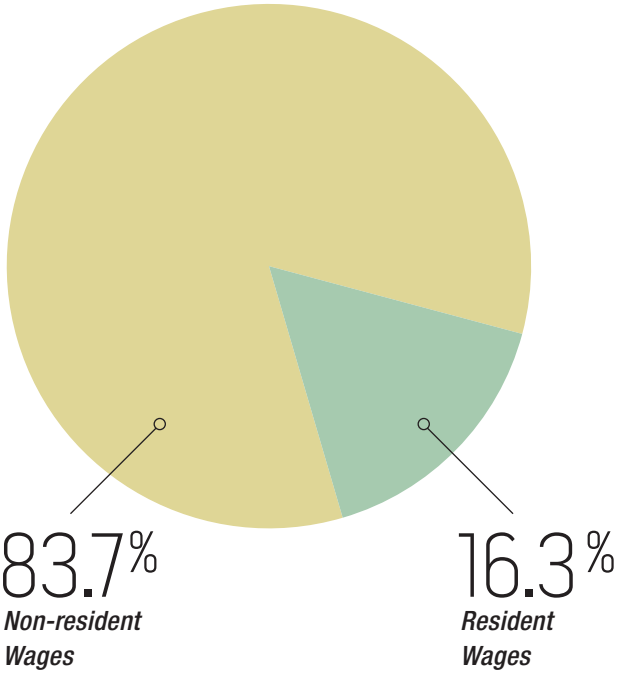
1,863 ***Drift Gillnet Permits Issued***

Set Net Permits Issued



982 ***Set Net Permits Issued***

2008 Bristol Bay Fishery Processing Industry



$23,923,732

Total Non-resident Wages

The Bristol Bay commercial fishery encompasses all coastal and inland waters east of a line from Cape Newenham to Cape Menshikof. In addition to the bay, the area includes nine major river systems: Naknek; Kvichak; Alagnak; Egegik; Ugashik; Wood; Nushagak; Igushik and Togiak. The bay itself is more than 100 miles southwest of the Pebble Deposit.

In 2009, non-resident permit holders accounted for 54 percent of the total drift gillnet permits fished in the Bristol Bay salmon fishery.

Historically, the industry has provided limited employment to local residents, and Alaska Natives often were excluded altogether during the early years of the commercial fishery. In 1973, the state of Alaska initiated a "limited entry program," which stipulated that entry permits could only be issued to "natural persons," but the permits could be sold to non-residents.

Among the holders of current limited-entry commercial fishing permits, Alaska residents consistently have smaller average earnings derived from the Bristol Bay salmon fishery, as compared to non-resident permit holders. Despite sound management and sustainability of Bristol Bay salmon stocks, the rise of farmed salmon on a world-wide scale throughout the past 25 years has profoundly affected Bristol Bay fishery economics. The harvest value has decreased substantially, as have the value of the permits and the number of fishermen participating in the fishery. Since 1990, the number of individuals involved in the harvest has fallen nearly 40 percent.

Salmon processing, taking place both in offshore floating and shore-based facilities, provides substantial seasonal employment. In 2008, seafood processing employed 2,943 persons in the Bristol Bay Borough, 565 persons in the Lake and Peninsula Borough and 459 persons in the Dillingham Consensus Area. According to 2009 Alaska Department of Labor and Workforce Development statistics, for the last decade, the vast majority of seafood processing jobs in the Bristol Bay Region were held by people from outside of the region.

Commercial fishing also contributes to the local economy by way of tax revenues. In 2009, the Bristol Bay Borough received $1,542,615 in shared fisheries business taxes; the Lake and Peninsula Borough received $151,743; and Dillingham received $187,259. Bristol Bay regional development tax receipts totaled $1,066,270. The Bristol Bay Borough collected $1,441,628 from its 3 percent raw fish tax; the Lake and Peninsula Borough collected $1,260,995 from its 2 percent raw fish tax.

According to the Alaska Department of Fish and Game, the 2009 harvest of all salmon species in Bristol Bay was approximately 32.4 million fish, while the calculated ex-vessel value of Bristol Bay's 2009 salmon fishery was approximately $129.7 million. Of that total harvest, the value of the larger drift gillnets permit harvest was $105.5 million in a fishery where non-resident permit holders accounted for 54 percent of the permits fished, while the value of the smaller setnet fishery was $24.2 million, in which 67 percent of the participating permit holders were Alaskan residents.

Government

Government is by far the largest source of year-round employment in the Lake and Peninsula Borough. In 2008, federal, state and local governments accounted for a monthly average of 424 jobs and nearly $11.5 million in annual payroll. Local government accounted for 373 jobs in the borough, while there were 42 jobs in the federal government and nine jobs in state government. Among the government employment in the borough are positions in the Alaska Department of Fish and Game, the United States Postal Service, regional courts, local law enforcement and tribal government.

Government is a stabilizing influence in the borough's otherwise highly seasonal economy, which is further burdened by a transient population. Private-sector employment in 2008 ranged from a low of 135 jobs in January to a high of 827 in July. In the same year, government employment ranged from a low of 276 jobs in July to a high of 483 in May.

Visitor Industry

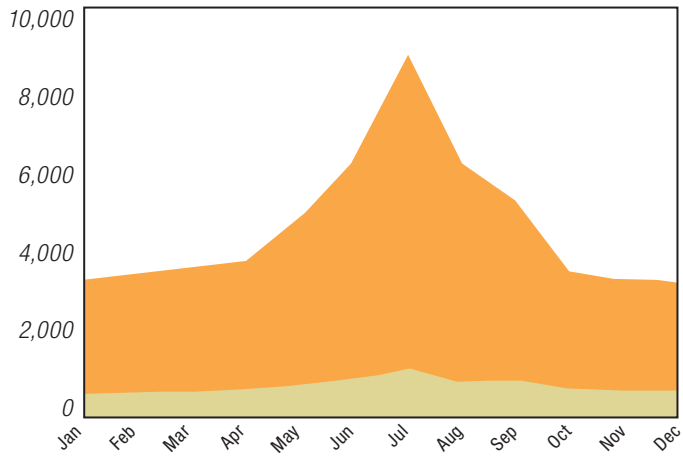
According to the Lake and Peninsula Borough Comprehensive Economic Development Strategies, tourism is the third largest industry in the borough, after commercial fishing and government services. With a primary focus on high-end sport fishing, hunting and bear-viewing, other visitor attractions include recreational activities such as hiking, camping, boating and rafting. In 2008, 103,860 sportfishing day trips were taken in the Bristol Bay area. The area is also home to three national wildlife refuges and numerous scenic rivers, parks and preserves. In 2009, 43,035 people visited Katmai National Park, while 9,711 visited Lake Clark National Park.

EMPLOYMENT

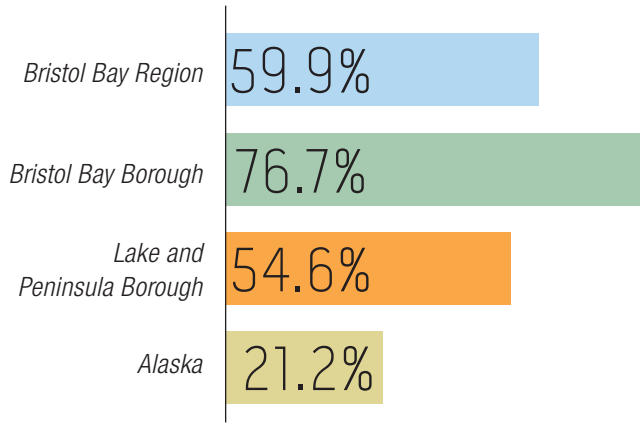
Employment levels are closely related to overall economic activity in any region. A large, active economy with multiple, interacting sectors of manufacturing, trade, distribution and consumption of goods offers more employment opportunities and a wider variety of career fields than a small or less robust economy. In southwest Alaska, the economy and related employment opportunities are limited due to a number of factors. Among them are small populations, underdeveloped infrastructure and the remote nature of the area.

Food sold in local groceries, for example, is significantly higher priced than it is in a typical community connected to the main road system. Simple food staples can be challenging to a family budget. Delivery of gasoline and other fuels to retail distributors in the region costs more because they must be transported by airplane or boat, increasing the downstream prices to consumers and local

Seasonality of Bristol Bay Regional Employment



Private Sector Non-resident Hire



Source: Alaska Department of Labor and Workforce Development, Research and Analysis Section

businesses. For example, home heating oil, which is used by 89 percent of households in the communities nearest the Pebble Deposit, increased 42 percent between 2006 and 2010 and can exceed $7.00 per gallon, compared to $3.79 per gallon in Anchorage. The cost of diesel fuel in the region, which is required for electricity generation, rose 193 percent between 2002 and 2009.

In the year 2000, average per capita income for the largest Lake Clark and Iliamna Lake communities studied ranged from $7,732 (Kokhanok) to $21,716 (Port Alsworth), while the median household income for these lake communities ranged from $18,750 (Levelock) to $60,625 (Iliamna).

SUBSISTENCE & TRADITIONAL KNOWLEDGE

Subsistence activities are a central feature of Alaska Native history and society. The term 'subsistence' collectively refers to the practices of hunting, fishing and gathering that have sustained the state's aboriginal peoples for thousands of years and is a primary characteristic of Alaska Native culture.

Subsistence activities help transmit cultural knowledge between generations, maintain the connection of people to their environment, and support healthy diet and nutrition. These activities are also recognized for their spiritual and cultural importance in forming Native peoples' worldview and maintaining ties to their ancient culture. For those people who live in rural areas without the opportunity or financial means to purchase sufficient amounts of groceries, and for those with means but who enjoy and choose to participate in subsistence activities, subsistence harvests can be a primary means of providing food.

Fieldwork among the 10 area communities for which subsistence studies were completed found that subsistence activities by residents who live in the vicinity of the Pebble Deposit occur over an extensive area. Total subsistence use areas ranged from 1,481 square miles for Pedro Bay to 26,764 square miles for Iliamna. The areas utilized for subsistence extend west as far as Kulukak Bay and Round Island, east into Cook Inlet, north to the Swift and Kuskokwim rivers, and south to the Naknek River area.

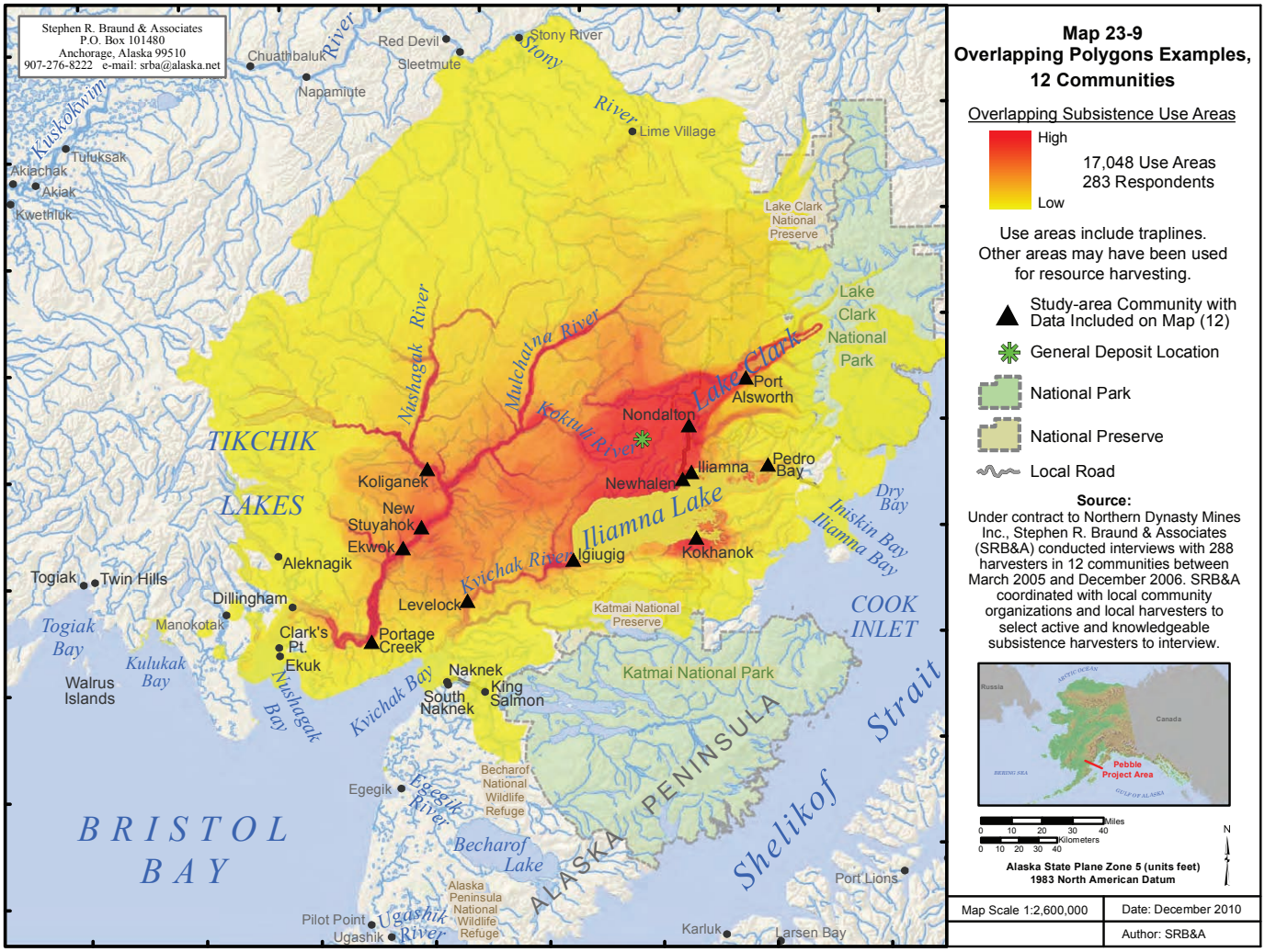
Residents of the study communities rely on a wide diversity of subsistence species such as trout, grayling, salmon, seal and larger mammals such as porcupine, moose and caribou.

The subsistence study area included 20 communities in the Lake Clark and Iliamna Lake areas (Nondalton, Port Alsworth, Iliamna, Newhalen, Pedro Bay, Kokhanok, Igiugig and Lime Village), communities downstream from the Pebble Deposit in the Koktuli-Mulchatna-Nushagak river drainages (Koliganek, New Stuyahok, Ekwok, Portage Creek, Dillingham, Clark's Point, Manokotak and Aleknagik) and communities downstream from the Pebble Deposit in the Kvichak River drainage (Levelock, Naknek, South Naknek and King Salmon). The EBD presents approximately 300 pages of information for each of the 10 communities for which subsistence reports were completed.

Residents of the study communities rely on a wide diversity of subsistence species such as trout, grayling, salmon, seal as well as larger mammals such as porcupine, moose and caribou. Residents have reported harvesting approximately 150 individual species, including species of large land mammals, small land mammals, marine mammals, fish, waterfowl, upland birds, marine invertebrates, berries and plants.

Respondents reported year-round subsistence activities, with peaks in activities generally occurring in the summer/early fall and late winter/early spring months.

Subsistence Participation



Per capita harvests in the reported communities ranged from 132 pounds by residents of Port Alsworth to 977 pounds by residents of Koliganek during the study years. Households reported harvesting an average of between 6.7 and 15.8 subsistence species and sharing an average of between 3.4 and 10.5 species. During the course of the study, between 91 to 100 percent of households in the communities surveyed reported participation in subsistence activities.

The study team gathered baseline information by combining fieldwork, which included household harvest surveys conducted by the Alaska Department of Fish

Per Capita Subsistence Resources Harvested

COMMUNITY	Lbs. Per Capita
Nondalton	358
Kokhanok	680
Newhalen	692
Port Alsworth	133
Iliamna	469
Levelock	527
Pedro Bay	306
Igiugig	542
Koliganek	977

and Game, with subsistence mapping and traditional knowledge interviews.

