Springfield Sockeye Hatchery

Master Plan for the Snake River Sockeye Program

Volume 2: Appendices

November, 2010

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APPENDICES

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Appendix A

Snake River Sockeye Draft Hatchery Genetic Management Plan

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HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	Snake River Sockeye Salmon Captive Broodstock, Research and Production
Species or Hatchery Stock:	Snake River sockeye salmon *Oncorhynchus nerka*
Agency/Operator:	State of Idaho – Department of Fish & Game
Watershed and Region:	Stanley Basin/Upper Salmon River, Custer County, Idaho
Date Submitted:	
Date Last Updated:	November 2010

EXECUTIVE SUMMARY

Precipitous declines of Snake River sockeye salmon *Oncorhynchus nerka* led to their Federal listing as endangered in 1991 (56 FR 58619). In that same year, the Idaho Department of Fish and Game (IDFG) initiated a captive broodstock program to maintain Snake River sockeye salmon and prevent species extinction. The long-term program goal is to reestablish sockeye salmon runs to Stanley Basin waters and to provide sport and treaty harvest opportunities. The near-term program goal is to prevent species extinction, slow the loss of critical population genetic diversity and heterozygosity, and increase the number of individuals in the population. The population abundance level established by NOAA-Fisheries to achieve de-listing criterion is 2,000 sockeye adults, of which 1,000 must be in Redfish Lake and 500 in each of two additional lakes. To meet this criterion, the program is using a three-tiered approach that: (1) increases number of adult sockeye returns, (2) incorporates more natural-origin returns in hatchery spawning designs and increases natural spawning escapement, and (3) moves towards the development of an integrated program that achieves Hatchery Scientific Review Group (HSRG)-recommended PNI levels.

The purpose of the Snake River sockeye hatchery program is to mitigate for fish losses caused by the construction and operation of the Federal Columbia River Power System (FCRPS). In the 2008 FCRPS Biological Opinion, NOAA-Fisheries established a juvenile sockeye production target for this program of one million smolts.

Since the inception of the program in 1991, all returning anadromous adult sockeye salmon (16 wild fish), several hundred Redfish Lake wild out-migrating smolts, and several residual sockeye salmon adults have been captured and used to develop captive broodstocks at the IDFG Eagle Fish Hatchery and at NOAA Fisheries facilities in Washington State. Adaptively managed, the program generates hatchery-produced eggs, juveniles, and adults for reintroduction to Stanley Basin waters. In addition, emphasis is placed on the annual development of genetically diverse broodstocks. Fish culture variables (e.g., broodstock mating designs, in-hatchery survival, maturation success, fecundity, egg survival to eye, and fish health) are continuously monitored and evaluated to ensure maximum program success. Juvenile out-migrant monitoring, adult return monitoring, and adult sonic telemetry studies provide information critical for the evaluation of program reintroduction strategies. Program methods and results undergo constant review through the Stanley Basin Sockeye Technical Oversight Committee, a team of technical experts assembled to review program results and to guide program direction.

Until a new hatchery facility is constructed to meet the million smolt production objective, current annual program production goals are as follows:

- 50,000 eyed-eggs planted in egg boxes in Pettit Lake
- 100,000 pre-smolts planted in Redfish, Alturas and Pettit lakes (combined release)
- 150,000 smolts planted at the outlet of Redfish Lake and in the Upper Salmon River upstream of the Sawtooth Hatchery, and

- 400 full-term hatchery adults planted in primarily Redfish Lake

Through 2009, the IDFG and NOAA Fisheries hatchery programs have produced in excess of 1,417,000 pre-smolts, 750,000 smolts, 4,000 adults, and 1,000,000 eyed-eggs for reintroduction to Stanley Basin lakes and tributary streams. Between 1995 and 2009, approximately 1,143,000 hatchery-produced sockeye salmon smolts (estimated) emigrated from project lakes.

In 1999, the first hatchery-produced, anadromous sockeye salmon returned to the program. In that year, seven age-3 adults (six males and one female) were trapped at project locations. In 2000, the program experienced its first significant return of hatchery-produced adults when 257 sockeye salmon returned to collection facilities on Redfish Lake Creek and the upper Salmon River at the IDFG Sawtooth Fish Hatchery. Between 2001 and 2009, over 1,500 hatchery-produced sockeye salmon adults returned to the project area.

Key performance standards for the program will continue to be tracked in a targeted monitoring and evaluation program. These standards include: (1) abundance and composition of natural spawners and hatchery broodstock (pHOS, pNOB, and PNI); (2) number of smolts released; (3) in-hatchery and post-release survival rates; (4) total adult recruitment, harvest and escapement of the natural and hatchery components; and (5) abundance, productivity, diversity and spatial structure of the naturally spawning sockeye population.

As of 2010, the captive broodstock phase has achieved sufficient success that the IDFG is proposing to initiate the next phase, population re-colonization. The increased production capacity required to accomplish recolonization of Sawtooth basin lakes would be achieved at the Springfield Hatchery complex proposed in Bingham County, Idaho. Dedicated to production of Snake River sockeye smolts, the resulting adult returns from fish produced at this facility would provide sufficient broodstock to meet re-colonization goals in Redfish, Pettit and Alturas lakes. More detail on the goals and objectives for the Springfield Hatchery can be found in the draft Springfield Master Plan, which is being submitted to the NPCC for approval.

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1 NAME OF HATCHERY OR PROGRAM

Hatchery: Eagle Fish Hatchery
Program: Snake River Sockeye Salmon Captive Broodstock, Research, and Production

Hatchery: NOAA Fisheries (Burley Creek Hatchery and Manchester Research Station)
Program: Snake River Sockeye Salmon Captive Broodstock, Research, and Production

Hatchery: Springfield Hatchery
Program: Snake River Sockeye Salmon Captive Broodstock, Research, and Production

1.2 SPECIES AND POPULATION (OR STOCK) UNDER PROPAGATION, AND ESA STATUS

Snake River sockeye salmon – *Oncorhynchus nerka*

The Snake River sockeye salmon ESU was listed as Endangered under the federal Endangered Species Act in 1991 and includes all anadromous and residual sockeye salmon from the Snake River Basin, Idaho, as well as artificially propagated sockeye salmon from the Redfish Lake captive brood propagation program (Figure 1).

1.3 RESPONSIBLE ORGANIZATION AND INDIVIDUALS

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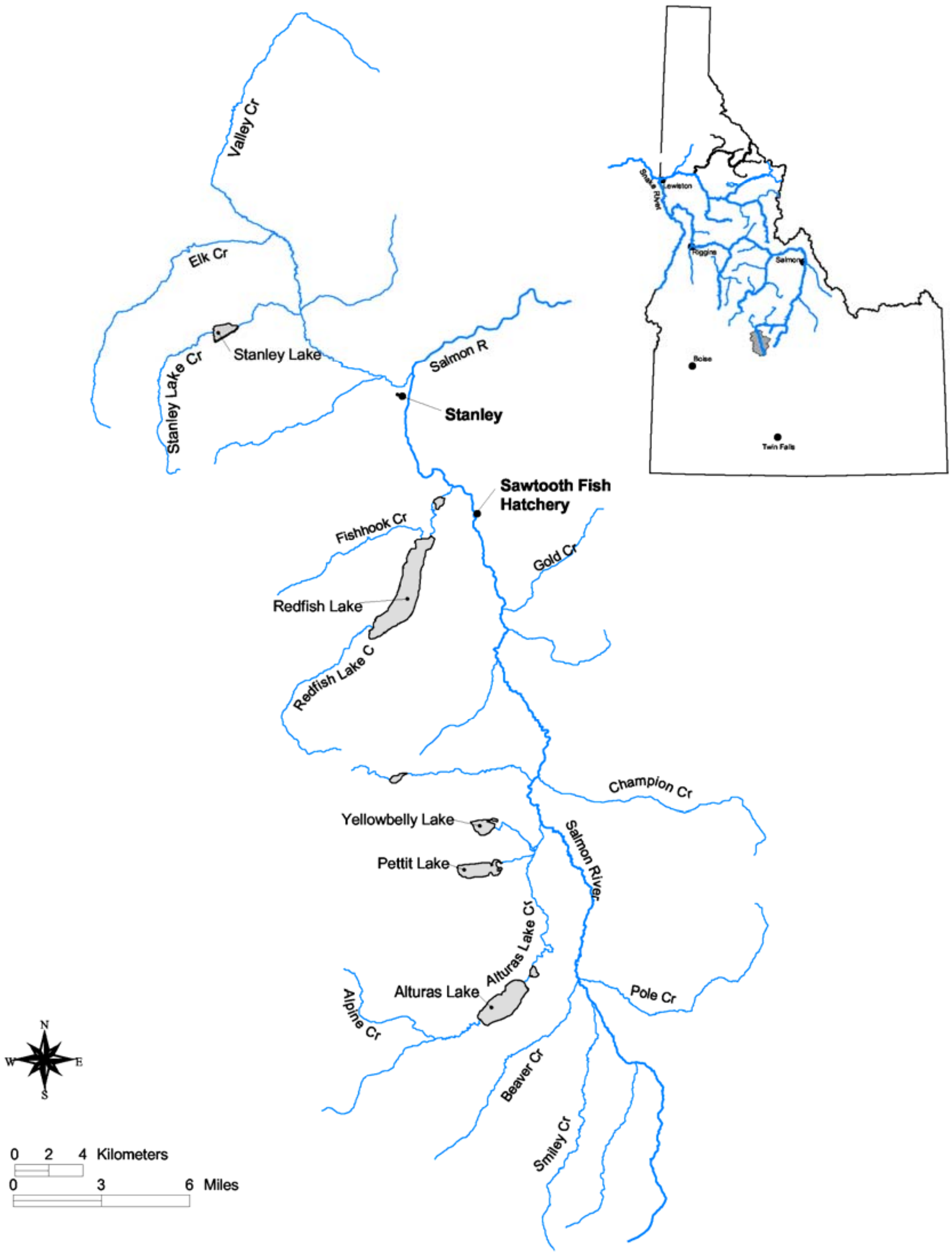

Figure 1. Snake River Sockeye ESU.

Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:

- **Bonneville Power Administration –** Funding agency and facilitator of Stanley Basin Sockeye Technical Oversight Committee

- **National Oceanic & Atmospheric Administration (NOAA) Fisheries –** Co-culture of Snake River sockeye salmon at NOAA's Manchester Research Station and Burley Creek Fish Hatchery (Manchester, WA).

- **Shoshone-Bannock Tribes –** The Shoshone-Bannock Tribes conduct lake habitat investigations and sockeye-specific monitoring and evaluation in Redfish, Alturas, and Pettit lakes.

- **Oregon Department of Fish & Wildlife (ODFW) –** ODFW provides personnel and rearing space for smolt production at the ODFW Oxbow Fish Hatchery (Cascade Locks, OR).

1.4 FUNDING SOURCE, STAFFING LEVEL, AND ANNUAL HATCHERY PROGRAM OPERATIONAL COSTS

- **Fund source** - Bonneville Power Administration (BPA)

- **Staffing** - The IDFG program is divided into two programmatic components consisting of both hatchery and research elements. A total of five permanent staff and up to 8 temporary staff address the annual personnel needs for the program. The NOAA Fisheries hatchery program is staffed by five permanent employees and one term employee.

  The proposed Springfield Hatchery would require two full-time equivalents (FTE) that are considered permanent staff and an estimated two temporary FTEs to address specific seasonal fish culture work.

- **Budget** - The current federal fiscal year (FY10) BPA contract for the IDFG program is approximately $1,172,000 (personnel/operating/capital combined). The federal fiscal year (FY10) BPA contract for the NOAA Fisheries program is $845,515 (personnel/operating/capital combined).

  It is estimated that planning and design of the Springfield Hatchery complex will cost approximately $1.2 million and construction will cost approximately $14 million. Annual operations, maintenance, monitoring and evaluation costs are roughly projected to be $1.06 million.

1.5 LOCATION(S) OF HATCHERY AND ASSOCIATED FACILITIES

Eagle Fish Hatchery – Eagle Fish Hatchery is located in Ada County, Idaho near the town of Eagle; latitude 43° 40' 40" N and longitude 116° 24' 11" W.

Sawtooth Fish Hatchery (IDFG) – Sawtooth Fish Hatchery (SFH) is in Custer County, Idaho near the town of Stanley; latitude 44° 8' 59" N and longitude 114° 52' 55" W. SFH is adjacent to the Salmon River (Salmon River subbasin) at river kilometer code 503.303.617; hydrologic unit code for the facility is 17060201.

Manchester Research Station (NOAA) – Manchester Research Station is in Kitsap County, Washington near the City of Port Orchard; latitude 47° 34’ 14” N and longitude 122° 33’ 11” W.

Burley Creek Fish Hatchery (NOAA) – Burley Creek Fish Hatchery is in Kitsap County, Washington near the City of Port Orchard; latitude 47° 26’ 36” N and longitude 122° 37’ 52” W.

Oxbow Fish Hatchery (ODFW) – Oxbow Fish Hatchery is in Multnomah County, Oregon near the town of Cascade Locks; latitude 45° 40’ 32” N and longitude 121° 51’ 31” W.

Springfield Fish Hatchery (SFH) **–** Springfield Fish Hatchery will be located in Bingham County, Idaho, near the town of Springfield, latitude 43˚, 03’36.46” N and longitude 112˚ 39’ 29.69” W (Figure 2).

1.6 GOAL OF PROGRAM

The management goal for the Snake River sockeye salmon population is to increase the abundance of the natural population to a level that exceeds the Endangered Species Act delisting criterion set by NOAA-Fisheries. The criterion is for a population of 2,000 sockeye adults, of which 1,000 must be in Redfish Lake and 500 in each of two additional lakes. To meet this criterion, the program is using a three-tiered approach: (1) increasing the number of adult sockeye returns; (2) incorporating more natural-origin returns in hatchery spawning designs and increasing natural spawning escapement; and (3) moving towards the development of an integrated program that achieves HSRG recommended Proportionate Natural Influence (PNI) levels.

1.7 PURPOSE OF PROGRAM

The purpose of the Snake River sockeye hatchery program is to mitigate for fish losses caused by the construction and operation of the Federal Columbia River Power System (FCRPS). In the 2008 FCRPS Biological Opinion, NOAA-Fisheries established a juvenile sockeye production target for this program of one million smolts.

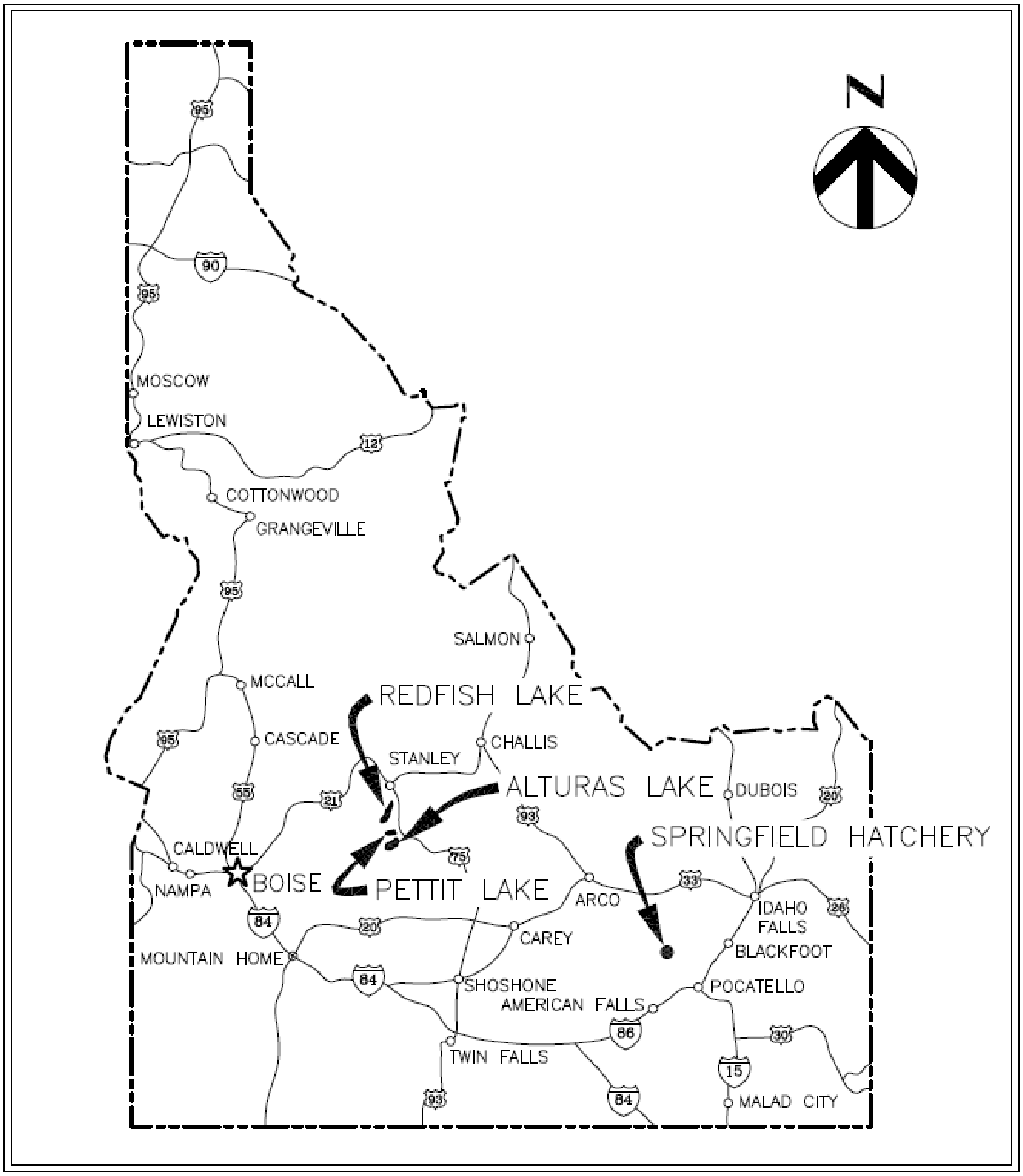

Figure 2. Location of proposed Springfield Fish Hatchery and sockeye salmon smolt and/or adult release locations in the Sawtooth Basin.

1.8 PROGRAM DESCRIPTION

The current program incorporates the use of state-of-the-art hatchery facilities, captive broodstock technology, cutting-edge genetic support, and a comprehensive monitoring and evaluation plan to maintain the genetic resource and to continue rebuilding numbers of fish in the natural environment.

To guard against catastrophic loss at any one brood facility, the captive broodstock components of the program are duplicated at facilities in both Idaho (Eagle FH) and Washington (Manchester Research Station, Burley Creek FH). Eggs produced from annual spawning events are transferred to either Oxbow FH or the Sawtooth FH for continued culture and release.

Annually, the program produces eggs and fish for reintroduction into natal waters (currently Redfish, Alturas, and Pettit lakes). The program uses a "spread-the-risk" reintroduction strategy and conducts ongoing research to determine the most successful release options.

Consistent with language contained in the FCRPS's Biological Opinion and the Idaho Fish Accords, the program is currently pursuing the acquisition of the Springfield Hatchery facility that would have the capacity to produce between 500,000 and 1 million full-term smolts annually for release to Sawtooth Valley waters. Until the new Springfield Hatchery is constructed, current production for the program is as follows:

- 50,000 eyed-eggs planted in egg boxes in Pettit Lake
- 100,000 pre-smolts planted in Redfish, Alturas and Pettit lakes (combined release)
- 150,000 smolts planted at the outlet of Redfish Lake and in the Upper Salmon River upstream of the Sawtooth Hatchery, and
- 400 full-term hatchery adults planted in primarily Redfish Lake

All hatchery operations and monitoring activities will be funded by the Bonneville Power Administration.

As described in the Springfield Hatchery Master Plan (see Section 5.4 of that Plan), once the Springfield facility is operational, the existing captive brood program will be transitioned to conventional hatchery production that uses anadromous adults as broodstock. The primary objectives of Phases 2 and 3 (this new program) will be (1) gene banking and (2) providing anadromous adults to re-colonize available habitat. These anadromous adults will allow managers to phase out the use of Redfish Lake captive broodstock to produce the eggs and juveniles required for re-colonization activities. Proposed program activities in Phase 2 are described below for each of the three targeted lakes: Redfish, Pettit and Alturas. The key criteria used to manage the program in this phase are:

- Minimum proportion of natural-origin adults used as broodstock (pNOB) will be 10%;
- Returning adults prioritized for broodstock;
- Average minimum natural-origin escapement of 500 adult sockeye;
- Average minimum natural-origin and hatchery-origin escapement of 1,300 adult sockeye;
- Harvest rate of less than 3% of natural-origin returns.

These criteria will be the decision rules for the program. Hatchery management and decision-making will be consistent with achieving the criteria.

1.9 LIST OF PROGRAM PERFORMANCE STANDARDS

3.1 - Legal Mandates

3.2 - Harvest

3.3 - Conservation of natural spawning populations

3.4 - Life History Characteristics

3.5 - Genetic Characteristics

3.6 - Research Activities

3.7 - Operation of Artificial Production Facilities

1.10 LIST OF PROGRAM PERFORMANCE INDICATORS DESIGNATED BY BENEFITS AND RISKS

Performance Standards and Indicators used to develop Sections 1.10.1 and 1.10.2 were taken from the final January 17, 2001 version of Performance Standards and Indicators for the Use of Artificial Production for Anadromous and Resident Fish Populations in the Pacific Northwest. Numbers referenced in Tables 1 and 2 correspond to numbers used in the above document.

Modified Performance Standards were created for the proposed Springfield Hatchery. The proposed monitoring and evaluation plan will be designed to ensure that the program achieves these standards established for natural production and in-hatchery culture practices and operations (Table 3).

Table 1. Performance indicators addressing the benefits of the current program.

Performance Standard	Performance Indicator	Monitoring & Evaluation
3.1 – Legal Mandates		
3.1.3: Program addresses ESA responsibilities.	Project conducts NOAA Fisheries Section 10 consultation and has provided a draft HGMP; sponsors currently working with NOAA staff on development of Recovery Plan.	Required data generated annually and provided to NOAA Fisheries as required.
3.3 – Conservation of Wild/Naturally Spawning Populations		
3.3.1: Artificial propagation program contributes to an increasing number of spawners returning to natural spawning areas.	Annual number and age of anadromous and captive spawners known; residual spawner counts conducted throughout spawning season.	Monitor annual spawner counts and redd production; monitor natural smolt production and parental contribution; annual trawling for population abundance.
3.3.2: Releases are sufficiently marked to allow statistically significant evaluation of program contribution to natural production, and to evaluate effects of the	All production releases are marked to identify juveniles and adults to specific release strategies; genetic evaluations established to identify both captive and natural production	Mark groups and genetic technologies allow evaluation of program contribution to target population (both natural and captive populations).

Performance Standard	Performance Indicator	Monitoring & Evaluation
program on the local natural population.	strategies.	

Table 2. Performance indicators addressing risks associated with the current program.

Performance Standard	Performance Indicator	Monitoring & Evaluation
3.2 – Harvest		
3.2.2: Release groups are sufficiently marked in a manner consistent with information needs and protocols to enable determination of impacts to natural- and hatchery-origin fish in fisheries.	All production releases are marked to identify juveniles and adults to specific release strategies; genetic evaluations established to identify natural production strategies.	Mark quality and tag retention checks are performed at marking, post-marking, and immediately prior to release.
3.4 – Life History Characteristics		
3.4.1: Fish collected for broodstock are taken throughout the return or spawning period in proportions approximating the timing and age distribution of the population from which broodstock is taken.	Broodstock are sourced throughout the return and/or spawning period as appropriate; replacement brood sourced from all spawn crosses and from equalized individual and family representation.	Annual spawning and brood sourcing consistent with Stanley Basin Sockeye Technical Oversight Committee (SBSTOC) and NOAA Northwest Fisheries Science Center genetics staff recommendations.
3.4.2: Broodstock collection does not significantly reduce potential juvenile production in natural rearing areas.	Artificial propagation program contributes to increased number of naturally-produced juveniles in nursery lakes.	Research RM&E element documents increasing numbers of naturally-produced juveniles over time.
3.4.3: Life history characteristics of the natural population do not change as a result of this artificial production program.	Artificial propagation program does not change life history characteristics of natural population.	Hatchery and Research elements monitor the following characteristics annually: juvenile migration timing, juvenile size at emigration, adult return timing, adult return age and sex composition and size at return, spawn timing and distribution, fecundity and egg size.
3.4.4: Annual release numbers do not exceed estimated basin-wide and local habitat capacity, including spawning, freshwater rearing, migration corridor, and estuarine and near-shore rearing.	IDFG and cooperators conduct annual investigations to address habitat carrying capacity, population dynamics, and system productivity.	Production releases approved annually and consistent with SBSTOC recommendations.
3.5 – Genetic Characteristics		
3.5.1: Patterns of genetic variation within and among natural populations do not change significantly as a result of artificial production.	Founder genetic profiles known and compared to genetic profiles developed each successive generation.	Intensive annual genetic monitoring of captive and anadromous contributors (Eagle Fish Genetics Laboratory).
3.5.2: Collection of broodstock does not adversely impact the genetic	Patterns of genetic variation do not change significantly as a result of	Intensive annual genetic monitoring of captive and anadromous

Performance Standard	Performance Indicator	Monitoring & Evaluation
diversity of the naturally spawning population.	artificial population.	contributors (Eagle Fish Genetics Laboratory).
3.5.3: Artificially produced origin adults in natural production areas do not exceed appropriate proportion of the total natural spawning populations.	Captive broodstock program initiated to preserve and augment natural spawning population.	Annual production of listed fish to natural environment (see annual reports and/or release tables).
3.5.4: Juveniles are released on-station, or after sufficient acclimation to maximize homing ability to intended return locations.	Program currently lacks in-basin infrastructure to accommodate acclimation of all smolt release groups; balance of juvenile releases maximize homing.	n/a
3.7 – Operation of Artificial Production Facilities		
3.7.1: Artificial production facilities are operated in compliance with all applicable fish health guidelines and facility operation standards and protocols such as those described by IHOT, PNFHPC, and INAD.	- Annual reports indicating level of compliance with applicable standards and criteria. - Periodic audits indicating level of compliance with applicable standards and criteria.	See http://www.efw.bpa.gov/searchpublications/ for annual reporting. Reports are available upon request.
3.7.2: Effluent from artificial production facility will not detrimentally affect natural populations.	- Discharge water quality compared to applicable water quality standards and guidelines, such as those described or required by NPDES, IHOT, PNFHPC, including pertinent State of Idaho water quality plans relating to temperature, nutrient loading, chemicals, etc	See http://www.efw.bpa.gov/searchpublications/ for annual reporting. Reports are available upon request.
3.7.3: Water withdrawals and instream water diversion structures for artificial production facility operation will not prevent access to natural spawning areas, affect spawning behavior of natural populations, or impact juvenile rearing environment.	- Water withdrawals compared to applicable passage criteria. - Water withdrawals compared to NOAA, USFWS, and IDFG juvenile screening criteria. - Number of adult fish aggregating and/or spawning immediately below water intake point. - Number of adult fish passing water intake point. - Proportion of diversion of total stream flow between intake and outfall.	Water withdrawal permits have been obtained to establish water rights for each hatchery facility. Intake system designed to deliver permitted flows. Operators monitor and report as required. Hatcheries participating in the programs will maintain all screens associated with water intakes in surface water areas to prevent impingement, injury, or mortality to listed salmonids.
3.7.4: Releases do not introduce pathogens not already existing in the local populations, and do not significantly increase the levels of existing pathogens.	- Certification of juvenile fish health immediately prior to release, including pathogens present and their virulence. - Juvenile densities during artificial rearing. - Samples of natural populations for disease occurrence before and after	Certification of fish health conducted prior to release (major bacterial, viral, parasitic pathogens); IDFG & NOAA fish health professionals sample and certify all release and/or transfer groups.

Performance Standard	Performance Indicator	Monitoring & Evaluation
	artificial production releases.	
3.7.5: Any distribution of carcasses or other products for nutrient enhancement is accomplished in compliance with appropriate disease control regulations and guidelines, including state, tribal, and federal carcass distribution guidelines.	n/a	n/a
3.7.6: Adult broodstock collection operation does not significantly alter spatial and temporal distribution of any naturally produced population.	- Spatial and temporal spawning distribution of natural population above and below weir/trap, currently and compared to historic distribution.	Artificial propagation program does not significantly alter spatial and/or temporal distribution of any naturally produced population.
3.7.7: Weir/trap operations do not result in significant stress, injury, or mortality in natural populations.	- Mortality rates in trap. - Pre-spawning mortality rates of trapped fish in hatchery or after release.	Facility will maintain all weirs/traps associated with program to either reduce or eliminate stress, injury, or mortality to listed salmonids. Mortality rates are documented.
3.7.8: Predation by artificially produced fish on naturally produced fish does not significantly reduce numbers of natural fish.	- Size at, and time of, release of juvenile fish, compared to size and timing of natural fish present. - Number of fish in stomachs of sampled artificially produced fish, with estimate of natural fish composition.	Sockeye salmon are not piscivorous.
3.8 – Socio-Economic Effectiveness		
3.8.2: Juvenile production costs are comparable to or less than other regional programs designed for similar objectives.	n/a	n/a
3.8.3: Non-monetary societal benefits for which the program is designed are achieved.	n/a	n/a

Table 3. Performance standards, indicators, benefits and risks and proposed monitoring and evaluation for the sockeye program.