CULTURAL RESOURCES

For many Alaskans, the past is as valuable as the future. Some of the study area traverses a greater region where possibly both Yup'ik and Dena'ina people have lived for several thousand years. Here, the surveys uncovered archaeological sites of potential cultural significance and compiled extensive knowledge, much of which had never before been captured, that will serve the region's historical and cultural record. Among their findings were:

Bristol Bay Drainages Study Areas

- *Two prehistoric lithic (stone tools) sites along the South Fork Koktuli River*
- *One rock circle and nearby rock stack on a large glacial rubble pile south of the Cone*
- *Two possible tent rings on a south-facing ridge of Kaskanak Mountain*
- *Several isolated lithic finds*

Cook Inlet Drainages Study Area

- *January 1910 Farallon shipwreck*
- *Trading post at AC Point, Iliamna Bay*
- *Beach front hearth and rock shelter near Knoll Head*

At a time when some Alaska Native cultural practices are in danger of becoming obsolete, language being one of the most notable, it is important to document and preserve as many ties to the past as is possible. A healthy economy and improved infrastructure can help revitalize some of the remote communities of southwest Alaska, which in turn, provides new opportunities to preserve the history, culture and traditional lifestyles of Alaska Natives – today and for generations to come.

III

Biological

FISH & AQUATIC HABITAT

Fish have been a commercial, sport and cultural cornerstone of the Bristol Bay region throughout history. Understanding the importance of fish in Alaska, coupled with its commitment to co-existence, the Pebble Partnership designed an environmental studies program that is the most comprehensive assessment of existing baseline conditions of fish resources ever assembled in the Bristol Bay region. These studies have thoroughly documented species, distribution and relative abundance; defined and characterized fish habitat types; and evaluated the complex relationships between fish habitat and water flow.

Between 2004 and 2008, biologists conducted more than 50 surveys in each of the river systems near the Pebble Deposit: the north and south forks of the Koktuli River and Upper Talarik Creek. In total, they surveyed nearly 3,000 sites to collect data on fish and fish habitat. The multifaceted research effort to assess fish resources in the waterways downstream from the Pebble Deposit is a key element of the more than $120 million invested in environmental studies.

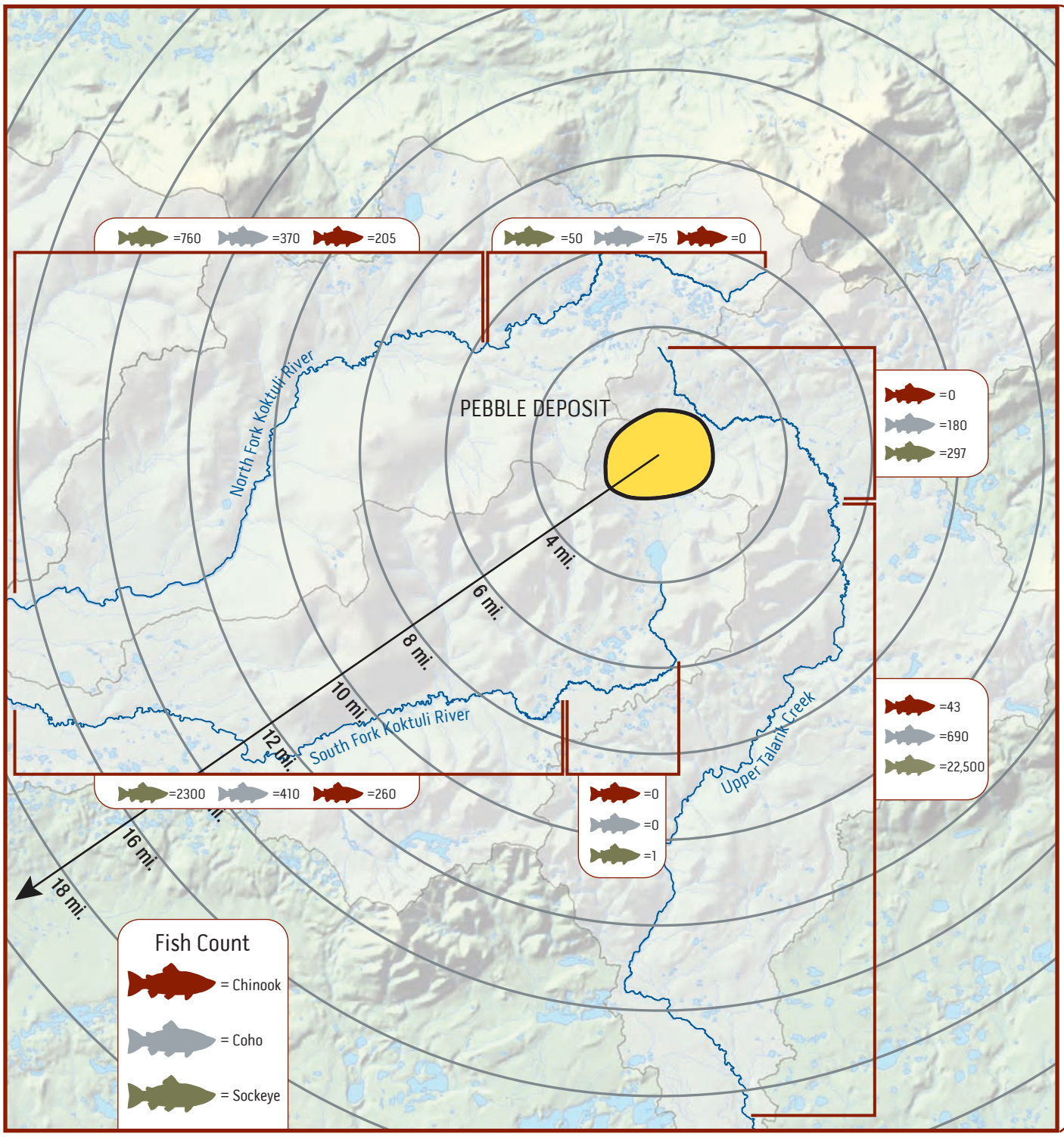
If Pebble is developed, results of the studies will assist environmental scientists and engineers in designing a project that will protect the area's rich fish resources and habitats. Should the project not move forward, the work remains compelling, providing a valuable legacy of environmental research and local knowledge.

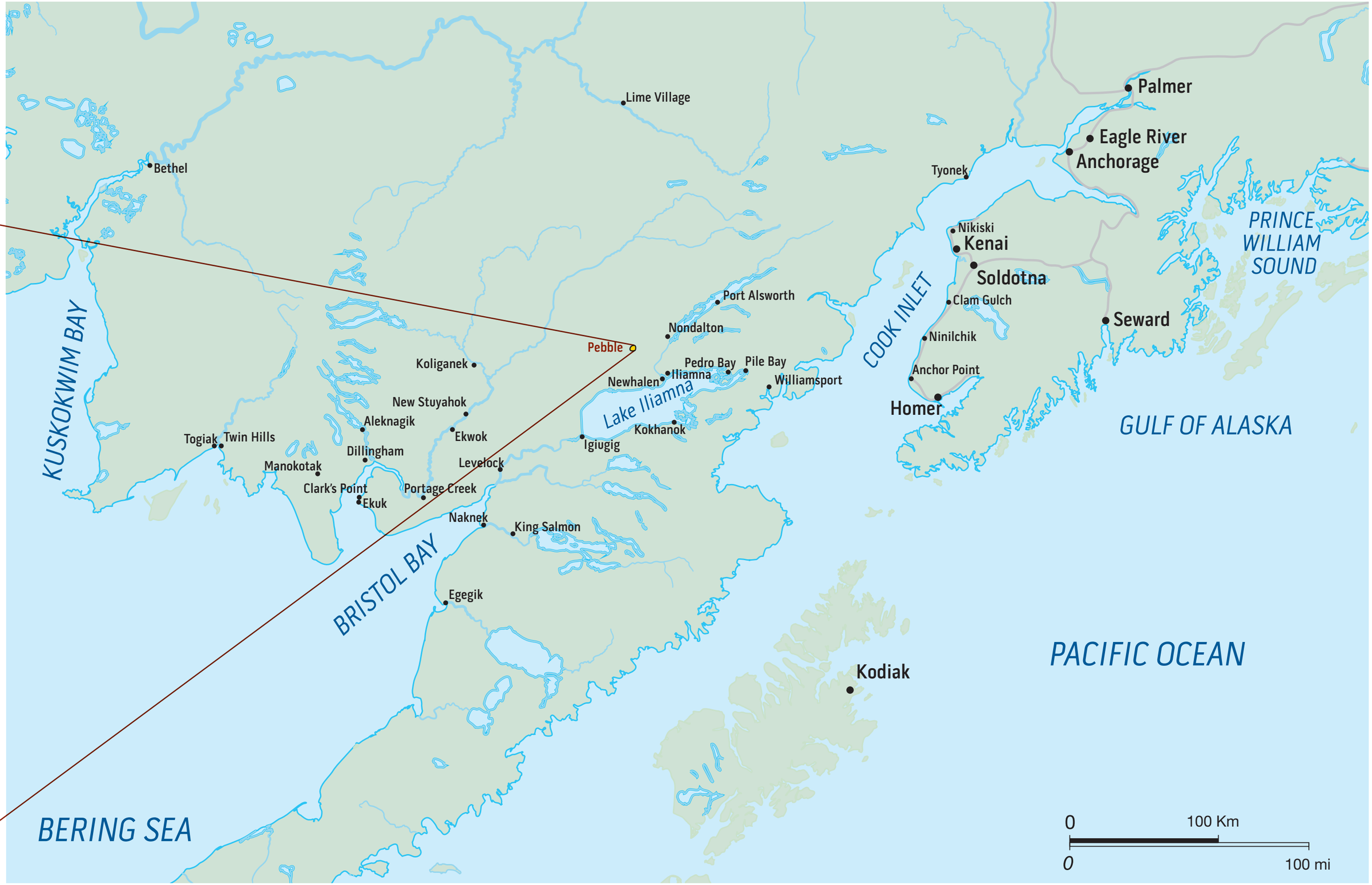
While sockeye account for roughly 95 percent of the volume and value of commercial fisheries in the Bristol Bay region, rivers and streams draining into Bristol Bay also support

Between 2004 and 2008, biologists conducted more than 50 surveys in each of the three river systems near the Pebble Deposit: the north and south forks of the Koktuli River and Upper Talarik Creek.

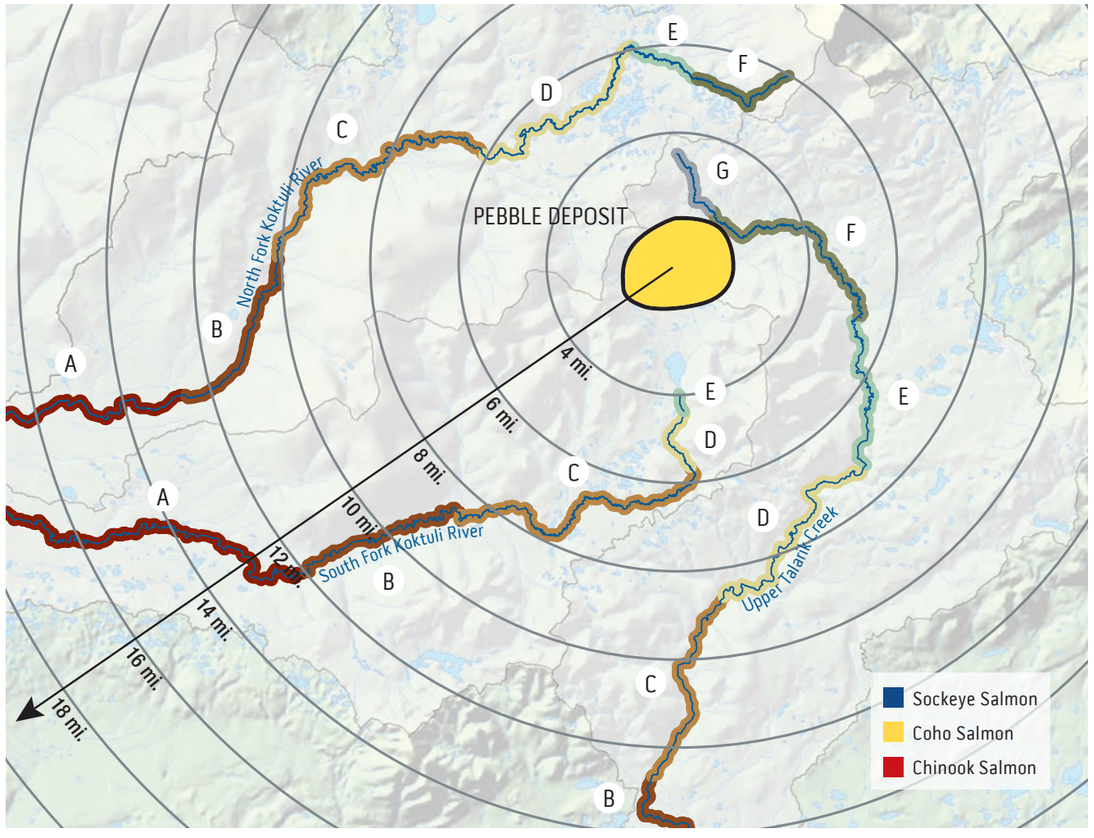
For the most part, anadromous spawning and rearing activity occur in the lower and middle reaches downstream from the Deposit and are limited near the Deposit site.

Area Salmon Spawning Distribution

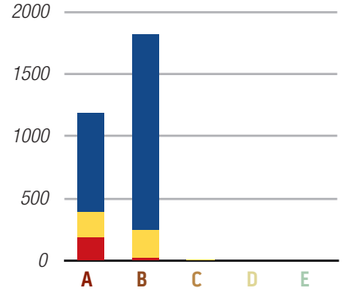



Lime Village
Bethel
Palmer
Eagle River
Anchorage
Tyonek
Nikiski
Kenai
Soldotna
Clam Gulch
Seward
Ninilchik
Anchor Point
Homer
PRINCE WILLIAM SOUND
COOK INLET
GULF OF ALASKA
KUSKOKWIM BAY
Port Alsworth
Nondalton
Pebble
Koliganek
Pedro Bay
Pile Bay
Iliamna
Newhalen
Williamsport
Lake Iliamna
New Stuyahok
Aleknagik
Kokhanok
Igiugig
Togiak
Twin Hills
Ekwok
Dillingham
Levelock
Manokotak
Clark's Point
Portage Creek
Ekuk
Naknek
King Salmon
BRISTOL BAY
Egegik
PACIFIC OCEAN
Kodiak
BERING SEA
0
100 Km
0
100 mi

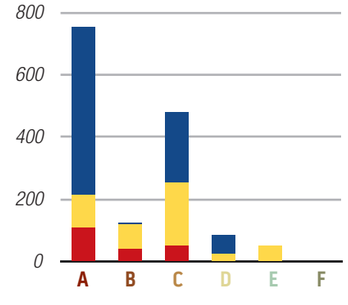
Salmon Spawning Distribution by Study Segment



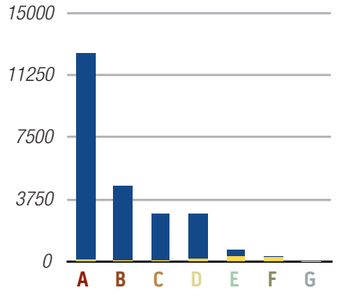
South Fork Koktuli River



North Fork Koktuli River



Upper Talarik Creek



*Although present, chums are relatively uncommon in the systems.

smaller commercial fisheries for Chinook, coho, chum and pink salmon.