Performance Standard	Indicator	Benefits and Risks	Monitoring and Evaluation
Hatchery Operations and Facilities			
Fish collected for broodstock are taken throughout the return or spawning period in proportions approximating the timing and age distribution of the population from which broodstock is taken.	Broodstock are sourced throughout the return and/or spawning period as appropriate; brood sourced from all spawn crosses and from equalized individual and family representation.	Achieving the broodstock indicator ensures that the hatchery population reflects the characteristics of the natural population to the extent possible by including natural-origin fish as broodstock, collecting fish randomly throughout the entire portion of the run, and including both jacks and adults into the broodstock. As these indicators become less representative of the natural population, the more divergent the two populations become, thereby reducing natural population productivity and diversity. Poor mating protocols may reduce genetic diversity and thereby reduce overall population productivity and reproductive success in the natural environment.	Annual spawning and brood sourcing will be consistent with Stanley Basin Sockeye Technical Oversight Committee (SBSTOC) and NOAA Northwest Fisheries Science Center genetics staff recommendations. Fish for broodstock will be collected throughout the entire run period. Males and jacks will be incorporated in ratios reflective of the natural population over time. Intensive annual genetic monitoring of captive and anadromous contributors at the Eagle Fish Genetics Laboratory. Genetic variation is protected by selecting broodstock that represent the genetic diversity of the entire run, selecting fish over the entire length of the run, selecting individuals from each release strategy, equalizing sex ratios and by equalizing family contribution.
Adult Holding and Spawning Survival Rate	> 95% survival	High survival rates ensure that hatchery operations are not inadvertently selecting for certain genetic or behavioral characteristics.	Hatchery culture staff will enumerate loss by life stage for each brood year. Data to be reported in annual operating reports.
Egg-to-Fry Survival Rate	>85% survival		
Fry-to-Parr Survival Rate	> 90% survival		
Parr-to-Smolt Survival Rate	> 95% survival		

Performance Standard	Indicator	Benefits and Risks	Monitoring and Evaluation
Release Timing, Fish Health, Size and Condition of Released Fish	Fish size, release date and range are similar to natural fish to the extent possible given that their survival rate achieves objectives. Released fish certified by pathologist to be disease-free.	Releasing healthy fish at the correct size and time increases overall survival and reduces the release numbers needed to achieve conservation and harvest objectives. Releasing fish that are too large may increase competition with natural fish populations. A mismatch between release timing and environmental conditions required for good survival may reduce overall hatchery and natural fish performance.	Natural fish populations will be monitored both in rearing lakes and as they migrate from the system. Data will be collected on fish abundance, size and migration timing. Culture staff will track juvenile HOR size, growth rates, health and abundance. These data will be reported in annual reports.
Release groups are sufficiently marked in a manner consistent with information needs and protocols to enable determination of impacts to natural- and hatchery-origin fish in fisheries.	HOR identification rate of >98%	Being able to identify HOR fish allows managers to determine program success and reduce/control negative impacts to natural populations.	HOR juveniles will be marked with a combination of coded wire-tags (CWT), PIT-tags and/or adipose clips.
Fish release numbers and location do not reduce NOR juvenile production in lakes and other areas	Fish release location consistent with SBSTOC recommendations	HOR fish compete with NOR populations for both food and space and therefore have the potential to reduce natural production. Selecting proper release locations and timing limits this effect.	The SBSTOC will make yearly recommendations of the number of HOR juvenile sockeye and adults released into the system. These recommendations will be based on the results of research designed to determine lake(s) productivity and juvenile production potential for a given year.
Similar hatchery-origin and natural-origin smolt-to-adult survival rate (SAR)	SAR of HOR > SAR NOR fish	The higher the SAR, the lower the level of hatchery production required to achieve program goals. Smaller hatchery releases result in reduced competition with natural-origin fish which should increase their survival.	Smolts released or captured at monitoring facilities will be marked with a combination of CWT, PIT-tags and or adipose clips. Adult production will be enumerated in fisheries, carcass surveys, dams and weirs. Smolt-to-adult survival rates will be developed for both hatchery- and natural-origin fish migrating from Redfish Lake, Pettit Lake and Alturas Lake. Data will be made available to regional data centers for analysis and storage. For an example see the DART link below: http://www.cbr.washington.edu/trends/index.php

Performance Standard	Indicator	Benefits and Risks	Monitoring and Evaluation
Maximize survival at all life stages using disease control and disease prevention techniques. Prevent introduction, spread, or amplification of fish pathogens. Follow co-managers' fish health disease policy	Necropsies of fish to assess health, nutritional status, and culture conditions. Performance indicators will be based on test performed.	Having fewer and less severe disease outbreaks reduces the disease risks that hatchery populations and operations pose to natural populations.	Staff will conducts health inspection of cultured fish. Pathologist implements corrective actions as needed.
Water diversions and withdrawals do not impact access to spawning and rearing areas	All in-river structures and diversions designed to meet NOAA Fisheries passage criteria	Water diversions and structures can kill juvenile fish through impingement on screens, block or delay access to key habitat, and reduce the amount of this habitat through dewatering of the stream channel	Fish passage facilities and water diversions that have the potential to negatively impact fish will be monitored throughout the year. Screens are constantly inspected for impinged fish and cleaned as needed. Biologists working at weirs and other facilities monitor for fish delay and injury as part of their daily work.
Hatchery effluent discharge requirements are met (Clean Water Act)	Various based on regulations	Achieving high quality hatchery effluent maintains water quality in the receiving stream. Good water quality is essential for the production of all anadromous fish species. Hatchery effluent that degrades water quality may decrease the survival and overall productivity of the natural population.	All hatchery facilities will operate under the "Upland Fin-Fish Hatching and Rearing" National Pollution Discharge Elimination System (NPDES) general permit which conducts effluent monitoring and reporting and operates within the limitations established in its permit.
Natural Production and Harvest Monitoring			
Achieve Natural Spawner Abundance Targets	Triggers achieved	Program success is determined by the number of NOR adults on the spawning grounds. The higher this value, the more likely the population will be able to maintain itself over time. Triggers also are used to determine when HOR releases are reduced or eliminated, thereby decreasing risk of the program to the natural population.	Determined by monitoring adult escapement to Redfish, Pettit and Alturas lakes

Performance Standard	Indicator	Benefits and Risks	Monitoring and Evaluation
Incorporate sufficient number of NOR adults into broodstock collection	pNOB of at least 10%	Achieving the pNOB standard (10%) ensures that the hatchery population does not diverge from the natural component.	The origin (hatchery or natural) of adult fish will be enumerated and classified using genetic analysis and marking information at weirs located on target streams. All natural-origin fish not used for broodstock will be released upstream of the weirs to spawn. Broodstock will consist of at least 20% NOR adults.
Adult run-timing (HOR and NOR)	HOR and NOR run-timing curves are similar over time	For integrated programs, the run-timing of hatchery and natural runs should match, as this is an indicator that the two populations are expressing similar life-histories, and that both are being exposed and adapting to the full range of environmental conditions present in the basin. A mismatch in run-timing between the two populations (HOR and NOR) indicates that hatchery practices are selecting for life-histories dissimilar to those being expressed by the natural population. The two populations may become more divergent over time resulting in greater genetic impacts to NOR populations from hatchery fish spawning in the natural environment. This could include a loss in productivity, diversity and spatial structure.	NOR and HOR run-timing data will be collected at weirs located at Redfish Lake and the Sawtooth Hatchery. Weir counting stations may be located at Alturas and Pettit lakes in later phases to better enumerate adult production and timing for these two systems.
Juvenile abundance over time in Pettit, Alturas and Redfish lakes	Increasing trend	Increasing juvenile abundance over time indicates that natural production levels and system productivity are improving.	Juvenile traps will be operated at the outlets of Redfish, Pettit and Alturas lakes. Trap operations and costs are covered by on-going monitoring efforts outside of the Master Plan.
Achieve ESA defined harvest rates on NOR adults	Variable	Managing the system to NOT exceed identified harvest levels maximizes the number of NOR adults returning to spawning areas.	In-season harvest rates are monitored as part of a regional efforts conducted by federal, state, and tribal entities

Performance Standard	Indicator	Benefits and Risks	Monitoring and Evaluation
Achieve the Proportion of Hatchery-Origin Spawners (pHOS) targets	pHOS decreases over the three phases of the program	Limiting the proportion of hatchery fish on the spawning grounds (pHOS) reduces possible genetic impacts to the natural population. The more dissimilar the two populations, the larger the risk hatchery strays pose. In a well integrated program, the proportion of natural-origin fish in the hatchery brood (pNOB) must exceed the proportion of hatchery fish on the spawning grounds (pHOS). This is to ensure that the populations posses similar genetic and phenotypic traits.	Weir counts and spawning carcass surveys will be used to determine/manage pHOS.
Proportionate Natural Influence (PNI)	> 0.67 (Phase 3)	Achieving the PNI goal >0.67 ensures that the natural, rather than the hatchery environment, is driving local adaptation. Fish better adapted to the natural environment are more productive and more resilient to environmental change. Low PNI (<0.50) is an indicator that the hatchery environment is driving local adaptation. Fish adapted to this environment are less likely to perform well in the wild and therefore reduce the productivity and diversity of the natural component of the combined population.	Natural escapement rates of HOR and NOR will be monitored and controlled both at the hatchery and the spawning grounds. Natural escapement HOR/NOR ratios will be achieved by operating adult weirs at Redfish Lake and Sawtooth Hatchery. Intensive annual genetic monitoring of captive and anadromous contributors to be performed at Eagle Fish Genetics Laboratory.
Reproductive success of naturally spawning HOR and NOR adults	HOR adult recruits per spawner > NOR adult recruits per spawner	Having HOR recruit per spawner (R/S) values > NOR indicates that the program is producing fish adapted to the natural environment as these HOR spawners produce as many returning adults as their NOR counterparts.	Genetic analysis (e.g., pedigree) will be used to determine reproductive success of various hatchery release strategies and the natural population

Performance Standard	Indicator	Benefits and Risks	Monitoring and Evaluation
Straying of program fish to other subbasins or areas	< 5% other subbasins or areas	Good homing fidelity of HOR fish to the hatchery or targeted areas is important for eliminating the genetic risks hatchery fish pose to wild fish from interbreeding. The higher the homing fidelity, the lower the risk. High homing rates also ensure that broodstock are available for culture so that wild populations do not need to be excessively used to achieve production targets.	Regional monitoring and evaluation efforts used to track stray rates out-of-subbasin stray rates

1.11 Expected Size of Program

1.11.1 Proposed annual broodstock collection level (maximum number of adult fish)

The current program uses broodstock from both IDFG and NOAA facilities to produce eggs for annual releases. Dedicated juvenile rearing space is a major limitation to the program and annual egg production is limited to the amount of space available in any given production cycle. At current levels of production, annual egg goals call for approximately 352,000 eyed eggs to be distributed as described in Table 4.

Table 4. Annual distribution of Snake River sockeye eggs under current operations.

Facility (Strategy)	Current Number of Eyed Eggs
IDFG Eagle (Replacement Brood)	1,000
NOAA Facilities (Replacement Brood)	500
NOAA Facilities (Adult Release)	500
Basin Lakes (Egg Boxes)	50,000
IDFG Sawtooth (Pre-Smolt Releases)	80,000
ODFW Oxbow (Smolt Releases)	100,000
IDFG (Smolt Releases)	120,000
Total	352,000

Current language contained in the 2008 FCRPS Biological Opinion and Idaho Fish Accords calls for the acquisition of suitable rearing space to expand the smolt rearing component of the program to produce between 500,000 and 1 million full-term smolts annually. The proposed Springfield Fish Hatchery would provide rearing space for 1 million smolts, thus achieving this objective. Additional eggs for the expanded smolt program would be produced through the use of captive brood at both IDFG and NOAA facilities, as well as increased use of anadromous adults trapped at Sawtooth Basin weirs. In Phase 3 of the program (see Master Plan) it is expected that all broodstock would be collected at these weirs. The total number of broodstock needed to achieve release targets as the program transitions to Phase 2 is 1,150 (Table 5).

Table 5. Proposed levels of broodstock needed for the Snake River sockeye program.

Broodstock Origin	Proposed Annual Broodstock
Hatchery Origin (HOR)	1,035
Natural Origin (NOR)	115
Total	1,150

1.11.2 Proposed annual fish release levels (maximum number) by life stage and location.

The estimated number of juvenile and adult sockeye released to the Sawtooth basin in Phases 1-3 is presented in Table 6. It should be noted that the number of HOR adults released each year will depend upon HOR and NOR run-size to the basin. Additionally, actual HOR releases in Phase 3 will depend upon the results from Phase 2. A set of management triggers will be used to determine when phases occur and the actions to be taken in each (see Master Plan).

Table 6. Proposed annual releases of Snake River sockeye by phase.

Life Stage	Release Location	Phase 1 Annual Release Levels	Phase 2 Annual Release Levels	Phase 3 Annual Release Levels
Eyed Eggs	Sawtooth Basin Lakes	Up to 50,000	0	0
Unfed Fry	Sawtooth Basin Lakes	0	0	0
Fry	Sawtooth Basin Lakes	0	0	0
Fingerling	Sawtooth Basin Lakes	Up to 150,000	0	0
Yearling	Sawtooth Basin Waters	Up to 1 million	1,000,000	1,000,000
Adults	Sawtooth Basin Lakes	Up to 1,500	Variable based on run size	Variable based on run size

Table 7. Adult sockeye hatchery broodstock requirements and natural escapement targets for Redfish, Pettit and Alturas lakes at various HOR and NOR run-sizes.

Run-Size	Hatchery Broodstock			Natural Escapement Targets		
HOR + NOR	No. HOR	pNOB (10%)	Total	Redfish Lake	Pettit Lake	Alturas Lake
1,150	1,035	115	1,150	0	0	0
1,500	1,035	115	1,150	350	0	0
2,000	1,035	115	1,150	850	0	0
2,500	1,035	115	1,150	1,350	0	0
3,000	1,035	115	1,150	1,850	0	0
3,500	1,035	115	1,150	2,350	0	0
4,000	1,035	115	1,150	2,850	0	0
4,500	1,035	115	1,150	3,350	0	0
5,000	1,035	115	1,150	3,800	50	0
5,500	1,035	115	1,150	3,850	500	0
6,000	1,035	115	1,150	4,000	850	0
6,500	1,035	115	1,150	4,200	1,150	0
7,000	1,035	115	1,150	4,400	1,450	0

1.12 CURRENT PROGRAM PERFORMANCE, INCLUDING ESTIMATED SMOLT-TO-ADULT SURVIVAL RATES, ADULT PRODUCTION LEVELS, AND ESCAPEMENT LEVELS. INDICATE THE SOURCE OF THESE DATA.

Program performance gauged by smolt-to-adult (SAR) return rates has varied considerably over the duration of the program. The program uses a spread-the-risk strategy when returning listed eggs and fish to natural habitats. In addition to "standard" hatchery production releases of both pre-smolt and full-term smolts to basin waters, the program also uses "natural production" release strategies by outplanting both pre-spawn adults and fertilized eyed eggs. Progeny produced from adults that spawn naturally in basin lakes, as well as juveniles that successfully hatch from eyed egg releases, are better adapted to lake environments and avoid potential domestication concerns that are typically associated with artificial production environments.

To date, natural production smolt groups have typically produced the highest SARs in the program, with full-term hatchery smolts producing the second-highest SAR values (Tables 8 and 9 should be considered preliminary data).

Table 8. Returns and SAR return rates for BY 2004.

Brood Year	Adult returns by year and age				Total BY Returns	SAR
	2004	2007 (age 3)	2008 (age 4)	2009 (age 5)		
Estimated or actual smolt emigration (total number of emigrants)	180,765	1	475	34	510	0.282%
Estimated emigration from Redfish Lake pre-smolt releases	17,185	0	7	1	8	0.047%
Estimated migration from Alturas and Pettit pre-smolt releases (combined)	16,216	0	13	1	14	0.086%
Actual emigration from Sawtooth-reared smolt release	39,622	0	86	3	89	0.225%
Actual emigration from ODFW-reared smolt release	46,430	1	229	23	253	0.545%
Estimated emigration from natural production in Redfish Lake	6,065	0	55	4	59	0.973%
Estimated emigration from natural production in Alturas and Petit lakes (combined)	55,247	0	85	2	87	0.157%

Source: Project annual reports to Bonneville Power Administration and project annual reports to NOAA Fisheries for ESA Section 10 activities.

Table 9. Returns and SAR return rates for BY 2005.

Brood Year	Adult returns by year and age				Total BY Returns	SAR
	2005	2008 (age 3)	2009 (age 4)	2010 (age 5)		
Estimated or actual smolt emigration (total number of emigrants)	143,547	163	651		814	0.567%
Estimated emigration from Redfish Lake pre-smolt releases	14,256	0	9		9	0.063%
Estimated migration from Alturas and Pettit pre-smolt releases (combined)	11,592	0	19		19	0.164%
Actual emigration from Sawtooth-reared smolt release	47,094	31	124		155	0.329%
Actual emigration from ODFW-reared smolt release	54,582	127	422		549	1.006%
Estimated emigration from natural production in Redfish Lake	5,280	3	69		72	1.364%
Estimated emigration from natural production in Alturas and Pettit lakes (combined)	10,743	2	8		10	0.093%

Source: Project annual reports to Bonneville Power Administration and project annual reports to NOAA Fisheries for ESA Section 10 activities.

Specific adult production and escapement levels have not been established for this population; NOAA Fisheries interim recovery goals for abundance are 1,000 naturally-produced adults returning to Redfish Lake and 500 naturally-produced adults returning to two additional lakes.

1.13 DATE PROGRAM STARTED (YEARS IN OPERATION), OR IS EXPECTED TO START

The Snake River sockeye salmon ESU was listed under the federal Endangered Species Act in 1991 and includes all anadromous and residual sockeye from the Snake River Basin, Idaho, as well as artificially propagated salmon from the Redfish Lake captive brood propagation program.

Construction of the Springfield Fish Hatchery is expected to be complete in 2012. The first releases from this facility would occur in 2013 or 2014.

1.14 EXPECTED DURATION OF PROGRAM

The expected program duration is unknown; the Idaho Fish Accords provide O&M funding for full-term smolt production through at least Federal Fiscal Year 2017. Future funding for captive brood components at both IDFG and NOAA facilities, as well as continued RM&E, is contingent on future BiOp language and CBFWA funding solicitation cycles.

1.15 WATERSHEDS TARGETED BY PROGRAM

Watershed of return: Upper Salmon River, Idaho; 3rd field Hydrologic Unit Code: Salmon, #17060201.

1.16 INDICATE ALTERNATIVE ACTIONS CONSIDERED FOR ATTAINING PROGRAM GOALS, AND REASONS WHY THOSE ACTIONS ARE NOT BEING PROPOSED

The Upper Snake River sockeye population is currently supported by a complex program that relies upon facilities in Idaho, Oregon and Washington to sustain what was a critically imperiled population. Success of this program has paved the way for larger-scale localized broodstock collection that is the foundation of the proposed program components. A number of alternative strategies for the Snake River sockeye program were examined by IDFG as part of this planning effort. In selecting the alternative presented in the Master Plan, among other factors, the IDFG considered the ability of different approaches to meet conservation and broodstock goals, reduce long-term costs, and provide sufficient localized broodstock to restore populations adapted to the specific conditions of lakes in the Sawtooth basin. Alternative approaches evaluated include:

- **Maintain current captive broodstock program**. Under this strategy, the program would continue as it is currently operated. Broodstock would be collected in the basin and reared at Eagle, Oxbow, Burley and Sawtooth hatcheries. Releases back to the Sawtooth basin would consist of eggs, pre-smolts, smolts and captive brood adults.

- **Eliminate captive broodstock program and rely on natural production only**. With this strategy, broodstock no longer would be collected at the Sawtooth Hatchery weir or at the Redfish Lake Creek weir. Returning adults would be allowed to volitionally access habitat upstream of the Sawtooth Hatchery. The population would rely upon current habitat conditions in Redfish, Pettit and Alturas lakes.

- **Five Lake Recovery Strategy**. Returning adult sockeye would be introduced to five lakes in the Sawtooth basin: Redfish, Pettit, Alturas, Stanley and Yellowbelly.

These alternatives were rejected as they did not meet identified conservation goals, were too costly, had a high risk of failure or required more resources for implementation than are currently available. A more detailed discussion of each alternative is presented in Section 5.3.

SECTION 2. PROGRAM EFFECTS ON NMFS ESA-LISTED SALMONID POPULATIONS

If present and potentially affected, USFWS ESA-Listed Salmonid Species and Non-Salmonid Species are addressed in Addendum A.

2.1 LIST ALL ESA PERMITS OR AUTHORIZATIONS IN HAND FOR THE HATCHERY PROGRAM

- Section 10(a)(1)(A) Permit 1124: Authorizes IDFG to annually take endangered Snake River (SR) sockeye salmon while conducting Redfish Lake, Pettit Lake, and Alturas Lake kokanee/sockeye research—as well as other research projects that have received authorization under section 4(d) of the ESA. Permit 1124 covers sockeye take for: upper Salmon River emigrant traps to monitor natural and hatchery Chinook salmon; mid-water trawling in Stanley Basin lakes to monitor the expansion of the sockeye reintroduction program into various nursery lakes; and provisions for transporting sockeye within the basin and for rescuing and salvaging sockeye salmon (Permit expires 12/31/10).

- Section 10(a)(1)(A) Permit 1454 (draft): Authorizes IDFG a direct take of endangered sockeye salmon from Redfish Lake and other tributaries of the upper Salmon River as a captive broodstock program to produce large numbers of juvenile fish for restoring anadromous sockeye runs to the Snake River. Draft Permit 1454 also includes take of juvenile sockeye in the upper Salmon River migrant traps. Permit 1454 replaces expired Permit 1120. Pending final issuance of Permit 1454, take is authorized through correspondence between IDFG and NOAA (Draft Permit; ongoing edits and consultation).

- Section 10(a)(1)(B) Permit 1481: Authorizes IDFG annual incidental take of ESA-listed anadromous fish (endangered Snake River sockeye salmon, threatened Snake River steelhead, threatened Snake River spring/summer and fall Chinook salmon) under the jurisdiction of NOAA Fisheries while implementing the State of Idaho's recreational fishing programs (Permit expires 05/31/10).

- Section 10 Permit 1455 (draft): Authorizes the NOAA Fisheries' Northwest Fisheries Science Center to take endangered Snake River Sockeye Salmon (*Oncorhynchus nerka*) for scientific research and to enhance the propagation of listed species to prevent the extinction and provide options for the recovery of the listed population. It also authorizes the development of techniques necessary to rear sockeye salmon from fertilized eggs through maturity in captivity and spawn the mature fish and rear their progeny for release into natural habitat. Permit 1455 replaces expired permit 1148. Pending final issuance of Permit 1455, take is authorized through correspondence between NOAA Fisheries NWFSC and NW Regional Office (Draft Permit; ongoing edits and consultation).

2.2 PROVIDE DESCRIPTIONS, STATUS, AND PROJECTED TAKE ACTIONS AND LEVELS FOR NMFS ESA-LISTED NATURAL POPULATIONS IN THE TARGET AREA

2.2.1 Description of NMFS ESA-listed salmonid population(s) affected by the program

The Snake River sockeye salmon ESU was listed under the federal Endangered Species Act in 1991 and includes all anadromous and residual sockeye salmon from the Snake River Basin, Idaho, as well as artificially propagated sockeye salmon from the Redfish Lake captive brood propagation program.

The Interior Columbia Technical Recovery Team (ICTRT) designated at least three historical populations within the Stanley Lakes Basin: Redfish Lake (including Little Redfish), Alturas Lake, and Stanley Lake. The Redfish Lake sockeye population includes both anadromous and residualized sockeye that spawn synchronously with the anadromous fish. Two other lakes – Pettit Lake and Yellowbelly Lake – may have supported independent populations; however; currently available information did not allow the ICTRT to determine their status with certainty.

In addition, three other lakes or groups of lakes in the Snake River drainage supported sockeye populations: Warm Lake (in the South Fork Salmon drainage); Payette, Upper Payette and Little Payette lakes (Payette River drainage); and Wallowa Lake (Grande Ronde drainage). The distance between these lakes or groups of lakes is consistent with observed distances between extant ESUs of lake-spawning sockeye, suggesting that each of these groups would likely have been separate major population groups and may have been separate ESUs.

Historically, it was estimated that as many as 40,000 sockeye returned to the Stanley River subbasin each year (NPCC 2004). The recovery goal for abundance is 1,000 naturally-produced adults returning to Redfish Lake and 500 naturally-produced adults returning to two additional lakes. This ESU has a very high risk of extinction (NMFS 2008).

Identify the NMFS ESA-listed population(s) that will be directly affected by the program

Snake River sockeye is an ESA listed population. The Snake River sockeye salmon ESU includes all anadromous and residual sockeye from the Snake River Basin, Idaho, as well as artificially propagated sockeye salmon from the Redfish Lake Captive Broodstock Program (IDFG, NOAA, and ODFW facilities).

Identify the NMFS ESA-listed population(s) that may be incidentally affected by the program

ESA-listed populations that may be incidentally affected include threatened Snake River spring/summer Chinook salmon (*O. tshawytscha*), threatened Snake River steelhead (*O. mykiss*), and threatened bull trout (*Salvelinus confluentus*).

Areas of potential impact are generally restricted to juvenile and adult trapping facilities on Redfish Lake Creek, the upper Salmon River weir adjacent to Sawtooth Fish Hatchery, as well as juvenile trapping facilities on both Alturas Lake Creek and Pettit Lake Creek (operated by the Shoshone-Bannock Tribes). Trapping of outmigrant sockeye juveniles is typically conducted from April through June and anadromous adult trapping generally occurs from mid-July through mid-October in most years.

A brief review of the life history traits of listed salmonids in the Upper Salmon River Basin (Chinook salmon, steelhead, bull trout) suggest that ecological interactions between Snake River sockeye salmon and co-occurring listed salmonids are of relatively minor concern. Juvenile sockeye salmon typically rear their entire juvenile life history phase in a nursery lake environment; juvenile Chinook, steelhead, and fluvial populations of bull trout generally adopt a stream- or riverine-type rearing environment. Life history variation with co-occurring listed salmonids would have little or no effect on common genetic, competition, predation, as well as residual life history concerns that are often the case in a multi-species recovery area.

2.2.2 Status of NMFS ESA-listed salmonid population(s) affected by the program

Describe the status of the listed natural population(s) relative to "critical" and "viable" population thresholds

To date, current status assessments and ESU summary sheets for Snake River sockeye salmon have not been developed by the ICTRT. Section 8.4.6.1 of the current 2008 FCRPS Biological Opinion Supplemental Comprehensive Analysis of the FCRPS and Mainstem Effects of the Upper Snake and other Tributary Actions provides the following summary on the recent status of the Snake River sockeye salmon ESU: The information presented below is taken from the 2008 Biological Opinion for the FCRPS: Supplemental Comprehensive Analysis of the FCRPS and Mainstem Effects of the Upper Snake and other Tributary Actions.

> **8.4.6.1 Recent Status of the Snake River ESU**
>
> The Snake River sockeye salmon ESU is comprised of a single MPG and single population spawning and rearing in Redfish, Pettit, and Alturas lakes in the Sawtooth Valley, and includes artificially propagated sockeye salmon from the Redfish Lake Captive Broodstock Program. This population is the last remaining in a group of what were likely to have been independent populations occupying the Sawtooth Valley lakes. The Interior Columbia Basin TRT has designated this species at very high risk. The extremely low number of natural spawners and reliance on a captive Broodstock Program implemented in 1992 illustrates the high degree of risk faced by this population.
>
> Recent annual abundances of natural-origin sockeye salmon to the Stanley Basin have been extremely low. Although residual sockeye salmon have been identified in Redfish and Pettit lakes, the abundance of the ESU is supported by adults produced through the captive propagation program. Recently, the smolt-to-adult survival of sockeye originating from the Sawtooth Valley lakes rarely has been greater than 0.3%. The current average productivity is substantially less than the productivity required for any population to be at Low (1-5%) long-term extinction risk at the minimum abundance threshold. Based on current abundance and productivity information, the Snake River sockeye salmon ESU does not meet the viability criteria for non-negligible risk of extinction over 100-year time period. Short-term extinction risk has been reduced by the captive propagation program; between 1999 and 2007, more than 355 adults returned from the ocean from captive broodstock releases – almost 20 times the number of wild fish that returned in the 1990s. The program has been successful in its goals of preserving important lineages of Redfish Lake sockeye salmon for genetic variability and in preventing extinction in the near-term.
>
> Ocean fishing mortality on Snake River sockeye is assumed to be zero. Non-Indian fisheries in the lower Columbia River are limited to a harvest rate of 1%. Treaty Indian fisheries are limited to a harvest rate of 5 to 7% depending on the

run size of upriver sockeye stocks. Actual harvest rates over the last ten years have ranged from 0 to 0.9%, and 2.8 to 6.1%, respectively.

A draft recovery plan containing strategies to address remaining key limiting factors is expected to be completed later in 2010. Given the extremely low levels of Snake River sockeye returns, initial recovery efforts are largely focused on improving survival rates of out-migrant smolts. The Stanley Basin Sockeye Technical Oversight Committee has determined that the next step toward meeting the goal of amplifying the wild population is to increase the number of smolts released.

The major factors limiting the conservation value of critical habitat for Snake River sockeye are the effects on the migration corridor posed by the mainstem lower Snake and Columbia River hydropower system, reduced tributary stream flows and high temperatures experienced by outmigrating smolts and returning adults, and barriers to tributary migration. The Sawtooth Valley lakes lie within nearly pristine areas. The production capacity of these naturally oligotrophic systems is low, but nutrient supplementation in recent years has stimulated primary productivity and the development of a favorable zooplankton forage community. Non-native kokanee salmon directly compete for zooplankton forage in most Sawtooth Valley lakes. Ocean conditions that have affected the status of this ESU generally have been poor since 1977, improving only in the last few years.

Provide the most recent 12 year progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population. Indicate the source of these data.

The number of natural-origin sockeye trapped at the Redfish Lake Creek trap is displayed in Table 10; the number of natural-origin sockeye trapped at the Sawtooth Fish Hatchery trap is displayed in Table 11.

Table 10. Mark history of anadromous sockeye adults returning to the Redfish Lake Creek trap, 1999 to present.

Return Year	Total Return	Mark Unknown	No Marks	PIT Only	Ad Only	Ad/PIT	Ad/CWT	Ad/ CWT/PIT	Ad/RV	Ad/RV/ CWT	Ad/RV/ CWT/PIT	Ad/LV	Ad/LV/ CWT	Ad/LV/ CWT/PIT
1999	0													
2000	119		10		17						1	33	58	
2001	15		4		9	1							1	
2002	8		2		6									
2003	1				1									
2004	1						1							
2005	2		2											
2006	0													
2007	1									1				
2008	432	51	50		7		8		42	270	4			
2009	584	16	75	1	11		19		1	453	6		2	
2010														

Source: Project annual reports to Bonneville Power Administration and project annual reports to NOAA Fisheries for ESA Section 10 activities.

Table 11. Mark history of anadromous sockeye adults returning to the Sawtooth Fish Hatchery trap, 1999 to present.

Return Year	Total Return	Mark Unknown	No Marks	PIT Only	Ad Only	Ad/PIT	Ad/CWT	Ad/CWT/ PIT	Ad/RV	Ad/RV/ CWT	Ad/RV/ CWT/PIT	Ad/LV	Ad/LV/ CWT	Ad/LV/ CWT/PIT
1999	7											2	5	
2000	138	14			25	1			1		2	31	64	
2001	11	3			8								1	
2002	14	7	4		3									
2003	2	1			1									
2004	26	3	4		8		8		2			1		
2005	4				1		1		2					
2006	3		1		2									

Return Year	Total Return	Mark Unknown	No Marks	PIT Only	Ad Only	Ad/PIT	Ad/CWT	Ad/CWT/ PIT	Ad/RV	Ad/RV/ CWT	Ad/RV/ CWT/PIT	Ad/LV	Ad/LV/ CWT	Ad/LV/ CWT/PIT
2007	3		3											
2008	218		92	1	14		108			4				
2009	249		8	2	20	1	116	4	1	12		6	77	2
2010														

Source: Project annual reports to Bonneville Power Administration and project annual reports to NOAA Fisheries for ESA Section 10 activities.

Provide the most recent 12 years of annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.

Table 12. Redfish Lake Sockeye Captive Broodstock Program, Eagle Fish Hatchery spawning results for wild anadromous, wild out-migrant, wild residual, and hatchery-produced adult sockeye salmon.