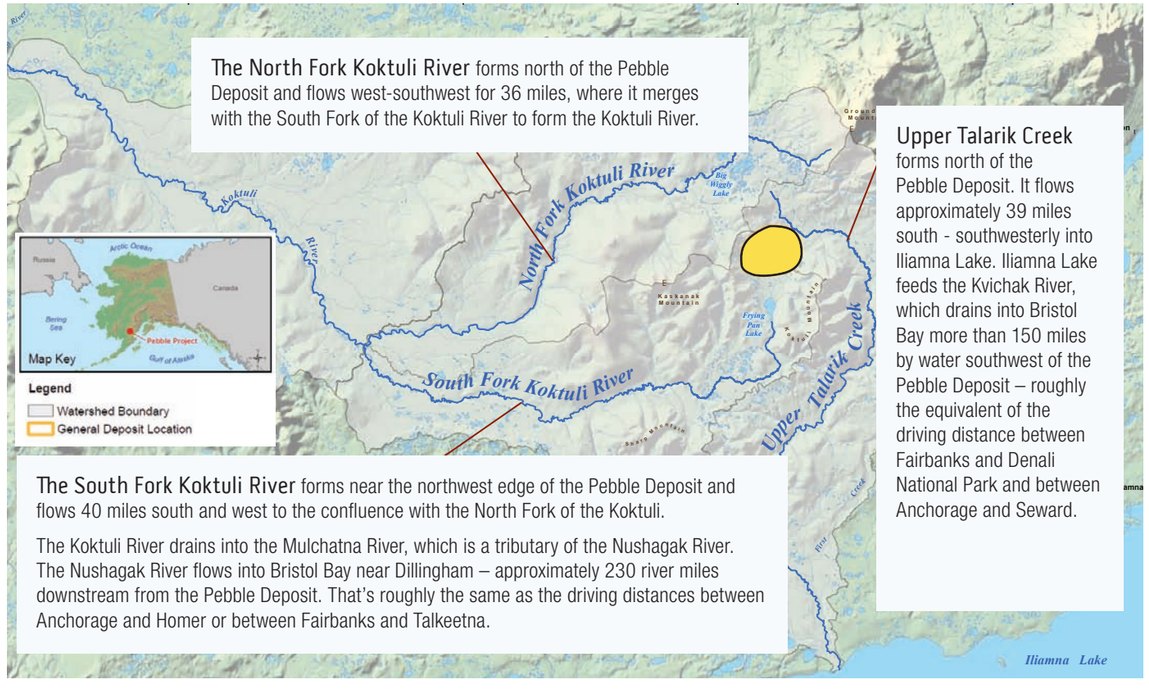
Likewise, salmon are not the only species of fish that populate the waters of southwest Alaska. Other species, like rainbow trout, Dolly Varden and arctic grayling, also play an important role in subsistence and sport fishing. The variety of fish species also provides a source of food for area wildlife, from brown bears and eagles to gulls and river otters.

The Pebble EBD presents extensive data on the aquatic habitats, migration and spawning activities for fish populations found in the Pebble Deposit Study Area. The five Alaska species of anadromous Pacific salmon (ones that migrate from saltwater to fresh water), as well as a number of resident fish, are present in various habitat locations and at different levels of abundance within the three watersheds near Pebble.

The Bristol Bay region comprises nine major river systems and is divided into five management districts by Alaska Department of Fish & Game (ADF&G). Of the three tributaries in the vicinity of the Pebble Deposit, the North Fork of the Koktuli River and the South Fork of the Koktuli River are included in ADF&G's Nushagak Management District, and Upper Talarik Creek is part of the Naknek-Kvichak District.

Each of these three watersheds individually composes approximately 0.3 percent of the total acreage in the Bristol Bay drainage region – combined, they still amount to less than 1 percent of the Bristol Bay Drainage.

Biologists studying the North and South Fork Koktuli rivers and Upper Talarik Creek produced the most extensive scientific report of fish in the Bristol Bay region to date. Studies encompassed the main rivers, as well as off-channel habitats like sloughs, pools and beaver ponds.



Surveys were conducted through the lengths of the three rivers, as well as habitats within the first 10 miles of the Koktuli River downstream from the confluence of its north and south forks. From these surveys, biologists gained a thorough understanding of existing aquatic habitat in the area. Additionally, the Pebble study expanded the known distribution of anadromous fish (those that migrate from saltwater to fresh water) in the Mine Study Area by 23 miles, extending and adding new streams to ADF&G's "Anadromous Waters Catalog."

Each of these three watersheds individually compose approximately 0.3 percent of the total acreage in the Bristol Bay drainage region – combined, they still amount to less than 1 percent of the Bristol Bay Drainages.

Geographically, the study area for fish was expansive. There were dozens of detailed surveys along a 65-mile Transportation Corridor Study Area from the Deposit area to Iniskin Bay on Cook Inlet. The study area crosses numerous rivers, streams and channels that eventually drain into Iliamna Lake, as well as three creeks that drain into Cook Inlet.

For research purposes, forks of the Koktuli and the Upper Talarik were divided into segments called "reaches," based on common physical characteristics such as the width of the river, the amount of flow and the steepness of the grade. There were five to seven reaches in each of the three rivers, ranging from fewer than two to more than 10 miles in length.

Additionally, the Pebble study expanded the known distribution of anadromous fish (those that migrate from saltwater to fresh water) in the Mine Study Area by 23 miles, extending and adding new streams to ADF&G's "Anadromous Waters Catalog."

The three watersheds showed many features in common, including complex off-channel habitats; groundwater and tributaries that moderate water temperatures; and water properties and riverbed gravel that promote spawning. Additionally, the three watersheds have a number of habitats favorable to rearing (growth) and overwintering. For example, there are more than 100 beaver ponds that support rearing, mostly off the main channels and in the upstream reaches.

The main river channels within each of the three watersheds are composed primarily of runs/glides and riffles, with most anadromous spawning occurring in the lower and middle reaches of the watersheds. The majority of rearing habitat, particularly for coho salmon, is found in off-channel habitats.

Perhaps of greatest interest to the Pebble Study Area, however, is what researchers learned about distribution and abundance of fish for a variety of species and life stages. The greatest diversity of species and abundance of fish and the most spawning and rearing activity are found in the lower and middle reaches downstream from the Deposit and are reduced as the rivers approach the Deposit.

Scientists believe this may be partially due to the moderating effects of inflow from groundwater and tributaries on water temperatures in the midstream and downstream reaches for the two forks of the Koktuli and

due to the proximity to Iliamna Lake for the Upper Talarik. Indeed, sockeye salmon, whose abundance in the Mine Study Area dwarfs all other species, spend little time in any of the rivers. They spawn in the lower reaches in late summer and early fall, they hatch in the spring and then, with few exceptions, they migrate out of the area for rearing.

From 2004 to 2008, the average index counts for sockeye salmon in the North Fork and South Fork Koktuli rivers together numbered somewhat less than 2000 annually, while the average index counts of sockeye counted in Upper Talarik Creek ranged from approximately 2,500 to 30,000 over the study period. The number of spawning sockeye in the Upper Talarik exceeds the numbers spawning in the two forks of the Koktuli. This may be due to Upper Talarik Creek providing preferred sockeye rearing habitat and zooplankton food source through its connection to Iliamna Lake. With no access to a lake habitat for rearing, the "river type" salmon in the two forks of the Koktuli rely mostly on main-channel river habitat for feeding.

In the Upper Talarik, where groundwater influence is present throughout, rather than limited to midstream and downstream reaches, sockeye spawning is concentrated downstream – nearest Iliamna Lake and farthest from the Pebble Deposit. In 2008, the average number of spawning sockeye declined in each consecutive upstream reach – from more than 10,000 nearest Iliamna Lake to fewer than 100 in the upper reaches.

Unlike sockeye hatched in the north and south forks of the Koktuli River, which must migrate long distances to the mouth of the Nushagak or rear in a river, fry in Upper Talarik Creek migrate a shorter distance to rear in Iliamna Lake. Smaller numbers of fry from Upper Talarik Creek also rear in the portion of the river closest to the lake.

Between 2004 and 2008, biologists conducted more than 50 surveys in each of the three river systems near the Pebble Deposit: the north and south forks of the Koktuli River and Upper Talarik Creek. In total, they surveyed nearly 3,000 sites to collect data on fish and fish habitat.

Although sockeye salmon are the most abundant species, the three watersheds in the Mine Study Area also support Chinook, chum and coho salmon in much smaller numbers. Biologists also found evidence of "exploratory runs" of pink salmon in the Upper Talarik. The various salmon species distribute themselves through the river systems based on different habitat preferences. The data suggest that Chinooks prefer the "big water" and groundwater influences in the lower reaches of the north and south forks of the Koktuli River, but are more widely distributed within Upper Talarik Creek. Interestingly, chums respond positively to groundwater inflow as

While any potential mine footprint in the area will be substantially smaller than the EBD study areas, the comprehensive fish research conducted in the Bristol Bay Drainages Study Areas will equip Pebble engineers and environmental scientists with the tools needed to develop a plan ensuring that one of the world's richest mineral deposits and one of the world's richest commercial, subsistence and sport fisheries will not only co-exist, but sustain the culture, enrich the communities and strengthen the economy of southwest Alaska for generations to come.

well, spawning primarily downstream in the forks of the Koktuli and throughout the Upper Talarik, but in very low numbers. Research consultants also observed that the

North Fork Koktuli exhibits the largest Chinook and chum salmon runs, followed closely by the South Fork, while the Upper Talarik has the largest coho salmon run. Coho are found in relative abundance throughout the three river systems, with the exception of the uppermost reaches of the two forks of the Koktuli, which are the closest to the Deposit. Coho also dominate off-channel habitats with rearing activity in all three watersheds. Most coho spawning occurs in the midstream and downstream reaches of the north and south forks of the Koktuli, but occurs throughout the reaches of the Upper Talarik.

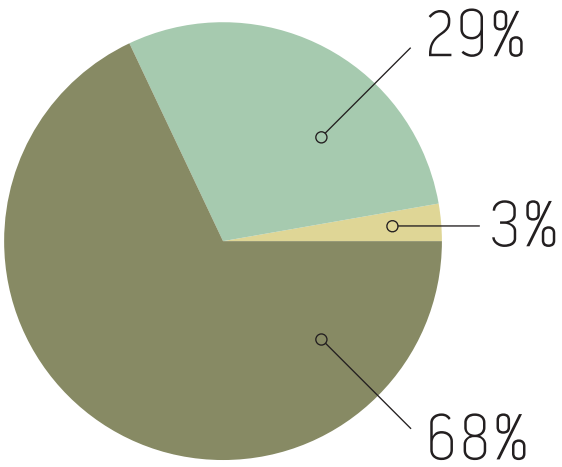
The Pebble EBD shows that resident species in the north and south forks of the Koktuli River and the Upper Talarik Creek are also important to subsistence and sport fishing in the region. Subsistence fishing is focused on arctic grayling, Dolly Varden, rainbow trout, whitefish, burbot and northern pike. Grayling, Dolly Varden, rainbow trout and pike are also popular sport fish. Most abundant among the non-salmon species are arctic grayling and sculpin. Although the resident non-salmon species are found throughout the three study area rivers, in general they are found in greater abundance in upstream reaches.

Recognizing the importance of the rainbow trout catch-and-release sport fishery in the Iliamna Lake region, researchers also conducted a two-year study of the seasonal distribution and migration patterns of rainbow trout in Upper Talarik Creek and Iliamna Lake. Biologists implanted radio transmitters in approximately 100 foraging and post-spawning rainbow trout captured in Upper Talarik Creek in order to track their movements remotely and found that foraging was widespread and occurred in Iliamna Lake, as well as several streams draining into and out of the lake.

Sockeye salmon spend little time in any of the rivers. They spawn there in late summer and early fall, they hatch in the spring and then, with few exceptions, they migrate out of the area for rearing.

While any potential mine footprint in the area will be substantially smaller than the EBD study areas, the comprehensive fish research conducted in the Bristol Bay Drainages Study Areas will equip Pebble engineers and environmental scientists with the tools needed to

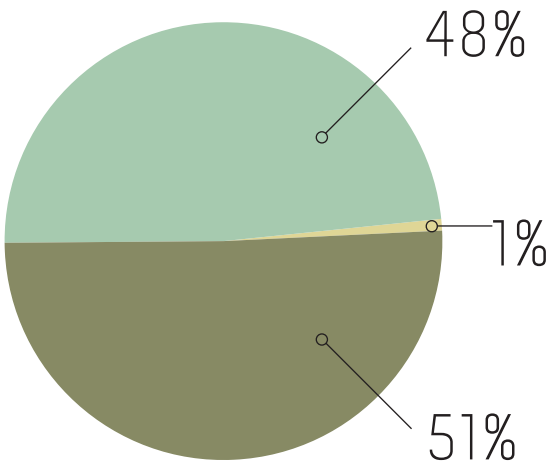
Nushagak/Mulchatna River System Sockeye – 2008



Total Run = 1,683,277

Escapement (493,000)
Commercial Catch (1,144,000)
Subsistence (46,277)

Kvichak River Sockeye – 2008



Total Run = 5,686,803

Escapement (2,758,000)
Commercial Catch (2,880,000)
Subsistence (48,803)

SNORKELING FOR SALMON

At seven o'clock in the morning on an overcast summer day, a team of biologists set out on their 20-minute commute to work. Helicopter-pooling to the jobsite, the researchers bring along enough provisions for a typical 10-hour shift in Alaska's wild and remote southwest.

Their destination: the North Fork Koktuli River, accessed solely by air, as there is no road or hiking trail access. Upon landing and finalizing an evening pick-up plan with the pilot, the biologists gather their equipment and move to the water's edge where they exchange their fleece and hiking boots for wetsuits and snorkel gear. Then, in the name of science, the group disappears into the cool rushing waters of the river, which has reached 43 degrees Fahrenheit by mid-July.

They are in search of salmon fry and other fish swimming beneath the surface.

As the biologists explore the world of salmon, they consider many aspects of the environment. The riverbed's composition and gravel quality is evaluated. They measure water temperatures and flow. They estimate species abundance and identify habitats conducive to spawning and rearing.

Their investigation is exhaustive and, after months of observation, documentation and evaluation, they have thoroughly characterized the habitat of the salmon species in the North Fork Koktuli River – a remarkable achievement.

Yet they are not alone. On any given day, as many as two dozen fellow biologists are conducting field surveys of fish and fish habitat in the area. In hundreds of miles of adjacent streams, tributaries, lakes and ponds, scientists peer through underwater masks, or from towers or low-flying aircraft. Some travel on foot others by boat or helicopter. Some use remote sensing technology and laser range finders. Others are radio-tagging rocks in streambeds to track stream bed movement over time. Some are minnow trapping and habitat mapping, while others are busy capturing the evidence with digital imagery.

The long, arduous day of research is both physically and mentally demanding. Equipment is weighty and cumbersome; weather can be unpredictable; and it often seems as if nature is working against them. But for the biologists, the expedition is well worth it, as any one of them will affirm – sometimes you must swim against the current to get where you need to go.

develop a plan ensuring that one of the world's richest mineral deposits and one of the world's richest commercial, subsistence and sport fisheries will not only co-exist, but sustain the culture, enrich the communities and strengthen the economy of southwest Alaska for generations to come.

TERRESTRIAL WILDLIFE

Encompassing both the Bristol Bay Drainages Study Areas and Cook Inlet Drainages Study Area, the terrestrial wildlife study consisted of extensive field surveys, resulting in habitat mapping, population density estimates and identification of migration patterns and breeding activity in a select set of bird and mammal species. The species studied were selected for their conservation, cultural or ecological importance to the region.

Habitat use for each species in each mapped habitat type was evaluated and qualitatively categorized into one of four value classes: high, moderate, low or negligible.

Terrestrial Mammals

A series of aerial surveys focused on the distribution and abundance of caribou, brown bears, black bears, moose, gray wolves and beaver dams in the Bristol Bay Drainages Study Areas, as well as on caribou and brown bears in the Cook Inlet Drainages Study Area. Observations of any of the other 40 or more species known or expected to occur in this area, such as red fox, river otters and other furbearers, were also recorded. Wildlife data was further enhanced with telemetry data on the Mulchatna Caribou Herd, ground visits to bear dens and incidental sighting by other scientists, pilots and project personnel.

Many species of large mammals that inhabit southwest Alaska, while ecologically and economically important, are not particularly populous.

Many species of large mammals that inhabit southwest Alaska, while ecologically and economically important, are not particularly populous. The Bristol Bay Drainages Study Areas contained moderate densities of brown bears and low densities of black bears, moose, coyotes, wolves, river otters and wolverines.

Specifically, the 2009 bear population survey conducted in collaboration with the Alaska Department of Fish and

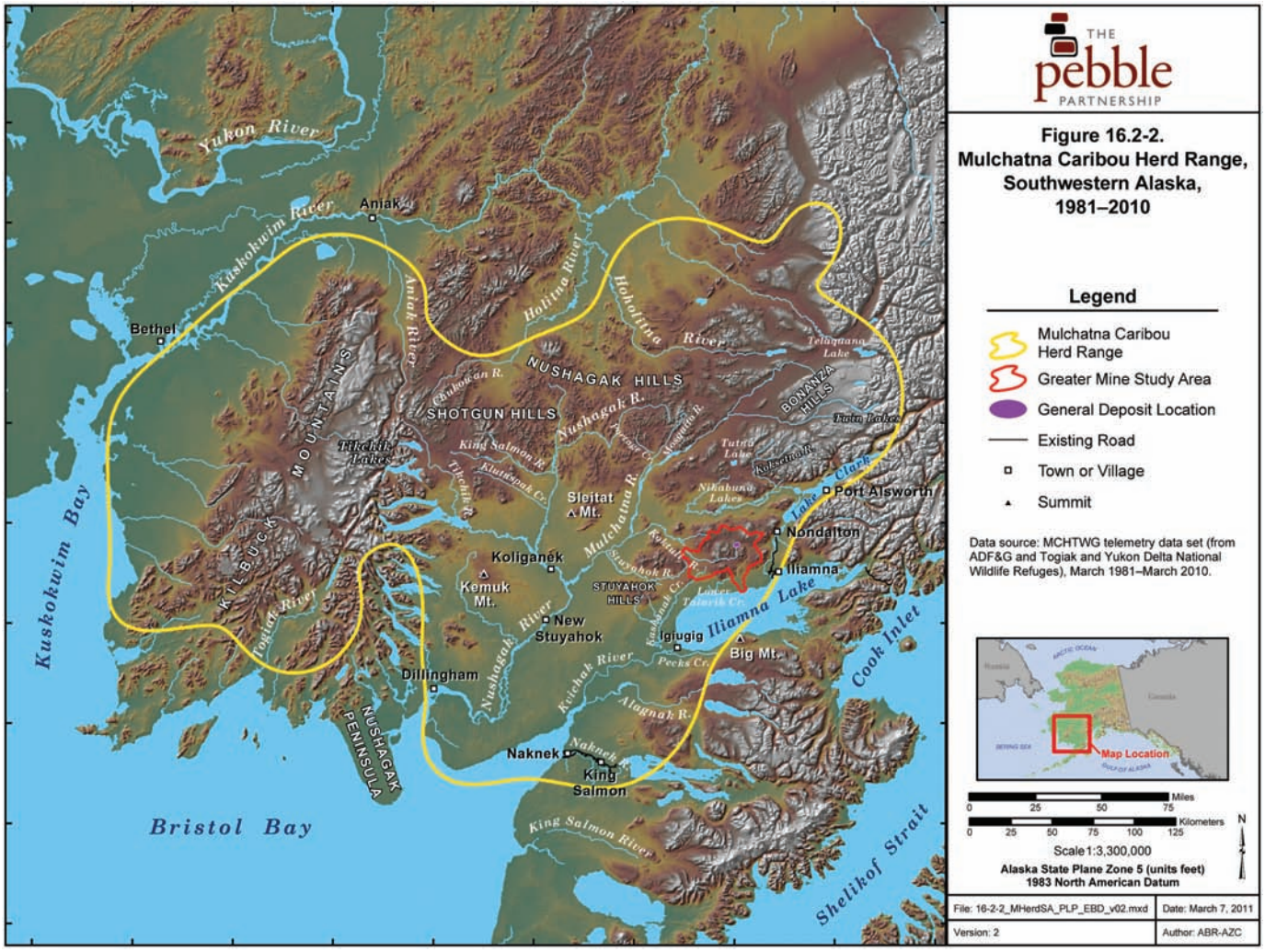
THE MULCHATNA CARIBOU HERD

Recognizing that the Mine Study Area is located within the historic range of the Mulchatna Caribou Herd (MCH), one of the larger herds in the state, scientists analyzed 29 years of radio-telemetry data from the Alaska Department of Fish and Game in order to understand population dynamics, seasonal patterns and changes in range use across several decades. Researchers then concluded, from telemetry data collected from 1981 through 2010, that the herd has declined dramatically in size since the mid-1990s. Use of the greater Mine Study Area by caribou from the MCH has varied considerably throughout the 29-year study period, with many different caribou using the area for at least a short period of time, with their principle range being located further west.

During all 29 years, seasonal patterns indicate that large groups of caribou pass through the Mine Study Area in midsummer after calving elsewhere. There has been moderate to high-density use during spring, low-density use during calving, high-density use during summer and winter, and moderate-density use during autumn. A small resident herd of caribou was thought to be present during the early 1990s. Since the late 1990s, radio telemetry data and aerial transect surveys suggest the resident caribou no longer

occur in the area and that high-density use only occurs during the summer (post-calving) season. No habitats in the Mine Study Area were classified as high value for caribou.

The Cook Inlet Drainages Study Area is almost completely out of the range of the MCH, and the steep coastal mountains and intertidal areas that dominate this area are not preferred caribou habitat. No caribou were observed during aerial transect surveys in the Cook Inlet Drainages Study Area in 2004 and 2005. In fact, in the 29 years of telemetry data analyzed, only one radio-collared caribou was found in the Cook Inlet Drainages Study Area.



MAMMALS INCLUDED IN SURVEY

Caribou	*Coyote*	*River Otters*
Moose	*Red Fox*	*Wolverines*
Brown Bear	*Beaver*	*Tundra Hare*
Black Bear	*Lynx*	
Gray Wolves	*Marten*	

Game over a large region surrounding Iliamna Lake and incorporating all the Pebble Study Areas to the north, produced density estimates of 47.7 to 58.3 brown bears per 386 square miles, while the numbers of black bears seen on that survey were insufficient to calculate a density estimate. A 2010 moose population survey for the Mine Study Area estimated 33 moose, an estimated density of only 0.03 moose per 0.39 square mile.

In the Cook Inlet Drainages Study Area, brown bears are found in high densities at the heads of Iniskin and Chinitna bays, and the stream in Y Valley between Iliamna and Iniskin bays when salmon are spawning. Black bears are found in lower densities than brown bears, and were observed most frequently in the forested areas on the Iniskin Peninsula between Iniskin and Chinitna bays. Of the few moose that were seen, 0.05 per 0.39 square mile, most were in the Y valley or on the Iniskin Peninsula.

Raptors

While land mammals like bears and wolves are arguably more common symbols of Alaska wildlife, some of its greatest predators hunt from the sky. Alaska's raptors – or birds of prey that hunt with their feet – include species such as eagles, falcons and owls. These raptors play an important part in balancing the ecosystem. Between April 2004 and August 2005, researchers recorded the distribution, abundance, nesting status and habitat use of large tree and cliff-nesting raptors throughout the Bristol Bay Drainages and Cook Inlet Drainages Study Areas.

Approximately 200 nests were discovered from at least 14 species of raptors and common ravens that inhabit or traverse the Bristol Bay Drainages Study Areas. In the

BEAR GUARDS

Don't move the bear, move the people. This training is one of the fundamental ideas behind the Pebble Partnership's bear guard training program, a safety initiative designed to allow personnel working in the field to focus on their work without worrying about possible bear encounters.

Bear season in the Bristol Bay region runs from April through October and is marked by large numbers of grizzlies that subsist on the area's rich vegetation, abundant berries and salmon runs. During the six-month season, it is not uncommon for crews to report daily bear sightings and, at times, reports indicate as many as five visuals in a single day. The season correlates with a steady stream of scientists working in the field and exploration-related projects, most of which take place in remote areas of dense brush and tall grass.

Pebble's bear safety program takes a proactive approach by training bear guards to avoid encounters and interference with the animals' habitat. Visual clues such as vegetation types that indicate prime bear habitat, scat size and composition, or proximity to salmon streams, are warning signs of possible bear activity in an area. When a bear is spotted, the guard stops all work, immediately moves crew members, or calls for helicopter transport until it is safe to return.

Training residents to be bear guards contributes to the local economy and is key to the program's success. The program has hired as many as 30 people in a season. The established curriculum includes both classroom and range instruction covering bear biology, behavior and human interaction; safety; defense; field first aid; firearms; CPR; and automatic external defibrillator (AED) training. Job hazard analysis training also teaches bear guards to identify potential hazards before they occur, so they can avoid potential harm.

Cook Inlet Drainages Study Area, 23 nests and five raptor and common raven species were found. Bald eagles are the most abundant in all study areas.

Researchers took great care to avoid disturbance of these majestic birds and their hunting activities, developing a comprehensive set of rules and standard aircraft operations near nests and fledging sites.

Waterbirds

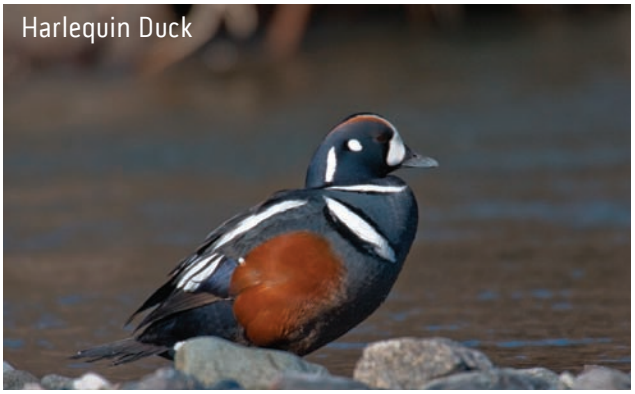
From geese and ducks, to cormorants and cranes, at least 40 species of waterbirds frequent the ponds, lakes, rivers and wetlands throughout the Bristol Bay Drainages Study Areas during breeding and seasonal migration. Twenty-two of these species, including swans, ducks, loons, shorebirds and gulls, were recorded as confirmed breeders.

At least 16 waterbird species use the coastal habitat of the Cook Inlet Drainages Study Area. Eight of those species were confirmed to breed in the area. The lower Iniskin River at the head of Iniskin Bay is a popular staging location for hundreds of ducks during spring and fall migration and a popular feeding area for glaucous-winged gulls in the fall when the salmon are running. Small creeks on the Iniskin Peninsula and in the Y Valley also provided habitat for various species in the area.

Breeding Landbirds & Shorebirds

While neither birds of prey nor waterfowl, breeding landbirds and shorebirds are impressive in the sheer numbers with which they flood Alaska every summer. Shrubs and trees fill with the colors and sounds of dozens of different species that make the state their seasonal home and breeding grounds.

Using point-count surveys and making many observations by sound (songs and calls of breeding birds), researchers investigated how breeding landbirds and shorebirds use



Harlequin Duck

Tundra Swan

Warbler

Greater Yellowleg

the Pebble Project Study Areas. Scientists found that in addition to there being a greater variety of landbird species, landbirds were numerically more abundant than shorebirds in both the Bristol Bay Drainages and Cook Inlet Drainages Study Areas, with the greatest abundance of both occurring in the Mine Study Area.

Iliamna Lake Harbor Seals

One interesting biological feature within the Bristol Bay Drainages Study Areas is the harbor seals that inhabit Iliamna Lake. The studies show that as far back as the late 19th century, Iliamna Lake has supported a freshwater population of harbor seals. While harbor seals typically inhabit marine waters, they also enter freshwater rivers and lakes as exhibited not just here, but also in Hudson Bay and in northern Quebec in Canada. These Iliamna Lake seals are considered to be year-round residents, although there are no geographic barriers to the movement of seals between the lake and Bristol Bay. This population of seals also provides an important source of food for local subsistence hunters.

The seals were observed using 15 different haul-out sites at various times during the study years. When seals haul out, they temporarily leave the water for sites on land or ice. The number of seals hauled out varied substantially among seasons and was highest in summer, peaking in August during the molting period. The largest number observed during a single survey was 357 seals in August 2008. This survey number was greater than the peak numbers counted by other researchers in 1991 (137 seals), 1998 (321 seals), 1999 (225 seals), and 2003 (171 seals), suggesting that the population is stable or possibly increasing.

Wood Frogs

Although rarely featured on Alaska's postcards, wood frogs are more common to the state than many people realize.

The EBD estimates that wood frogs breed in approximately 50 percent of the mapped water bodies in the Mine Study Area. Interestingly, water bodies that are at least 1.5 meters deep are more likely to have wood frogs than shallow waters, while habitat conducive to hibernation and the presence of aquatic vegetation also increases the likelihood of wood frog habitation.


Wood Frog

While harbor seals typically inhabit marine waters, they also enter freshwater rivers and lakes as exhibited not just here, but also in Hudson Bay and in northern Quebec in Canada.

ENDANGERED SPECIES

No threatened or endangered species listed under the nation's Endangered Species Act (ESA) or any candidate or proposed species for the ESA is known to occur in the Bristol Bay Drainages Study Areas. However, endangered species are present in the Cook Inlet Drainages Study Area.

No threatened or endangered species listed under the nation's Endangered Species Act (ESA) or any candidate or proposed species for the ESA is known to occur in the Bristol Bay Drainages Study Areas.

The Pebble Partnership is committed to dedicating resources to ongoing studies in order to ensure that ample surveys are conducted for the possible occurrence of any and all endangered or threatened species of flora and fauna within the Pebble Study Areas. The significant volume of data collected in the Pebble EBD will help determine if conservation measures or design changes are required of any future mining project, especially with respect to any species that are listed under the ESA.

Throughout the five-year study, scientists paid special attention to the four species listed under the ESA that are found in the Cook Inlet Drainages Study Area: Steller's Eiders (threatened); southwestern Alaska distinct population segment (DPS) of northern sea otters (threatened); western DPS of Steller's sea lion (endangered); and Cook Inlet DPS of beluga whales (endangered). While significant numbers of sea otters, Steller's sea lions, and beluga whales exist in other places around Alaska, these specific marine mammal populations have been officially designated as "distinct" under the ESA by federal agencies and are therefore subject to increased oversight.

In the Pebble EBD, researchers report that Steller's Eiders occur regularly in the offshore waters of the Cook Inlet Drainages Study Area during winter and early spring. Steller's sea lions were recorded in small

numbers from spring to fall, most often on islands at the mouth of Iniskin Bay and in the open bight between Iliamna and Iniskin bays. The Cook Inlet population of belugas has only rarely been recorded within the Cook Inlet Drainages Study Area, as this area is at the southernmost extent of their known historical habitat. Sea otters were recorded in the study area primarily during winter, with only scattered individuals recorded during spring and summer. Most were found outside Iniskin and Iliamna bays, in offshore habitats and among the islands at the mouths of the bays.

The Pebble Partnership also focused its environmental study on species that may be of conservation concern in the future, dedicating resources to ensure that adequate information for these species was collected. For example, Kittlitz's Murrelet is a candidate species under the ESA and may be present in the Cook Inlet Drainages Study Area. However, there are currently no records or observations of the species in the region.

Wildlife biologists also focused their studies on bird species that may be considered by some of conservation concern. A species of conservation concern is simply a species that is rare, either naturally or has experienced a population decline, one which nests or winters in habitat that is declining, or one for which there is little biological information currently available. This is an informal, or unofficial, designation – these species are not listed under the ESA, but, instead, by at least two of 10 statewide or national-level management agencies or non-governmental organizations that address bird conservation.