Spawn Year	Female Brood Year and Origin	Total Green Eggs Taken	Total Eyed Eggs Produced	Mean Fecundity	Percent Egg Survival to Eyed Stage
1991	Wild anadromous (1 female)	2,177	1,978	2,177	91%
1992	Wild residual (1 female)	36	36	-	100%
1993	Wild anadromous (2 females)	6,320	3,699	3,160	58%
	OM91 wild out-migrants	32,956	9,656	2,059	29%
	Wild residual (2 females)	317	292	158	92%
1994	BY91 hatchery-produced	466,830	256,756	1,995	55%
	Wild anadromous (1 female)	2,896	2,780	2,896	96%
1995	BY92 hatchery-produced residuals	3,289	1,349	1,644	41%
	OM92 wild out-migrants	2,079	1,156	2,079	56%
	OM93 wild out-migrants	1,080	501	1,080	46%
1996	BY93 hatchery-produced	180,000	109,000	2,118	61%
	Wild anadromous (1 female)	2,067	1,756	2,067	85%
1997	BY91 hatchery-produced	253,673	152,760	2,205	60%
1998	BY94 hatchery-produced	32,375	15,580	1,199	48%
1999	BY96 hatchery-produced anadromous	1,469	1,370	1,469	93%
	BY96 hatchery-produced	160,436	61,798	1,976	39%
2000	BY97 hatchery-produced	377,550	214,298	2,924	57%
	BY96 hatchery-produced anadromous	44,151	32,022	2,772	73%
	BY98 hatchery-produced	11,603	6,727	1,527	58%
2001	BY97 hatchery-produced anadromous	5,286	3,199	2,743	61%
	BY98 hatchery-produced	282,434	118,121	2,213	42%
2002	BY00 hatchery-produced	31,143	25,435	1,165	82%
	BY99 hatchery-produced	88,412	40,889	1,444	46%
2003	BY00 hatchery-produced	324,645	287,381	1,656	89%
	BY01 hatchery-produced	12,121	11,560	1,102	95%
	BY99 hatchery-produced anadromous	5,155	5,042	2,578	98%
2004	BY00 hatchery-produced	677	474	677	70%
	BY01 hatchery-produced	171,778	121,573	1,684	71%
	BY00 hatchery-produced anadromous	20,894	18,776	2,322	90%
2005	BY02 hatchery-produced	203,812	141,207	1,706	70%
	BY00 & 01 hatchery-produced anadromous	4,900	4,000	2,450	82%
2006	BY03 hatchery-produced	328,180	255,523	1,833	78%

Spawn Year	Female Brood Year and Origin	Total Green Eggs Taken	Total Eyed Eggs Produced	Mean Fecundity	Percent Egg Survival to Eyed Stage
	BY02 hatchery-produced anadromous	4,495	2,819	2,248	63%
2007	BY04 hatchery- produced	230,794	172,679	1,614	75%
	BY03 hatchery-produced	2,174	385	2,174	18%
	BY03 hatchery-produced anadromous	3,425	2,746	2,846	80%
2008	BY04 hatchery- produced	1,896	1,549	1,896	82%
	BY05 hatchery-produced	135,534	123,701	1,784	91%
	BY04 hatchery-produced anadromous	103,790	95,084	2,661	92%
2009	BY06 hatchery- produced	169,639	152,844	1,616	90%
	BY05 hatchery-produced anadromous	156,670	138,124	2,749	88%
Total		3,869,158	2,596,625		67.11%

Source: Project annual reports to Bonneville Power Administration and project annual reports to NOAA Fisheries for ESA Section 10 activities.

Table 13. Redfish Lake Sockeye Captive Broodstock Program, NOAA Fisheries spawning results for hatchery-produced adult sockeye salmon.

Spawn Year	Female Brood Year and Origin	Total Green Eggs Taken	Total Eyed Eggs Produced	Mean Fecundity	Percent Egg Survival to Eyed Stage
1994	BY91 hatchery-produced	92,079	54,118	1,644	58.8
1995	BY92 Hatchery-produced	-	-	-	-
1996	BY93 Hatchery-produced	660,321	378,471	1,384	57.3
1997	BY93 hatchery-produced	198,293	59,865	2,542	30.2
1997	BY94 Hatchery-produced	119,015	87,749	1,700	73.7
1998	BY94 Hatchery-produced	99,740	47,171	1,788	47.3
1998	BY96 Hatchery-produced	997	533	997	53.5
1999	BY96 Hatchery-produced	235,442	75,974	1,685	32.3
2000	BY96 Hatchery-produced	5,180	1,573	2,269	30.4
2000	BY97 Hatchery-produced	148,885	93,383	2,256	62.7
2001	BY97 Hatchery-produced	25,446	11,979	2,827	47.1
2001	BY98 Hatchery-produced	181,653	91,098	2,088	50.1
2001	BY99 Hatchery-produced	1,587	630	794	39.7
2002	BY99 Hatchery-produced	92,483	72,446	1,492	78.3
2003	BY00 Hatchery-produced	207,655	142,497	1,610	68.6
2004	BY00 Hatchery-produced	5,384	3,472	1,795	64.5
2004	BY01 Hatchery-produced	192,575	132,227	1,563	68.7
2005	BY02 Hatchery-produced	209,112	144,136	1,693	68.9
2006	BY03 Hatchery-produced	322,080	190,878	2,219	59.3
2007	BY03 Hatchery-produced	6,552	4,260	3,276	65.0
2007	BY04 Hatchery-produced	260,181	189,627	2,168	72.9

Spawn Year	Female Brood Year and Origin	Total Green Eggs Taken	Total Eyed Eggs Produced	Mean Fecundity	Percent Egg Survival to Eyed Stage
2008	BY05 Hatchery-produced	178,155	134,106	1,472	75.3
2009	BY06 Hatchery-produced	159,502	129,849	1,734	81.4
2009	BY07 Hatchery-produced	1,158	65	1,158	5.6
Total			2,046,107		

Source: Project annual reports to Bonneville Power Administration and project annual reports to NOAA Fisheries for ESA Section 10 activities.

Provide the most recent 12 year estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.

Table 14. Redfish Lake Sockeye Captive Broodstock Program eyed-egg release history and estimated hatch results.

Release Year	Release Location	No. of Eggs Planted	Estimated Hatch
1996	Redfish Lake	105,000	97%
1997	Redfish Lake	85,378	98%
	Alturas Lake	20,389	72%
1999	Pettit Lake	20,311	74%
2000	Pettit Lake	65,200	79%
2002	Pettit Lake	30,924	91%
2003	Pettit Lake	149,966	94%
	Alturas Lake	49,700	98%
2004	Pettit Lake	49,134	86%
2005	Pettit Lake	51,239	92%
2006	Pettit Lake	79,908	51%
	Alturas Lake	104,688	99%
2007	Pettit Lake	51,008	95%
2008	Pettit Lake	67,984	94%
2009	Pettit Lake	56,910	Pending
	Alturas Lake	15,568	Pending
Total		1,003,307	

Source: Project annual reports to Bonneville Power Administration and project annual reports to NOAA Fisheries for ESA Section 10 activities.

2.2.3 Describe hatchery activities, including associated monitoring and evaluation and research programs that may lead to the take of NMFS listed fish in the target area, and provide estimated annual levels of take.

Describe hatchery activities that may lead to the take of listed salmonid populations in the target area, including how, where, and when the takes may occur, the risk potential for their occurrence, and the likely effects of the take.

Specific hatchery and research activities that address take of listed salmonids in the target areas are addressed in NOAA Section 10 Permits for the program (see Section 2.1):

- Section 10(a)(1)(A) Permit 1124
- Section 10(a)(1)(A) Permit 1454 (draft)
- Section 10(a)(1)(A) Permit 1455 (draft)
- Section 10(a)(1)(B) Permit 1481

Provide information regarding past takes associated with the hatchery program, (if known) including numbers taken and observed injury or mortality levels for listed fish.

As outlined in NOAA Section 10 permits, annual progress reports documenting take levels for listed stocks are provided to NOAA Fisheries under current permits. The known take of ESA-listed Snake River sockeye for broodstock is listed in Table 15.

Table 15. Redfish Lake sockeye salmon returns to traps on Redfish Lake Creek and the Upper Salmon River at the Sawtooth Fish Hatchery.

Return Year	Wild or Hatchery Produced	Number
2004	H	27
2005	H	6
2006	H	3
2007	H	4
2008	H	650
2009	H	833

Provide projected annual take levels for listed fish by life stage (juvenile and adult) quantified (to the extent feasible) by the type of take resulting from the hatchery program (e.g. capture, handling, tagging, injury, or lethal take).

All adult sockeye are trapped and handled at either the Redfish Lake Creek or Sawtooth Fish Hatchery weirs. The take of returning adults varies annually and is regulated through annual consultation with the Stanley Basin Sockeye Technical Oversight Committee (see Table 15). Following capture, sockeye may be released to spawn naturally or retained to be used as broodstock. Take of other life stages can be found in Table 1 (Appendix A).

Indicate contingency plans for addressing situations where take levels within a given year have exceeded, or are projected to exceed, take levels described in this plan for the program.

Additional mortality and/or take associated with this program that deviates from existing permit conditions will be communicated to NOAA Fisheries per permit requirements.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

3.1 DESCRIBE ALIGNMENT OF THE HATCHERY PROGRAM WITH ANY ESU-WIDE HATCHERY PLAN OR OTHER REGIONALLY ACCEPTED POLICIES

The Snake River Sockeye Salmon Captive Broodstock, Research, and Production program is exclusive to this ESU; no additional programs currently address Snake River sockeye recovery. Recent major regional policies and plans that are linked to this program include:

- U.S. v. Oregon Columbia River Fish Management Plan – 2008-2017
- NPCC Fish and Wildlife Program
- NPCC Salmon Subbasin Management Plan
- Idaho Fish Accords
- FCRPS 2008 Biological Opinion
- IDFG 2007 – 2012 Fisheries Management Plan

3.2 LIST ALL EXISTING COOPERATIVE AGREEMENTS, MEMORANDA OF UNDERSTANDING, MEMORANDA OF AGREEMENT, OR OTHER MANAGEMENT PLANS OR COURT ORDERS UNDER WHICH PROGRAM OPERATES.

This HGMP is consistent with all agreements, plans, and policies referenced in Section 3.1.

3.3 RELATIONSHIP TO HARVEST OBJECTIVES

3.3.1 Describe fisheries benefitting from the program, and indicate harvest levels and rates for program-origin fish for the last 12 years, if available

Snake River sockeye salmon are listed as Endangered under the ESA; there are no specific harvest objectives for this program. Substantive information on fisheries benefitting from the program is lacking; the current FCRPS 2008 Biological Opinion provides the following information on harvest associated with Snake River sockeye salmon:

Recent Ocean and Mainstem Harvest

Few sockeye are caught in ocean fisheries. Ocean fishing mortality on Snake

River Sockeye is assumed to be zero. Fisheries in the mainstem Columbia River that affect Snake River sockeye were managed subject to the terms of the U.S. v. Oregon Interim Management Agreement for 2005-2007. These fisheries were limited to ensure that the incidental take of ESA-listed Snake River sockeye does not exceed specified rates. Non-Treaty fisheries in the lower Columbia River were limited to a harvest rate of 1%. Treaty Indian fisheries are limited to a harvest rate of 5 to 7% depending on the run size of upriver sockeye stocks. Harvest rates have ranged from 0 to 0.95%, and 2.8 to 6.1% since 2001, respectively.

3.4 RELATIONSHIP TO HABITAT PROTECTION AND RECOVERY STRATEGIES

Habitat protection for Snake River sockeye salmon is addressed in the NPCC Salmon Subbasin Management Plans. Habitat protection programs that generally benefit all migratory anadromous salmonids in Idaho (and downstream habitats) are assumed to provide similar benefits to migrating sockeye salmon.

NOAA Fisheries has not developed a recovery plan specific to Snake River sockeye salmon, but the program is operated consistent with existing Biological Opinions and NOAA Section 10 Permit language.

In April 2009, IDFG provided Snake River sockeye salmon language to NOAA Fisheries staff (Rob Jones, Mike Delarm, David Mabe) for inclusion in a future Snake River salmon and steelhead recovery plan. IDFG described a phased approach of moving the captive broodstock program to an integrated conservation supplementation program. This concept is included as Appendix A to this HGMP and is not intended to be the Department's final management plan for Snake River sockeye salmon.

3.5 ECOLOGICAL INTERACTIONS

Salmonid and non-salmonid fishes or other species that could:

1) *negatively impact program;*

   Snake River sockeye salmon typically spend one to three years in a nursery lake prior to emigrating from Sawtooth Basin lakes as smolts in spring. This extended period of juvenile lake residence contrasts with the typical life history phases of listed Chinook, steelhead and bull trout (see Section 2.2.1). While diet overlap with listed salmonids is certainly feasible, albeit unlikely, competition for limited food resources may play a role in the mortality of juvenile sockeye. More importantly, freshwater predation from listed salmonids (also avian predation) would be of greater concern and likely occurs as smolts congregate and emigrate from lake environments.

2) *be negatively impacted by program;*

   Large concentrations of migrating sockeye salmon may attract predators (fish, avian) and could contribute indirectly to the predation of listed salmonids. In addition, the presence of large numbers of hatchery sockeye salmon may alter the behavioral patterns of wild salmonids (sockeye and others) and potentially influence their susceptibility and vulnerability to predation.

3) *positively impact program;*

Increased numbers of listed salmonids that escape to spawn in lake inlets may actually contribute to lake nutrient levels, ultimately benefitting listed sockeye salmon by increasing lake productivity.

4) *be positively impacted by program.*

Sockeye emigrating from Basin lakes may actually benefit co-occurring listed salmonids populations; increased concentrations of migrating fish may overwhelm predator populations and provide a beneficial, protective effect to co-occurring fish.

SECTION 4. WATER SOURCE

4.1 PROVIDE A QUANTITATIVE AND NARRATIVE DESCRIPTION OF THE WATER SOURCE (SPRING, WELL, SURFACE), WATER QUALITY PROFILE, AND NATURAL LIMITATIONS TO PRODUCTION ATTRIBUTABLE TO THE WATER SOURCE

Eagle Fish Hatchery - Eagle Fish Hatchery is the primary Idaho site for the sockeye salmon captive broodstock program. Artesian water from three wells is delivered with three separate pump/motor systems. Water temperature remains a constant 13.5°C and total dissolved gas averages 100% after degassing. In 2008, construction of a new captive broodstock building and modifications to the water delivery system from wells #1 and #2 was completed. The new building allows the captive broodstock capacity to double (from 400 to 800 per year class) and provides isolated holding for anadromous sockeye adults. Water chilling capability was added at Eagle Fish Hatchery in 1994 with a second chiller added in 2008. Chiller capacity accommodates incubation, a portion of fry rearing, and a portion of adult holding needs. Backup and system redundancy is in place for degassing, pumping, and power generation. The alarm system was modified in 2008 and currently includes seven alarms tied to the water system and two alarms tied to chiller operation, with alarms linked through an emergency service contractor.

Burley Creek Hatchery - The hatchery is supplied with about 500 gallons per minute (gpm) of pathogen free 10°C well water pumped from two of four available wells. Water sourcing is rotated between the wells to minimize screen impaction, provide a maintenance opportunity, and extend the useful life expectancy of each well. A fifth well is presently under development to increase the available water supply above 500 gpm, while maintaining proper well rotation protocols. The current water right is for 500 gpm and a hydrogeological study of the facility completed in 2008 indicates the aquifer can sustain withdrawals of 1000 gpm should the need arise. The water is passed through packed columns on a central degassing tower to remove excess nitrogen and raise dissolved oxygen levels to 10.3 ppm before it is distributed to the rearing tanks. The water supplied to incubation and fry rearing vessels can be diverted through a chiller to decrease the water temperature by 5°C. Additional chilling capability is available if needed. Oxygen can be supplied to the rearing tanks for life support in the event of water flow disruption. At a 7 lbs/gpm loading rate the facility can maintain a maximum of 3,500 lbs of fish on 500 gpm of first pass water. This figure can be doubled to maintain a maximum of 7,000 lbs of fish on 1,000 gpm of first pass water if the new well proves to be as productive as designed. The ground water is rich in manganese, but otherwise meets all potable water standards.

Manchester Research Station-- The Manchester Research Station is located on Clam Bay, a small bay adjoining the central basin of western Puget Sound. A major advantage of the site is the excellent seawater quality. Clam Bay is a major tidal mixing zone between Sinclair and Dyes Inlets to the West and the waters of central Puget Sound to the east. Annual seawater temperature at the site normally ranges between 7-14°C and salinity ranges between 26-29 ppt. The high quality seawater environment makes the Manchester Research Station an excellent site for the culture of anadromous salmonids during the marine portion of their life cycle.

A 60 hp centrifugal pump supplies about 1,500 gpm of seawater through a 2,300 ft long pipeline from the end of the pier to the Station's land based facilities. The system is outfitted with a back-up 40-hp pump in case of primary pump failure. An alarm system monitors the pump and electrical supply and is tied into an automatic dialer system linked to cellular telephones. Redundant emergency generators are automatically serially activated in the event of a power failure.

The seawater supplied to the station is processed to prevent naturally occurring pathogens from entering the rearing tanks. Primary filtering consists of six 20.4 ft^2 sand filters containing number 20-grade sand or glass micro beads that filter out all organic and inorganic material more than 20 microns in diameter. Secondary water filtration occurs in two cartridge filter systems capable of filtering out all material more than 5 microns in diameter. The water then passes through UV irradiation (50,000 to 90,000 microwatts/second) to inactivate remaining pathogenic material. Sensors monitor water flow and pressure through the seawater filtration system.

Before entering fish rearing tanks, the processed seawater is passed through packed column degassers to boost dissolved oxygen levels and off-gas excess nitrogen, which can be present in pumped water situations. In addition, each tank is directly supplied with oxygen to maintain life support in the event of an interruption in water flow. Tanks where maturing fish are held are supplied with combinations of ambient and chilled water. At a 7 lb/gpm loading rate the facility can maintain a maximum of 10,500 lbs of fish on 1,500 gpm of first pass water.

Sawtooth Fish Hatchery – The Sawtooth Fish Hatchery receives water from the Salmon River and from four wells. River water enters an intake structure located approximately 0.8 km upstream of the hatchery facility. River water intake screens comply with NOAA Fisheries criteria. Flows pass from the collection site to a control box located in the hatchery building where they are screened to remove fine debris then distributed to indoor vats, outside raceways, or adult holding raceways. The hatchery's surface water right is approximately 60 cfs. Incubation and early rearing water is supplied by two primary wells. A third well provides tempering water to control the build-up of ice on the river water intake during winter months. The fourth well provides domestic supply for the facility. The hatchery's groundwater right is approximately 9 cfs. River water temperatures range from 0.0ºC in the winter to 20.0ºC in the summer. Well water temperatures range from 3.9ºC in the winter to 11.1ºC in the summer.

Oxbow Fish Hatchery - The Oregon Department of Fish and Wildlife's (ODFW) Oxbow Fish Hatchery was originally constructed in 1913 and was a state-funded hatchery until 1952. In 1952, the facility was modified and expanded using Mitchell Act funding, a Columbia River fisheries development program set up to enhance declining fish runs in the Columbia River Basin. Oxbow Fish Hatchery receives 7.2°C water through gravity flow from Oxbow Springs. The flow rate is highly variable depending on the time of year, with the lowest flows of 1,135.5 liters per minute (300 gpm) in the summer and fall. Water rights for the Oxbow Fish Hatchery are 3.30 cubic meters per second (116.51 cfs). Calendar year 2009 was the sixth year that Oxbow Fish Hatchery personnel and facilities were used for sockeye smolt rearing with the captive broodstock program.

Springfield Fish Hatchery – The proposed Springfield Hatchery site is on a parcel containing nine artesian wells. The artesian aquifer that underlies the site provides an excellent source of high quality water for fish rearing, and is the primary reason this site was selected for the project. The design of this facility will be to use gravity flow artesian well water to the greatest degree possible in order to minimize pumping costs. In an average water year, artesian flows will be adequate to meet hatchery demand for at least six months (May through October). During the peak months (November through April), up to four of the highest producing wells will most likely need to be pumped in order to meet water supply demand. Once pumps are turned on, the amount of artesian flow available to the non-pumped wells will likely decline; however, gravity-supplied flow may still be available. A 50 cfs water right associated with the former trout hatchery located on the parcel will be used for the sockeye hatchery. Discharge from the trout facility was factored into the 2006 total maximum daily load (TMDL) allocations established for the American Falls Subbasin Assessment (IDEQ et al. 2006). Fish production at the Springfield site has an authorized discharge allocation of 1.22 tons/year of phosphorus, 6.7 tons/year of nitrogen, and 61.1 tons/year of suspended sediment.

The conceptual design of this facility includes duel elevation degassing head boxes; a lower elevation head box for degassing and oxygenating artesian flows, and a higher elevation head box for degassing and oxygenating pumped flows. There may also be need for a chiller and associated chilled water head box and piping system that would be used to slow the development rate of eggs and fry in order to produce smolts that meet targets for fish size and release dates.

4.2 INDICATE RISK AVERSION MEASURES THAT WILL BE APPLIED TO MINIMIZE THE LIKELIHOOD FOR THE TAKE OF LISTED NATURAL FISH AS A RESULT OF HATCHERY WATER WITHDRAWAL, SCREENING, OR EFFLUENT DISCHARGE.

Eagle Fish Hatchery – Eagle Fish Hatchery maintains a water right of 7.2 cfs. This water right is supplied from three pump-assisted artesian wells. The hatchery effluent is discharged through screened pipes into a flow-through settling pond.

Burley Creek Hatchery - Burley Creek Hatchery maintains a water right for 500 gpm and the ground water use provides no risk of take to listed natural fish. The effluent from the hatchery is depurated through a settling basin, UV irradiated, and screened to reduce risks to listed natural fish.

Manchester Research Station - The Station complies with NOAA Fisheries surface water intake screen requirements.

Sawtooth Fish Hatchery - Intake screens at all facilities are in compliance with NOAA Fisheries screen criteria by design of the Corp of Engineers.

Oxbow Fish Hatchery – The Oregon Department of Fish and Wildlife's Oxbow Fish Hatchery HGMP describes screening structures at the Oxbow Fish Hatchery.

Springfield Fish Hatchery – The Springfield Fish Hatchery has a water right of 50 cfs to be supplied from artesian wells. There are no listed fish in the system that may be affected by effluent discharge.

SECTION 5. FACILITIES

5.1 BROODSTOCK COLLECTION FACILITIES (OR METHODS)

Eagle Fish Hatchery – Eagle Fish Hatchery maintains a captive broodstock of Snake River sockeye salmon from Redfish Lake. Currently four identical groups of eyed eggs (500 eggs each) are selected for Eagle FH and NOAA Fisheries. Two groups of 500 eyed-eggs remain at Eagle FH for replacement broodstock and two groups are transferred to NOAA Fisheries, one group of 500 eyed-eggs for replacement broodstock and one group of 500 eyed-eggs for the adult release production group. The captive broodstock are reared in tanks ranging from one meter to four meters in size. Two, three and four meter tanks are also used to hold anadromous sockeye that have been collected from Redfish Lake Creek trap or Sawtooth Fish Hatchery trap. Trapped anadromous sockeye are transferred to Eagle Fish Hatchery within 48 hours of being collected.

Redfish Lake Creek Trap/Weir - A temporary weir is installed annually on Redfish Lake Creek approximately 1.4 kilometers below the mouth of Redfish Lake. Anadromous sockeye trapped here are transferred daily to Eagle Fish Hatchery, where it is determined which fish to incorporate into the captive broodstock population based on genetic relatedness. Those sockeye not incorporated into the captive broodstock are held until early September and then released into Redfish Lake for volitional spawning.

Sawtooth Fish Hatchery – Adult collection at the Sawtooth Fish Hatchery is facilitated by a permanent weir that spans the Salmon River. Weir panels are installed to prevent the upstream migration of adult sockeye salmon. Fish are allowed to volitionally migrate into the adult trap where they are manually sorted into transportation vehicles. Anadromous sockeye trapped at the Sawtooth Fish Hatchery weir are transferred daily to Eagle Fish Hatchery, where it is determined which fish to incorporate into the captive broodstock population based on genetic relatedness. Sockeye not incorporated into the broodstock are held until early September and then released into Redfish Lake for volitional spawning.

IDFG has identified additional infrastructure needed to accommodate increased smolt production for the recovery of Snake River sockeye salmon; additional detail is provided in the Department's Draft Snake River Sockeye Salmon Recovery Strategy (Appendix A).

Burley Creek Hatchery—NOAA collects no broodstock from the wild and generates its broodstock from eyed eggs it receives from IDFG's Eagle Hatchery. Half the 1,000 eyed eggs NOAA currently receives each year are designated for use in its captive broodstock program and the other half are incorporated into the adult release production program.

Manchester Research Station—This facility does not collect broodstock and is used exclusively for marine rearing of the ocean life history phase of sockeye transferred to it from Burley Creek Hatchery.

Springfield Fish Hatchery – This facility would not collect broodstock and would be used to rear sockeye salmon to the smolt life history stage before being transported back to the Sawtooth Basin lakes.

5.2 FISH TRANSPORTATION EQUIPMENT (DESCRIPTION OF PEN, TANK TRUCK, OR CONTAINER USED)

IDFG Fish Transportation - Adult sockeye salmon are transferred using truck mounted insulated tanks. Hauling densities are maintained at or below 0.5 pounds per gallon. Transportation tanks range from 250 gallons up to 2,700 gallons. The tanks are also equipped with an oxygen system, re-circulating fresh flows, and air scoops for tank ventilation. Additional information is available in annual NOAA Permit reports and/or BPA project completion reports (see Section 2.2.1).

IDFG has identified additional fish transportation needed to accommodate increased smolt production and future recovery of Snake River sockeye salmon; additional detail is provided in the Department's Draft Snake River Sockeye Salmon Recovery Strategy (Appendix A). Criteria for juvenile/smolt transport facilities are being developed as part of the Master Plan for this program.

NOAA Fisheries Transportation - All transportation emphasizes fish health and safety. Adults and juveniles are transported in 200-2,100 gallon insulated HDPE or fiberglass transport tanks and temperature is not allowed to rise more than 2^{o}C. The transport containers are supplied with continuous oxygen that maintains dissolved oxygen at full saturation and are loaded at no more than 0.5 lb fish/gallon of water. All tanks used for transport on trips of a 4 hour or longer duration are equipped with air scoops. The oxygen reservoir contains at least double the quantity of oxygen needed to make the entire trip.

Eggs transported to between facilities are placed into open-mesh perforated plastic Aquaseed® egg tubes (27-cm long by 6-cm diameter) up to approximately 3,000 eggs per tube. Each packed tube is wrapped in wet paper toweling to contain moisture and placed in a small insulated shipping container. A small amount of ice is placed in a top layer of toweling to keep the eggs cool and moist during shipment. Shipment to Boise, Idaho is by a common carrier flight of about two hours duration. Eggs transported to Oregon are packaged in the same manner (2,000 eggs per tube) and transported by government vehicle, about four hours.

5.3 BROODSTOCK HOLDING AND SPAWNING FACILITIES

Eagle Fish Hatchery - Broodstock for the Eagle Fish Hatchery program are obtained from one of two sources. The primary sockeye broodstock is maintained as a captive broodstock (reared from egg to mature adult) at Eagle Fish Hatchery. Eggs for each generation of captive broodstock are selected to represent the entire spawning population with equal representation for both males and females. The second broodstock source is collected from returning anadromous sockeye that will be the broodstock for the Springfield facility. A portion of the returning anadromous sockeye are incorporated into the spawning design with the captive reared sockeye. The two broodstocks are held in isolation from each other to prevent possible viral or bacterial contamination into the captive broodstock. Broodstock groups are held in two, three, and four meter tanks until spawning. Additional information is available in annual NOAA Permit reports and/or BPA project completion reports (see Section 2.2.1).

Burley Creek Hatchery - Broodstock for the Burley Creek Hatchery program are obtained from eyed-eggs transferred from Eagle Fish Hatchery. Eggs for each generation of captive broodstock are selected to represent the entire spawning population (from Eagle Fish Hatchery spawn crosses) with equal representation for both males and females. Eyed-eggs are selected in four identical groups, with two groups transferred to NOAA Fisheries.

At Burley Creek Hatchery a 2,034-ft^2 building housing ten raceways is used for holding maturing salmon under near-natural light levels. The tensioned-fabric structure is located on a 31-ft x 88-ft concrete pad. The cover of the arching structure is a clear PVC fabric. The fabric allows sunlight to illuminate the structure and provides near-natural lighting to the maturing fish. Past observations showed that sockeye salmon reared under natural sunlight adopted more of their natural red coloring than that of their indoor-maturing counterparts. The walls are a white opaque PVC fabric that visually isolates the raceways for security and restricts the glow from car headlights at night. The structure houses ten 19-ft long by 4-ft wide by 4-ft tall grey fiberglass raceways that are used for final maturation of broodstock. The center of each raceway is fitted with center dividers to create a mild water velocity the fish can swim against and facilitate handling operations. Each raceway is supplied with hatchery well water and supplemental oxygen and is one-quarter to one-third covered with a dark tarp to provide shelter for the fish to seek refuge. A combination of adult release and captive broodstock fish are held in this structure each summer for final maturation. A metal sided pole building with many high windows is also used for final adult maturation. The pole building houses an additional four of the raceways described above. During final maturation fish density is allowed to increase to 1.0 $lb/ft^{3.}$

Spawning at Burley Creek Hatchery is done under cover in an open space of a metal sided pole building. Gamete quality and sampling is conducted in an adjoining heated laboratory equipped with refrigerators, microscopes, balances that weight to the nearest 0.001 g, and a centrifuge.

IDFG has identified additional infrastructure needed to accommodate increased smolt production and future recovery of Snake River sockeye salmon; additional detail is provided in the Department's Draft Snake River Sockeye Salmon Recovery Strategy (Appendix A).

5.4 INCUBATION FACILITIES

Eagle Fish Hatchery – Eggs are incubated at Eagle Fish Hatchery using specially designed upwellers that hold one-third of a female's eggs (up to 1,200 eggs). Approximately 750 individual upwellers can be operated at Eagle Fish Hatchery. Upwellers are two liters in volume and are supplied with a flow of approximately one liter per minute. The ambient water temperature is 13.5°C, but incubation water is chilled to supply water between 8.0° and 10.0°C. The majority of eggs are transferred to other production facilities after they reach the eyed-egg stage (approximately 400 Celsius Temperature Units at transfer). A representative group of 1,000 eyed-eggs is maintained at Eagle Fish Hatchery to represent the next generation of captive broodstock. Additional information is available in annual NOAA Permit reports and/or BPA project completion reports (see Section 2.2.1).

Burley Creek Hatchery - A 1,940 incubation room sided with fiberglass reinforced paneling to facilitate disinfection houses twelve 12-ft long aluminum troughs that can each hold 32 plastic iso-buckets for incubation (Novotny et al. 1985). Eggs are incubated in iso-buckets that are specially designed upwellers that hold one-half of a female's eggs (up to 1,200 eggs). Approximately 360 individual upwellers can be operated at Burley Creek Hatchery. Each upweller is two liters in volume and is supplied with a flow of approximately one liter per minute. The ambient water temperature is 10.0°C, but incubation water is chilled to supply water between 8.0° and 10.0°C. All production eggs are transferred to other production facilities after they reach the eyed-egg stage (approximately 400 Celsius Temperature Units at transfer). A representative group of 1,000 eyed-eggs is transferred from Eagle Hatchery to Burley Creek Hatchery for the captive broodstock and adult release programs. Additional information is available in annual NOAA Permit reports and/or BPA project completion reports (see Section 2.2.1).

Sawtooth Fish Hatchery – The Salmon River Spring Chinook HGMP describes incubation facilities at the Sawtooth Fish Hatchery.

Oxbow Fish Hatchery – The Oregon Department of Fish and Wildlife's Oxbow Fish Hatchery HGMP describes incubation facilities at the Oxbow Fish Hatchery.

Springfield Fish Hatchery – Eggs will be disinfected with iodophor in small batches in an egg preparation room and then loaded into heath tray incubators at 4,000 eggs per tray. Incubators will be configured in four tray stacks with isolation baffles in between each stack. Pathogen-free groundwater will be provided at a flow rate of 4 to 5 gpm to each stack. A total of 72 stacks and 283 gpm of supply flow will be required. A smaller separate quarantine incubation room will be provided for research and experimental egg handling operations. Both chilled and ambient groundwater supplies will be provided to each incubator.