IV Physical

PEBBLE MINERAL DEPOSIT

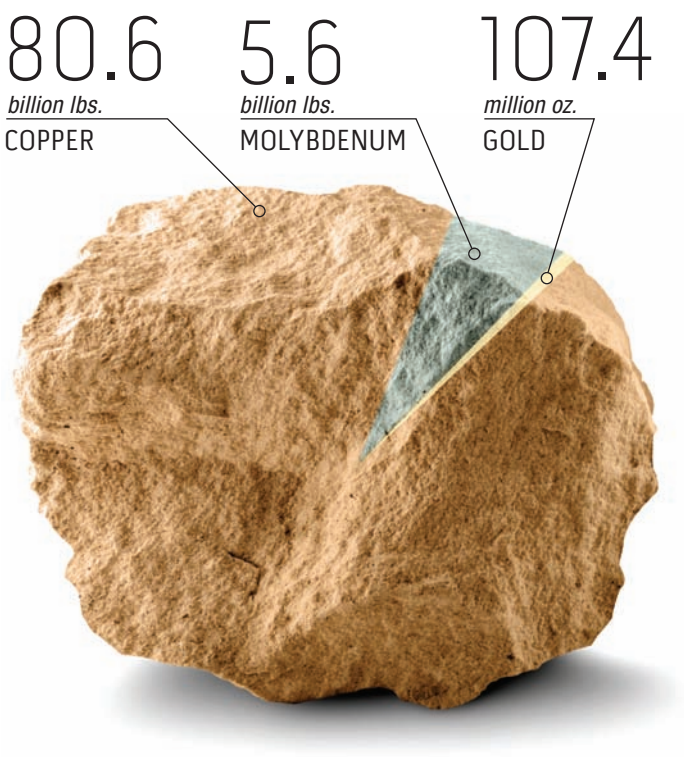
The Pebble Deposit is a word-class Deposit of copper, gold and molybdenum.

The Pebble Deposit is located approximately 65 miles from the shores of Cook Inlet and 17 miles northwest of the villages of Iliamna and Newhalen. The Pebble Deposit lies 18 miles west-southwest of Nondalton within the Lake and Peninsula Borough. The Deposit resides near the upper reaches of the Upper Talarik Creek and South Fork Koktuli River drainages, and is adjacent to the upper reaches of the North Fork Koktuli River drainage. The north and south forks of the Koktuli River are two of 24 tributaries of similar or larger size in the 315-mile long Nushagak River system. By area, the two drainages compose 1.7 percent of the total Nushagak watershed.

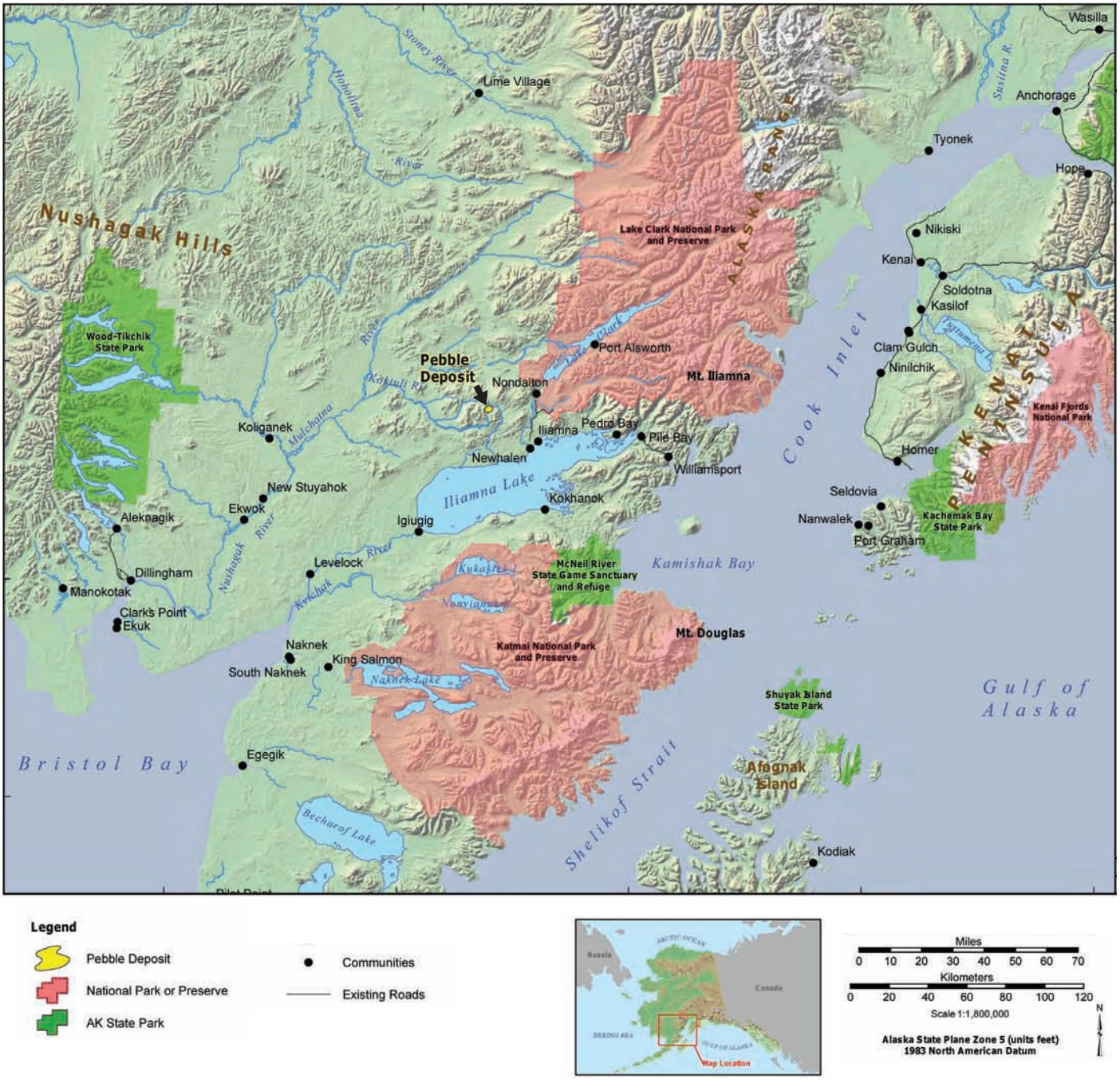
The Pebble Deposit is located on Alaska state land specifically designated for mineral exploration and development. The Pebble Deposit represents a small portion of all lands designated for mineral exploration within the Bristol Bay area. Cumulatively, all lands designated for mineral exploration compose only 2.2 percent of the total Bristol Bay Area Plan acreage.

The Deposit area known as Pebble West was discovered in 1988 by Cominco Alaska Exploration. In 2005, Pebble East was discovered by Northern Dynasty Minerals, which acquired 100 percent control of the mineral rights to the Pebble Deposit and associated resource lands by 2005. The Pebble Limited Partnership, formed in 2007

Estimated Mineral Endowment



Pebble Project Environmental Baseline Studies Regional Map



The north and south forks of the Koktuli River are two of 24 tributaries of similar or larger size in the 315-mile long Nushagak River system. The two drainages compose 1.7 percent of the total Nushagak watershed. Upper Talarik Creek is in the 225–mile long Kvichak River system and composes 1.4 percent (by area) of the Kvichak watershed.

and responsible for management of the project, is a 50/50 partnership between a wholly-owned affiliate of Northern Dynasty Minerals Ltd. and a wholly-owned subsidiary of Anglo American Plc.

The Pebble Deposit is located on Alaska state land specifically designated for mineral exploration and development.

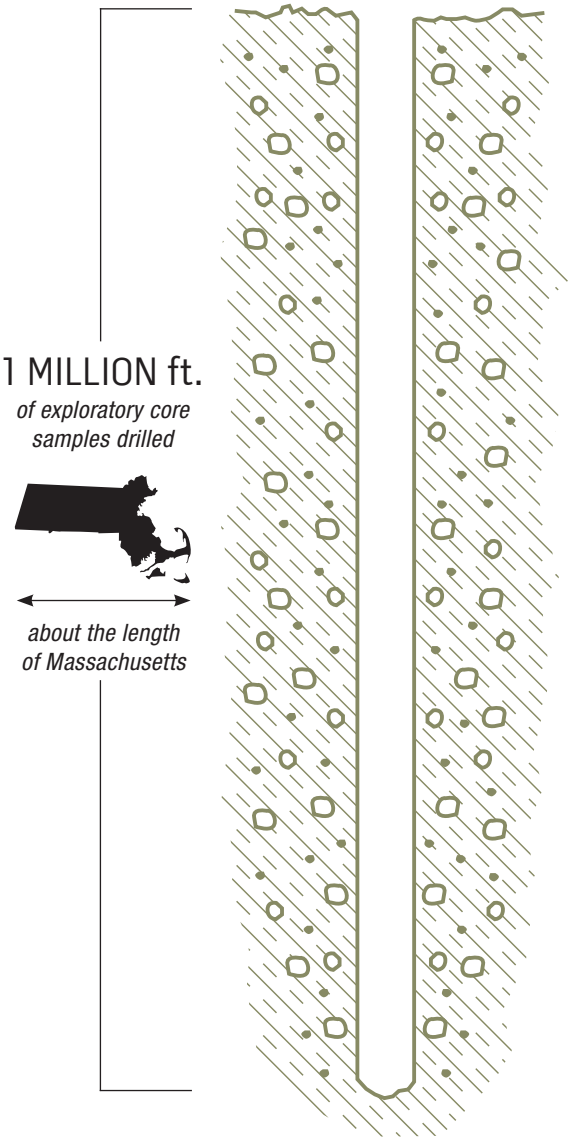
The Pebble Deposit is now viewed as one of the most significant undeveloped porphyry deposits in the world. The two deposits are contiguous, with Pebble West lying closer to the surface, while Pebble East is deeper and of a higher-grade mineralization.

Although soils in the Bristol Bay region have been influenced by volcanic ash deposits over time, there are no active volcanoes located in the Bristol Bay Drainages Study Areas. The nearest active volcano is Mount Augustine, about 60 miles southeast of the Pebble Deposit.

The area was glaciated during the Pleistocene era – spanning from roughly two million years ago to the last ice age, approximately 10,000 years ago. The direct and indirect effects of that glaciation dominate the surficial geology of the Pebble Deposit Area. A large glacier fed from the Aleutian Range icefields flowed southwestward down the Lake Clark structural trough; it then split into two separate tongues that extended down the present-day Chulitna and Newhalen drainages. A second major ice body, that likely extended westward from an ice cap over lower Cook Inlet, filled the broad basin now occupied by Iliamna Lake. That glacier extended northward, filling southern parts of the Pebble Deposit Area. At various times, these glaciers blocked the three major drainages and created ice-dammed lakes that filled the lowlands.

Since 2002, the Pebble Partnership has undertaken an extensive exploration drilling program to study the geology and mineralization of the Deposit area. To date, more than 1,100 exploratory holes have been drilled, totaling nearly one million feet of core. Exploration drilling has expanded the known resources at Pebble by more than 1,000 percent and resulted in the discovery of significant new areas of high-grade mineralization.

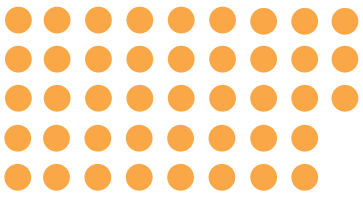
Exploratory Core Samples



Number of Exploratory Core Samples

21,500

● = 500 exploratory cores drilled



THE EARTH TELLS A STORY

Since the dawn of civilization, copper has been an essential element of human life, from tools traced to the Copper Age in Europe to currency facilitating trade. One of the first metals ever extracted from the earth, copper is easily molded and shaped, resistant to corrosion, and an efficient conductor of heat and electricity. Today, the exceptional alloying properties of copper make it invaluable when combined with other metals – it is as important to the modern, industrialized world as it was to ancient societies.

The Pebble Deposit is classified as a porphyry copper deposit. This type of deposit currently yields about two-thirds of the world's copper, thereby making it globally the most important type of copper deposit. The Pebble Deposit is predominantly a copper deposit in both volume and value, but also has significant amounts of molybdenum and gold, as well as several rare earth elements.

Porphyry deposits form in proximity to crustal plate subduction zones when descending crust melts and the resulting magma ascends into the overriding crust. Hot fluids driven off by the cooling magma body and dissolved minerals precipitate as the cooling progresses. This common geologic process produces localized metal ore deposits, such as the copper, gold and molybdenum of the Pebble Deposit.

In a state as large as Alaska, identifying the existence and boundaries of a mineral deposit is no small feat. Specialized knowledge of the landscape and geological processes, combined with data from exploratory drilling, geophysical surveys, stream sediment and soils sampling programs, has given geologists the ability to locate, examine and evaluate mineral-rich sites such as the Pebble Deposit.

For those who know how to decipher its code, the earth tells a story. As teams of surficial geologists surveyed the mine study area, they identified four episodes of glaciation that formed the landscape seen today. Glacial processes from 100,000 to 10,000 years ago carved large U-shaped valleys, buried portions of the bedrock with glacial drift and ancient lake sediments, and formed Lake Iliamna. Likewise, geologists documented, through drill core, inactive tectonic structures in the area. These structures provided pathways for intrusive magmas and mineralizing fluids that deposited minerals in the igneous rock as well as the host sedimentary rock.

Through geophysical surveys of the earth, geochemical analyses of soils and stream sediments, and examinations of drill core, researchers have characterized the events that led to mineralization in the region. A complex setting created by an active continental margin, the area surrounding the Pebble Deposit has undergone multiple magmatic hydrothermal events, occurring millions of years ago, that resulted in a highly mineralized corridor that extends northeast to southwest by more than 13 miles (21 kilometers) within the Pebble claim block.

SURROUNDING AREA

Located in a remote, southwest corner of the state away from major urban centers, approximately 200 miles from Anchorage, the Pebble area is lightly populated. Nearby communities include Port Alsworth, Nondalton, Pedro Bay, Iliamna, Newhalen, Kokhanok, Igiugig and Levelock.

MINE STUDY AREA

The area landscape setting includes rolling mountains

and hills of varying topographic relief, fast-flowing rivers, tundra, marshy lowlands and ponds. Depending on elevation and location, much of the land is covered by alpine tundra, low or tall shrubs or areas of mixed broadleaf and spruce trees.

The elevation above sea level in the region of the Mine Study Area ranges from approximately 580 feet at the confluence of the south and north forks of the Koktuli River, to 3,074 feet on Groundhog Mountain. The elevation of the Pebble Deposit is approximately 1,000 feet.

The area to the south of the Mine Study Area presents relatively flat-lying topography with abundant ponds on the north shore of Iliamna Lake.

An environment predominantly formed by glaciers, the Mine Study Area is composed of glacial and fluvial (river) sediments of different thickness. These sediments cover most of the study area at elevations below about 1,400 feet. The ridges and hills above this elevation generally present exposed bedrock or thin veneers of surficial material. Area hills tend to have a moderate slope with rounded tops, while the valleys are generally flat.

Topographic anomalies in the Mine Study Area are attributable to the glacial history of surface materials, including:

- *The main stream channels of local water courses are sinuous and flow within flood channels*
- *Glaciofluvial terraces of outwash sediments occupy parts of the main valleys and include flat, well drained terrain*
    - > *Glaciofluvial refers to material transported by glaciers and subsequently sorted and deposited by streams flowing from the melting ice*
- *Frying Pan Lake is the largest lake in the Mine Study Area. It is a shallow lake with an average depth of approximately three feet*
- *Extensive areas of glacial drift deposits occur along lower hillslopes and near the upper reaches of the main stream valleys and are characterized by many lakes and rolling terrain*

HARSH CONDITIONS, CHALLENGING SCIENCE

Always keep one eye on the sky. This advice, scientists familiar with southwest Alaska will tell you, is critical when it comes to working in the Pebble Deposit study area during harsh winter months. Weather can change in a matter of moments, shifting quickly from a sunny, blue-bird day, to ground blizzards, below freezing temperatures and white-out conditions.

Although summer at the Pebble Deposit is markedly the busiest for consultants in all scientific disciplines, what most people don't realize is that the winter season – seemingly frozen and lifeless – in fact continues to be a critical time to measure changes in the region's ecosystem. Regardless of the harsh conditions, studies in several disciplines continue as part of Pebble's efforts to collect baseline data within the region.

Aerial surveys are conducted to determine the extent and location of open water. Open water during the winter season is important evidence that scientists use to determine where groundwater is entering a stream. Aerial surveys are also flown to record visual observations and to conduct telemetry surveys for wildlife.

Field work conducted throughout the winter helped shape subsequent fish habitat studies near and within the Pebble Deposit Area. This included meteorology data, water quality samples, hydrology measurements and snow pack depth and distribution surveys.

Rivers covered with snow are often found by using a global positioning system (GPS) and identifying landmarks from previous visits. At times, even metal detectors were used to locate previously marked streams.

Once the site is located, researchers are often required to dig through the snow to the river – sometimes just a few inches, sometimes 16 feet – before drilling several holes through the ice so they can begin the actual sample collection process. Any other time of year, the process would be fairly routine. In winter months, though, weather conditions present safety considerations critical for survival. Being inventive and resourceful, while also observing the Pebble Partnership's safety procedures, is the key to working in the elements, whether it means figuring out how to collect water samples without submerging arms in the water, or how to avoid sweating so as not to risk becoming hypothermic.

At the same time, keeping the instrumentation warm is also an exercise in innovation. Researchers make their own version of "sleeping bags" for the equipment. Meters used to determine the discharge of water into the streams are wrapped in layers of protective foam, heat packs, duct tape and plastic wrap so they stay dry and warm. Spare batteries, cameras, GPS units – and even sandwiches – are tucked inside jackets and hip waders to prevent them from freezing.

Studies that are fairly standard during summer months become what consultants call "the most dangerous science" under these conditions. The Pebble Partnership's safety provisions require scientists to have extensive winter training and to also be prepared with survival gear in the event that the weather prevents helicopter pilots from being able to safely retrieve people from the field. Safety huts provide protection in some areas and workers are adept at building snow walls for windbreaks. Mandatory, well-equipped survival bags include everything from freeze dried foods and pots and pans to tents, sleeping bags and pads, fire starters and decks of playing cards to fill the hours when winter weather leaves researchers stranded for what may turn out to be days.

Careful planning before heading out into the field, and employing extra sensibilities according to constantly changing conditions, is critical.

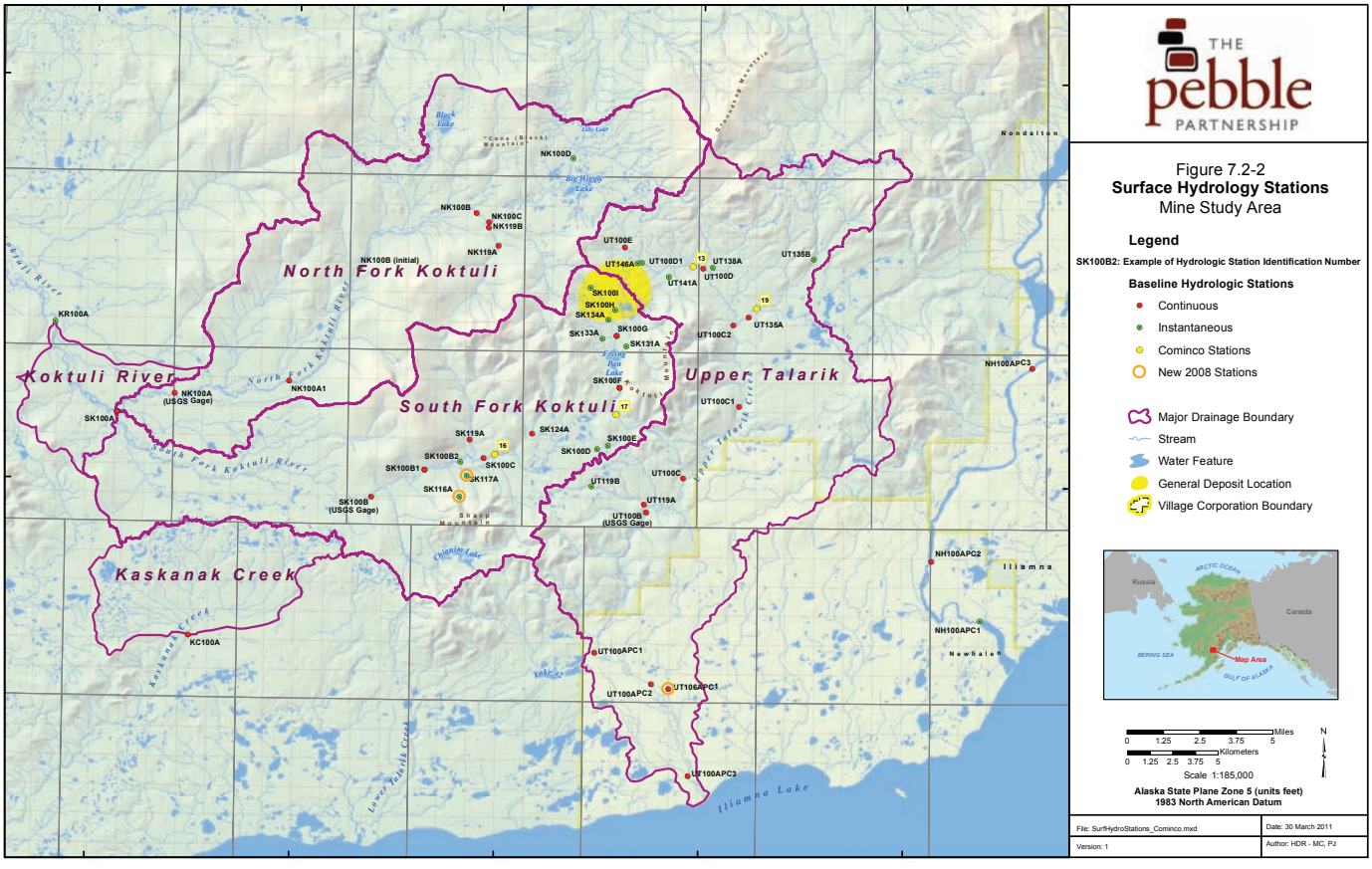
WATER

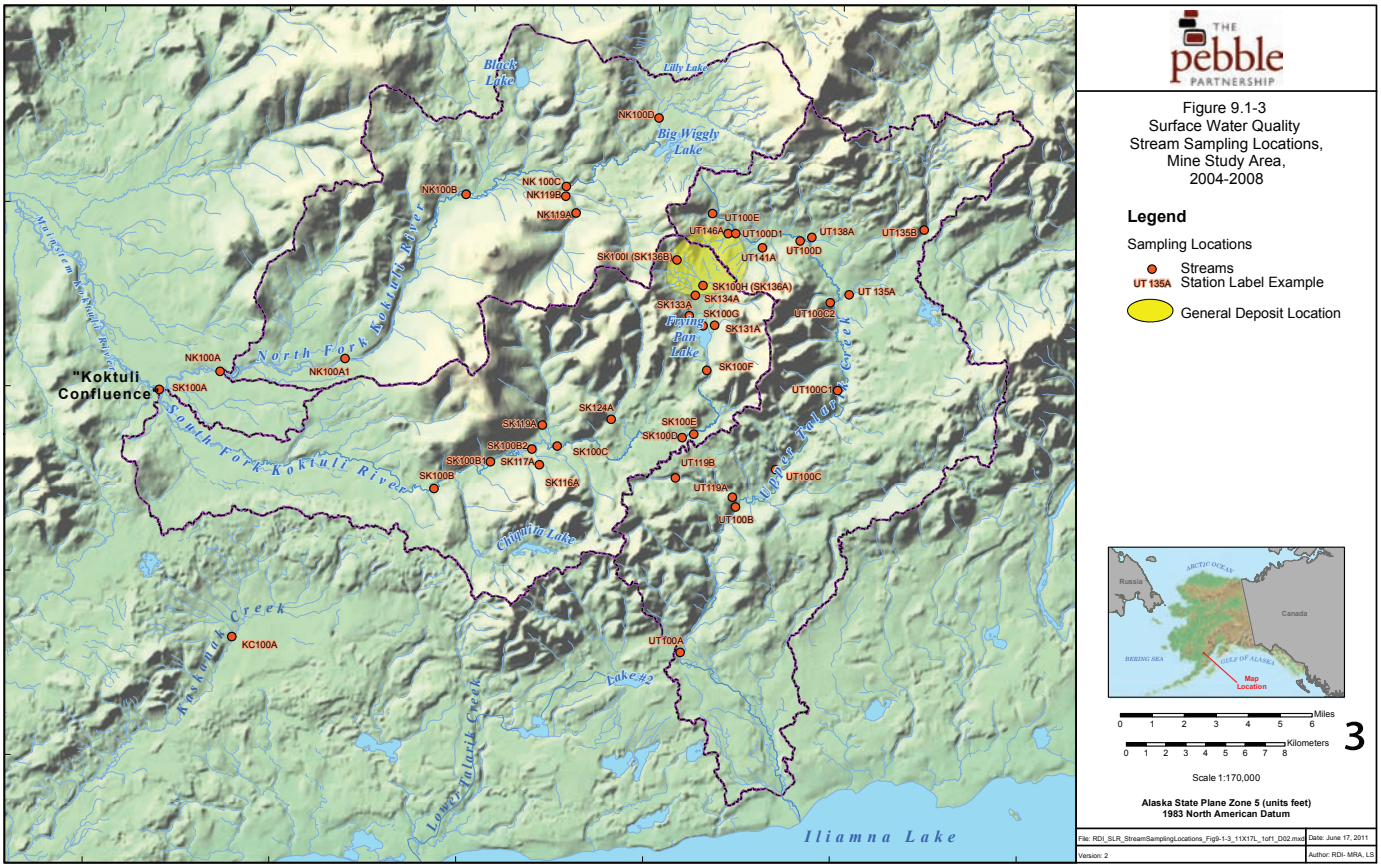
From rivers and lakes to groundwater and seawater, Pebble's environmental study program included an intensive, multi-year investigation into water resources in a wide range of areas that could potentially be affected by Pebble mineral development. Scientists collected flow measurements and water samples from numerous locations in the watersheds surrounding the Pebble Deposit, as well as marine water in Cook Inlet. The major areas of study included: Surface Water Hydrology (flow of streams, rivers and lakes); Groundwater Hydrology (flow beneath the surface); and Water Quality (chemical composition for surface water, groundwater and marine).

The result of this research is a thorough understanding of the characteristics of water in the environment. Comprehensive knowledge of water quality and quantity, as well as the inter-relationships between surface and sub-surface water sources near the Pebble Deposit, is critical to responsible development and management of natural resources. Now, with a robust set of data, scientists are able to develop a site-wide watershed model linking precipitation, evaporation, groundwater dynamics and surface water runoff – providing an accurate representation of naturally occurring conditions in the area.

Surface Water Hydrology

By measuring the rate of surface water flow in streams and lakes at various locations and different times throughout the year, hydrologists can identify many interesting characteristics, including if a river typically runs dry during a particular season; how lake water is affected by contributing streams; or where groundwater may cross a topographical divide into another drainage





basin. Knowing the seasonal patterns and sources that affect peak flows and low flows is also an important component of project planning. Spring snowmelt is known to produce a significant peak-flow period, and engineers will carefully consider options for handling changes in volumes of water throughout the year.

Instantaneous measurements are taken by shoveling snow off a transect of the stream at an identified GPS site, drilling a series of holes through the ice and measuring the depth and speed of the water under the ice to determine flow rate. This is done at every continuous hydrology gauging station where the gauging equipment has been removed during freeze-up.

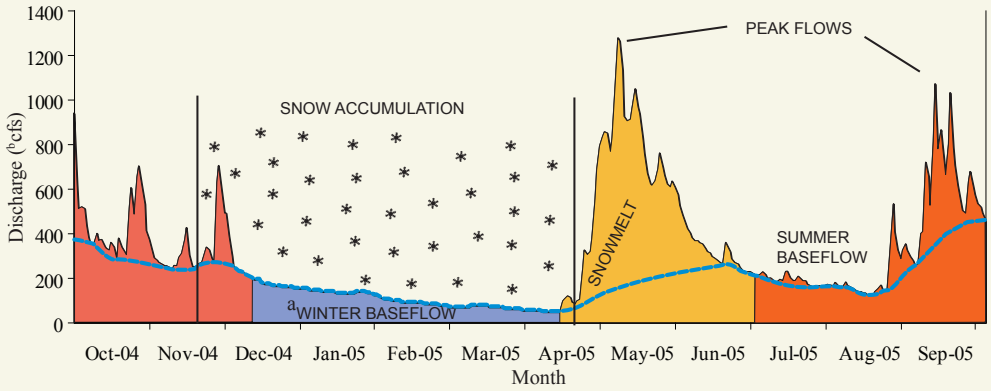
Measuring everything from low flow and peak flow to snow distribution and small pools, scientists collected extensive hydrology statistics throughout every season of the year.

Around the Pebble Deposit Area, an extensive network of flow-gauging stations measured stream flow continuously, meaning water levels were recorded every 10-15 minutes 24/7 during ice-free months, providing a continuous data log. During ice-affected conditions, researchers took instantaneous flow measurements, by hand, on a monthly basis.

Instantaneous measurements are taken by shoveling snow off a transect of the stream at an identified GPS site, drilling a series of holes through the ice and measuring the depth and speed of the water under the ice to determine flow rate. This is done at every continuous hydrology gauging station where the gauging equipment has been removed during freeze-up.

The Pebble Deposit Area straddles the watershed boundary between the South Fork Koktuli River and Upper Talarik Creek, and lies close to the upper reaches of the North Fork Koktuli River. The Mine Study Area

WHAT IS BASEFLOW?



Annual Hydrograph of the South Fork Koktuli River at SK100B

Notes:

a. Blue dashed line represents approximated baseflow

b. cfs = cubic feet per second

"Baseflow" is that portion of stream flow which originates from groundwater upwelling into a river and which is not directly attributable to precipitation or snowmelt entering the stream as surface runoff. In the accompanying annual hydrograph for a representative location on the South Fork Koktuli River, baseflow levels throughout the year are indicated by the blue line. During winter, freezing conditions result in snow accumulation and the flow of the river is almost entirely due to groundwater discharge into the creek. Groundwater levels are gradually depleted throughout the winter, resulting in declining baseflow until warming springtime breakup conditions rapidly melt the snow. The snow accumulated during the winter provides an influx of water, which recharges the groundwater levels to increase baseflow and enters the stream as surface runoff, resulting in total stream flow in excess of baseflow. Peak flows in spring and early summer can occur during sunny days due to snowmelt and also during rainstorms. By the time of late summer and autumn, the snow accumulation from the previous winter is almost entirely melted and peak flow events and further groundwater recharge are caused by heavy rainfall.

encompasses the drainages of these three watercourses, as well as the upper reaches of Kaskanak Creek, located further south of the Deposit area. These watersheds encompass a combined area of 373 square miles above the lowest-placed gauging station in each watershed.

The Pebble EBD shows that peak flows occur either as a result of spring snowmelt or autumn rainstorms.

Researchers found that low-flow periods occur during late summer and the winter-freeze period, both times when surface flows in streams are supplied almost entirely by groundwater discharge, the occurrence of ground water flowing to the surface. Additionally, water levels were higher during the late spring and summer than during winter because of recent snowmelt and intermittent rainstorms.

The study also shows that snow accumulation and snowmelt drive streamflow patterns throughout winter and spring. As snow accumulates and surface runoff ceases during winter, streamflows drop to winter baseflow levels.