5.5 REARING FACILITIES

Eagle Fish Hatchery – Eagle Fish Hatchery maintains a captive broodstock for Redfish Lake sockeye salmon. Approximately 1,000 eyed-eggs are selected to represent each individual year class (brood year). Early rearing takes place in a number of small rearing containers from five gallon pots to two meter semi-square tanks. Rearing densities do not exceed eight kilograms per cubic meter during the first two years of development. Smolts are transferred to three meter tanks and final maturation occurs in four meter tanks.

Additional information is available in annual NOAA Permit reports and/or BPA project completion reports (see Section 2.2.1).

The IDFG has identified additional infrastructure needed to accommodate increased smolt production and future recovery of Snake River sockeye salmon (proposed Springfield Fish Hatchery program); additional detail is provided in the Department's Draft Snake River Sockeye Salmon Recovery Strategy (Appendix A).

Burley Creek Hatchery—NOAA's freshwater swimup fry to smolt rearing is conducted at Burley Creek Hatchery near Burley, WA (approximately 21 km south of the Manchester Research Station). This fresh water hatchery is designed as a protective rearing facility for salmonid captive broodstocks. The facility includes a 3,200-ft^2 rearing area in building 2 that contains nine 12-ft diameter grey and twelve 5-ft diameter blue circular tanks. The adjoining 2,760-ft^2 building 3 currently contains four 12-ft grey circular tanks and four 19-ft raceways. This building can be reconfigured to hold twenty 18-ft grey rearing troughs should the need arise. A fourth 4,048 ft^2 building is now in the procurement process and should be able to contain an additional twenty 19-ft long grey raceways or twelve 12-ft diameter grey circular tanks. These spaces and the 12-ft circular tanks are also used for some smolt to pre-spawning adult rearing.

All buildings are equipped with abundant windows that provide natural lighting for proper photoperiod entrainment. Artificial lights are designed to slowly ramp up and down to prevent startling the fish.

All tanks and raceways used for sockeye captive broodstock rearing are completely covered with a taut 2.5 x 2.5 cm or smaller mesh nylon netting to prevent fish from jumping out. The energy absorbing properties of the nylon mesh minimized injuries that could occur to fish when they leaped against it. In addition to the mesh, half of each tank is covered with solid black fabric that provides a covered refuge area fish can move under when they are disturbed. Raceways are one-quarter to one-third covered with dark plastic tarps. All circular tanks are half covered with black shade cloth.

A mild current (< 35 cm/sec) is generated in the circular rearing tanks by their shape, center drain, and inlet. This current provides a partial self cleaning action in the tank and a very slight exercise potential. At least once a week, bottom material that is not swept out of the tank by the current is removed by brushing.

Manchester Research Station - A land-based seawater captive broodstock rearing complex has 4,304 ft^2 of floor space for fish rearing tanks in one building, and 13,773 ft^2 in another. The 4,304-ft^2 seawater laboratory contains six 13-ft diameter brown circular fiberglass tanks. The 13,773-m^2 facility houses twenty 20-ft diameter circular grey fiberglass tanks. Portions of both buildings are used for the project. Abundant high windows, skylights, and translucent panels provide natural lighting. Artificial light is designed to slowly ramp up and down to prevent startling the fish.

All tanks used for sockeye captive broodstock rearing are completely covered with a taut 1 inch x 1inch or smaller mesh nylon netting to prevent fish from jumping out. A solid black fabric covers half the netting to provide fish a refuge to hide beneath. Center standpipes on all 13’ and larger circular tanks are constructed to hold at least 6 inches of water depth in the tank when the external standpipe is pulled to lower tank water level. This design minimizes the chance of fish being accidentally dewatered during tank draining or flushing.

The shape of the tanks generates a mild current that carries non-settleable solids out of the tank. Settled solids are removed by brushing as needed.

Sawtooth Fish Hatchery – The Salmon River Spring Chinook HGMP describes rearing facilities at the Sawtooth Fish Hatchery.

Oxbow Fish Hatchery – The Oregon Department of Fish and Wildlife’s Oxbow Fish Hatchery HGMP describes rearing facilities at the Oxbow Fish Hatchery.

Springfield Fish Hatchery – Early rearing will take place in rearing troughs located in a 60- by 120-foot room adjacent to the incubation area. The troughs will be 42-foo-long, 4-foot-wide and 2.75-foot-deep fiberglass vessels, configured in pairs, with narrow access aisles between each pair. Pathogen-free groundwater will be supplied to the upstream end of each rearing trough through a valved connection for flow control. Typical flow rates to each trough will be 80 gpm, at an average temperature of 10˚C. Each trough will have screens for segregating and retaining batches of fish, and stop logs or standpipes for water level control. A grated floor trench will run the length of the room at the downstream end of the troughs to collect overflow/drain water and route it into the hatchery drain pipe system. A cleaning waste drain pipe will be routed inside the floor trench to collect and convey vacuumed cleaning wastes to an off-line settling basin.

5.6 ACCLIMATION/RELEASE FACILITIES

Eagle Fish Hatchery – Eagle Fish Hatchery is operated as a captive broodstock facility; typically no releases occur from this facility. In years of high anadromous returns, a portion of the anadromous returning sockeye will be incorporated into the captive broodstock program. In this scenario, a portion of the captive broodstock may be released to Stanley Basin lakes, so green eggs in excess of program goals are not taken.

NOAA Fisheries – NOAA Fisheries rears sockeye salmon to mature adults (Age 3, 4, and 5) annually. These adults are reared at both the Burley Creek Hatchery and Manchester Research Station. Mature adults are transferred to Idaho in September and released to Redfish Lake (no additional acclimation period).

Sawtooth Fish Hatchery – Sawtooth Fish Hatchery rears sockeye salmon to pre-smolt (Age 1) and full-term smolt (Age 1.5) annually. Pre-smolts are reared on well water before release to Stanley Basin lakes (no additional acclimation period). During the last six months of rearing, smolts are transferred into Salmon River water, after which they are released to the Salmon River and Redfish Lake with no additional acclimation.

Oxbow Fish Hatchery – Oxbow Fish Hatchery rears sockeye (eyed-egg to smolt) for the program. Smolts are transferred from Oxbow Fish Hatchery to the Stanley Basin and released directly to the Salmon River and/or Redfish Lake Creek.

The IDFG has identified additional infrastructure needed to accommodate increased smolt production and future recovery of Snake River sockeye salmon. This infrastructure can be provided by the proposed Springfield Fish Hatchery. Additional detail is provided in the Department's Draft Snake River Sockeye Salmon Recovery Strategy (Appendix A).

Springfield Fish Hatchery – The Springfield Fish Hatchery will rear sockeye (eyed egg to smolt stage) for the program. Smolts will be transferred from the Springfield site to the Sawtooth basin and released directly into Redfish Lake Creek.

5.7 DESCRIBE OPERATIONAL DIFFICULTIES OR DISASTERS THAT LED TO SIGNIFICANT FISH MORTALITY

Eagle Fish Hatchery – There have been no events at Eagle Fish Hatchery that have resulted in high fish mortality.

Burley Creek Hatchery- There have been no events at Burley Creek Hatchery that have resulted in high sockeye mortality.

Manchester Research Station- There have been no events at Manchester Research Station that have resulted in high sockeye mortality.

Springfield Fish Hatchery – This facility is not operational and has therefore not experienced fish mortality.

5.8 INDICATE AVAILABLE BACK-UP SYSTEMS, AND RISK AVERSION MEASURES THAT WILL BE APPLIED, THAT MINIMIZE THE LIKELIHOOD FOR THE TAKE OF LISTED NATURAL FISH THAT MAY RESULT FROM EQUIPMENT FAILURE, WATER LOSS, FLOODING, DISEASE TRANSMISSION, OR OTHER EVENTS THAT COULD LEAD TO INJURY OR MORTALITY.

Eagle Fish Hatchery – Eagle Fish Hatchery is staffed with three full time employees that live on station and share alarm monitoring duty. Mountain Alarm provides the alarm service at Eagle Fish Hatchery that incorporates six low water alarms and three chilled water alarms. The water supply at Eagle Fish Hatchery is provided by three 50hp submersible pumps, each with generator back-up in case of power failure. The water system is tied together so any of the three pumps can provide water to all parts of the facility. In the case of complete power/generator failure, artesian water flow of around 250 gallons per minute can be supplied to rearing units. Each three meter and four meter tank is also backed-up with an oxygen system, with full oxygen bottles in place. A second population of Snake River sockeye is maintained offsite at the NOAA Fisheries facility in the event of complete system failure and loss of fish at Eagle.

When anadromous sockeye are transferred to Eagle Fish Hatchery, complete isolation is maintained between the anadromous sockeye and the captive broodstock at Eagle Fish Hatchery. Staff working with anadromous sockeye are not allowed to enter the captive broodstock building. Iodine footbaths and equipment disinfection is maintained in all working areas.

Burley Creek Hatchery – Security measures to protect fish and property include water flow, fire, and intruder alarms. These are monitored through a security system linked to home and cellular telephones. A back-up generator is automatically activated during power failures. Resting wells can be readily turned on in the event of well or well pump failure. Manually operated life support oxygen can be turned on to every fish rearing container to help protect fish life during the event of a water flow stoppage.

Manchester Research Station- A constant source of processed seawater ensures successful captive survival. A 40 hp standby pump is in place and can manually be brought on line in the event the primary 60 hp pump fails. The pipeline always has one replacement line available should a primary line fail. Two 330 kW generators can supply electrical power to the pumps and water processing system in the event of a power failure. Manually operated life support oxygen can be turned on to every fish rearing container to help protect fish life during the event of water flow stoppage. An alarm system monitors the pumps and electrical supply and is tied into an automatic dialer system linked to cellular and home telephones.

Sawtooth Fish Hatchery – The Salmon River Spring Chinook HGMP describes system back-up and risk aversion measures at the Sawtooth Fish Hatchery.

Oxbow Fish Hatchery – The Oregon Department of Fish and Wildlife's Oxbow Fish Hatchery HGMP describes back-up and risk aversion measures at Oxbow Fish Hatchery.

Springfield Fish Hatchery – The Springfield Fish Hatchery will have two FTE permanent staff members that live on station and cover shifts for alarm duties and other production checks, and up to two FTE temporary staff for various seasonal fish culture duties. An alarm system will be installed that will alert staff to low water and water temperatures outside of the accepted range. Artesian wells equipped with pumps will each have generator back-up in case of power failure. The water system will be integrated so that any well can provide water to all parts of the facility. Artesian water flow can be supplied to rearing units in the case of complete power/generator failure.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

Describe the origin and identity of broodstock used in the program, its ESA-listing status, annual collection goals, and relationship to wild fish of the same species/population.

6.1 SOURCE

Redfish Lake sockeye is considered to be a closed population. The population was listed as endangered on November 11, 1991. The sockeye captive broodstock program was started to protect and preserve the genetics of the remaining population. The captive broodstock originated by collecting out-migrating natural smolts from Redfish Lake. Approximately 886 smolts were collected representing three migration years (1991, 1992, and 1993). These juveniles were transferred to Eagle Fish Hatchery and reared to full maturation in captivity. Sixteen anadromous returning adults were collected from 1991 through 1998 and spawned at Eagle Fish

Hatchery. Residual sockeye (26) were collected from Redfish Lake and incorporated into the captive broodstock. Cryopreserved milt from these original founders is maintained at Eagle Fish Hatchery and has been incorporated in spawning matrices.

Natural returning anadromous sockeye are all considered to be a result of different hatchery release strategies and are considered to be related to fish in the captive broodstock. The Redfish Lake sockeye program is considered to be a closed population. Natural returning anadromous sockeye are incorporated into the Eagle Hatchery spawning matrix. Depending on number of returning adults, zero to 100% can be incorporated into the spawn matrix.

6.2 Supporting Information

6.2.1 History

Historically, the broodstock program used pedigree information to pool eyed-eggs developed from hatchery spawning into broodstock rearing groups. Identity of familial groups was maintained by tank segregation until they were large enough to PIT-tag. Currently, breeding plans rely on DNA microsatellite. Microsatellite data are generated from DNA samples at thirteen loci. Kinship coefficients and mean kinship coefficients are used to determine relative founder contribution in the population, genetic importance, and relative relatedness. Spawning plans also consider heterozygosity and genetic diversity among and within individuals. Genetic-based spawning plans provide a higher level of resolution than was possible with pedigree information, which can minimize the loss of heterozygosity and inbreeding.

6.2.2 Annual size

The production goals at Eagle Fish Hatchery are achieved by maintaining a captive broodstock. Anadromous returning sockeye are routinely incorporated into the captive broodstock. Selection of anadromous sockeye broodstock is based on relatedness values obtained from microsatellite analysis. Currently, the captive broodstock maintained at Eagle Fish Hatchery meets production goals. Anadromous sockeye incorporated into the captive broodstock will displace the number of captive reared sockeye needed. In this scenario, captive broodstock reared sockeye are released to Redfish Lake.

6.2.3 Past and proposed level of natural fish in broodstock

The Redfish Lake sockeye population is considered to be a closed population. All returning anadromous sockeye (natural or hatchery) are considered to be a result of the hatchery program. For this reason, all returning anadromous sockeye are genotyped to determine which sockeye to incorporate into the captive broodstock. Even though the captive broodstock program currently meets all production goals, a portion of the returning anadromous sockeye are incorporated into the spawning design. As production goals increase to meet smolt production numbers, the number of returning anadromous adults incorporated into the hatchery broodstock will increase. Table 16 displays the number of natural and hatchery-origin sockeye that returned to Redfish Lake from 1998 through 2009.

Table 16. Hatchery and natural sockeye returns to Redfish Lake, 1998-2009.

Return Year	Total Return	Natural Return	Hatchery Return	Observed (Not Trapped)	Naturals Kept for Broodstock	Hatchery Kept for Broodstock
1998	1	1	0	0	1	0
1999	7	0	7	0	0	7
2000	257	10	233	14	4	39
2001	26	4	19	3	0	9
2002	22	6	9	7	0	0
2003	3	0	2	1	0	2
2004	27	4	20	3	4	20
2005	6	2	4	0	2	4
2006	3	1	2	0	1	2
2007	4	3	1	0	3	1
2008	650	142	457	51	25	48
2009	833	85	732	16	63	84

Source: Project annual reports to Bonneville Power Administration and project annual reports to NOAA Fisheries for ESA Section 10 activities.

As the program transitions into using only anadromous returns for broodstock needs, natural-origin adults will be incorporated into the broodstock at an initial rate of 10 percent (115 adults).

The IDFG has identified current and future broodstock needs reliant on an increased and consistent return of anadromous adults; additional detail is provided in the Department's Draft Snake River Sockeye Salmon Recovery Strategy (Appendix A).

6.2.4 Genetic or ecological differences

Not applicable; see Section 1.2.

6.2.5 Reasons for choosing

Not applicable; see Section 1.2.

6.3 INDICATE RISK AVERSION MEASURES THAT WILL BE APPLIED TO MINIMIZE THE LIKELIHOOD FOR ADVERSE GENETIC OR ECOLOGICAL EFFECTS TO LISTED NATURAL FISH THAT MAY OCCUR AS A RESULT OF BROODSTOCK SELECTION PRACTICES.

All returning anadromous sockeye salmon trapped in the Stanley Basin are genotyped. This genetic information is used to determine which fish to include into the captive broodstock population and also to develop spawning matrices used to cross the least related individuals in the population.

The IDFG has identified current and future broodstock needs reliant on an increased and consistent return of anadromous adults; additional detail is provided in the Department's Draft Snake River Sockeye Salmon Recovery Strategy (Appendix A).

SECTION 7. BROODSTOCK COLLECTION

7.1 LIFE-HISTORY STAGE TO BE COLLECTED (ADULTS, EGGS, OR JUVENILES)

Historically, juvenile outmigrants, residual adult spawners, and anadromous adult spawners were used to create founding broodstocks (1991-1998).

Currently, captive broodstocks are created annually by spawning both captive and anadromous adult spawners. With the implementation of the Master Plan, it is envisioned that only anadromous-origin adults returning to Sawtooth basin weirs will be used as broodstock. This action achieves the objective of creating a locally adapted broodstock over time.

7.2 COLLECTION OR SAMPLING DESIGN

All returning anadromous sockeye salmon are collected at two locations in the Stanley Basin (Sawtooth Fish Hatchery trap on the Salmon River and Redfish Lake Creek trap). Genetic samples are taken from all returning anadromous sockeye for real-time analysis. A spawning design is developed that incorporates a portion of the returning anadromous sockeye and is approved by the Stanley Basin Sockeye Technical Oversight Committee (SBSTOC) annually.

The IDFG has identified additional infrastructure and programmatic needs to aid in the future recovery of Snake River sockeye salmon. These needs will be met by the proposed Springfield Fish Hatchery program. Additional detail is provided in the Department's Draft Snake River Sockeye Salmon Recovery Strategy (Appendix A).

7.3 IDENTITY

Only one population of Redfish Lake sockeye is present in the Stanley Basin. Hatchery-origin fish are identified using a variety of marks and tags based on rearing strategies.

7.4 PROPOSED NUMBER TO BE COLLECTED

Current sockeye production goals are met with sockeye maintained at Eagle Fish Hatchery in the captive broodstock program. Anadromous returning sockeye are routinely incorporated into the captive broodstock spawning design, but this number varies depending on how many sockeye return and recommendations by the SBSTOC.

With the development of the Springfield Hatchery facility and implementation of the Master Plan, the program will begin shifting to the use of locally adapted broodstock. Both NOR and HOR adults (and jacks) will be collected at weirs located in the Sawtooth basin. The goal is to eventually collect 1,150 anadromous adults for use as broodstock.

Additional detail on broodstock collection and utilization is provided in the Department's Draft Snake River Sockeye Salmon Recovery Strategy (Appendix A).

7.4.1 Program goal (assuming 1:1 sex ratio for adults)

Currently, 520 captive broodstock spawners (260 females and 260 males) are required to meet the production goal of 352,000 eyed-eggs. Anadromous sockeye incorporated into the captive broodstock will reduce the number required. Captive broodstock in excess of the number required will be released to Redfish Lake for volitional spawning.

Once recruit-per spawner levels, and therefore adult return levels, needed to facilitate population recovery are met, the Springfield program would then transition to Phase 3, implementing a sliding-scale model that integrates broodstock and escapement management driven by natural production. It is estimated that 1,150 adults will be used, on average, as broodstock for the program (NOR = 115, HOR = 1,035).

7.4.2 Broodstock collection levels for the last twelve years or for most recent years available

Table 17. The number of broodstock collected for the current Redfish Lake sockeye production program.

Year	Adults				Eggs	Juveniles
	Females	Males	Jacks	Jills		
1998	0	1	0	0	NA	NA
1999	0	0	3	1	NA	NA
2000	18	22	0	0	NA	NA
2001	0	0	0	0	NA	NA
2002	0	0	0	0	NA	NA
2003	2	0	0	0	NA	NA
2004	9	12	0	0	NA	NA
2005	2	3	0	0	NA	NA
2006	2	1	0	0	NA	NA
2007	2	1	1	0	NA	NA
2008	39	25	9	0	NA	NA
2009	56	61	6	1	NA	NA

Source: Project annual reports to Bonneville Power Administration and project annual reports to NOAA Fisheries for ESA Section 10 activities.

7.5 DISPOSITION OF HATCHERY-ORIGIN FISH COLLECTED IN SURPLUS OF BROODSTOCK NEEDS

Hatchery-origin sockeye collected in surplus of hatchery broodstock needs are released to Redfish Lake for volitional spawning.

7.6 FISH TRANSPORTATION AND HOLDING METHODS

Anadromous sockeye trapped returning to the Stanley Basin are transported to Eagle Fish Hatchery and temporarily held before release or incorporation into the spawning design. Sockeye are held in 3- and 4-meter rearing tanks for up to 6 weeks if released or up to 12 weeks if incorporated into the spawning design. Anadromous returning adults are not transferred to NOAA Fisheries for broodstock incorporation.

The IDFG has identified additional infrastructure and programmatic needs to aid in the future recovery of Snake River sockeye salmon; additional detail is provided in the Department's Draft Snake River Sockeye Salmon Recovery Strategy (Appendix A).

NOAA Fisheries Transportation - NOAA's transports pre-spawning broodstock adults from seawater rearing at the Manchester Research Station to Burley Creek Hatchery for final freshwater maturation. In addition, NOAA transports maturing adults from Burley Creek Hatchery to Redfish Lake for adult release. The transit time between Manchester and Burley is usually less than 30 minutes in the containers described in section 5.2. The transit time from Burley Creek Hatchery to Redfish Lake is between 14-16 hours. In general, the fish are handled with extreme care and kept in water to the maximum extent possible during transport and processing procedures. Whenever possible, ESA-listed fish are transferred with a sanctuary net or fish transfer tube that holds water to prevent the added stress of a waterless transfer. In no case is a fish left out of water for more than 10 seconds. Prior to transport fish are fasted for 48 hours to reduce metabolic demand and stress. The containers are loaded at no more than 0.5 lb/gallon. Drivers are equipped with cell phones and have backup personnel ready to respond in event of equipment failure. About 1.5 months before spawning captive broodstock females are dorsal sinus injected with a prophylactic dose (20 mg/kg) of erythromycin 100.

7.7 DESCRIBE FISH HEALTH MAINTENANCE AND SANITATION PROCEDURES APPLIED

Fish health protocols used in the captive broodstock program follow accepted, standard practices. For an overview of standard methods, see Leitritz and Lewis 1976; Piper et al. 1982; Erdahl 1994; McDaniel et al. 1994; Bromage and Roberts 1995; Pennell and Barton 1996; and Wedemeyer 2001. Protocols conform to the fish health requirements detailed in ESA Section 10 Propagation Permit Number 1120 for IDFG rearing of ESA-listed Snake River sockeye salmon. Additionally, considerable coordination was carried out between NOAA and IDFG fish health experts, as well as participants at the SBSTOC level.

NOAA Fisheries Facilities - See description above and in Section 9.2.7.

Springfield Fish Hatchery – Once received, eyed eggs will be disinfected with iodophor in small batches in an isolated egg preparation room before loading into heath tray incubators. Due to concerns with horizontal disease transmission, the incubators will be configured in four tray stacks with isolation baffles in between each stack. A hard-piped chemical feed system will be used to deliver argentine or formalin treatments to each incubator stack on a daily basis to prevent fungus growth on the eggs.

7.8 DISPOSITION OF CARCASSES

As per NOAA Section 10 Permit guidelines, all carcasses resulting from captive broodstock activities at Eagle Fish Hatchery and NOAA Fisheries are transported to the local rendering plant for disposal.

7.9 INDICATE RISK AVERSION MEASURES THAT WILL BE APPLIED TO MINIMIZE THE LIKELIHOOD FOR ADVERSE GENETIC OR ECOLOGICAL EFFECTS TO LISTED NATURAL FISH RESULTING FROM THE BROODSTOCK COLLECTION PROGRAM.

Artificial production programs and associated RM&E components are developed to minimize genetic and ecological risks to target population. The program complies with NOAA Section 10 permitting language and program oversight is further dictated by Stanley Basin Sockeye Technical Oversight Committee member recommendations.

Future programmatic risk aversion measures to minimize adverse genetic and ecological effects are provided in Appendix A, Draft Snake River Sockeye Salmon Recovery Strategy.

SECTION 8. MATING

This section describes fish mating procedures that will be used, including those applied to meet performance indicators identified previously.

8.1 SELECTION METHOD

Annual spawning guidelines are approved after SBSTOC and NOAA Northwest Fisheries Science Center review and recommendations.

Eagle Fish Hatchery – Eagle Fish Hatchery maintains a captive broodstock of Redfish Lake sockeye salmon. Eyed-eggs are selected to represent all spawners (equally) for each individual brood year. Anadromous returning sockeye are incorporated into the captive broodstock spawning design annually. Anadromous sockeye and captive broodstock not required to meet green egg production goals are released to Redfish Lake to spawn naturally. Genetic information is analyzed for all broodstock individuals and spawning matrices are developed to cross least related individuals in the population.

Burley Creek Hatchery - All captive broodstock females that survive to maturity and ripen in September, October, or November are spawned. All available males (producing motile milt) ripening in this same time frame are used at least once in spawning, and many are used twice. Genetic information is analyzed for all broodstock and spawning matrices are developed to cross least related individuals in the population. All progeny from healthy parents are shipped out as eyed eggs for use in reintroduction activities.

Current and future spawn matrices will be reliant upon the successful return of large numbers of anadromous adults for broodstock development; additional detail is provided in the Department's

Draft Snake River Sockeye Salmon Recovery Strategy (Appendix A).

8.2 MALES

Eagle Fish Hatchery – No back-up males or pooled samples are used in spawn crosses. Every attempt is made to spawn males equally with no preference to age of male. A factorial spawning matrix is used with the eggs from each female split into three equal subfamilies. Each subfamily is crossed with a unique male. Assuming a one-to-one sex ratio, each male would be used on average three times.

Burley Creek Hatchery—No back-up males or pooled samples are used in spawn crosses. Every attempt is made to spawn all maturing males at least once. A 2 x 2 factorial spawning matrix is used with the eggs from each female split into two equal subfamilies. Each subfamily is crossed with a unique male. Assuming a one-to-one sex ratio, each male is used at least once and usually twice.

8.3 FERTILIZATION

Eagle Fish Hatchery – A factorial spawning design is used at Eagle Fish Hatchery, with the eggs from one female split into three equal subfamilies. Each subfamily is crossed with milt from one male (1:3 ratio). The individual spawn crosses are determined from relatedness of the individual fish, with the least related individuals crossed (genetic-based spawn matrices). Milt is collected from the desired male in a whirl-pak. A small sample is collected to determine milt quality, oxygen is added to the sample and it is temporarily stored in a cooler (three male milt samples are collected for each female spawned). The green eggs from the female and the three bags of milt are transferred to the fertilization station where the eggs are weighed and split into three equal subfamilies. Each subfamily is crossed with one bag of milt. The milt is poured directly into the ziplock bag of eggs, the milt bag is then rinsed with approximately 5 mls of activator (1% saline solution) and added to the fertilized eggs. The eggs/milt are gently mixed to insure good fertilization. After two minutes, excess solution is drained from the eggs and the eggs are added to an incubator containing 100 ppm argentine for a 20 minute surface disinfection. After 20 minutes, the incubator of fertilized eggs is placed in a one meter tank and supplied with a flow of one liter per minute well water for incubation.

Burley Creek Hatchery-- Gamete crosses are structured to maintain genetic diversity. Eggs from each female are divided into two lots. Each lot of eggs is paired with a different male to decrease the risk of all eggs of one female being crossed with an infertile male. Currently, an inbreeding-avoidance matrix using allele-sharing coefficients is used to guide breeding decisions within the sockeye salmon captive broodstock program. The matrix, produced by IDFG geneticists (C. Kozfkay, IDFG, personal communication) is a listing of preferential mates based upon the proportion of shared alleles at 13 microsatellite loci. The lower the matrix number, the better the cross because the individuals share fewer alleles in common. The use of an inbreeding avoidance matrix minimizes losses of genetic diversity that might occur in a random mating system.

During the captive broodstock spawning season, which typically begins after October 1 and lasts until mid-November, mature salmon are anesthetized with a 50 g/l stock solution of tricaine methanesulfonate (MS-222) being added to a handling tank to produce a final anesthetic environment of approximately 26 mg/l. Females are checked for ripeness on a weekly basis, or more frequently as the fish mature. In most years, at the onset of the spawning season, males may have low milt volumes when live spawned, and sometimes the milt lacks sufficient motility. Hormone implants consisting of 100-150µg gonadotropin releasing hormone analog (GnRHa) pellets supplied by Center for Marine Biotechnology, University of Maryland are injected into the dorsal musculature of many of the males to expedite spermiation to coordinate spawning timing between males and females (Swanson 1995). The GnRHa implants subsequently increase the volume of milt produced. The implants also aid in ensuring the availability of a sufficient number of spermiating males to pair with ovulating females at the outset of spawning for desirable matrix crosses containing fewer shared alleles. At the end of the spawning season, a few late ripening females may also be implanted to ensure that their eggs reach the eyed stage in time to be transported and placed in the Stanley Basin lakes before ice-over.

Female fish that are ready to spawn, as determined by egg expression and ventral softness (FRED 1983), are anesthetized, killed, and their PIT tag, fork length, and weight recorded. The females are bled by severing the caudal peduncle to the depth of the caudal blood vessels. The bleeding procedure limits the amount of blood that might accumulate with the eggs and might interfere with fertilization. Females are bled for 3-5 minutes and then abdominally incised with a sterile spawning knife. The free flowing eggs are then gently stripped and collected into a pre-weighed 4-liter “zipper-locking” plastic bag. The eggs from each female are weighed, divided into two lots, and held on an insulating layer of plastic placed over ice in a cooler until they are fertilized. All spawned fish are analyzed for common bacterial and viral pathogens by analysis of tissue and fluid samples that are collected from the kidney, spleen, and pyloric caeca of each fish and ovarian fluid from each female. The samples are placed on ice until they can be transported to the Fish Health Facility in Seattle.

All available males (producing motile milt) are used at least once in spawning, and many are used twice. Males are selected based upon their ripeness and ranking on the spawning matrix. Males are live-spawned by ventral compression, and the milt collected into pre-weighed 4-ml Whirl-pak bags. The milt is weighed, and a spermatocrit sample extracted with a standard hematocrit tube. Milt motility is then qualitatively assessed using a microscope (40x) and classified as “very good” (Near 100% motility) “good” (80% motility), “fair” (about 50% motility), “poor” (less than 20% motility), or “no good” (0% motility). To ensure consistency, the qualitative milt analyses are typically performed by the same individual. Bags of milt are inflated with oxygen, sealed and chilled until used on the day they are collected. Once spawning is completed for the season, all males are killed and tissue samples are collected for health analysis.

Eggs are fertilized following “dry method” procedures (Piper et al 1992). A measured amount of milt (0.5 to 5 ml) from an individual male is transferred by a sterile pipette into the plastic bag containing one egg-lot. The eggs and milt are gently mixed for one full minute by gently palpating the bag. Enough water is added to just cover the eggs and activate the sperm, and the eggs are lightly agitated to distribute the activated milt. The bags are left undisturbed for approximately five minutes for fertilization to take place. The eggs are water hardened in a 1 ppm free iodine solution (buffered to obtain a pH of 6.5-7.0) for 20 minutes, and then poured from the bags into down-flow containers for isolated incubation.

8.4 CRYOPRESERVED GAMETES

Eagle Fish Hatchery – Cryopreserved milt from original founders is maintained at Eagle Fish Hatchery. Occasionally the cryopreserved milt is used in random spawn crosses in the program. Currently, genetic testing is underway to genetically inventory the remaining cryopreserved milt. This will guide best use of the milt in the future. Since the program started, fifty-five crosses have been made with cryopreserved milt. Of these crosses, twenty have produced viable eggs, with an overall survival to the eyed-egg stage of 14.3%.

Burley Creek Hatchery - Cryopreserved gametes are neither taken nor used at Burley Creek Hatchery.

8.5 INDICATE RISK AVERSION MEASURES THAT WILL BE APPLIED TO MINIMIZE THE LIKELIHOOD FOR ADVERSE GENETIC OR ECOLOGICAL EFFECTS TO LISTED NATURAL FISH RESULTING FROM THE MATING SCHEME

Annual spawning guidelines are approved after SBSTOC and NOAA Northwest Fisheries Science Center review and recommendations.

A factorial mating scheme is applied to reduce the risk of losing Redfish Lake sockeye population genetic diversity. Additionally, microsatellite analysis is used to determine spawn crosses based on relatedness of individual sockeye in the spawning population.

Future programmatic risk aversion measures to minimize adverse genetic and ecological effects are provided in Appendix A, Draft Snake River Sockeye Salmon Recovery Strategy.

SECTION 9. INCUBATION AND REARING

Specify any management goals (e.g., egg to smolt survival) that the hatchery is currently operating under for the hatchery stock in the appropriate sections below. Provide data on the success of meeting the desired hatchery goals.

9.1 INCUBATION

9.1.1 Number of eggs taken and survival rates to eye-up and/or ponding

Table 18. Survival of hatchery sockeye eggs from the Snake River, 1998-2009.

Year	Egg Take	Green-Eyed Survival (%)	Eyed-Ponding Survival (%)	Egg Survival Performance Standard	Fry – Fingerling Survival (%)	Rearing Survival Performance Standard	Fingerling – Smolt Survival (%)
1998	32,375	48.10%	84.09%	NA	99.60%	NA	96.80%
1999	162,056	39.00%	88.71%	NA	89.52%	NA	94.96%
2000	433,304	58.40%	95.27%	NA	92.81%	NA	98.09%
2001	287,720	42.20%	85.52%	NA	89.97%	NA	96.34%
2002	119,555	55.10%	93.33%	NA	86.48%	NA	99.71%
2003	341,921	88.90%	98.80%	NA	97.09%	NA	99.50%
2004	193,349	72.83%	98.42%	NA	95.99%	NA	99.58%
2005	208,712	69.57%	99.63%	NA	91.93%	NA	99.19%
2006	332,675	77.66%	97.50%	NA	86.28%	NA	100.00%
2007	236,393	74.37%	99.00%	NA	56.76%	NA	99.78%
2008	241,220	91.34%	98.38%	NA	78.19%	NA	Pending
2009	326,309	89.23%	Pending	NA	Pending	NA	

Source: Annual project reports to Bonneville Power Administration and annual project reports to NOAA Fisheries for ESA Section 10 activities.

Table 19. Survival of hatchery sockeye eggs from NOAA Fisheries, 1998-2009.

Year	Egg Take	Green-Eyed Survival (%)	Eyed-Ponding Survival (%)	Egg Survival Performance Standard	Fry – Fingerling Survival (%)	Rearing Survival Performance Standard	Fingerling – Smolt Survival (%)
1998	NA	NA	84.6	NA	96.8	NA	95.3
1999	NA	NA	78.1	NA	97.3	NA	74.8
2000	NA	NA	83.8	NA	99.1	NA	97.8
2001	NA	NA	82.4	NA	99.4	NA	97.6
2002	NA	NA	94.0	NA	99.4	NA	98.1
2003	NA	NA	96.0	NA	98.9	NA	98.5
2004	NA	NA	93.7	NA	99.3	NA	96.7
2005	NA	NA	88.3	NA	100	NA	97.0
2006	NA	NA	76.6	NA	100	NA	97.7
2007	NA	NA	68.2	NA	99.2	NA	98.0
2008	NA	NA	64.2	NA	99.2	NA	Pending
2009	NA	NA	Pending	NA	Pending	NA	Pending

Source: Annual project reports to Bonneville Power Administration and annual project reports to NOAA Fisheries for ESA Section 10 activities.

9.1.2 Cause for, and disposition of surplus egg takes

Eagle Fish Hatchery and NOAA Fisheries maintain a captive sockeye salmon broodstock developed and maintained to protect the genetic diversity of the Redfish Lake sockeye. A small group of sockeye are reared to maturity the Eagle and NOAA Fisheries for spawning. A representative sample of eyed-eggs is maintained at Eagle and NOAA Fisheries for the next generation (currently 1,000 eyed-eggs per program). The remaining eyed-eggs produced are transferred to other hatcheries for production rearing or released to egg boxes in Pettit and Alturas lakes. Anadromous adults are also incorporated into the spawning design at Eagle Fish Hatchery. Adults in excess of current program needs are released to Redfish Lake for volitional spawning. Eyed-eggs above the program goal (higher survival or higher fecundities) are released to Pettit Lake and/or Alturas Lake egg boxes.

9.1.3 Loading densities applied during incubation

Eagle Fish Hatchery – Eagle Fish Hatchery uses isolation incubators (three sub-families per female) for egg incubation through the eyed-egg stage. Incubators are approximately two liters and maintain a flow of approximately one liter per minute. Incubators are loaded with between 400 and 1,200 eggs each.

Burley Creek Hatchery--Incubators are approximately four liters and maintain a flow approximately 0.5 liter per minute. Incubators are loaded with between 400-1,200 eggs each.

Springfield Fish Hatchery – Springfield Fish Hatchery will use heath tray incubators at 4,000 eggs per tray. Pathogen-free groundwater will be supplied at a flow rate of 4 to 5 gpm to each stack of trays.

9.1.4 Incubation conditions

Eagle Fish Hatchery – Eggs are incubated between 8°C and 10°C. Dissolved oxygen is maintained around 9.0 ppm (saturation) on well water flow (no silting concerns).

Burley Creek Hatchery--Individual lots of eggs spawned at Burley are placed into isolation containers in the incubation troughs and covered with heavy black plastic to eliminate light. The eggs are left undisturbed during the sensitive period beginning 48 hours after fertilization until they reach the eyed stage (30 days at 10^{o}C). The eggs are then packed into plastic mesh tubes (Aquaseed[1]), packaged, and shipped to IDFG for outplanting (see below).

Captive broodstock eggs that are received from IDFG and the subsequent sac fry are incubated in the above described isolation buckets and periodically checked for mortalities. Early growth is regulated by temperature to bring emergence timing into closer synchrony with the wild sockeye salmon, reducing the need for limiting post-ponding feeding. The water temperature is chilled to 5-6° C to align the egg and fry development with that of their wild counterparts in the Sawtooth Basin lakes.

Springfield Fish Hatchery – Eggs will be incubated between 9˚C and 10˚C on well water flow.

9.1.5 Ponding

Eagle Fish Hatchery – Cumulative temperature units are monitored to determine ponding timing. The actual pond date varies and final ponding is determined by physical observation of the button-up fry. No yolk sac is visible on the button-up fry when ponding occurs. Historically, ponding occurs at approximately 1,100 CTUs.

Burley Creek Hatchery--At swim-up stage, when the yolk sac is completely absorbed and the fish are off the bottom of the bucket, the inner flow-through containers with the swim-up fry are moved from the incubation stacks and suspended in floating foam rings in blue plastic 1.8-m diameter tanks. To assure that fry are feeding and thriving, they remain in the containers or are transferred to larger flow-through suspended containers until they reach approximately 0.7 g, at which time they are released from the containers into the tank. The water temperature is normally increased to 10º C (ambient well water temperature) on or around 1 April. Historically, ponding occurs at approximately 1,100 CTU's.

Springfield Fish Hatchery – Early rearing is proposed to be accomplished in indoor rectangular troughs, located in the hatchery building. Based on flow and density indices, the total rearing trough volume required will be 7,443 cubic feet. A total of 18 troughs at 4 feet wide, 40 feet long, and 2.5 feet average depth are proposed. Fish will be transferred out at an approximate size of 2.25 grams. This results in a peak early rearing flow of 1455 gpm in April of each year.

9.1.6 Fish health maintenance and monitoring

Fish health protocols used in the captive broodstock program follow accepted, standard practices. For an overview of standard methods, see Leitritz and Lewis 1976; Piper et al. 1982; Erdahl 1994; McDaniel et al. 1994; Bromage and Roberts 1995; Pennell and Barton 1996; and Wedemeyer 2001. Protocols conform to the fish health requirements detailed in ESA Section 10 Propagation Permit Number 1120 for IDFG rearing of ESA-listed Snake River sockeye salmon. Additionally, considerable coordination was carried out between NOAA and IDFG fish health experts, as well as participants at the SBSTOC level.

When required, the captive broodstock rearing program has used various disinfectants, antibiotics, vaccinations, and antifungal treatments to control pathogens. When used, the dosage, purpose of use, and method of application were as follows:

- **Antibiotic therapies**: Erythromycin treatments are administered orally in feed to produce a dose of 100 mg/kg of bodyweight for up to 28 days. When oral administration is not feasible (as with anadromous adults), an intraperitoneal injection of erythromycin is given to fish at a dose of 20 mg/kg of bodyweight. In addition, fish may be fed oxytetracycline as needed to control outbreaks of pathogenic myxobacteria, as well as aeromonad and pseudomonad bacteria.

- **Egg disinfection**: Newly fertilized eggs are water hardened in 100 mg/L solution of buffered Iodophor for 20 minutes to inactivate viral and bacterial pathogens on the egg surface and in the perivitelline space. In addition, eyed-eggs transferred to IDFG facilities are disinfected in a 100 mg/L buffered Iodophor solution for ten minutes prior to facility incubation.

- **Formalin Treatments**: Beginning two days after fertilization, the eggs are treated with a formalin drip into the hatchery head tank at 1,668 ppm for 15 minutes on alternating days for control of *Saprolegnia* spp. Eyed eggs are shocked and dead or unfertilized eggs are removed to reduce the risk of fungus spreading to healthy eggs.

9.1.7 Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish during incubation

Eagle Fish Hatchery – Eagle Fish Hatchery incubates eggs on well water; there is no risk associated with siltation or pathogens in the current water supply. Incubating eggs are treated with a 20 minute formalin bath at 1,667 ppm three times per week to control fungus on the eggs.

Burley Creek Hatchery - Eggs are incubated with well water to minimize the risk of catastrophic loss due to siltation or surface water-borne pathogens.

Springfield Fish Hatchery – Eggs will be incubated on well water after treatment with iodophor and regular treatments of argentine or formalin to control fungus on the eggs.

9.2 REARING

9.2.1 Provide survival rate data (average program performance) by hatchery life stage (fry to fingerling; fingerling to smolt) for the most recent twelve years or for years dependable data are available.

Table 20. Survival of hatchery sockeye eggs for Snake River production, 1998-2009.

Year	Egg Take	Green-Eyed Survival (%)	Eyed-Ponding Survival (%)	Egg Survival Performance Standard	Fry – Fingerling Survival (%)	Rearing Survival Performance Standard	Fingerling – Smolt Survival (%)
1998	32,375	48.10%	84.09%	NA	99.60%	NA	96.80%
1999	162,056	39.00%	88.71%	NA	89.52%	NA	94.96%
2000	433,304	58.40%	95.27%	NA	92.81%	NA	98.09%
2001	287,720	42.20%	85.52%	NA	89.97%	NA	96.34%
2002	119,555	55.10%	93.33%	NA	86.48%	NA	99.71%
2003	341,921	88.90%	98.80%	NA	97.09%	NA	99.50%
2004	193,349	72.83%	98.42%	NA	95.99%	NA	99.58%
2005	208,712	69.57%	99.63%	NA	91.93%	NA	99.19%
2006	332,675	77.66%	97.50%	NA	86.28%	NA	100.00%
2007	236,393	74.37%	99.00%	NA	56.76%	NA	99.78%

Year	Egg Take	Green-Eyed Survival (%)	Eyed-Ponding Survival (%)	Egg Survival Performance Standard	Fry – Fingerling Survival (%)	Rearing Survival Performance Standard	Fingerling – Smolt Survival (%)
2008	241,220	91.34%	98.38%	NA	78.19%	NA	Pending
2009	326,309	89.23%	Pending	NA	Pending	NA	Pending

Source: Annual project reports to Bonneville Power Administration and annual project reports to NOAA Fisheries for ESA Section 10 activities.

9.2.2 Density and loading criteria (goals and actual levels)

Eagle Fish Hatchery – A variety of rearing containers are used for different sizes of sockeye. Tanks range in size from 24 gallons to 2,350 gallons. Flow indices are maintained between 1.0 and 1.5. Fry through smolt size are maintained below eight kg/cu meter. Maturing adults are maintained below 14 kg/cu meter.

Burley Creek Hatchery-- Based on practical experience and published literature, loading densities for ESA captive broodstocks were set to not exceed 7 lbs/gpm, except for non-feeding maturing adults with oxygen supplementation. In practice, loading densities at BCH in freshwater tanks ranged from 2.0 lb/gpm to 7 lb/gpm. Raceway loading densities at BCH reached a maximum of 15.4 lb/gpm with non-feeding maturing adults and supplemental oxygen. Generally, juvenile-to-adult rearing density in the tanks was maintained at less than 0.5 lb/ft^3 during most of the culture period; however, fish density increased to 1.0 lb/ft^3 at maturity.

Manchester Rearing Station--Seawater loading densities reached a maximum of 7 lb/gpm. Sockeye rearing densities in seawater are always maintained at 0.5 lb/ft^3 or less.

Springfield Fish Hatchery – The goal for the Springfield facility is to perform early rearing in 18 troughs. Fry size at transfer into the troughs is estimated to be 0.18 grams. Size at transfer out is estimated to be 2.25 grams. Peak flow will be 1,455 gpm for each trough. Density at transfer is estimated to be 0.30 lb/ft3/inch.

9.2.3 Fish rearing conditions

Fish culture methods used in the captive broodstock program follow accepted, standard practices. For an overview of standard methods, see Leitritz and Lewis 1976; Piper et al. 1982; Erdahl 1994; McDaniel et al. 1994; Bromage and Roberts 1995; Pennell and Barton 1996; and Wedemeyer 2001. Protocols conform to the husbandry requirements detailed in ESA Section 10 Propagation Permit Number 1120 for IDFG rearing of ESA-listed Snake River sockeye salmon. Additionally, considerable coordination was carried out between NOAA and IDFG culture experts, as well as participants at the SBSTOC level.

9.2.4 Indicate biweekly or monthly fish growth information (average program performance), including length, weight, and condition factor data collected during rearing, if available.

Table 21. Average monthly growth rate of Snake River sockeye at Sawtooth Fish Hatchery in first two years of hatchery environment.

Rearing Period	Fork Length (mm)	Weight (gms)	Condition Factor	Growth Rate (avg mm/mo)	Hepatosomatic Index	Body Moisture Content
January	NA	NA	NA	NA	NA	NA
February	41.2	0.68	NA	9.9	NA	NA
March	51.1	1.29	NA	5.9	NA	NA
April	57	1.85	NA	16	NA	NA
May	73	3.78	NA	9	NA	NA
June	82	5.3	NA	21	NA	NA
July	103	10.71	NA	17	NA	NA
August	120	17.09	NA	18	NA	NA
September	138	25.21	NA	19	NA	NA
October	157	37.94	NA	11	NA	NA
November	168	45.82	NA	16	NA	NA
December	184	59.32	NA	8	NA	NA
January	192	69.62	NA	11	NA	NA
February	203	79.91	NA	35	NA	NA
March	238	130.55	NA	15	NA	NA
April	253	156.49	NA	10	NA	NA
May	263	177.01	NA	20	NA	NA
June	283	218.53	NA	27	NA	NA
July	310	289.86	NA	18	NA	NA
August	328	343.42	NA	28	NA	NA
September	356	436.62	NA	2	NA	NA
October	358	443.85	NA	62	NA	NA
November	420	711.89	NA	33	NA	NA
December	453	896.71	NA	NA	NA	NA

Source: Historical sample count data from Eagle Hatchery. Length recorded as “Fork Length”, condition factor not calculated.

9.2.5 Indicate monthly fish growth rate and energy reserve data (average program performance), if available

See Table 21 in Section 9.2.4 for monthly growth information; energy reserve data is not available.

NOAA Fisheries Facilities - The fish are grown according to the profile described in Figure 3 which is based upon periodic sample-weights of past brood years.

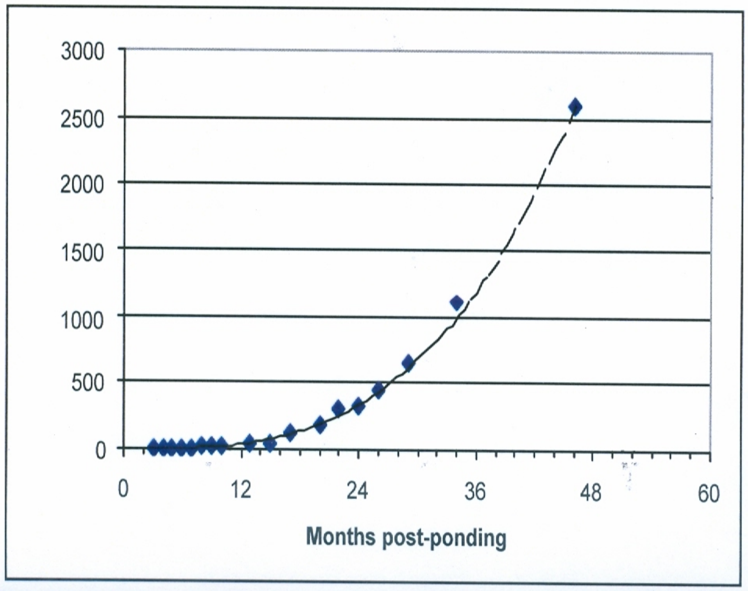

Figure 3. Growth profile, by weight, of sockeye salmon based on past broodyears.

9.2.6 Indicate food type used, daily application schedule, feeding rate range (e.g. % B.W./day and lbs/gpm inflow), and estimates of total food conversion efficiency during rearing (average program performance).

Table 22. Feeding regime for Snake River sockeye production at Sawtooth Fish Hatchery.

Rearing Period	Food Type	Application Schedule (# feedings/day)	Feeding Rate Range (% B.W./day)	Lbs. fed per gpm of inflow	Food Conversion During Period
Swim-up to 0.25g	Starter #0	8	3.5	0.002	1
0.25 to 0.55 g/f	Starter #1	8	3.3	0.004	1
0.55 to 3.0 g/f	Starter #2	8	2.5	0.008	1.1
3.0 to 5.0 g/f	1.2	4	2.25	0.011	1.1
5.0 to 8.0 g/f	1.5	4	2.08	0.008	1.2
8.0 to 18.0 g/f	2	4	1.76	0.015	1.2
18 to 40 g/f	2.5	4	1.44	0.017	1.2
40 to 100 g/f	3	4	1.3	0.0325	1.3
100 to 800 g/f	4	4	1.1	0.088	1.4
> 800 g/f	6	4	0.8	0.096	1.5

Source: BioOregon feed recommendations followed for feed size and percent Body Weight per day. Food conversion and pounds fed per gpm based on historical hatchery data.

NOAA Fisheries Facilities-- Fish at Burley Creek Hatchery are reared on commercial feeds produced by BioOregon or Skretting.[1] Beginning at swim-up at BCH, fry are fed a semi-moist starter mash. As they grow, the fish are transitioned through standard pelleted semi-moist or dry grower feeds and progressed through "brood" ration sizes (6 mm, 9 mm). Fish reared at Manchester Research Station receive Skretting commercial feed in dry pellet sizes appropriate for fish size, dispensed by automatic feeders. The pellet size fed follows the feed manufacturer's recommendations, based on current guidelines for commercial aquaculture and guidance provided in Fowler (1989). However, pellet size is adjusted from the recommendation to ensure that the smallest fish in the population are able to feed. Daily ration ranges from 5.6% body weight per day for swim-up fry to 0.4% for adults depending on fish size and water temperature (Iwama 1996).

Feeding of swim-up fry is initiated with *ad lib* hand feeding in 5-ft diameter circular tanks. After the fish are transferred to12-ft diameter circular tanks, their diet is either hand fed or rationed by belt feeders. Prior to loading the feeders, a portion of the day's ration is broadcast over the surface to observe the fish's feeding response. Feeding frequency varies with day length, feeder type and fish size, as suggested by Fowler (1989).

Feeding operations for the Springfield Hatchery will be similar to that used at the NOAA facilities.

9.2.7 Fish health monitoring, disease treatment, and sanitation procedures

Eagle Fish Hatchery – Fish health is monitored daily by observing feeding response, external condition, and behavior of fish in each tank as initial indicators of developing problems. In particular, fish culturists look for signs of lethargy, spiral swimming, side swimming, jumping, flashing, unusual respiratory activity, body surface abnormalities, or unusual coloration. Presence of any of these behaviors or conditions is immediately reported to the program fish pathologist.

Presence of moribund fish is immediately reported to the fish pathologist for blood and parasite sampling; the fish pathologist routinely monitors captive broodstock mortalities to try to determine cause of death. American Fisheries Society (AFS) "Bluebook" procedures are employed to isolate bacterial or viral pathogens and to identify parasite etiology (Thoesen 1994). Moribund fish are routinely analyzed for common bacterial and viral pathogens (e.g., bacterial kidney disease, infectious hematopoietic necrosis virus, etc.). When a treatable pathogen is either detected or suspected, the program fish pathologist prescribes appropriate therapeutic drugs to control the problem. Select carcasses are appropriately preserved for pathology, genetic, and other analyses. After necropsy, carcasses that are not vital to further analysis are disposed of as per language contained in the ESA Section 10 permit for the program.

NOAA Fisheries Facilities- Biosecurity practices are in place to prevent the spread of diseases from local fish to the ESA stocks and from one stock to another within the ESA program. Housing fish within a fully enclosed building and rearing them on treated water is essential to ensure pathogens from wild fish do not reach the ESA captive broodstocks. For the seawater system, an insight that was developed over the course of operations was to ensure a direct linkage (both on or both off) between the pumps and the UV treatment to ensure untreated water was not pumped into ESA tanks. In recent years, we prohibited the holding of salmonids in facility net pens located near the intake pumps to reduce potential salmonid pathogens from entering the water supply.

Biosecure culture practices form the basic approach to prevent pathogens from being spread from one cultured stock to another. Separate brushes and nets are provided for each pool; staff use a new pair of disposable gloves per pool when brushing pools or removing mortalities. All equipment is disinfected in 100 ppm Iodophore for a minimum of 30 minutes before being moved to a new pool. Disinfection includes crowder screens, nets, transfer tubes, anesthetic tank, tables, weighing pan, scale, PIT Tag reader equipment waders, and raingear. Personnel are expected to change raingear as they move between pools to provide proper disinfection time. Shower curtains are placed around anesthetic tanks during fish sampling and transfer to prevent splashed water from reaching adjacent pools. Adjacent pools may be temporarily covered with disinfected plastic when there is a risk of cross-contamination. After fish handling, the floor is sprayed with an iodophore disinfectant.

Fish health is monitored in several ways. Fish are observed daily for feeding response, external condition and behavior as initial indicators of developing problems. Indicators include signs of lethargy, erratic swimming, side swimming, flashing, unusual respiratory activity, body surface abnormalities and unusual coloration. Dead or morbid fish are removed immediately, bagged, PIT tags read, and submitted for pathology screening. A fish pathologist performs necropsies to determine cause of death. Infectious disease screening includes collection of kidney tissue, which is subjected to enzyme-linked immunosorbent assay (ELISA) to determine *Renibacterium salmoninarum* infection (bacterial kidney disease or BKD). Virology screening is performed on the kidney samples using a Chinook salmon epithelial cell (CHSE) tissue culture-based assay in order to detect infectious hematopoietic virus (IHNV) and viral hemorrhagic septicemia virus (VHSV). Any tissue culture monolayer showing signs of cytopathic effects are then subjected to polymerase chain reaction (PCR)-based identification of the virus species. Samples from other overt lesions are also cultured on a variety of laboratory medium and subjected to microbial analysis. Other common bacterial pathogens that may be encountered include *Aeromonas salmonicida*, *Vibrio anguillarum*, and members of the *Flavobacterium* genus. Typically, when a treatable pathogen is either detected or suspected, the NMFS fish pathologist prescribes appropriate prophylactic and therapeutic drugs, e.g., oxytetracycline or erythromycin. Azithromycin (an erythromycin derivative) is also used to treat BKD in *R. salmoninarum*-infected populations. Medication is either mixed with feed or injected, with dosage based on fish weight. Prior to transfer to seawater, fish in the adult release group receive an injection of the *Vibrio anguillarum* bacterin vaccine. In addition, maturing fish are injected with erythromycin as a prophylactic approximately one month prior to spawning. The injection is administered interpertionally at the base of the ventral fins at a dose of 20 or 30 mg/kg of fish wet weight. Ovarian fluid and milt from spawning adults are also screened with the BKD-ELISA and for IHNV and VHSV.

Springfield Fish Hatchery – Fish health will be observed daily for feeding response, external condition, behavior and initial indicators of developing problems. In particular, fish culturists will look for signs of lethargy, spiral swimming, side swimming, jumping, flashing, unusual respiratory activity, body surface abnormalities, or unusual coloration. Presence of any of these behaviors or conditions will be immediately reported to the program fish pathologist.

9.2.8 Smolt development indices (e.g. gill ATPase activity), if applicable

Not applicable.

9.2.9 Indicate the use of "natural" rearing methods as applied in the program

Natural rearing methods are addressed in RM&E component of the program (pre-spawn adult releases, eyed-egg releases); no in-hatchery "natural" rearing methods are currently used in the program or will be implemented when the Springfield Hatchery comes on-line.

Burley Creek Hatchery - Natural lighting is a "natural" rearing method applied to fish during the maturation process at Burley Creek Hatchery.

Manchester Research Station - Seawater rearing is the "natural" rearing environment for sockeye salmon during the ocean portion of their life cycle.

9.2.10 Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish under propagation

Currently, Redfish Lake sockeye salmon are released at all life stages to minimize the risk of domestication.

Manchester Research Station - Seawater rearing during the marine portion of their life cycle should aid in promoting the retention of anadromous traits in these fish.

SECTION 10. RELEASE

This section describes fish release levels, and release practices applied through the hatchery program.

10.1 PROPOSED FISH RELEASE LEVELS

Table 23. Proposed release numbers, date, and location of hatchery-reared Snake River sockeye based on current program.

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Eggs	50,000		Nov/Dec	Pettit Lake
Unfed Fry	NA	NA	NA	NA
Fry	NA	NA	NA	NA

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Pre-smolts	15,000	60 – 80 fpp	October	Pettit Lake
Pre-smolts	15,000	60 – 80 fpp	October	Alturas Lake
Pre-smolts	60,000	60 – 80 fpp	October	Redfish Lake
Smolts	75,000	10 – 20 fpp	May	Salmon River
Smolts	75,000	10 – 20 fpp	May	Redfish Lake Creek
Captive Adults	400	0.25 fpp	September	Redfish Lake

Under the proposed Springfield Fish Hatchery program, 1 million smolts will be released into Redfish Lake Creek and 200 adults will be released into Pettit and Alturas lakes respectively (400 fish total) (Table 24). The proposed Springfield smolts will take the place of all pre-smolt releases and smolt releases into the Salmon River.

Table 24. Sockeye release numbers and the date, source, size and location of hatchery-rearing Snake River sockeye.

Age Class	Source	Maximum Number	Size (fpp)	Release Date	Location
Redfish Lake					
Smolts	Springfield	500,000	10 – 20 fpp	May 1-10	Redfish Lake Subbasin
Smolts	Springfield	500,000	10 – 20 fpp	May 11-20	Redfish Lake Subbasin
Pettit Lake					
Redfish Lake Captive Adults	Eagle	200[a]	0.25	September /October	Pettit Lake
Alturas Lake					
Redfish Lake Captive Adults/Alturas Lake Captive Adults	Eagle	200[a,b]	0.25	August	Alturas Lake

a- Source of captive brood is Pettit Lake or Redfish Lake-origin fish
b- Source of captive brood is Alturas Lake-origin fish

10.2 SPECIFIC LOCATION(S) OF PROPOSED RELEASE(S)

- Stream, river, or watercourse: Redfish Lake
  Release point: 44.117643 Latitude/ -114.931738 Longitude
  Major watershed: Salmon River
  Basin or Region: Upper Salmon River Basin

- Stream, river, or watercourse: Alturas Lake

Release point: 43.913094 Latitude/ -114.861687 Longitude
Major watershed: Salmon River
Basin or Region: Upper Salmon River Basin

- Stream, river, or watercourse: Pettit Lake
  Release point: 43.978881 Latitude/ -114.879352 Longitude
  Major watershed: Salmon River
  Basin or Region: Upper Salmon River Basin

- Stream, river, or watercourse: Redfish Lake Creek Trap
  Release point: 44.146724 Latitude/ -114.912022 Longitude
  Major watershed: Salmon River
  Basin or Region: Upper Salmon River Basin

- Stream, river, or watercourse: Sawtooth Hatchery Trap
  Release point: 44.150253 Latitude/ -114.884411 Longitude
  Major watershed: Salmon River
  Basin or Region: Upper Salmon River Basin

10.3 ACTUAL NUMBERS AND SIZES OF FISH RELEASED BY AGE CLASS THROUGH THE PROGRAM

Table 25. Number and sizes of hatchery sockeye released in the Snake River, 1998-2009.

Release year	Eggs/ Unfed Fry	Average size	Pre-smolt	Average size	Smolt	Average size	Adults	Average size
1998	0	NA	141,871	37.93	81,615	7.96	0	NA
1999	20,311	NA	40,271	44.90	9,718	17.87	21	.18
2000	65,200	NA	72,114	43.78	148	17.6	271	.20
2001	0	NA	106,166	24.51	13,915	9.19	79	.25
2002	30,924	NA	140.410	34.66	38,672	16.45	178	.25
2003	199,666	NA	76,788	41.79	0	0	315	.30
2004	49,134	NA	130,716	44.11	96	22.7	241	.23
2005	51,239	NA	72,108	77.51	78,330	12.96	173	.27
2006	184,596	NA	107,292	73.52	86,052	12.42	464	.25
2007	51,008	NA	82,105	66.91	101676	11.98	494	.31
2008	67,984	NA	84,005	89.16	150,395	14.55	969	.36
2009	72,478	NA	59,538	72.87	173,055	16.54	1,349	.32
Average	66,045	NA	81,093	54.30	61,139	13.35	380	.265

Note: Table includes all sockeye releases into the Sawtooth basin.
Source: Project annual reports to Bonneville Power Administration and project annual reports to NOAA Fisheries for ESA Section 10 activities.

10.4 ACTUAL DATES OF RELEASE AND DESCRIPTION OF RELEASE PROTOCOLS

Eyed-eggs – Eyed-eggs are released to Pettit Lake and Alturas Lake in November and December (range November 10 – December 17). Eyed-eggs are placed in incubation boxes and released based on Celsius temperature units.

Pre-smolts – Pre-smolts are released to Redfish, Alturas and Pettit lakes in October (range October 2 to October 7). Late summer and fall release strategies have been evaluated but the October release provides the highest overwinter survival. This is a forced mid-lake release from tanks mounted on boats.

Smolts – Smolts are released to Redfish Lake Creek and Salmon River in May. Release dates are based on historical out-migration timing and peak flow rates. All sockeye smolt releases are forced releases from transport vehicles.

Adults – Adults are released to Redfish Lake in September (range September 2-16). Time of release occurs two weeks prior to the observed spawn timing of anadromous sockeye. Releases from Eagle Fish Hatchery are forced releases from transport vehicles. In the future program, adult releases to Pettit Lake will occur in September/October, with releases to Alturas Lake occurring in August.

10.5 FISH TRANSPORTATION PROCEDURES, IF APPLICABLE

Eyed-eggs – Eyed-eggs are released from Eagle Fish Hatchery to Pettit and Alturas lakes. Eggs are loaded in specially designed egg boxes and transported in water filled coolers. Coolers are loaded with water matching the incubation temperature of the eggs. Ice is added to the cooler to begin the tempering process while in transit. Transit time is approximately four hours. Coolers are tempered to lake temperature before egg boxes are placed into the lakes.