Baseflows typically drop gradually until April as groundwater levels decrease in the absence of surface input. The spring snowmelt event typically extends from mid-to-late April through June. Snow does not accumulate evenly across the study area, and it is redistributed frequently during high-wind events. Annual surveys indicated that mid-April snow depth varied from 5.3 at wind-scoured sites to more than 207.7 inches in deep drifts on the leeward side of ridges.

You cannot step into the same river twice – the old adage identifies an environmental condition that plays a critical role in natural resource development: rivers and streams are dynamic, ever-changing and influenced by a great many variables. While it may seem intuitive that surface

SEISMICITY

The Alaska-Aleutian Megathrust is a subduction zone off the coast of Alaska where two tectonic plates are converging.

- *Seismicity of southern Alaska is associated with three types of earthquakes, which occur where the two tectonic plates meet in the subducting slab and shallow crustal faults*
- *The Lake Clark fault is a westerly extension of the Castle Mountain fault system*
- *The Castle Mountain fault system is active (M5 to M7+), with movement occurring approximately every 700 years*
- *The Lake Clark fault is inactive. Studies indicate that there has been no movement recorded for the past 11,000 years*

A piezometer is a device used to measure the pressure of groundwater at the point of installation. This pressure is then converted to a measure of the groundwater table.

flow increases as it moves downstream from a higher elevation to a lower elevation, there are other factors that increase and decrease the exchange of surface flow and groundwater flow along a river, some of which occurs downstream of the Deposit area.

The topography of the study area is relatively gentle, with glacial and fluvial sediments of varying thickness covering most of the area and playing an important role in surface water runoff and groundwater storage and exchange. For example, each major river valley is partially filled with glacial drift of varying permeability, causing the ground to absorb more water, which, in turn, may decrease the surface flow of the river. Conversely, each channel also regains flow where the bedrock valley narrows downstream, forcing groundwater up from the subsurface. Surface runoff also varies and may contribute minimal or substantial flow to the stream. While these events naturally occur throughout the study area, they are most pronounced in the mainstem of the South Fork Koktuli River.

Because of its unique stream flow characteristics, the South Fork Koktuli River was studied intensively. As noted above, groundwater plays a prominent role in the flow patterns of all the creeks and rivers that were studied. While analysis of the baseline data indicates that more than 95 percent of groundwater recharges and discharges within the same drainage basin, there is one notable exception in the South Fork Koktuli River as it heads downstream of the Pebble Deposit. About one third of the way down the river, surface water goes to groundwater in the South Fork flats, leaving the area by two routes, which is unusual for a river valley. Some of this groundwater crosses

With more than 14,000 groundwater level measurements taken from among hundreds of monitoring locations, the groundwater study was most intensive within a two-to six-mile radius of the Pebble Deposit.

the topographical divide into the Upper Talarik Creek watershed where it resurfaces in a small tributary. Below the South Fork flats, the remaining South Fork groundwater flows west along the same route as the river, where some of it resurfaces in an upwelling area of natural springs a couple of miles downstream.

Knowing where these subsurface pathways are and understanding how groundwater alters surface water flow in the area is important, primarily for maintaining fish habitat. For example, the South Fork Koktuli River is known to support certain salmon populations, however, a few miles of stream above the springs are known to naturally go dry some years, impeding migration and restricting spawning locations upstream from this ephemeral reach.

Groundwater Hydrology

With more than 14,000 groundwater level measurements taken from among hundreds of monitoring locations, the groundwater study was most intensive within a two-to six-mile radius of the Pebble Deposit. This area included the upper reaches of Upper Talarik Creek and the north and south forks of the Koktuli River. Compiling and analyzing an extensive set of data, the Pebble EBD characterizes the existing groundwater flow regime. The complete field program consisted of multiple components, including monitoring well installation, groundwater sampling, seep and spring sampling, stream seepage evaluation, and piezometer installation and hydraulic conductivity testing.

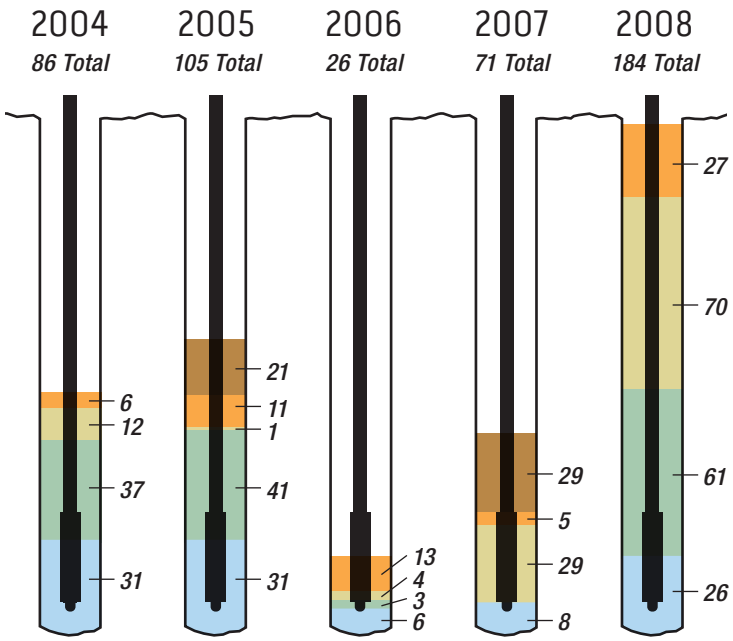
The Pebble EBD shows that bedrock groundwater flow within the Mine Study Area is generally localized.

HYDRAULIC CONDUCTIVITY

Hydraulic conductivity generally refers to a property of soil or rock that describes the ease with which water can move through pore spaces or fractures in the ground. The permeability of the soil or rock material and the degree of water saturation are factors of consideration. In practical terms, hydraulic conductivity is the volume of water flowing through an aquifer in a given amount of time. Hydraulic conductivity may be expressed in ft./day, ft/second or m/second. Materials such as gravel and sand have a higher hydraulic conductivity than a densely packed material such as clay or metamorphic rock.

Piezometer Installations

- South Fork Koktuli
  Total = 102 (in Deposit area)
- South Fork Koktuli
  Total = 142 (remainder)
- North Fork Koktuli
  Total = 116
- Upper Talarik
  Total = 62
- Small Pools Study
  Total = 50



ROCK TAGGING

Rock and roll is serious stuff when it comes to understanding fish habitats in the Mine Study Area. Or, as scientists who study rivers and streams explain it, when a rock starts to roll, knowing when it moves is critical for understanding flow characteristics and how this affects fish habitat.

Rock tagging, a technology-based study method, is one technique scientists use to analyze the stability of a river channel, which is an important element in defining the distribution of fish habitat and how it is influenced by stream flow. Similar to the methodology used to tag fish when tracking their migration, in this application, a hole is drilled in a rock, a battery-operated transponder is implanted and the stone is sealed with epoxy.

Within the Mine Study Area, tagged rocks of various sizes were positioned at stations across a river or stream. Signals were transmitted to a receiver as the rocks were moved naturally by the water flow. This information was interpreted along with depth and other flow characteristics to define when and where river beds move under different flow conditions. Pebble researchers use this knowledge to help understand how water flow influences a water channel's size, width and depth, which in turn helps define the relationship between stream characteristics and fish habitat.

The quality and quantity of fish habitat is influenced by stream flow. High flows often shape and create new habitats, as well as maintain the quality of existing habitats. Scientists used the radio-tagged rocks to help identify flows that do the most work in the stream: for example, flows that flush sediments from the streambed, transport sediments downstream and have a direct influence on channel form. Data provided through the rock tagging study, when considered along with other flow-related studies, help Pebble scientists understand the evolution of each river system so that informed resource management decisions can be made to avoid, minimize and mitigate impacts to fish populations.

There is no evidence of regional-scale groundwater flow within any of the bedrock units. Scientists also found that most groundwater flow occurs at shallow levels within the overburden and shallow bedrock, within approximately 50 feet of the surface.

Groundwater recharge is a hydrologic process where water moves downward from surface water to groundwater.

Likewise, geology plays an important role in groundwater hydrology. The area's crystalline, volcanic and metamorphic rock settings have resulted in the formation of groundwater compartments, particularly within the deeper groundwater system, where the effects of weathering are less. Interestingly, the chemistry of the groundwater in the deep bedrock groundwater system has higher concentrations of total dissolved solids (TDS) than that measured in the

shallow groundwater. Elevated concentrations of TDS can be attributed to the groundwater having longer contact time with the surrounding rock.

The high volume of data collected allows Pebble scientists to accomplish many objectives, including defining groundwater flow directions and rates; determining seasonal responses of groundwater levels; identifying groundwater recharge locations; locating groundwater divides; and establishing the depth to the water table.

Groundwater recharge is a hydrologic process where water moves downward from surface water to groundwater.

Researchers identified a number of site-specific conditions that enhance groundwater recharge at the Pebble site, allowing the drainage of surface water into the ground, rather than generating runoff. The data showed that disturbed bedrock at the surface has left open joints where water can easily enter the ground; frost has migrated gravel and pebbles to the surface, resulting in a coarse surface that water can easily infiltrate; tussocks have resulted in depressions that store water, thereby increasing the infiltration; and, at several locations, glacial outwash has left enclosed depressions that store water for eventual infiltration.

The average annual groundwater recharge rates for the North Fork Koktuli, Upper Talarik and South Fork Koktuli watersheds are 11, 16 and 23 inches per year, respectively. Variation in recharge rates within the watersheds reflects differences in the surficial geology. Within each of the drainages, the surficial geology varies from low-permeability deposits to high-permeability glacial outwash and ice-contact deposits. The large differences in the permeability, coupled with variations in the topographic gradient, result in localized recharge rates that vary greatly – from five to 47 inches per year.

Water Quality

The water quality study provides scientific documentation of the naturally occurring constituents present, their concentrations and their variability in surface water, groundwater and marine water. Collecting a vast amount of water quality data from more than 3,400 total samples of surface water, seeps water, groundwater and marine water, which produced more than 243,000 individual water analysis results, scientists compiled one of the most extensive volumes of water quality data ever recorded for southwest Alaska.

Collecting a vast amount of water quality data, from more than 3,400 total samples of surface water, seeps water, groundwater and marine water, which produced more than 243,000 individual water analysis results, scientists compiled one of the most extensive volumes of water quality data ever recorded for southwest Alaska.

Water quality data for rivers, lakes and seeps were collected in the Mine Study Area throughout a 392-square-mile block. This included the north and south forks of the Koktuli River, which drain into the Mulchatna River then into the Nushagak River, as well as Upper Talarik and Kaskanak creeks, which drain into Iliamna Lake then into the Kvichak River. Water quality data were also collected from streams that traverse typical areas of the Transportation Corridor Study Area and from Iliamna Lake. For the marine water quality study, data were collected from Iliamna Bay and Iniskin

QA/QC PROTOCOLS

All environmental sampling and analysis for the Pebble EBD was performed in accordance with a project Quality Assurance Program Plan (QAPP), individual study plans and field-sampling plans that compose a system of Quality Assurance/Quality Control (QA/QC) protocols, which governed the organization, planning, sampling and analysis methodology, data collection, documentation, evaluation and reporting of results.

The QA/QC program ensures that all reported sample results meet the study's data quality objectives by measuring the precision, accuracy, repeatability and comparability of sample results. Examples of this effort are demonstrated by the ongoing requirement to collect multiple replicates for 10 percent of the environmental samples in order to perform a QA duplicate analysis at the same laboratory as the primary sample and also a QC triplicate analysis at a separate, independent laboratory.

Sample blanks consisting of pure, uncontaminated water were routinely analyzed to ensure that samples were not being contaminated during shipment, handling and storage. All laboratory results were subjected to a validation procedure by an independent, third party chemist to assess the data quality and definability before data was reported by consultants.

Bay in Cook Inlet, and tested for a variety of factors, including salinity, temperature and turbidity (water clarity), in addition to chemical composition.

Surface Water And Groundwater Quality

Teams of hydrologists established a comprehensive network of stations in the Mine Study Area for sampling surface water from streams, lakes and seeps. Altogether, more than 1,000 samples were collected from streams, more than 600 samples from seeps, and approximately 50 samples from lakes. For groundwater quality studies, 39 wells of depths up to 200 feet were installed in the Mine Study Area, including one deep drillhole for sampling at depths ranging from 640 to 4,050 feet. Each sample was analyzed for a comprehensive list of chemical constituents, with all results reflecting naturally occurring elements.

Field measurements and laboratory analysis were performed for each sample in order to quantify a comprehensive list of physical parameters and chemical constituents, with all results reflecting naturally occurring conditions.

Continuously Gauged Stations

29

= 5 Stations

Instantaneous Measurement Sites

125+

= 5 Sites

The samples were analyzed for physical parameters such as temperature and pH, and for chemical constituents such as dissolved and total major ions, nutrients, dissolved and total trace elements, cyanides, and dissolved organic carbon. Selected surface water samples were also analyzed for organic compounds.

To assist with the data interpretation, data were plotted using a variety of parameters and analyzed with extensive statistical tests. The data were also compared with the most stringent Alaska Department of Environmental Conservation (ADEC) and Environmental Protection Agency (EPA) water quality criterion for each parameter.

The surface water in the Mine Study Area was generally characterized by cool, clear waters with near-neutral pH that were well oxygenated, low in alkalinity and generally low in nutrients and other trace elements. Water types ranged from calcium-magnesium-sodium-bicarbonate to calcium-magnesium-sodium-sulfate. In some areas, water quality naturally exceeded the maximum regulatory criteria for concentrations of various trace elements. Some differences in water quality between watersheds and some trends in water quality along streams were noted. Sulfate, copper, zinc, nickel and molybdenum concentrations were greatest in the South Fork Koktuli River, consistent with the upper reaches of this river passing through the Deposit area. Copper from the South Fork Koktuli River exceeded the ADEC water quality criterion most frequently, with total copper exceeding the criterion in 42 percent of samples. In contrast, copper had one of the lowest frequencies of exceeding ADEC criterion in the other watersheds that were studied.

Most groundwater samples from depths of 200 feet or less were typically characterized by median levels of total dissolved solids (TDS) less than 100 milligrams per liter (comparable to surface water), with concentrations of trace elements below the most stringent ADEC maximum water quality criteria. There are some exceptions around the Deposit area, as might be expected near a mineralized deposit. The wells with relatively high TDS also generally had relatively higher concentrations of arsenic, barium and molybdenum compared with other wells in the study area. All of the wells with more than two trace metals at relatively high concentrations were located close to the Deposit area. The pH values in groundwater also varied considerably throughout the Mine Study Area, ranging from approximately 4.5 to 9. These data show chemical composition that is consistent with the varying geology of the Deposit and surrounding area.

The data were also compared with the most stringent Alaska Department of Environmental Conservation (ADEC) and Environmental Protection Agency (EPA) water quality criterion for each parameter.

Using nine sampling sites, the Iliamna Lake study data suggest that the lake has water quality conditions similar to the natural conditions of other regional lakes. Only aluminum, copper, iron, lead, manganese, zinc and alkalinity were detected at concentrations that were outside the most stringent ADEC water quality criteria.