Pre-smolts – Pre-smolts for the sockeye program are reared at the Sawtooth Fish Hatchery. Pre-smolts are loaded into 250 truck-mounted insulated tanks. Transport tanks are supplied with oxygen and recirculation fresh flows. Transit times range from 30 to 90 minutes. Loading densities do not exceed 0.5 pounds per gallon.

Smolts – Currently, smolts for the sockeye program are reared at two different locations, IDFG's Sawtooth Fish Hatchery and ODFW's Oxbow Fish Hatchery. Transport tanks range from 250 gallons to 2,700 gallons. Tanks are supplied with oxygen and recirculating systems. Transit time for the Sawtooth reared smolts ranges from 15 to 45 minutes. Transit times for the Oxbow reared smolts is approximately 12 hours. With the implementation of the Springfield Hatchery facility, smolt transport from Oxbow and Burley will be terminated. Smolt transport from Springfield will use similar methods and require approximately eight hours per trip.

Adults – Adults for the sockeye program are reared at Eagle Fish Hatchery and NOAA's Manchester Research Facility. Transport tanks range from 250 gallons to 2,000 gallons. Tanks are supplied with oxygen and recirculating systems. Transit time for adults reared at Eagle (captive and/or anadromous) is approximately three to four hours. Transit time for the NOAA reared adults is approximately 15 to 18 hours.

The IDFG has identified the Springfield Fish Hatchery as additional infrastructure needed to accommodate increased smolt production and future recovery of Snake River sockeye salmon; additional detail is provided in the Department's Draft Snake River Sockeye Salmon Recovery Strategy (Appendix A).

10.6 ACCLIMATION PROCEDURES (METHODS APPLIED AND LENGTH OF TIME)

All releases are forced releases with no period of acclimation.

10.7 MARKS APPLIED, AND PROPORTIONS OF THE TOTAL HATCHERY POPULATION MARKED, TO IDENTIFY HATCHERY ADULTS

All juvenile and adult sockeye released from the sockeye captive broodstock program are marked/tagged to identify hatchery reared fish. Pre-smolts are 100% adipose clipped and a representative sample (1,000 pre-smolts per release site) is PIT-tagged for evaluation. Smolts are 100% coded wire-tagged (CWT) prior to release and a representative group (1,000 smolts per release site) is PIT-tagged for evaluation purposes. Full-term captive reared adults are 100% adipose clipped and PIT-tagged before release.

10.8 DISPOSITION PLANS FOR FISH IDENTIFIED AT THE TIME OF RELEASE AS SURPLUS TO PROGRAMMED OR APPROVED LEVELS

Not applicable.

10.9 FISH HEALTH CERTIFICATION PROCEDURES APPLIED PRE-RELEASE

Sockeye salmon captive broodstock are 100% sampled for a variety of pathogens. No eyed-eggs are transferred to other facilities or released, without approval from the IDFG Fish Health supervisor and State transport permits are approved before transferring eyed-eggs out of state. Juveniles, pre-smolts and smolts, are sampled (60 fish sample) 45 to 60 days before release. All transport permits are approved before juveniles are transferred. All mortality from captive reared adult release groups is sampled. This disease history is used to obtain approval before transfer and release.

10.10 EMERGENCY RELEASE PROCEDURES IN RESPONSE TO FLOODING OR WATER SYSTEM FAILURE

Eagle Fish Hatchery - Eagle Fish Hatchery is staffed with three full time employees that live on station and share alarm monitoring duty. Mountain Alarm provides the alarm service at Eagle Fish Hatchery that incorporates six low water alarms and three chilled water alarms. The water supply at Eagle Fish Hatchery is provided by three 50hp submersible pumps, all with generator back-up in case of power failure. The water system is tied together so any of the three pumps can provide water to all parts of the facility. In the case of complete power/generator failure, artesian water flow of around 250 gallons per minute can be supplied to rearing units. Each three meter and four meter tank is also backed-up with an oxygen system, with full oxygen bottles in place.

Burley Creek Hatchery – Emergency response to water system failure as described in section 4.1.

Manchester Research Facility –Emergency response to water system failure as described in section 4.1.

Sawtooth Fish Hatchery – The Salmon River Spring Chinook HGMP provides a description of system back-up and risk aversion measures at Sawtooth Fish Hatchery.

Oxbow Fish Hatchery – The HGMP for ODFW's Oxbow Fish Hatchery provides a description of system back-up and risk aversion measures.

Springfield Fish Hatchery – Emergency response to water system failure as described in Section 4.1.

10.11 INDICATE RISK AVERSION MEASURES THAT WILL BE APPLIED TO MINIMIZE THE LIKELIHOOD FOR ADVERSE GENETIC AND ECOLOGICAL EFFECTS TO LISTED FISH RESULTING FROM FISH RELEASES

Annual egg and fish releases are conducted pursuant to NOAA Section 10 permitting guidelines and are approved after SBSTOC review and recommendation.

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

11.1 MONITORING AND EVALUATION OF PERFORMANCE INDICATORS PRESENTED IN SECTION 1.10

11.1.1 Describe plans and methods proposed to collect data necessary to respond to each Performance Indicator identified for the program.

3.2.2 Performance Standard: Release groups are sufficiently marked in a manner consistent with information needs and protocols to enable determination of impacts to natural- and hatchery-origin fish in fisheries.

Performance Indicator: All production releases are marked to identify juveniles and adults to specific release strategies; genetic evaluations established to identify natural production strategies.

Monitoring and Evaluation plan: Mark quality and tag retention checks are performed at marking, post-marking, and immediately prior to release. Production fish are currently marked as follows: pre-smolts are adipose fin-clipped, Sawtooth Hatchery reared smolts receive coded-wire tags, Oxbow Hatchery reared smolts receive coded-wire tags. Return data for the past two years indicates very strong homing to the original release site so adults returning to the Sawtooth Hatchery weir marked with coded-wire tags will be assumed to be from the Sawtooth smolt production group and adults returning to the Redfish Lake Creek weir marked with coded-wire tags will be assumed to be from the Oxbow smolt production group. By using PIT-tagged adult returns, we will be able to estimate both coded-wire tag loss and homing fidelity to develop a correction factor when developing SARs for return groups.

3.3.1 Performance Standard: Artificial propagation program contributes to an increasing number of spawners returning to natural spawning areas.

Performance Indicator: Annual number and age of anadromous and captive spawners known; residual spawner counts conducted throughout spawn season.

Monitoring and Evaluation plan: We will monitor annual spawner counts and redd production, monitor natural smolt production, parental contribution and conduct annual trawling for population abundance. Night snorkeling is also conducted to estimate the number of residual spawners within the lake.

3.3.2 Performance Standard: Releases are sufficiently marked to allow statistically significant evaluation of program contribution to natural production, and to evaluate effects of the program on the local natural population.

Performance Indicator: All production releases are marked to identify juveniles and adults to specific release strategies; genetic evaluations established to identify both captive and natural production strategies.

Monitoring and Evaluation plan: Mark groups and genetic technologies allow evaluation of program contribution to the target population (both natural and captive populations). Mark quality and tag retention checks are performed at marking, post-marking, and immediately prior to release. Production fish are currently marked as follows: pre-smolts are adipose fin-clipped, Sawtooth Hatchery reared smolts receive coded-wire tags, Oxbow Hatchery reared smolts receive coded-wire tags. Return data for the past two years indicates very strong homing to the original release site so adults returning to the Sawtooth Hatchery weir marked with coded-wire tags are assumed to be from the Sawtooth smolt production group and adults returning to the Redfish Lake Creek weir marked with coded-wire tags are assumed to be from the Oxbow smolt production group. By using PIT-tagged adult returns, we will be able to estimate both coded-wire tag loss and homing fidelity to develop a correction factor when developing SARs for return groups.

3.4.1 Performance Standard: Fish collected for broodstock are taken throughout the return or spawning period in proportions approximating the timing and age distribution of the population from which broodstock is taken.

Performance Indicator: Broodstock are sourced throughout the return and/or spawning period as appropriate; replacement brood sourced from all spawn crosses and from equalized individual and family representation.

Monitoring and Evaluation plan: Protection of genetic variation is achieved by selecting broodstock that represent the genetic diversity of the entire run, selecting fish over the entire length of the run, selecting individuals from each release strategy, equalizing sex ratios and by equalizing family contribution. Annual spawning and brood sourcing is consistent with the Stanley Basin Sockeye Technical Oversight Committee and NOAA Northwest Fisheries Science Center genetics staff recommendations.

3.4.2 Performance Standard: Broodstock collection does not significantly reduce potential juvenile production in natural rearing areas.

Performance Indicator: Artificial propagation program contributes to increasing number of naturally-produced juveniles in nursery lakes.

Monitoring and Evaluation plan: The research M&E element will document increasing numbers of naturally-produced juveniles resulting from natural spawning occurring within the basin lakes. Our ability to achieve this task is limited at two of our lake outlets (Alturas Lake Creek and Pettit Lake Creek) during high flow events. Modifications will be necessary at these trap sites to enable us to determine if any increase in natural production from these two lakes occurs.

3.4.3 Performance Standard: Life history characteristics of the natural population do not change as a result of this artificial production program.

Performance Indicator: Artificial propagation program does not change life history characteristics of natural population.

Monitoring and Evaluation plan: Hatchery and Research elements monitor the following characteristics annually: juvenile migration timing, juvenile size at emigration, adult return timing, adult return age and sex composition and size at return, spawn timing and distribution, fecundity and egg size (see Baker et al. *In* review and Peterson et al. 2008).

3.4.4 Performance Standard: Annual release numbers do not exceed estimated basin-wide and local habitat capacity, including spawning, freshwater rearing, migration corridor, and estuarine and near-shore rearing.

Performance Indicator: IDFG and cooperators conduct annual investigations to address habitat carrying capacity, population dynamics, and system productivity.

Monitoring and Evaluation plan: The carrying capacity of the basin lakes is determined by performing mid-water trawling and hydroacoustics to estimate O. *nerka* populations as well as limnological studies to quantify available food resources. Production releases are approved annually and are consistent with SBSTOC recommendations.

3.5.1 Performance Standard: Patterns of genetic variation within and among natural populations do not change significantly as a result of artificial production.

Performance Indicator: Founder genetic profiles known and compared to genetic profiles developed each successive generation.

Monitoring and Evaluation plan: Intensive annual genetic monitoring of captive and anadromous contributors is conducted at the Eagle Fish Genetics Laboratory. The development of the spawning matrix allows us to spawn the least genetically related individuals within the population and helps maintain the genetic diversity of the population.

3.5.2 Performance Standard: Collection of broodstock does not adversely impact the genetic diversity of the naturally spawning population.

Performance Indicator: Patterns of genetic variation do not change significantly as a result of artificial population.

Monitoring and Evaluation plan: Intensive annual genetic monitoring of captive and anadromous contributors is conducted at the Eagle Fish Genetics Laboratory. Protection of genetic variation is achieved by selecting broodstock that represent the genetic diversity of the entire run, selecting fish over the entire length of the run, selecting individuals from each release strategy, equalizing sex ratios and by equalizing family contribution.

3.5.3 Performance Standard: Artificially produced origin adults in natural production areas do not exceed appropriate proportion of the total natural spawning populations.

Performance Indicator: Captive broodstock program initiated to preserve and augment natural spawning population.

Monitoring and Evaluation plan: The annual production of listed fish that are contributed to the natural environment is described in Section 12.1.

3.7.1 Performance Standard: Artificial production facilities are operated in compliance with all applicable fish health guidelines and facility operation standards and protocols such as those described by IHOT, PNFHPC, and INAD.

Performance Indicator: Annual reports indicating level of compliance with applicable standards and criteria.

Performance Indicator: Periodic audits indicating level of compliance with applicable standards and criteria.

Monitoring and Evaluation plan: When applicable, facility is operated in compliance with all fish health guidelines and facility operations standards; see http://www.efw.bpa.gov/searchpublications/ for annual reporting (reports are available upon request). In addition, facility has completed a Best Management Practices (BMP) document that is updated as management and programmatic needs change.

3.7.2 Performance Standard: Effluent from artificial production facility will not detrimentally affect natural populations.

Performance Indicator: Discharge water quality compared to applicable water quality standards and guidelines, such as those described or required by NPDES, IHOT, PNFHPC, including pertinent State of Idaho water quality plans relating to temperature, nutrient loading, chemicals, etc.

Monitoring and Evaluation plan: Facility is operated in compliance with all NPDES and Idaho Department of Water Resources discharge and monitoring requirements; monthly, quarterly, and annual discharge and monitoring reports are provided as required by law and/or permitting requirements. Permits and compliance reports (current and historical) are available upon request.

3.7.3 Performance Standard: Water withdrawals and instream water diversion structures for artificial production facility operation will not prevent access to natural spawning areas, affect spawning behavior of natural populations, or impact juvenile rearing environment.

Performance Indicator: Water withdrawals compared to applicable passage criteria.

Performance Indicator: Water withdrawals compared to NOAA, USFWS, and IDFG juvenile screening criteria.

Performance Indicator: Number of adult fish aggregating and/or spawning immediately below water intake point.

Performance Indicator: Number of adult fish passing water intake point.

Performance Indicator: Proportion of diversion of total stream flow between intake and outfall.

Monitoring and Evaluation plan: In general, water withdrawal permits have been obtained to establish water rights for each hatchery facility, intake systems are designed to deliver permitted flows, and facility monitors and reports as required. Facility and associated satellite facilities, if applicable, will maintain all screens associated with water intakes in surface water areas to prevent impingement, injury, or mortality to listed salmonids.

Numbers of adult fish aggregating and/or spawning immediately below facility water intakes (where relevant) are monitored annually by IDFG research personnel in accordance with species-specific annual redd counts. Numbers of adult fish passing water intake points as well as facility flow information (monthly, annually) are provided in annual facility reports.

3.7.4 Performance Standard: Releases do not introduce pathogens not already existing in the local populations, and do not significantly increase the levels of existing pathogens.

Performance Indicator: Certification of juvenile fish health immediately prior to release, including pathogens present and their virulence.

Performance Indicator: Juvenile densities during artificial rearing.

Performance Indicator: Samples of natural populations for disease occurrence before and after artificial production releases.

Monitoring and Evaluation plan: IDFG and NOAA fish health professionals sample and certify all release and/or transfer groups prior to liberation. In addition, the IDFG samples a small number of natural outmigrants annually to monitor pathogen status in natural O. nerka populations.

Raceway/tank flow and density indices during artificial rearing stages are maintained at or below IHOT guidelines (monthly monitoring).

3.7.5 Performance Standard: Any distribution of carcasses or other products for nutrient enhancement is accomplished in compliance with appropriate disease control regulations and guidelines, including state, tribal, and federal carcass distribution guidelines.

Performance Indicator: Number and location(s) of carcasses or other products distributed for nutrient enrichment.

Performance Indicator: Statement of compliance with applicable regulations and guidelines.

Monitoring and Evaluation plan: Nutrient enhancement projects, where/when applicable, are outlined in IDFG research, management, and/or hatchery permits and annual production reports. Nutrient enhancement projects comply with all IDFG Eagle Fish Health Lab disease, processing, and handling guidelines prior to carcass distribution.

3.7.6 Performance Standard: Adult broodstock collection operation does not significantly alter spatial and temporal distribution of any naturally produced population.

Performance Indicator: Spatial and temporal spawning distribution of natural population above and below weir/trap, currently and compared to historic distribution.

Monitoring and Evaluation plan: Monitoring and evaluation plans will vary depending on the management goals of the program (integrated broodstock, segregated broodstock, localized broodstock, etc). In general, facility trapping sites document the temporal distribution of both wild/natural and artificially-produced adults that return to trapping locations. Current and historical trap data is provided in annual production reports and/or is available upon request.

3.7.7 Performance Standard: Weir/trap operations do not result in significant stress, injury, or mortality in natural populations.

Performance Indicator: Mortality rates in trap.

Performance Indicator: Pre-spawning mortality rates of trapped fish in hatchery or after release.

Monitoring and Evaluation plan: In general, facility maintains all weirs/traps associated with program to either reduce or eliminate stress, injury, or mortality to listed salmonids. Mortality rates in trap, as well as pre-spawning mortality rates of trapped fish in hatchery are monitored and reported in annual production reports. Mortality rates of hatchery fish released to spawn naturally (when applicable) are not monitored; numbers of adult spawners above and below weirs/traps are monitored annually by IDFG research personnel in accordance with species-specific annual redd counts.

3.7.8 Performance Standard: Predation by artificially produced fish on naturally produced fish does not significantly reduce numbers of natural fish.

Performance Indicator: Size at, and time of, release of juvenile fish, compared to size and timing of natural fish present.

Performance Indicator: Number of fish in stomachs of sampled artificially produced fish, with estimate of natural fish composition.

Monitoring and Evaluation plan: Juvenile size-at-release targets are designed to mimic the range of naturally-produced fish in Stanley Basin environments; piscivory is not a concern for this stock/species. Future size-at-release studies may be necessary to determine the range most beneficial to both hatchery and wild populations; see http://www.efw.bpa.gov/searchpublications/ for annual reporting.

Monitoring and evaluation measures for the proposed Springfield Fish Hatchery program are currently in the development stage. Draft monitoring and evaluation measures for each performance standard can be found in Table 3 in Section 1.10.

11.1.2 Indicate whether funding, staffing, and other support logistics are available or committed to allow implementation of the monitoring and evaluation program

Funding, staffing and support logistics are dedicated to the existing monitoring and evaluation program through the BPA Fish and Wildlife program. However, the research component of this program is subject to the BPA solicitation process (typically every 3-5 years) and is not part of the State of Idaho Fish Accord with BPA. Additional funding and staffing may also be needed when the program expands the smolt release strategy of the project (as identified in the 2008 Biological Opinion and that is within the State of Idaho Fish Accord with BPA).

11.2 INDICATE RISK AVERSION MEASURES THAT WILL BE APPLIED TO MINIMIZE THE LIKELIHOOD FOR ADVERSE GENETIC AND ECOLOGICAL EFFECTS TO LISTED FISH RESULTING FROM MONITORING AND EVALUATION ACTIVITIES

Risk aversion measures for research activities associated with the evaluation of the Snake River Sockeye Salmon Captive Broodstock Program Research Element are specified in our ESA Section 7 Consultation and Section 10 Permit Nos. 1120, 1124 and 1481. A brief summary of the kinds of actions taken is provided.

Adult handling activities are conducted to minimize impacts to ESA-listed, non-target species. Adult and juvenile weirs and screw traps are engineered properly and installed in locations that minimize adverse impacts to both target and non-target species. All trapping facilities are constantly monitored to minimize a variety of risks (e.g., high water periods, high emigration or escapement periods, security).

Adult spawner and redd surveys are conducted to minimize potential risks to all life stages of

ESA-listed species. The IDFG conducts formal redd count training annually. During surveys, care is taken to not disturb ESA-listed species and to not boat close to the vicinity of completed redds.

Marking and tagging activities are designed to protect ESA-listed species and allow for evaluation of the different release strategies utilized. Pre-smolts are adipose fin-clipped, Sawtooth Hatchery reared smolts receive coded-wire tags, and Oxbow Hatchery-reared smolts receive coded-wire tags to differentiate them from their wild/natural counterpart.

SECTION 12. RESEARCH

12.1 OBJECTIVE OR PURPOSE

Snake River Sockeye Salmon Captive Broodstock Program Research Element (IDFG)

The captive broodstock program reintroduction plan follows a "spread-the-risk" philosophy incorporating multiple release strategies and multiple lakes (Hebdon et al. 2004). Progeny from the captive broodstock program are reintroduced to Sawtooth Valley waters at different life stages using a variety of release options including: 1) eyed-egg plants to in-lake incubator boxes in November and December, 2) pre-smolt releases direct to lakes in October, 3) smolt releases to outlet streams in May, and 4) pre-spawn adult releases (hatchery-reared) direct to lakes in September. An extensive monitoring and evaluation program is conducted in the Sawtooth Valley waters to determine the contribution the release strategies listed above of hatchery-produced sockeye salmon make toward avoiding population extinction and increasing population abundance.

Research and evaluation activities associated with Snake River sockeye salmon are permitted under the ESA (NOAA) Section 10 Incidental Take Permits (IDFG Nos. 1120, 1124, and 1481). Research data collected includes O. *nerka* population monitoring in Sawtooth Valley lakes using both hydroacoustic and mid-water trawling techniques, sport fishery evaluation on Redfish Lake, smolt out-migration monitoring and evaluation at lake outlets, radio telemetry studies of mature adult sockeye salmon released to Sawtooth Valley lakes for natural spawning, and predator investigations in tributaries to Redfish and Alturas lakes. For methodology associated with each of these research activities, see Peterson et al. 2008.

Snake River Sockeye Salmon Bypass vs. Transport Pilot Study (ACOE and Biomark)

The text presented in this section was taken from the Biomark Proposal to the ACOE. (Dean Park, Biomark, personal communication).

> The Corps of Engineers (Corps) collects migratory juvenile salmonids at the Federal Columbia River Power System dams on the Snake and Columbia rivers and barges them around as many as 8 downstream dams in an effort to increase survival of these fish to the ocean. Some analyses of passive integrated transponder (PIT) tag data indicate that bypassed fish return as adults at a lower rate than those fish that are never detected at a hydroelectric facility (those passing through spillways and turbines). Currently, PIT-tag detectors are only present in the bypass systems; therefore, only PIT-tags of bypassed fish are detected. The lower return rates of bypassed fish is often attributed to elevated stress

levels, associated with bypass passage, that eventually manifest in elevated mortality rates and lower adult return rates. The Corps is currently interested in determining if a subset of bypass facilities could be depressing the SAR of bypassed fish.

Little information is available on the survival of sockeye salmon (*Oncorhynchus nerka*) through the Corps hydrosystem. Due to higher adult returns to the Stanley Basin in Idaho in 2007 and 2008, there was an opportunity to PIT-tag hatchery reared juvenile sockeye to begin to get estimates of in-river survivals, collection efficiencies, and eventually SARs. In an effort to better estimate in-river survivals and SARs, a pilot study was initiated in 2009 to examine the different management strategies of transport, bypass, and spill on the SARs of Snake River sockeye salmon. For this study, sockeye salmon smolts were PIT-tagged at hatcheries in Idaho (Sawtooth Fish Hatchery, n = 52,833) on the Salmon River and in Oregon (Oxbow Fish Hatchery, n = 10,957) on the Columbia River. PIT-tagged fish were released in the spring 2009 near Stanley, Idaho and allowed either to migrate through the hydropower system or be collected for transportation. A total of 10,937 PIT-tagged sockeye salmon were released into Redfish Lake Creek and 52,551 PIT-tagged sockeye salmon were released into the Upper Salmon River. Approximately 70% of the PIT-tag codes were assigned to be diverted for transport and 30% returned to the river. The goal was to achieve a 1:1 ratio of transported vs. in-river migration. Analyses of the detection efficiencies, juvenile in-river survival, and SARs are required to design a rigorous study of sockeye salmon survival relative to hydrosystem operations. This program is scheduled to be on-going for two-three years beginning in the spring of 2009.

12.2 Cooperating and Funding Agencies

- NOAA Fisheries and Shoshone Bannock Tribes are cooperating agencies.
- Bonneville Power Administration is the funding agency for the program.

12.3 Principle Investigator or Project Supervisor and Staff

- Jeff Heindel - Conservation Hatchery Supervisor, Idaho Department of Fish and Game
- Dan Schill - Fisheries Research Manager, Idaho Department of Fish and Game
- Dan Baker - Eagle Fish Hatchery Manager, Idaho Department of Fish and Game
- Mike Peterson - Senior Research Fisheries Biologist, Idaho Department of Fish and Game

12.4 Status of Stock, Particularly the Group Affected by Project, if Different than the Stock(s) Described in Section 2

Not applicable; natural and propagated populations are identical (see Section 2).

12.5 TECHNIQUES: INCLUDE CAPTURE METHODS, DRUGS, SAMPLES COLLECTED, TAGS APPLIED

Snake River sockeye salmon captive broodstock program research staff work to assemble annual juvenile sockeye salmon out-migration and adult return data sets. Incline bar traps and screw traps are used to capture emigrating juvenile sockeye salmon. Generally, a subsample of target species captured are anesthetized (using buffered tricaine methane sulfonate) and handled. A portion of captured juveniles may be fin-clipped (for genetic analysis) or PIT-tagged (see Peterson et al. 2008 for Snake River sockeye salmon captive broodstock program research studies detail). Adult information is assembled from a variety of information sources including: dam and weir counts, coded-wire tag information, redd surveys, and spawning surveys. IDFG and cooperator staff may sample adult O. *nerka* carcasses to collect tissue samples for subsequent genetic analysis. Additionally, otoliths, scales, or fins may be collected for age analysis.

12.6 DATES OR TIME PERIOD IN WHICH RESEARCH ACTIVITY OCCURS

All smolt out-migration data collection (used to estimate abundance and survival to Lower Granite Dam) at the basin lake trap sites begins by approximately April 1st and typically runs through November 1st of each calendar year. The PSMFC PIT-Tag Information System is queried year round to retrieve juvenile PIT-tag information.

The Redfish Lake sport fishery creel data collection begins on Memorial Day weekend (at the end of May) and operates until the close of the kokanee fishery on August 7th of each year. Data analysis occurs within one month of the final creel interview and is submitted in a final NOAA Section 10 Incidental Take Permit report by January 31 of each year.

Adult sockeye salmon return to the Stanley Basin trap locations (Sawtooth Fish Hatchery and Redfish Lake Creek trap) beginning on approximately the 20th of July. The run is complete by mid to late October and the traps are removed from these waters. Collected age distribution data is analyzed immediately at the conclusion of the run and presented at the winter Cooperators meeting in January.

Mid-water trawling is conducted when the Stanley Basin lakes stratify by water temperature in the fall and when the out-migration of anadromous smolts from the lakes is complete. Trawling is typically accomplished over a three night period (one night per lake) during the new moon phase in either September or early October. Data analysis occurs immediately thereafter and genetic samples are analyzed typically within two or three months after trawling occurs. This data is submitted in a final NOAA Section 10 Incidental Take Permit report by January 31 of each year.

Predator abundance monitoring is conducted during the last week of August (visual peak counts) and the second week of September (peak redd counts). This data is reported in the yearly work progress report to the funding agency due by March 31st.

12.7 CARE AND MAINTENANCE OF LIVE FISH OR EGGS, HOLDING DURATION, TRANSPORT METHODS

Research activities that involve handling eggs or fish apply the same protocols reviewed in Section 9 above. Hatchery staff generally assists with all cooperative activities involving the handling of eggs, live fish, holding or transport.

For juvenile fish that are captured and tagged using the inclined bar traps and screw traps, all are anesthetized prior to tagging and held approximately 8-10 hours to monitor tag/handling mortality, and then released at dusk.

12.8 EXPECTED TYPE AND EFFECTS OF TAKE AND POTENTIAL FOR INJURY OR MORTALITY

Specific hatchery and research activities that address take of listed salmonids in the target areas are addressed in NOAA Section 10 Permits for the program:

- Section 10(a)(1)(A) Permit 1124
- Section 10(a)(1)(A) Permit 1454 (draft)
- Section 10(a)(1)(B) Permit 1481

12.9 LEVEL OF TAKE OF LISTED FISH: NUMBER OR RANGE OF FISH HANDLED, INJURED, OR KILLED BY SEX, AGE, OR SIZE, IF NOT ALREADY INDICATED IN SECTION 2 AND THE ATTACHED "TAKE TABLE" (TABLE 1)

See Sections 2 and 12.8.

12.10 ALTERNATIVE METHODS TO ACHIEVE PROJECT OBJECTIVES

Alternative methods to achieve research objectives have not been developed.

12.11 LIST SPECIES SIMILAR OR RELATED TO THE THREATENED SPECIES; PROVIDE NUMBER AND CAUSES OF MORTALITY RELATED TO THIS RESEARCH PROJECT

Not applicable.

12.12 INDICATE RISK AVERSION MEASURES THAT WILL BE APPLIED TO MINIMIZE THE LIKELIHOOD FOR ADVERSE ECOLOGICAL EFFECTS, INJURY, OR MORTALITY TO LISTED FISH AS A RESULT OF THE PROPOSED RESEARCH

ACTIVITIES

See Section 11.2 above.

SECTION 13. ATTACHMENTS AND CITATIONS

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SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

"I hereby certify that the information provided is complete, true and correct to the best of my knowledge and belief. I understand that the information provided in this HGMP is submitted for the purpose of receiving limits from take prohibitions specified under the Endangered Species Act of 1973 (16 U.S.C.1531-1543) and regulations promulgated thereafter for the proposed hatchery program, and that any false statement may subject me to the criminal penalties of 18 U.S.C. 1001, or penalties provided under the Endangered Species Act of 1973."

Name, Title, and Signature of Applicant:

Certified by_____________________________ Date:_____________

SECTION 15 PROGRAM EFFECTS ON OTHER (NON-ANADROMOUS SALMONID) ESA-LISTED POPULATIONS

A species list is attached and anadromous salmonid effects are addressed in Section 2.

15.1 LIST ALL ESA PERMITS OR AUTHORIZATIONS FOR ALL NON-ANADROMOUS SALMONID PROGRAMS ASSOCIATED WITH THE HATCHERY PROGRAM

ESA Section 6 Cooperative Agreement for Bull Trout Take Associated with IDFG Research

IDFG annually prepares a bull trout conservation program plan and take report that describes their management program for bull trout to meet the provisions contained in Section 6 of the ESA and to comport with the spirit of Section 10(a)1(A). This plan identifies the benefits to bull trout resulting from management and research conducted or authorized by the state, provides documentation of bull trout take conducted and authorized by IDFG and provides an estimate of take for the coming year. Each year the report is submitted to USFWS, which then makes a determination whether this program is in accordance with the ESA. The plan/report is due annually to USFWS by March 31. A summary of recent take in the Salmon River subbasin is further discussed in Section 15.3 of this HGMP.

ESA Section 7 Consultation and Biological Opinions

ESA Section 7 Consultation and Biological Opinion through the USFWS Lower Snake River Compensation Program for bull trout take associated with hatchery operations.

15.2 DESCRIPTION OF NON-ANADROMOUS SALMONID SPECIES AND HABITAT THAT MAY BE AFFECTED BY HATCHERY PROGRAM

This program releases hatchery juvenile sockeye into the Salmon River subbasin where bull trout are the only listed (threatened) non-anadromous aquatic ESA-listed species present. Bull trout life history, status and habitat use in Salmon River subbasin is summarized below.

General Species Description, Status and Habitat Requirements

Bull trout (members of the family *Salmonidae*) are a species of char native to Nevada, Oregon, Idaho, Washington, Montana, and western Canada. While bull trout occur widely across the western United States, they are patchily distributed at multiple spatial scales from river basin to local watershed and individual stream reach levels. Due to widespread declines in abundance, bull trout were initially listed as threatened in Idaho in 1998, and listed throughout their coterminous range in the United States in 1999. On January 13, 2010, the USFWS proposed to revise its 2005 designation of critical habitat for bull trout, encompassing a substantial portion of the Salmon River subbasin (5,045 stream miles are proposed as critical habitat in the Salmon River subbasin).