Marine Water Quality

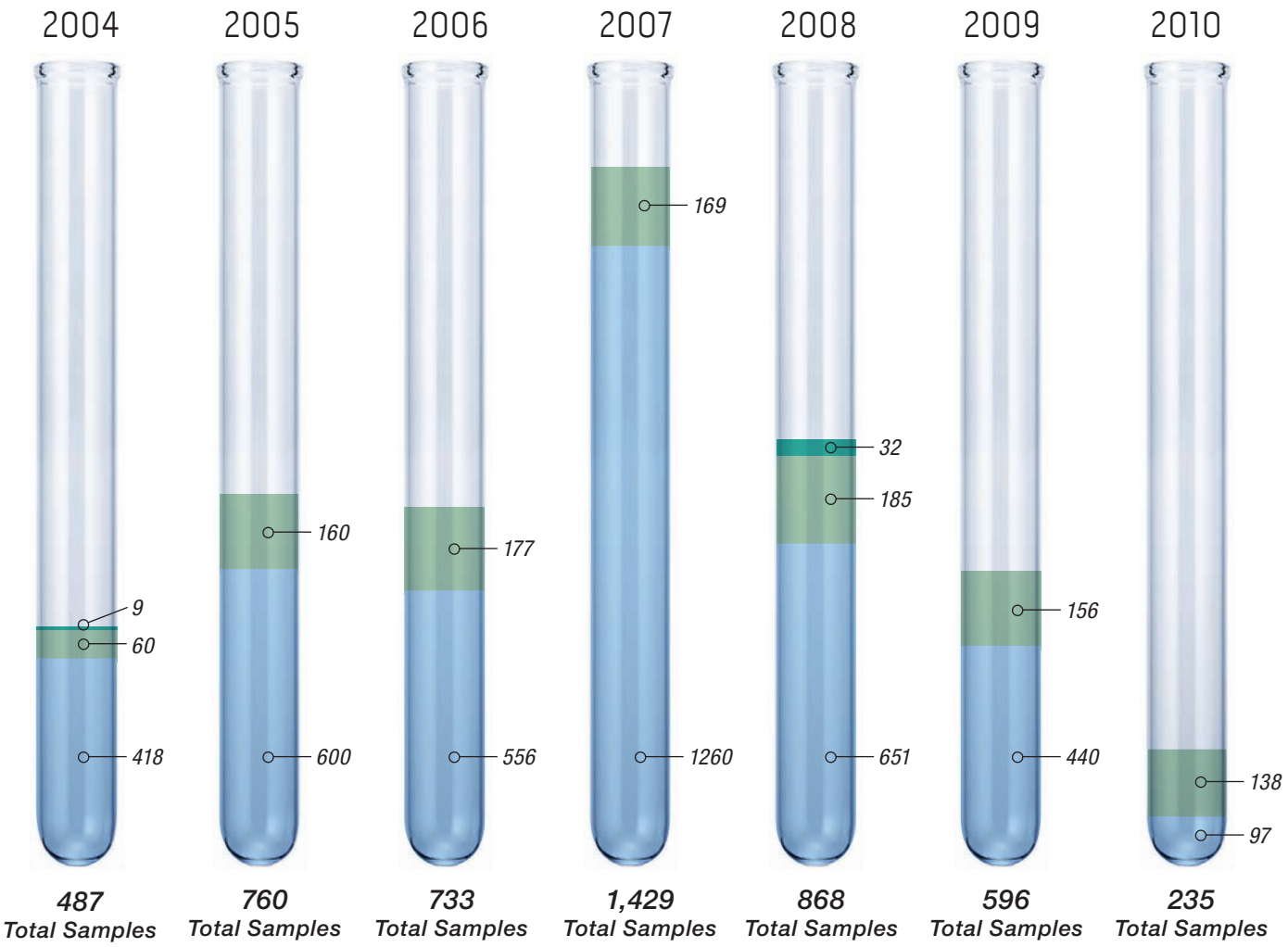
Marine water quality parameters include various chemical constituents for which laboratory analyses were done, as well as salinity, temperature and turbidity, which were measured in the field. Field parameters were measured in conjunction with the marine habitat assessments documented by marine biologists. Water samples for chemical analysis were collected in two sampling events, then analyzed for trace elements and inorganic and organic constituents.

Water quality in the Iliamna/Iniskin Estuary appears to be dominated by tidal exchange with Cook Inlet and Kamishak Bay, with smaller, localized effects from freshwater inputs and local wind waves. Average salinity decreased from the outer stations of Iliamna Bay to the inner stations. This is likely a result of freshwater inputs at the head of Iliamna and Iniskin bays and Yualley Creek. Salinity decreases from spring to late summer and increases again in the fall, thus providing an additional indicator of the influence of regional water on the bays.

The research indicates the following general trends. Hydrocarbon concentrations in marine water showed little to no connection to human sources. Concentrations of all inorganic constituents are less than maximum water quality criteria recommended by the Environmental Protection Agency and the National Oceanic and Atmospheric Administration for marine habitat, many by orders of magnitude. Organic constituents are similarly at low levels and appear to be derived from marine life, rocks or other non-human sources.

Water Quality

Environmental Baseline Program Samples Collected



Total Surface Water Quality

Total Number of Samples = 3,395
Total Lab Results

116,623

Total Ground Water Quality

Total Number of Samples = 751
Total Lab Results

73,976

Total Marine Water Quality

Total Number of Samples = 41
Total Lab Results

1,774

V

Conclusion

With more than 20,000 pages of scientific data and analyses from field studies, laboratory testing, government records and interviews of Alaska residents, the Pebble EBD serves as a testament to the Pebble Partnership's commitment to responsible development, environmental health and public safety. The science-driven project is a compelling example of how human expertise and advanced technology can come together to achieve accurate results on a large scale.

The Pebble EBD has been published not only to provide the public and regulatory agencies with a description of the environmental baseline studies that were conducted from 2004 through 2008, but to set the stage for future development of a responsible mine plan. By thoroughly characterizing the existing physical, biological and social environments in the Bristol Bay Drainages and Cook Inlet Drainages Study Areas, the Pebble EBD provides baseline information to engineers and environmental scientists to address characterization of the project area. This knowledge will be supplemented with reports of ongoing studies in order to enhance future design efforts and to minimize the impact of the project on its surroundings, as well as better inform the development of mitigation plans and processes.

As with any scientific study, it is not only the volume of data but also the quality of the data that is important. The complete, five-year environmental study, which called for extensive fieldwork in every season across diverse terrain and within dozens of scientific disciplines to provide robust data sets, was accomplished with the highest standard of quality control policies and procedures.

The resulting body of work provides a clear picture of the environmental baseline conditions throughout the project area – from geology and hydrology to wildlife habitat and migration patterns, to household incomes and the economic realities of local communities.

With a great respect for the land, the culture and the people of southwest Alaska, the Pebble Partnership hopes to take part in growing the regional economy and takes its responsibility as an environmental steward, now and in any potential future endeavors, seriously.

VI

Study Areas & Disciplines

STUDY DISCIPLINES & ASSOCIATED CONSULTANTS & AUTHORS

Environmental Baseline Document

Climate and Meteorology

The studies for climate and meteorology covered the range and seasonality of precipitation, evaporation, temperatures and wind data collected in the Mine Study Areas.

Consultants: Hoefler Consulting Group; CH2M Hill

Geology and Mineralization

Information was collected regarding surficial and bedrock geology, geological structure, deposit types, alteration and mineralization as part of understanding the mining potential of the area.

Author: Knight Piésold

Physiography

This section of the EBD reviews topography, landforms, permafrost and stream drainage patterns, along with aerial photos.

Consultants: Knight Piésold

Soils

These chapters of the study are a comprehensive review of soil types in the study area.

Consultants: Three Parameters Plus, Inc.

Geotechnical Studies, Seismicity and Volcanism

Based on on-site geotechnical investigations, these chapters outline surficial geology, overburden and bedrock geology, hydrogeology, physiography, topography and surficial materials in relation to rock mass, water movement and seismicity.

Consultants: Knight Piésold; Water Management Consultants Inc.; Schlumberger Water Services; Frontier Geosciences Inc.; SRK Consulting, Inc.

Surface Water Hydrology

An overview of regional and local hydrology, streamflow gauging, snow survey programs for the greater Bristol Bay Drainages.

Consultants: Mine Study Area — Knight Piésold HDR Alaska, Inc.; ABR, Inc.; APC Services, LLC; CH2M Hill

Transportation Corridor/Cook Inlet Drainages Study Area — Bristol Environmental and Engineering Services Corp.

Groundwater Hydrology

These chapters of the study describe the groundwater flow regime, water balance modeling, flow rates, hydraulic conductivity, water level fluctuations and pathways.

Consultants: Mine Study Area — Water Management Consultants; Schlumberger Water Services; SLR International Corp.; Bristol Environmental and Engineering Services Corp.; HDR Alaska, Inc.; CH2M Hill

Water Quality

Overview of physical and chemical parameters related to surface and groundwater quality based on extensive year-round field sampling.

Consultants: Mine Study Area — Water Management Consultants; Schlumberger Water Services; HDR

Alaska, Inc.; APC Services, LLC; SLR International Corp.; CH2M Hill

Transportation Corridor/Cook Inlet Drainages Study Area — Bristol Environmental and Engineering Services Corp.; Pentec Environmental/Hart Crowser, Inc.

Trace Elements and other Naturally Occurring Constituents

Assessment of spatial and temporal variability in soil, vegetation, sediments and fish tissue.

Consultants: Mine Study Area — SLR International Corp.; HDR Alaska, Inc.; CH2M Hill

Transportation Corridor/Cook Inlet Drainages Study Area — Bristol Environmental and Engineering Services Corp.; SLR International Corp.; Pentec Environmental/Hart Crowser, Inc.

Geochemical Characterization

Extensive testing was undertaken to determine geochemical properties. This overview assesses the risk potential for acid rock drainage and metal leaching.

Consultants: Mine Study Area - SRK Consulting, Inc.

Noise

A review of monitoring data collected to establish baseline noise levels.

Consultants: Michael Minor & Associates

Vegetation

These chapters discuss dominant vegetation types within the Mine Study Area, as well as typical plant species composition and distribution.

Consultants: Three Parameters Plus, Inc.; HDR Alaska, Inc.

Wetlands

A discussion of the extent and types of wetlands within the study area.

Consultants: Three Parameters Plus, Inc.; HDR Alaska, Inc.

Fish and Aquatic Invertebrates

These chapters present results from extensive field studies addressing distribution, density and abundance, channel morphology, habitat, flow, fluvial geomorphology and temperature modeling.

Consultants: R2 Resource Consultants, Inc.; HDR Alaska, Inc.; Buell & Associates; Bailey Environmental; Northern Ecological Services; EcoFish; Inter-fluve; Pacific Hydrologic, Inc.; Pentec Environmental/Hart Crowser, Inc.

Wildlife and Habitat

Data was gathered from a wide variety of ground-based and aerial surveys, as well as aerial photography, on the habitat availability and habitat-value assessments for birds and mammals.

Consultants: ABR, Inc.; Bristol Environmental and Engineering Services Corp.; Pentec Environmental/ Hart Crowser, Inc.; RWJ Consulting

Threatened and Endangered Species

Studies and research were conducted to determine the potential for rare plant species to be present in the study area, along with the conservation status of protected wildlife.

Consultants: ABR., Inc.

Land and Water Use

An overview of existing land ownership, present use and management status of private and public lands and surface waters.

Consultants: Kevin Waring Associates

Regional Transportation

Information is presented based on existing and proposed land, water and air transportation facilities and services.

Consultants: Kevin Waring Associates

Power

These chapters describe existing services and facilities for supplying power and petroleum fuels to area communities.

Consultants: Kevin Waring Associates

Socioeconomics

Information is provided on demographics, economy, infrastructure and history of the Lake and Peninsula Borough, Bristol Bay Borough and the Dillingham Census Area.

Consultants: Kevin Waring Associates; McDowell Group

Cultural Resources
Existing data is summarized on prehistory, ethnography and history. In addition, information from interviews with tribes and interested parties is provided.

Consultants: Stephen R. Braund & Associates

Subsistence
This section contains a look at the role of subsistence with current and historical subsistence harvests and use areas, traditional knowledge about changes in subsistence resources and local concerns.

Consultants: Stephen R. Braund & Associates

Visual Resources
The scenic quality of the landscape is analyzed using U.S. Forest Service methods.

Consultants: Land Design North

Recreation
These sections contain a description of outdoor recreational resources and activities with estimated economic contributions to the study area.

Consultants: Kevin Waring Associates

Oceanography and Marine Water Quality
This chapter contains marine water quality data for physical and chemical parameters.

Consultants: Mine Study Area — Water Management Consultants; Schlumberger Water Services; HDR Alaska, Inc.; APC Services, LLC; SLR International Corp.; CH2M Hill

Transportation Corridor/Cook Inlet Drainages Study Area — Bristol Environmental and Engineering Services Corp.; Pentec Environmental/Hart Crowser, Inc.

Marine Nearshore Habitat
A review of the diverse range of habitat in the vicinity of Iliamna and Iniskin bays.

Consultants: Pentec Environmental/Hart Crowser, Inc.

Marine Benthos
A review of extensive investigations conducted into the benthic flora and fauna of the intertidal and subtidal habitats of Iliamna and Iniskin bays.

Consultants: Pentec Environmental/Hart Crowser, Inc.

Nearshore (Marine) Fish and Invertebrates
These chapters contain information on beach seine sampling, gill net and trammel net sampling and trawl net sampling for fish and invertebrates.

Consultants: Pentec Environmental/Hart Crowser, Inc.

Marine Wildlife
This chapter addresses seasonal distribution and abundance of marine-oriented wildlife.

Consultants: ABR, Inc.

Analytical Quality Assurance/Quality Control
Shaw Alaska. Inc.; Argon, Inc.

Iliamna Lake Studies
HDR Alaska, Inc.

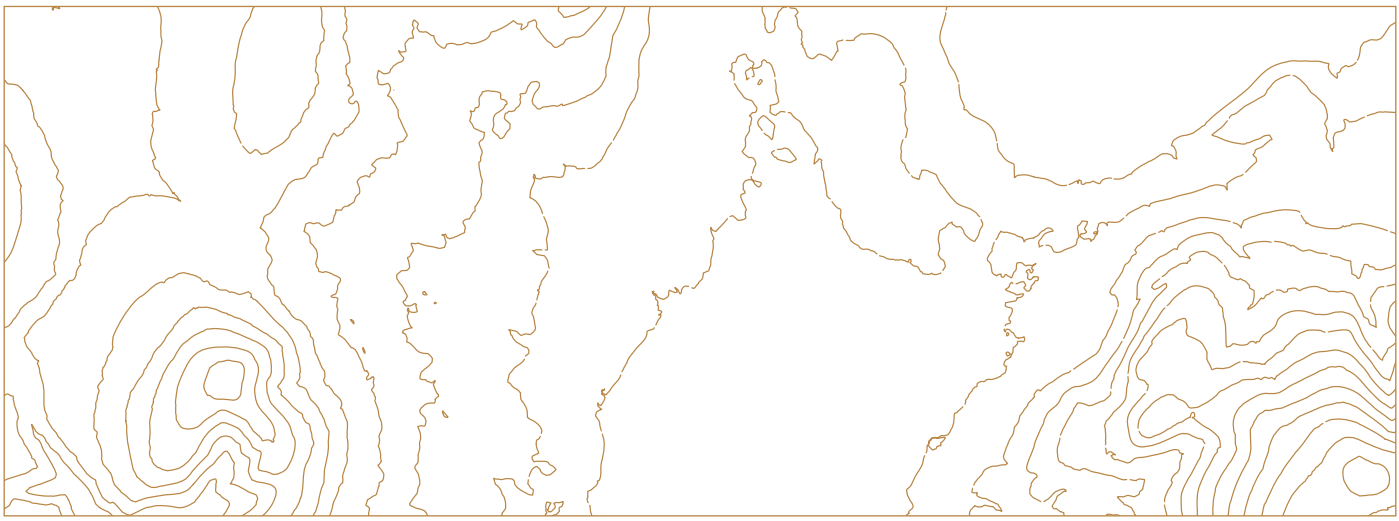
Data Management
Resource Data Inc.; DES.IT; Shaw Alaska, Inc.; Argon, Inc.

Analytical Laboratories
SCS North America; Columbia Analytical Services; SGS CEMI; SGS Lake field; TestAmerica Laboratories, Inc.; University of Waterloo; ACZ Laboratories, Inc.; Texas A&M University; Frontier GeoSciences

Aerial Photography
Aerometric; Eagle Mapping; Kodiak Mapping; Dudley Thompson Mapping

THE PEBBLE ENVIRONMENT

A Scientific Overview of Environmental and Social Data in Southwest Alaska



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