Throughout their range, bull trout have declined due to habitat degradation and fragmentation, blockage of migratory corridors, poor water quality, past fisheries management (such as over-harvest and bounties), and the introduction of non-native species such as brown, lake and brook trout. Range-wide, several local extinctions have been documented. Many of the remaining populations are small and isolated from each other, making them more susceptible to local extinctions. However, recent work in Idaho concluded that despite declines from historical levels, Idaho bull trout are presently widely distributed, relatively abundant, and apparently stable (High et al. 2008). High et al. (2008) concluded that over half of the Idaho bull trout population (0.64 million fish) occurred in the Salmon River Recovery Unit, although overall density was relatively low (4.4 bull trout/100 m).

Bull trout exhibit a wide variety of life history types, primarily based on general seasonal migration patterns of subadult and adult bull trout between headwater spawning and rearing streams to other habitats (usually downstream) for foraging and overwintering, including resident (residing in small headwater streams for their entire lives); fluvial (migrating to larger river systems); adfluvial (migrating to lakes or reservoirs); and anadromous (migrating to estuarine or marine waters) (Goetz et al. 2004). All of these life history strategies are present in the Salmon River subbasin, except anadromy. Fluvial and resident bull trout populations have been commonly observed throughout the current range of bull trout in the Salmon River subbasin, and adfluvial populations are present, associated with several natural lakes (USFWS 2002).

Bull trout spawning and rearing requires cold water temperatures (generally below 16°C during summer rearing), and less than about 10°C during spawning (Dunham et al. 2003). Juvenile bull trout require complex rearing habitats (Dambacher and Jones 1997, Al-Chokhachy et al. 2010). Migratory adult and subadult bull trout are highly piscivorous (Lowery et al. 2009), and migratory adults need unobstructed connectivity to diverse habitats where forage fish species are plentiful and water temperatures are relatively cool (less than about 18°C maximum) during migration (Howell et al. 2009).

Population Status and Distribution by Core Area

Bull trout are well distributed throughout most of the Salmon River Recovery Unit in 125 identified local populations located within 10 core areas (USFWS 2002). The recovery team also identified 15 potential local populations. The Upper Salmon River B-run steelhead program releases hatchery juveniles into Squaw Creek, East Fork Salmon River and Pahsimeroi River. Broodstock are collected in the same areas at trapping facilities. These activities occur primarily in two bull trout core areas, the Upper Salmon River and Pahsimeroi River core areas. Juvenile steelhead released in these core areas migrate downstream through three other Salmon River bull trout core areas, including the Middle Salmon-Panther Creek, Middle Salmon-Chamberlain River, and Little-Lower Salmon River core areas. The following information on these five core areas, and local population status and habitat use within, is summarized from the bull trout draft recovery plan (USFWS 2002) unless otherwise cited.

Upper Salmon River Core Area

Bull trout are widely distributed in the Upper Salmon River with 18 known local populations and one potential local population. The draft recovery plan estimated adult abundance to be greater than 5,000 individuals. Both resident and migratory bull trout are present in the Sawtooth Valley. The inlet of Alturas Lake has adfluvial bull trout and is one of the largest local populations in the Sawtooth Valley. Adfluvial bull trout are also known to be present in Redfish

Lake.

The bull trout 5-year status review conducted in 2006 (USFWS 2008) determined the Upper Salmon River Core Area had an unknown adult abundance level, occupied from 620-3,000 stream miles, had an unknown short-term trend with moderate/imminent threat to persistence, and a final ranking of “potential risk” to become extirpated (Table 26). More recent analysis by High et al. (2008) determined a weakly positive rate of population change before 1994, but a significantly positive change post-1994, indicating an increasing population trend post-1994 (17-year record at 25 survey sites) (Table 27). This increasing population trend was the highest of nine Core Areas analyzed in the Salmon River Recovery Unit during all periods analyzed.

Table 26. Summary table of bull trout core area rankings for population abundance, distribution, trend, threat, and final rank, Salmon River Recovery Unit.

Core Area	Population Abundance Category (individuals)	Distribution Range Rank (stream length miles)	Short-term Trend Rank	Threat Rank	Final Rank
Upper Salmon River	unknown	620-3000	Unknown	Moderate, imminent	Potential Risk
Pahsimeroi River	unknown	125-620	Unknown	Substantial, imminent	At Risk
Lemhi River	250-1000	125-620	Unknown	Substantial, imminent	At Risk
Middle Salmon River / Panther	unknown	125-620	Unknown	Moderate, imminent	At Risk
Lake Creek	50-250	25-125	Unknown	Widespread, low-severity	At Risk
Opal Lake	unknown	2.5-25	Unknown	Widespread, low-severity	Potential Risk
Middle Fork Salmon R.	unknown	620-3000	Unknown	Slightly	Low Risk
Middle Salmon River / Chamberlain	unknown	125-620	Unknown	Widespread, low-severity	Potential Risk
South Fork Salmon R.	unknown	125-620	Unknown	Moderate, imminent	At Risk
Little-Lower Salmon R.	50-250	125-620	Unknown	Substantial, imminent	High Risk

Source: USFWS (2008)

Table 27. Intrinsic rates of population change (r) with 90% confidence limits (CLs) for bull trout in the core areas of the Salmon River Recovery Unit of Idaho with available data.

Drainage or core area	Starting year	Years of record	Sites	Pre-1994 *r* Estimate	Pre-1994 *r* Lower CL	Pre-1994 *r* Upper CL	Post-1994 *r* Estimate	Post-1994 *r* Lower CL	Post-1994 *r* Upper CL	*r* for all years Estimate	*r* for all years Lower CL	*r* for all years Upper CL
Little–Lower Salmon River (S)	1985	19	34	−0.010	−0.097	0.077	0.063	−0.021	0.146	0.015	−0.016	0.045
Rapid River (W)	1973	32	1	−0.013	−0.039	0.012	0.047	−0.026	0.119	−0.001	−0.015	0.014
South Fork Salmon River (S)	1985	19	36	−0.365*	−0.670	−0.060	0.305*	0.200	0.411	0.032	−0.078	0.143
Middle Fork Salmon River (S)	1985	19	77	0.035	−0.082	0.152	−0.043	−0.131	0.046	−0.007	−0.043	0.030
Middle Salmon River–Chamberlain (S)	1985	16	10	−0.007	−0.456	0.443	0.006	−0.102	0.115	0.060	−0.017	0.138
Middle Salmon River–Panther (S)	1985	17	12	0.054	−0.195	0.303	−0.309*	−0.600	−0.018	−0.202*	−0.307	−0.096
Lemhi River (S)	1985	19	10	−0.176*	−0.335	−0.016	0.064	−0.016	0.144	−0.038	−0.089	0.014
East Fork Salmon River (W)	1984	8	1	0.003	−0.115	0.121	0.075	−0.474	0.624	0.057*	0.001	0.114
Upper Salmon River (S)	1985	17	25	0.068	−0.103	0.240	0.536*	0.312	0.759	0.557*	0.453	0.660

Source: High et al. (2008)
Note: The sampling method used in each drainage or area is shown (S = snorkeling, R = redd count). Trends in r were evaluated for the period before 1994, the period after 1994, and all years; asterisks indicate trends that were significant (i.e., confidence intervals did not include zero).

Pahsimeroi River Core Area

Bull trout in the Pahsimeroi River are found in most of the tributaries that drain the eastern, southern and southwestern portion of the core area. Local populations include the upper Pahsimeroi River, and Big, Patterson, Falls, Morse, Morgan (includes the lower Pahsimeroi River), Tater, and Ditch creeks. The creeks in the upper Pahsimeroi River were considered a population stronghold in this core area during the subbasin review process. The mainstem Pahsimeroi River serves as a migratory corridor for fish access to the mainstem Salmon River.

Adult abundance was estimated to be between 500 and 5,000 individuals in the draft recovery plan. The bull trout 5-year status review conducted in 2006 (USFWS 2008) determined the Pahsimeroi River Core Area had an unknown adult abundance level, occupied from 125 to 620 stream miles, had an unknown short-term trend and substantial/imminent threat to persistence, and a final ranking of "at risk" to become extirpated (Table 26). The Pahsimeroi River Core Area population growth rates were not analyzed by High et al. (2008).

Middle Salmon River-Panther Core Area

Bull trout are widely distributed in this core area, including 20 local populations and 2 potential local populations. Both resident and migratory populations are present. Adult abundance was estimated to be between 500 and 5,000 individuals in the draft recovery plan.

The bull trout 5-year status review conducted in 2006 (USFWS 2008) determined the Middle Salmon River-Panther Core Area had an unknown adult abundance level, occupied from 125 to 620 stream miles, had an unknown short-term trend, a moderate/imminent threat to persistence, and a final ranking of "at risk" to become extirpated (Table 26). More recent analysis by High et al. (2008) determined a weakly positive rate of population change occurred before 1994, but a significantly negative trend after 1994 (17-year record at 12 survey sites) (Table 27).

Middle Salmon River-Chamberlain Core Area

A substantial portion of the Middle Salmon River-Chamberlain Core Area is encompassed by the Frank Church and Gospel Hump Wilderness areas. Bull trout are found in nine local populations and one potential local population in this core area, and are widely distributed.

Fluvial bull trout are fairly common, and adult abundance was estimated to be between 500 and 5,000 individuals in the draft recovery plan. The bull trout 5-year status review conducted in 2006 (USFWS 2008) determined the Middle Salmon River-Chamberlain Core Area had an unknown adult abundance level, occupied from 125 to 620 stream miles, had an unknown short-term trend, widespread/low severity threat to persistence, and a final ranking of "potential risk" to become extirpated (Table 26). More recent analysis by High et al. (2008) determined a weakly negative rate of population change before 1994 and a weakly positive trend after 1994 (16-year record at 10 survey sites) (Table 27).

Little-Lower Salmon River Core Area

Local populations in this core area include the Rapid River and Slate, John Day, Boulder, Hard, Lake/Lower Salmon, and Partridge creeks. Potential local populations include Hazard, Elkhorn and French creeks. The mainstem Salmon River provides habitat for migration and adult and subadult foraging, rearing, and wintering. Resident and migratory populations are known to be present. Annual runs of fluvial bull trout in the Rapid River drainage have been monitored since 1973, and bull trout abundance data has been collected since 1992 at the Rapid River Hatchery trap. Upstream migrant spawner counts at the trap have ranged from 91 to 461 over the last 20 years (IDEQ 2006).

Adult abundance was estimated to be from 500 to 5,000 individuals in the draft recovery plan. The bull trout 5-year status review conducted in 2006 (USFWS 2008) determined the Little-Lower Salmon River Core Area had an adult abundance level of 50-250, occupied from 125 to 620 stream miles, had an unknown short-term trend, substantial/imminent threat to persistence, and a final ranking of "high risk" to become extirpated (Table 26). More recent analysis by High et al. (2008) determined a weakly negative rate of population change before 1994 and a weakly positive change after 1994 (19-year record at 34 survey sites, snorkel surveys) (Table 27). High et al. (2008) also reported that trap counts of upstream migrant fluvial bull trout in the Rapid River over 32 years of record followed these same trends (Table 27).

15.3 ANALYSIS OF EFFECTS

Direct Effects

Direct effects primarily arise through collection of Chinook salmon broodstock. However, operation of the adult trap for sockeye occurs before bull trout are captured in their upstream migration. Captures of bull trout typically start at the end of June while trap operations for steelhead cease in May.

A small percentage of bull trout sampled in a fish trap, may be injured or killed (generally less than 1%) as evidenced by the very small level of mortality reported in IDFG (2006, 2007, 2008, 2009, and 2010). This fish trapping management activity has occurred for many years in the Salmon River subbasin, apparently without hindering positive bull trout population growth rates since 1994, as evidenced by results of High et al. (2008), and are not expected to limit bull trout population growth rates into the future.

Competition is also possible between residualized juvenile sockeye and subadult bull trout. Efforts are ongoing to reduce and minimize residualism rates of hatchery sockeye. Release of juvenile hatchery sockeye also likely provides increased forage (a beneficial effect) for migratory adult and subadult bull trout, which are highly piscivorous.

Indirect Effects

Indirect effects may arise through hatchery operations such as water withdrawals, effluent discharge, routine operations and maintenance activities, non-routine operations and maintenance activities (e.g., intake excavation, construction, emergency operations, etc.). Hatchery operations are not expected to affect bull trout population productivity. These activities have occurred for many years in the Salmon River subbasin, apparently without hindering positive population growth rates since 1994, as evidenced by results of High et al. (2008), and are not expected to limit bull trout population growth in the future.

Cumulative Effects

Cumulatively, the effects of the Snake River Sockeye salmon hatchery program and associated monitoring and evaluation results in increased forage for migratory adult and subadult bull trout, possible competition and predation of bull trout by residual hatchery steelhead, and contributes knowledge on bull trout population distribution and abundance through incidental captures in broodstock collection traps and in monitoring and evaluations studies. Such knowledge can be used to evaluate bull trout population trends over time.

Take

Annual bull trout take in the form of observation, capture, handling, and bio-sampling occurs each year at various broodstock collection traps and through associated monitoring and evaluation studies. At the end of each year, bull trout take is quantified and projected for the upcoming year's operations and monitoring in a report prepared by IDFG (the Idaho Bull Trout Conservation Plan and Take Report). Take is derived from observing, or capture and handling of bull trout through a variety of survey methods, including snorkeling, redd surveys, electrofishing, hook-and-line, weir trapping, screw trapping, and seining. Direct mortality associated with hatchery program operations has not occurred Upper Salmon River sockeye traps in recent years.

15.4 ACTIONS TAKEN TO MITIGATE FOR POTENTIAL EFFECTS

Actions being taken to minimize adverse effects on bull trout include:

1. Continuing to reduce effects of releasing large numbers of juvenile sockeye at a single site by spreading the release over a number of days.

2. Continue research to improve post-release survival of sockeye to potentially reduce numbers released to meet management objectives.

3. Continue fish health practices to minimize the incidence of infectious disease agents. Follow IHOT, AFS, and PNFHPC guidelines.

4. Monitoring hatchery effluent to ensure compliance with the National Pollutant Discharge Elimination System permit.

5. Continuing Hatchery Evaluation Studies that comprehensively monitor and evaluate sockeye, also providing valuable incidental bull trout data.

6. Conducting adult trapping activities to minimize impacts to bull trout and other non-target species. Trapping provides valuable incidental bull trout data.

7. Continuing to modify broodstock collection traps to minimize bull trout mortality as necessary.

15.5 REFERENCES

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Appendix A

Table 1. Estimated listed salmonid take levels of by hatchery activity.

Listed species affected: Sockeye Salmon ESU/Population: Snake River Sockeye Salmon Activity: Captive Broodstock Program				
Location of hatchery activity: Sawtooth Basin Hatchery program operator: Jeff Heindel				
	Annual Take of Listed Fish By Life Stage (Number of Fish) i			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)		3700		
Capture, handle, tag/mark/tissue sample, and release d)		1000	667	
Removal (e.g. broodstock) e)			166	
Intentional lethal take f)		83		
Unintentional lethal take g)		Up to 100		
Other Take (specify) h)				

a. Contact with listed fish through stream surveys, carcass and mark recovery projects, or migrational delay at weirs.
b. Take associated with weir or trapping operations where listed fish are captured and transported for release.
c. Take associated with weir or trapping operations where listed fish are captured, handled and released upstream or downstream.
d. Take occurring due to tagging and/or bio-sampling of fish collected through trapping operations prior to upstream or downstream release, or through carcass recovery programs.
e. Listed fish removed from the wild and collected for use as broodstock.
f. Intentional mortality of listed fish, usually as a result of spawning as broodstock.
g. Unintentional mortality of listed fish, including loss of fish during transport or holding prior to spawning or prior to release into the wild, or, for integrated programs, mortalities during incubation and rearing.
h. Other takes not identified above as a category.
i. All numbers are variable on annual returns to the Sawtooth Basin. Take listed is based on 2009 returns.

Instructions:
1. An entry for a fish to be taken should be in the take category that describes the greatest impact.
2. Each take to be entered in the table should be in one take category only (there should not be more than one entry for the same sampling event).
3. If an individual fish is to be taken more than once on separate occasions, each take must be entered in the take table.

ATTACHMENT 1. DEFINITION OF TERMS REFERENCED IN THE HGMP TEMPLATE

Augmentation - The use of artificial production to increase harvestable numbers of fish in areas where the natural freshwater production capacity is limited, but the capacity of other salmonid habitat areas will support increased production. Also referred to as “fishery enhancement”.

Critical population threshold - An abundance level for an independent Pacific salmonid population below which: depensatory processes are likely to reduce it below replacement; short-term effects of inbreeding depression or loss of rare alleles cannot be avoided; and productivity variation due to demographic stochasticity becomes a substantial source of risk.

Direct take - The intentional take of a listed species. Direct takes may be authorized under the ESA for the purpose of propagation to enhance the species or research.

Evolutionarily Significant Unit (ESU) - NMFS definition of a distinct population segment (the smallest biological unit that will be considered to be a species under the Endangered Species Act). A population will be/is considered to be an ESU if 1) it is substantially reproductively isolated from other conspecific population units, and 2) it represents an important component in the evolutionary legacy of the species.

Harvest project - Projects designed for the production of fish that are primarily intended to be caught in fisheries.

Hatchery fish - A fish that has spent some part of its life-cycle in an artificial environment and whose parents were spawned in an artificial environment.

Hatchery population - A population that depends on spawning, incubation, hatching or rearing in a hatchery or other artificial propagation facility.

Hazard - Hazards are undesirable events that a hatchery program is attempting to avoid.

Incidental take - The unintentional take of a listed species as a result of the conduct of an otherwise lawful activity.

Integrated harvest program - Project in which artificially propagated fish produced primarily for harvest are intended to spawn in the wild and are fully reproductively integrated with a particular natural population.

Integrated recovery program - An artificial propagation project primarily designed to aid in the recovery, conservation or reintroduction of particular natural population(s), and fish produced are intended to spawn in the wild or be genetically integrated with the targeted natural population(s). Sometimes referred to as “supplementation”.

Isolated harvest program - Project in which artificially propagated fish produced primarily for harvest are not intended to spawn in the wild or be genetically integrated with any specific natural population.

Isolated recovery program - An artificial propagation project primarily designed to aid in the recovery, conservation or reintroduction of particular natural population(s), but the fish produced are not intended to spawn in the wild or be genetically integrated with any specific natural population.

Mitigation - The use of artificial propagation to produce fish to replace or compensate for loss of fish or fish production capacity resulting from the permanent blockage or alteration of habitat by human activities.

Natural fish - A fish that has spent essentially all of its life-cycle in the wild and whose parents spawned in the wild. Synonymous with natural origin recruit (NOR).

Natural origin recruit (NOR) - See natural fish.

Natural population - A population that is sustained by natural spawning and rearing in the natural habitat.

Population - A group of historically interbreeding salmonids of the same species of hatchery, natural, or unknown parentage that have developed a unique gene pool, that breed in approximately the same place and time, and whose progeny tend to return and breed in approximately the same place and time. They often, but not always, can be separated from another population by genotypic or demographic characteristics. This term is synonymous with stock.

Preservation (Conservation) - The use of artificial propagation to conserve genetic resources of a fish population at extremely low population abundance, and potential for extinction, using methods such as captive propagation and cryopreservation.

Research - The study of critical uncertainties regarding the application and effectiveness of artificial propagation for augmentation, mitigation, conservation, and restoration purposes, and identification of how to effectively use artificial propagation to address those purposes.

Restoration - The use of artificial propagation to hasten rebuilding or reintroduction of a fish population to harvestable levels in areas where there is low, or no natural production, but potential for increase or reintroduction exists because sufficient habitat for sustainable natural production exists or is being restored.

Stock - (see “Population”).

Take - To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.

Viable population threshold - An abundance level above which an independent Pacific salmonid population has a negligible risk of extinction due to threats from demographic variation (random or directional), local environmental variation, and genetic diversity changes (random or directional) over a 100-year time frame.

ATTACHMENT 2. AGE CLASS DESIGNATIONS BY FISH SIZE AND SPECIES FOR SALMONIDS RELEASED FROM HATCHERY FACILITIES.

(generally from Washington Department of Fish and Wildlife, November, 1999).

Species	Age Class	Number of fish/pound	Size Criteria (grams/fish)
Chinook	Yearling	<=20	>=23
	Fingerling (Zero)	20 to 150	3 to <23
	Fry	>150 to 900	0.5 to <3
	Unfed Fry	>900	<0.5
Coho	Yearling [1]	<20	>=23
	Fingerling	>20 to 200	2.3 to <23
	Fry	>200 to 900	0.5 to <2.3
	Unfed Fry	>900	<0.5
Chum	Fed Fry	<=1000	>=0.45
	Unfed Fry	>1000	<0.45
Sockeye	Yearling [2]	<=20	>=23
	Fingerling	>20 to 800	0.6 to <23
	Fall Releases	<150	>2.9
	Fry	>800 to 1500	0.3 to <0.6
	Unfed Fry	>1500	<0.3
Pink	Fed Fry	<=1000	>=0.45
	Unfed Fry	>1000	<0.45
Steelhead	Smolt	<=10	>=45
	Yearling	<=20	>=23
	Fingerling	>20 to 150	3 to <23
	Fry	>150	<3
Cutthroat Trout	Yearling	<=20	>=23
	Fingerling	>20 to 150	3 to <23
	Fry	>150	<3
Trout	Legals	<=10	>=45
	Fry	>10	<45

[1] Coho yearlings defined as meeting size criteria and 1 year old at release, and released prior to June 1st.
[2] Sockeye yearlings defined as meeting size criteria and 1 year old.

Appendix B

IDFG Draft Snake River Sockeye Salmon Recovery Strategy

APPENDIX B
IDAHO DEPARTMENT OF FISH AND GAME
DRAFT SNAKE RIVER SOCKEYE SALMON RECOVERY STRATEGY
APRIL 13, 2009

The following is a draft overview of the Idaho Department of Fish and Game's (Department) management strategy for Snake River sockeye salmon. This strategy incorporates the use state-of-the-art hatchery facilities, captive broodstock technology, cutting-edge genetic support and a comprehensive monitoring and evaluation plan to maintain the resource and to continue rebuilding numbers of fish in the wild. This document is not intended to serve as the Department's final management plan for Snake River sockeye salmon; but to assist NOAA Fisheries in their effort to develop recovery plan language for the ESU. Included in this document is a list of anticipated infrastructure improvements considered essential to maximize program success.

Precipitous declines of Snake River sockeye salmon led to their Federal listing as endangered in 1991 (56 FR 58619). In that same year, the Department initiated a captive broodstock program. The program's near-term goal is to slow the loss of critical population genetic diversity and heterozygosity and to prevent species extinction. The ultimate program goal is to reestablish Snake River sockeye in the wild, de-list the population, and provide for sport and treaty harvest opportunities.

A critical limiting factor for the Snake River sockeye captive broodstock program is the maintenance of population genetic diversity and heterozygosity. The Department is addressing this need through a coordinated effort involving staff at the Eagle Fish Hatchery and the Eagle Genetics Lab. Annually, individual-based genotype information is generated to guide the development of spawning plans. Spawning plans are designed to minimize the crossing of closely related individuals and to slow the loss of critical genetic information. Additionally, every effort is made to spawn all sockeye salmon that mature in the captive broodstock program and to avoid over- and under-representing specific individuals in the process. Broodstock retained to perpetuate the program are carefully selected to equalize family representation. Annually, the Department produces new broodstock cohorts to be reared at the Eagle Fish Hatchery in Idaho and at the NOAA facilities in Washington State. It is the Department's recommendation that the NOAA recovery plan stress the importance of the captive broodstock component and understand that it continues to serve a critical role in the overall recovery effort.

It is well documented that supportive breeding programs can lead to: 1) a reduction of the genetically effective population size, 2) elevated rates of inbreeding, and 3) loss of genetic diversity and heterozygosity in captive populations of species at some level of genetic, environmental and/or demographic risk (Ryman and Laikre 1991; Fleming 1994; Ryman 1994; Nomura 1999; Ryman et al. 1999; Wang and Ryman 2001; Ford 2002). Additionally, the loss of genetic diversity coupled with an increasing risk of inbreeding has been correlated with a reduction in reproductive fitness (Bryant and Reed 1999; Reed and Frankham 2003; Reed 2005).

By implementing breeding strategies that manage allelic diversity and the contribution of parents to successive generations, the rate of loss of critical population genetic diversity can be reduced (Fernández et al. 2004). The Snake River sockeye salmon captive broodstock program has made every effort to implement state-of-the art fish husbandry practices as well as advanced breeding plans that adhere to the principles described by Fernández et al. (2004). Despite these efforts, it is inevitable that some loss of genetic information will occur annually – just due to genetic drift alone. Additionally, because captive populations are maintained under fairly uniform environmental conditions, they experience relaxed natural as well as sexual selection pressure (Lynch and O'Hely 2001; Berejikian et al. 2004). Adaptation to the captive environment can alter a variety of behavioral traits and fitness correlates such as reproductive success, fecundity, growth rate, and survival (Mousseau and Roff 1987; Sheffer et al. 1997; Bryant and Reed 1999). Some of these traits, such as fecundity, breeding time, and general reproductive success have been shown to be heritable (Smoker et al. 1998; Quinn et al. 2000; Kruuk et al. 2000; Quinn et al. 2002; Seamons et al. 2004; Dickerson et al. 2005).

A second limiting factor for the Snake River sockeye salmon recovery program is the number of anadromous adults that return to collection sites in the Sawtooth Valley. Limited numbers of adult returns impacts the program's ability to take advantage of local adaptation and to improve the fitness of the composite population. To increase the number of adults that return to the program, the Department has developed a phased plan that includes: 1) increased smolt production, 2) increased use of anadromous adults in captive spawning designs as well as in natural spawning events in the habitat, and ultimately, 3) the integration of natural- and hatchery-origin adults in the hatchery as well as in the habitat. More detail on each phase is provided below:

PHASE I: INCREASED SMOLT PRODUCTION

Currently, insufficient incubation and juvenile rearing space is available to meet the project's long-term goal. Juvenile sockeye salmon are reared at the IDFG Sawtooth Fish Hatchery (a Lower Snake River Compensation Plan facility) and at the Oregon Department of Fish and Wildlife's Oxbow Fish Hatchery (a Mitchell Act facility). As both facilities are focused on higher priority mitigation mandates, limited rearing space is available for sockeye salmon. As such, the Department is currently pursuing the acquisition of suitable hatchery space to meet this objective. Consistent with the FCRPS Biological Opinion and the Idaho Fish Accord, the new Idaho facility would have the capacity to produce between 500,000 and 1 million full-term smolts annually for release to locations in the Sawtooth Valley. Focusing on a smolt release strategy maximizes the potential to return anadromous adults.

The interim abundance guidelines established by NOAA suggest that 1,000 naturally-produced adults are needed to return to Redfish Lake and 500 adults to Pettit and Alturas lakes over a two-generation period to initiate any policy discussions related to ESA-listing status. Little information is available to guide the development of minimum effective population size targets for this ESU. However, it is probably safe to assume, that the "50/500" rule described by Franklin (1980), Soulé (1980), and Nelson and Soulé (1987) should be considered, at a minimum, rough guidance for the development of adult return criteria. Under their rule, an effective population size of 50 or less is not considered genetically viable in the long-term and is vulnerable to the effects of inbreeding depression while an effective population size of 500 or greater would allow the population to retain adaptive genetic variation over time (evolutionary potential).

The Department anticipates that releasing up to 1 million smolts could consistently return approximately 5,000 anadromous adults annually. Increased eggs for the expanded smolt program will be produced at the Department's newly expanded Eagle Fish Hatchery broodstock station and possibly from increased production from NOAA facilities in Washington State.

PHASE II: INCREASED USE OF ANADROMOUS ADULTS IN CAPTIVE AND NATURAL SPAWNING EVENTS

The program's mid-term hatchery goal is to function as a conventional supplementation program, relying on genetically diverse, rack returns of anadromous adults to meet in-hatchery captive broodstock as well as pre-spawn adult out-planting needs. The Department's proposal to expand the production of this program to return and utilize more anadromous adults in breeding plans and for volitional spawning in the wild is consistent with the guiding principles discussed above.

Anadromous, adult sockeye salmon have been exposed to considerable natural selection pressure. If incorporated in hatchery spawning designs, benefits associated with the heritability of fitness correlates such as fecundity and breeding success should be passed on to the population. In fact, adaptation to the captive environment and associated fitness loss can be ameliorated through immigration from wild (or natural in our case) contributors through equalization of genetic contributions among families or founding lineages (Bryant and Reed 1999). If released to spawn volitionally, adult sockeye salmon (both full-term hatchery and anadromous) experience the relatively intense selection processes associated with pairing and breeding. Appropriately, positive fitness benefits may be passed on to the resulting natural population.

The current program restricts the use of pre-spawn anadromous adults to Redfish Lake only; the expansion of pre-spawn adult releases to either Pettit or Alturas lakes in the near-term presents an unacceptable level of risk to juvenile sockeye at the Sawtooth Fish Hatchery. Current rearing strategies include the culture of up to 100,000 full-term sockeye salmon smolts at the Department's Sawtooth facility. The final 9 months (September through May) of smolt culture at Sawtooth involves the rearing of fish on surface water from the Salmon River. The Sawtooth intake structure for the Salmon River is located downstream of both Pettit and Alturas lakes; the horizontal (fish-to-fish) transmission of bacterial and viral pathogens from anadromous sockeye spawning in Pettit/Alturas poses an extreme risk to juvenile sockeye that are cultured downstream of these key Basin lakes. While the Department ultimately favors the release of pre-spawn anadromous adults to both Pettit and Alturas lakes (and/or natural escapement of adults above the Sawtooth adult weir on the main Salmon River), we believe that the timing of this release strategy must coincide with the full transfer of the smolt program from the Sawtooth facility to the Department's new smolt rearing facility (Springfield Fish Hatchery).

PHASE III: DEVELOP AN INTEGRATED APPROACH TO MANAGING THE COMPOSITE POPULATION

The final phase of the draft program expansion plan takes advantage of local adaptation to increase program success. As anadromous adult returns increase to the point where consistent numbers are available to meet pre-spawn adult release objectives to the habitat (Phase II), it follows that increasing numbers of natural-origin adults (produced from in-lake spawning events) will return to collection sites in the Sawtooth Valley. As discussed above, benefits associated with natural selection as well as local adaptation are expected to increase the productivity of this component of the population (e.g., adult-to-adult survival). As sufficient numbers of natural-origin adults return, a sliding management scale will be developed to guide how natural- and hatchery-origin adults are used in the hatchery as well as in the wild. In other words, an integrated approach to manage both components of the composite population will be developed. The management plan will include a minimum escapement target for natural-origin adults (e.g., that proportion allowed to spawn volitionally in the habitat), the proportion of 1st generation integrated adults allowed to spawn with natural-origin adults in the habitat, and the proportion of natural-origin adults brought into the hatchery to spawn with 1st generation integrated adults. Spawn crosses consisting of hatchery-origin x hatchery-origin adults will be minimized when possible.

Integrated broodstock and escapement management plans must be driven by the natural population. In order for the benefits associated with local adaptation and increased fitness of natural-origin adults to influence the composite population, gene flow must be dominated by the natural-origin component (e.g., more natural-origin adults incorporated in the hatchery broodstock than hatchery-origin adults released to the habitat to spawn). If implemented, theory suggests that survival of the composite population will increase over time as adults become better adapted to the habitat as opposed to the hatchery. If the release of 500,000 to 1 million hatchery-origin smolts is expected to return approximately 5,000 hatchery-origin anadromous adults, adult returns from a fully integrated program are expected to be even greater (over time as local adaptation increases).

INFRASTRUCTURE NEEDS

As program expansion unfolds, some existing facilities will need to be modified and new facilities developed to accommodate increased juvenile production as well as adult returns. For example:

1. There is an immediate need to modify adult trapping and holding facilities on Redfish Lake Creek and on the Salmon River at the Sawtooth Fish Hatchery.

    a. Redfish Lake Creek. The present structure was constructed in the 1950's and functions as a juvenile out-migrant trap as well as an adult trap. Since the inception of the current recovery program in 1991, major repairs have been required to keep the facility operational. Facility needs include:

        i. A structural inspection of the existing facility with some level of new construction anticipated to meet the needs of the growing program. At a minimum, new structural work, new weir panels, and new adult trapping components are needed.

ii. Adult holding (other than the trap box associated with the weir) space is needed to accommodate expected numbers of returning adults. This could include temporary, on-site tanks or in-lake net pens.

iii. Electrical service to the site is needed to improve options associated with trapping and holding sockeye salmon. Improved PIT tag detection equipment (e.g., plate PIT tag detector) would improve the collection of emigration and immigration information and facilitate better life history, survival, and productivity data development for the ESU.

iv. Temporary living quarters are needed to increase program security and to isolate the work environment from the sleeping environment.

b. Sawtooth Fish Hatchery. The present fish hatchery was built in the mid 1980s as a mitigation hatchery for Chinook salmon and summer steelhead. The hatchery includes a weir on the Salmon River, a fish ladder, and adult holding ponds.

i. The design of the current fish ladder (and attraction water flow) as well as the presence of large numbers of Chinook salmon deters sockeye salmon from entering the fish ladder and adult trap. An engineering analysis of existing facilities is needed. Weir and ladder modifications are likely needed to address limiting factors.

ii. Adult holding, independent from that used to hold Chinook salmon, needs to be developed. This could include on-site temporary or permanent ponds or containers supplied with pathogen-free well water (not currently available), or chilled river water for short-term holding (not currently available).

iii. Adult "work-up" area needs to be expanded to accommodate sockeye.

2. New marking and tagging plans will need to be developed that will require increased fin clipping and likely increased coded wire tagging and PIT tagging. Funds will need to be identified to modify existing infrastructure or to develop new capabilities to meet this need.

3. New fish transportation capability will need to be developed to move up to 1 million smolts to release locations in the Sawtooth Valley. Up to two weeks of time could be needed to move smolts to release locations (at four trips per day). Funds will need to be identified to modify existing infrastructure or to develop new capabilities to meet this need.

GENERAL RECOMMENDATIONS

1. The Department urges NOAA to work with the Northwest Power and Conservation Council and the Bonneville Power Administration to maintain the hatchery conservation research program managed by NOAA from their Manchester, WA facility (BPA project # 199305600). A portion of the project should focus on answering sockeye broodstock questions such as – synchronizing maturation timing with and without the use of gonadotropin-releasing hormones, determining ideal adult size, improving fertilization success and egg survival to the eyed-stage of development, and - - important - - determining how to best incorporate anadromous adults into the captive broodstock spawning program as the program transitions to Phase II.

2. The Department urges NOAA to consider providing collaborative genetics support for the Snake River sockeye salmon captive broodstock program through the Conservation Biology division of the Science Center. Support could include analytical assistance, interpretation of results, and management recommendations.

3. The Department urges NOAA to work with cooperators to address logistical issues that may prevent implementing an adult sockeye salmon trap and transport plan from Lower Granite Dam to holding facilities at Eagle Fish Hatchery or to release locations in the Sawtooth Valley.

4. The Department generally supports the recommendations of the Columbia River Hatchery Scientific Review Group to:

   a. Focus on a smolt reintroduction strategy (500,000 to 1 million released annually)

   b. Transport, if necessary, adults from Lower Granite to Stanley

   c. Be prepared to discuss the logistics, pros, and cons of a downstream production element (eliminates the majority of migration mortality for both juveniles and adults)

5. The Department supports continuing a spread-the-risk approach to reintroduction. This includes maintain the existing egg box program in Pettit Lake, maintaining presmolt programs in up to three lakes, and emphasizing the expanded smolt program described above. The existing adult release program (hatchery-origin adults released to the habitat to spawn volitionally) should be maintained. As the program transitions to relying more on anadromous adults to meet broodstock as well as adult release needs, the captive component (maintained more as a safety net in the future than as the primary spawning source for broodstock renewal and production releases) will be released to lakes to spawn as opposed to spawned in the hatchery.

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Appendix B

Columbia Basin Fish Accords - Memorandum of Agreement between the State of Idaho and FCRPS Action Agencies

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2008 Columbia Basin Fish Accords
Memorandum of Agreement between the
State of Idaho and FCRPS Action Agencies

IDAHO-ACTION AGENCY MOA

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MEMORANDUM OF AGREEMENT BETWEEN THE STATE OF IDAHO, THE BONNEVILLE POWER ADMINISTRATION, THE U.S. ARMY CORPS OF ENGINEERS, AND THE U.S. BUREAU OF RECLAMATION

I. INTRODUCTION

The Bonneville Power Administration ("BPA"), the U.S. Army Corps of Engineers ("Corps") and the U.S. Bureau of Reclamation ("Reclamation") (collectively, "Action Agencies") and the State of Idaho ("Idaho" or "State") have developed this Memorandum of Agreement ("Agreement" or "MOA") through good faith negotiations to address for the term of the Agreement issues associated with the direct and indirect effects of construction, inundation, operation and maintenance of the Federal Columbia River Power System ("FRCPS")[1] and Reclamation's Upper Snake River ("Upper Snake") Projects,[2] on the fish and wildlife resources of the Columbia River Basin. The Action Agencies and Idaho intend to provide for a long-term agreement that provides benefits to all the Parties. Specific reasons for this Agreement include the following:

- To address legal mandates for the FCRPS and Upper Snake Projects under the Endangered Species Act ("ESA"), the Northwest Power Act ("NPA"), and the Clean Water Act ("CWA").
- To address the Parties' mutual concerns for certainty and stability in the funding and implementation of projects for the benefit of fish and wildlife affected by the FCRPS and Upper Snake Projects, affirming and adding to the actions proposed in the draft FCRPS and Upper Snake Biological Opinions ("BiOps"); and
- To foster a cooperative and partnership-like relationship in implementation of the mutual commitments in this Agreement

II. HYDRO COMMITMENTS

A. Hydro Performance

A.1. Performance Standards, Targets, and Metrics:

Idaho concurs in use of the hydro performance standards, targets, and metrics as described in the Main Report, Section 2.1.2.2 of the Action Agencies' August 2007

[1] For purposes of this Agreement, the FCRPS comprises 14 Federal multipurpose hydropower projects. The 12 projects operated and maintained by the Corps are: Bonneville, the Dalles, John Day, McNary, Chief Joseph, Albeni Falls, Libby, Ice Harbor, Lower Monumental, Little Goose, Lower Granite, and Dworshak dams. Reclamation operates and maintains the following FCRPS projects: Hungry Horse Project and Columbia Basin Project, which includes Grand Coulee Dam.

[2] For purposes of this Agreement, the Upper Snake River Projects (Upper Snake) are Minidoka, Palisades, Michaud Flats, Ririe, Little Wood River, Boise, Lucky Peak, Mann Creek, Owyhee, Vale, Burnt River and Baker.

FCRPS Biological Assessment (FCRPS BA)(pages 2-3 through 2-6) and the draft FCRPS BiOp at RPA 51 (pages 63-64 of 85). Idaho and its representatives may recommend to the Action Agencies actions that may exceed performance standards, which will be considered and may be implemented at the discretion of the Action Agencies.

A.2 Performance and Adaptive Management:

The Parties agree that the BiOps will employ an adaptive management approach, including reporting and diagnosis, as described in Section 2.1 of the Action Agencies' FCRPS BA. The Parties agree that if biological or project performance expectations as described in the FCRPS BA are not being met over time as anticipated, diagnosis will be done to identify causes, and remedies will be developed to meet the established performance standard. The performance standard for species or the federal projects will not be lowered during the terms of the BiOps (although as provided in the FCRPS BA, tradeoffs among Snake River and lower Columbia River federal dams are allowed). The Parties recognize that new biological information will be available during the term of this Agreement that will inform the methods and assumptions used to analyze the effects of hydro operations on fish species covered by this Agreement. The Parties will work together to seek agreement on methods and assumptions for such analyses building on analyses performed in development of the FCRPS BiOp as warranted.

As described in the draft FCRPS BiOp, a comprehensive review will be completed in June 2012 and June 2015 that includes a review of the state of implementation of all actions planned or anticipated in the FCRPS and Upper Snake BiOps and a review of the status and performance of each ESU addressed by those BiOps. The Parties agree that they will jointly discuss the development, analyses and recommendations related to these comprehensive evaluations and, in the event performance is not on track, to discuss options for corrective action.

A.3. Research, Monitoring, and Evaluation.

Maintaining and improving research, monitoring, and evaluation programs is critical to informed decision making on population status assessments and improving management action effectiveness. The Parties agree that the program of research, monitoring, and evaluation provided in the draft FCRPS and Upper Snake BiOps and this Agreement provide a comprehensive RM&E program that addresses critical uncertainties. The Action Agencies will implement status and effectiveness research, monitoring and evaluation sufficient to robustly track survival improvements and facilitate rebuilding actions accomplished, in part, through projects and programs identified in the FCRPS BA and the draft BiOp. The Parties further agree that the Action Agency effort should be coordinated with implementation partners including other fishery managers.

B. Spill/Transport

The Parties agree that the spill and fish transportation measures proposed in the draft BiOps, subject to adaptive management as provided in the FCRPS BA, satisfy ESA and

NPA requirements with respect to salmon and steelhead affected by the FCRPS and Upper Snake Projects.

C. Dam Breaching

Idaho supports the adequacy of the combined package of the BiOps and this Agreement, and therefore agrees that breaching some or all of the Snake River FCRPS dams is not necessary to satisfy the ESA, NPA or CWA.

D. Flow Actions

The Parties agree to the flow and water management actions in the draft FCRPS and Upper Snake BiOps and further recognize the need for such actions to be consistent with the Snake River Water Rights Act of 2004, Pub. L. No. 108-447, Div. J, Tit. X, 118 Stat. 2809, 3431. In particular, concerning the relationship between the FCRPS BiOp and the Council's Fish and Wildlife Program and Mainstem Amendments with respect to Hungry Horse and Libby Dams, the Parties support implementing the Water Management strategies for *Summer reservoir operations at Hungry Horse and Libby, Grand Coulee and Dworshak Dams* contained in the Council's Mainstem Amendments to the Columbia River Basin Fish and Wildlife Program as to such Montana facilities.

E. Emergency Operations for Unlisted Fish

The Action Agencies agree to take reasonable actions to aid non-listed fish during brief periods of time due to unexpected equipment failures or other conditions and when significant detrimental biological effects are demonstrated. Where there is a conflict in such operations, operations for ESA-listed fish will take priority.

III. HABITAT AND HATCHERY COMMITMENTS

A. BPA Funding for Habitat

A.1 General Principles:

- Habitat projects funded under this Agreement are linked to biological benefits based on limiting factors for ESA-listed fish. See Attachment B.
- Projects funded under this Agreement are consistent with recovery plans and subbasin plans now included in the Council's Program. More specific linkages will be documented as a function of the BPA contracting process.
- Projects may be modified by mutual agreement over time based on biological priorities, feasibility, science review comments, or accountability for results.

A.2 Types of Projects

BPA is committing to funding a suite of projects and activities that are summarized in Attachment A. The projects or actions are all designed to address ESA-listed salmon and steelhead, in support of the draft FCRPS BiOp and Council program implementation in Idaho.

B. Funding for Hatchery Actions

B.1. General Principles:

- BPA's funding will be in addition to and not replace funding for hatcheries provided by other entities, including but not limited to funding provided by Congress pursuant to the Mitchell Act,
- If the hatchery action identified in Attachment A is not able to be implemented as originally proposed but the need for the hatchery to meet FCRPS BiOp commitments remain, BPA and Idaho will seek a replacement in accordance with the principles in Section III.E below. Otherwise, if the hatchery action identified in Attachment A is not able to be implemented, the Action Agencies are not obligated to fund a replacement or alternative project. Unused hatchery funds may be shifted to non-hatchery projects only upon the Parties' mutual agreement.

B.2. Expense and Capital Hatchery Actions:

BPA will make available funding for a sockeye conservation hatchery (new facility construction and/or expansions of existing facilities), as described in Attachment A. Most of this funding is anticipated to qualify as capital funding. The remaining amount is anticipated to be expense funding to provide for planning expenses or other non-capital activities associated with hatchery design, construction, and implementation. Starting with the FY 2010 rate period, BPA will collaborate with Idaho to develop a capital spending plan in advance of each new rate period that arises during the Agreement, so as to ensure that adequate rate period capital budgets are available for funding the capital actions in this Agreement.

C. General Provisions For All Projects

C.1. All projects funded pursuant to this Agreement shall:

- Be consistent with the Council's Program (including sub-basin plans), as amended, otherwise compliant with the NPA's science and other review processes; applicable ESA recovery plans; and applicable data management protocols adopted by the Action Agencies.
- For BPA funded commitments, be consistent with BPA's then applicable policies, including but not limited to BPA's *in lieu* policy and BPA's capital policy.
- For BPA funded commitments, report results annually (including ongoing agreed upon monitoring and evaluation) via PISCES and/or other appropriate databases.
- Remain in substantive compliance with any applicable project contract terms.

C.2. In addition, for non-hatchery projects identified as providing benefits to listed ESA fish, Idaho shall:

- provide estimated habitat quality improvement and survival benefits from the project to a population or populations of listed salmon and steelhead based on key limiting factors;
- identify these benefits based on expert determination; and
- support and defend these estimates of habitat improvement and survival benefits with scientific, policy, and legal arguments.

C.3. In addition, for hatchery projects, Idaho shall, prior to capital funding:

- Identify the biological benefits associated with a hatchery project based on expert determination and will support and defend these estimates of biological benefits;
- Obtain a NOAA determination that the hatchery project will not impede and where possible will contribute to recovery.
- Secure or assist in securing all necessary permits for hatchery construction and operation.

C.4. The Parties will coordinate their RM&E projects with each other and with regional RM&E processes (particularly those needed to ensure consistency with the FCRPS BiOp RM&E framework), as appropriate and agreed to among the Parties.

C.5. For actions on federal lands, Idaho will consult with the federal land managers and obtain necessary permits and approvals.

D. Council and ISRP Review

D.1. As described in Section III.C.1, above, all projects funded by BPA pursuant to this Agreement must be consistent with the Council's Program and follow the NPA's science and other review processes. The Parties agree that, subject to Section III.C.1, BPA funding commitments in this Agreement and the associated projects to be implemented by Idaho are consistent with the Council's Program.

D.2. The Parties recognize that the Council's Program is a maturing program, which through several decades of implementation has established a continuing framework for mitigating the impacts of hydroelectric development in the Columbia River Basin. The Parties acknowledge that nothing in this Agreement precludes any Party from making recommendations to the Council about modifications to the Council or ISRP review processes to facilitate project implementation under this Agreement or generally.

D.3. The Parties further acknowledge Idaho's desire to not include ongoing projects in this Agreement, with the exception of those ongoing projects contained in Attachment A that are being expanded "Ongoing projects" means projects proposed by Idaho, recommended by the Council, and funded by BPA during the FY 07-09 period pursuant to BPA's FY 07-09 programmatic fish and wildlife decisions.[3] The Action Agencies agree that this Agreement does not preclude Idaho from seeking funds to continue such ongoing projects or for new projects through the Council's Program and that all requests for such funds will be considered by BPA in accordance with the NPA. Requests for such funds shall be not be predicated, or otherwise justified, in whole or part on grounds inconsistent with the forbearance and adequacy commitments in Section IV.A and B. As a result, the Parties acknowledge that Idaho may continue to seek funding for ongoing or new projects from BPA pursuant to the NPA for habitat, hatchery, and research, monitoring and evaluation (RM&E) activities to protect, mitigate, and enhance resident fish and terrestrial life inside and outside the anadromous zone in Idaho. The Parties recognize that any questions over the applicability of this Agreement to projects concerned with resident fish in the anadromous zone, to the extent that a project may affect anadromous fish, will be resolved in accordance with Section IV.F. Idaho also may continue to seek funding for ongoing or new projects from BPA in addition to funding provided pursuant to this Agreement for habitat, hatchery, or RM&E activities to protect, mitigate, and enhance anadromous fish in the anadromous zone, and BPA shall comply with applicable NPA requirements in determining whether to fund such requests; provided that, as provided in the forbearance and adequacy provisions in Section IV.A and B, any such funding determinations shall not be subject to judicial or other challenge.

E. Replacement Projects and Adaptive Management

E.1. General Principles:

- This section does not apply to hatchery projects unless, as described above, the original proposed hatchery action is not able to be implemented but the need for hatchery to meet FCRPS BiOp commitments remains.
- The Parties agree that a project identified in this Agreement may not ultimately be implemented or completed due to a variety of possible factors, including but not limited to:
    - Problems arising during regulatory compliance (e.g., ESA consultation, NEPA, NHPA review, CWA permit compliance, etc);
    - The project does not meet BPA's in lieu policy or does not meet BPA's capital policy;
    - New information regarding the biological benefits of the project (e.g., new information indicating a different implementation action is of higher priority, or monitoring or evaluation indicates the project is not producing its anticipated benefits);
    - Changed circumstances (e.g., completion of the original project or inability to implement the project due to environmental conditions); or
    - Substantive non-compliance with the implementing contract.

[3] The ongoing projects are: BPA Project Nos. 198806500, 198909800, 199005500, 199107200, 199107300, 199202603, 199206100 , 199206103, 199303501, 199401500, 199404700, 199505700, 199505701, 199608600, 199700100, 199800200, 200002800, 200700300, 200717000, 200733200, 200739400, 200739900, 200740200, 200740300, and 200799000.

- Should a project not be implemented due to one or more of the above factors, the Action Agency and Idaho will promptly negotiate a replacement project.

E.2. Replacement Projects:

- A replacement project should be the same or similar to the one it replaces in terms of target species, limiting factor, mitigation approach, geographic area and/or subbasin and biological benefits.
- A replacement project will not require additional Council or ISRP review if the original project has been reviewed.
- A replacement project should have the same or similar planning budget as the one it replaces (less any expenditures made for the original project). Such budget must address carry-forward funding whose amount and calculation will be subject to the Parties' mutual agreement.

E.3. Adaptive Management

In addition to project-specific adaptation described above, the Parties may mutually agree to adaptively manage this shared implementation portfolio on a more programmatic scale based on new information or changed circumstances.

F. Inflation, Ramp Up, Planning v. Actuals, Carry-over:

F.1. Inflation.

Beginning in fiscal year (FY) 2010, BPA will provide an annual inflation adjustment of 2.5 percent.

F.2. Treatment of Ramp-up of new/expanded work:

In recognition of the need to "ramp up" work (timing of Agreement execution, contracting, permitting, etc), the Parties agree that average BPA spending for the new/expanded projects in fiscal year 2008 is expected to be approximately one-third of the average planning level shown for the project in Attachment A; and for fiscal year 2009, it is expected to be up to 75 percent of the average planning level shown for the project in Attachment A, with full planning levels expected for the projects in Attachment A starting in fiscal year 2010.

F.3. Assumptions regarding Planning versus Actuals

Historically, the long-term average difference between BPA's planned expenditures for implementing the expense component of the Power Council's Fish and Wildlife Program, and actual spending (what BPA is invoiced and pays under the individual contracts), has been about seven percent, with the actual spending averaging 93 percent of planned spending. While BPA will plan for spending up to 100 percent of the funding commitments described in this Agreement, nevertheless, due to a variety of factors, BPA's actual expenditures may be less. As a result, the Parties agree that provided BPA's actual spending for the totality of project commitments in this Agreement averages 93 percent of the planning amount annually, BPA is in compliance with its funding commitments. If BPA is not meeting the 93 percent average annually due to circumstances beyond the Parties' control, BPA will not be in violation of this Agreement, but the Parties will meet to discuss possible actions to remove the impediments to achieving 93 percent. The Parties also agree that, for the reasons given above regarding ramp up, new projects and projects expansions during their FY08 and FY09 ramp up phase will be excluded from this calculation.

F.4. Unspent funds, and pre-scheduling/rescheduling.
Annual project budgets may fluctuate plus or minus 20 percent in relation to the planning budgets for each project, to allow for shifts in work between years (within the scope of the project overall), if work will take longer to perform for reasons beyond the sponsors' control (reschedule), or can potentially be moved to an earlier time (preschedule). Fluctuations within an overall project's scope of work, but outside of the 20 percent band, can also occur if mutually agreeable for reasons such as, but not limited to, floods, fires, or other *force majeure* events.

Generally speaking, unspent project funds that are carried over per the reschedule/preschedule provisions above (i.e., within +/- 20 percent of the annual project budget and within the project's scope of work) may be carried forward from one contract year (i.e., Year 1), to as far as two contract years (i.e., Year 3) into the future before such funds are no longer available. There are two exceptions to this reschedule/preschedule criteria and the limitation on carry-forward.

First, as an additional limitation on carry-forward, for project expansions and new projects (which describes all the projects in Attachment A), if actual total FY08 and FY09 spending is less than the sum of 33 percent of the FY08 budget and up to 75 percent of the FY09 budgets reflected in Attachment A for the project due to circumstances within Idaho's control, then the difference between what is actually spent in FY08 and FY09, and the sum of 33 percent of the FY08 budget and up to 75 percent of the FY09 budgets reflected in the spreadsheet, cannot be carried over into FY10.

Second, to the extent that the projects proposed for funding in this Agreement involve the acquisition of interests in land or water from willing sellers, BPA and Idaho may, by mutual agreement, adjust the 20 percent fluctuation band for the budgets for such projects to accommodate the uncertainties of negotiations with sellers. In addition, BPA may extend the two year carry-forward limit for such projects, provided that Idaho provides at least six months notice of the potential need for such an extension, and provided further that BPA may decline to extend the carry-forward limit to avoid a "bow wave" of spending in any given year, or towards the end of this Agreement's term, or on any other reasonable ground.

IV. FORBEARANCE, WITHDRAWAL, AND DISPUTE RESOLUTION

A. Effects on Litigation

A.1. The Parties will discuss the appropriate means of alerting the district court in *NWF v. NMFS* of this Agreement (if needed) and will undertake any agreed-upon approach within14 calendar days of the effective date of this Agreement.

A.2. Idaho covenants that during the term of this Agreement:

a. Idaho will not initiate, intervene in, or support in any manner ESA, NPA, CWA, or Administrative Procedure Act ("APA") suits against the Action Agencies or NOAA regarding the legal sufficiency of the FCRPS proposed action, FCRPS BiOp, Upper Snake BiOp and/or conforming implementing Records of Decision (RODs) absent consent of all federal defendants.

b. Idaho will not initiate, intervene in, or support in any manner ESA, NPA, CWA or APA suits against the Action Agencies or NOAA regarding the effects on fish resources or water quality resulting from the operations or existence of the FCRPS and Upper Snake Projects that are specifically addressed in the FCRPS PA, FCRPS BiOp, Upper Snake BiOp and/or conforming implementing RODs absent consent of all federal defendants. Water quality for purposes of this provision includes only water temperature and total dissolved gas requirements and therefore excludes all other matters, such as (by way of illustration and not limitation) the Corps' program under 33 U.S.C. § 1344 and toxics clean up regulation. Nothing in this Agreement, including without limitation Section II.D regarding flow and water management, shall preclude Idaho from enforcing, to the extent permitted by federal law, the provisions of state water quality statutes, currently the Idaho Environmental Protection and Health Act (Idaho Code §§ 39-101 to -175C) and the Idaho Water Quality Act (Idaho Code §§ 39-3601 to -3639), or rules promulgated under such statutes, with respect to any effect from the operation the FCRPS and Upper Snake Projects, except effects on total dissolved gas or water temperature when an FCRPS Project is operated consistently with the draft FCRPS BiOp.

c. Idaho's participation in ongoing and future BPA rate proceedings (ratemaking, approval, or review) will be consistent with the terms of this Agreement.

d. Idaho shall not advocate against, either directly or through parties not subject to the Agreement, the adequacy of the FCRPS and Upper Snake BiOps and the Action Agencies' implementation of the BiOps and this Agreement. The term "advocate" does not include (1) reporting data or results from projects or activities that have been undertaken pursuant to, or are otherwise consistent with, this Agreement; or (2) producing or testifying concerning such data or results when compelled by law to do so—e.g., by virtue of judicial process or compliance with state public record statutes.

e. These commitments apply to state agencies, boards, commissions or other Executive Branch entities, and any person that acts as an agent or representative of same. Subject to Section IV.C.3, the Parties agree that Idaho's appointees to the Council are excluded from the obligations under this Agreement to the extent that such exclusion is necessary to enable Idaho's appointees to perform their responsibilities under the NPA.

B. Affirmation of Adequacy

B.1. This Agreement builds upon and expands the commitments of the Action Agencies called for in the FCRPS and Upper Snake BiOps. The Parties support this package of federal and Agreement actions as an adequate combined response of these entities to address the government's duties to mitigate for the FCRPS effects under applicable environmental laws and regulations for the ten year duration of the BiOps. This includes requirements for:

- conserving listed salmon and steelhead, including avoiding jeopardy and adverse modification of critical habitat under the ESA;
- protection, mitigation, enhancement and equitable treatment of fish and wildlife under the NPA; and
- CWA provisions related to water temperature and total dissolved gas requirements for FCRPS dams to the extent compliant with the draft FCRPS BiOp and subject to the enforcement authority retained in Section IV.A.2.b.

B.2. Idaho further agrees that the Action Agencies' commitments under this Agreement and the BiOps as to hatchery projects are adequate for 30 years from the effective date of this Agreement, except that after year 15 of the 30 year forbearance for hatcheries, there is a change in the status of an evolutionarily significant unit (e.g., a new listing) or if after year 15 there is new information or changed circumstances that indicate additional hatchery actions are needed to assist in mitigating impacts of the FCRPS consistent with current science and applicable law, Idaho is not precluded from seeking additional funding from the Action Agencies for hatcheries. This commitment continues beyond termination of this Agreement's other provisions on September 30, 2018.

B.3. Idaho's determination of adequacy under applicable law is premised on several important assumptions and understandings with which the federal parties to this Agreement concur:

- The specific actions identified in this Agreement are carried out and/or funding for such actions is provided by the federal parties in a timely manner;
- Other actions not specifically identified in this Agreement, but committed to in the FCRPS BiOp are carried out in a timely manner;
- The biological performance and status of the species affected by the development and operation of the FCRPS and Upper Snake hydroprojects are diligently and comprehensively monitored and analyzed, and reported to Idaho and others as provided the BiOps; and

- Adaptive management will be used as described in the section 2.1 of the Action Agencies' FCRPS BA to ensure achievement of performance objectives for the FCRPS.

C. Council Program Amendment Process and Other Provisions

C.1. During the term of the Agreement, the Parties will submit comments or recommendations for Council Program amendments that are consistent with and are intended to effectuate this Agreement.

C.2. If third parties recommend an amendment to the Program that any Party believes is contrary to this Agreement, the Party is not precluded by the terms of this Agreement from asserting any arguments it may have as to whether such an amendment is lawful or unlawful under the NPA, or any other law, provided in so doing they act consistent with the terms of this Agreement.

C.3. Idaho's Council representatives participated in the development of this Agreement. Nothing in the Agreement, however, is intended to affect, or shall be construed as affecting, consideration by such representatives of recommendations from parties other than Idaho when discharging their duties under the NPA. Similarly, nothing in this Agreement is intended to affect, or shall be construed as affecting, the Action Agencies' rights under Section IV.E with respect to withdrawal or Section IV.F with respect to dispute resolution in the event that the Council takes action inconsistent with Idaho's commitments under this Agreement.

D. Good Faith Implementation and Support

Best effort good-faith implementation and support of this Agreement is the general duty to which all Parties agree to be bound. Nonetheless, the Parties understand that from time to time questions or concerns may arise regarding a Party's compliance with the terms of this Agreement. In furtherance of the continuing duty of good faith, each Party agrees that the following specific actions or efforts will be carried out:

D.1. On a continuing basis, it will take steps to ensure that all levels of their government/institution is made aware of the existence of this Agreement and the specific commitments and obligations herein, and emphasize the importance of meeting them;

D.2. Each Party will designate a person to be initially and chiefly responsible for coordinating internal questions regarding compliance with the Agreement;

D.3. Each Party will make best efforts to consult with other Parties prior to taking any action that could reasonably be interpreted as inconsistent with any part of this Agreement. To assist in this, the Parties will designate initial contact points. The formality and nature of the consultation will likely vary depending circumstances. The initial contact points are initially charged with attempting to agree on what form of consultation is required. In some instances, the contact between initial contact points may suffice for the consultation, while in others, they may need to recommend additional steps. The Parties agree that consultations should be as informal and with the least amount of process necessary to ensure that the Parties are fulfilling the good-faith obligation to implement and support the Agreement.

D.4. If a Party believes that another Party has taken action that contrary to the terms of the Agreement, or may take such action, it has the option of a raising a point of concern with other Parties asking for a consultation to clarify or redress the matter. The Parties will endeavor to agree upon any actions that may be required to redress the point of concern. If after raising a point of concern and having a consultation the Parties are unable to agree that the matter has been satisfactorily resolved, any Party may take remedial actions as it deems appropriate, so long as those remedial actions do not violate the terms of the Agreement.

E. Changed Circumstances, Renegotiation/Modification, Withdrawal

E.1. The Parties assume that NOAA will issue final BiOps for the FCRPS and Upper Snake whose provisions, including any reasonable and prudent alternative, will be consistent with the draft BiOps insofar as material to this Agreement. If a Party believes that a material difference exists between the draft and final BiOps for either the FCRPS or Upper Snake, the provisions of Section E.3 apply.

E.2 If any court, regardless of appeal, finds that the BiOp or agency action is arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law, and subsequently remands the BiOp to NOAA Fisheries this Agreement shall remain in force. If any court, regardless of appeal finds that the BiOp or agency action is arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law, the Parties will seek to preserve this Agreement, and will meet promptly to determine the appropriate response as described below:

(a) In the event that a portion(s) of this Agreement is in direct conflict with the court order or resulting amended BiOp, the Parties shall meet and agree on an appropriate amendment to that section, or, if such amendment is not possible under the terms of the court order or resulting amended BiOp, then a substitute provision shall be negotiated by the Parties.

(b) If the court-ordered FCRPS operations or resulting amended BiOp require additional actions that are either financially material to an Action Agency or that materially constrain the Corps or Reclamation from meeting FCRPS purposes, Section IV.E.5 shall apply.

(c) The Parties will participate in any court-ordered process or remand consultation in concert with Sections IV.D and IV.E.

(d) The Parties intend that determinations of materiality will only be made in cases of great consequence.

E.3. In the event of the occurrence of any of the material effects in Section E.2, or in the event of material non-compliance with the Agreement not resolved by dispute resolution, the affected Party or Parties shall notify the other Parties immediately and identify why the event is considered material. The Parties shall utilize dispute resolution if there is a disagreement as to whether the event is material. In addition, prior to any withdrawal, the Parties shall first make a good faith effort to renegotiate mutually agreeable modifications to the Agreement. If renegotiation is not successful, the affected Party may notify the other Parties in writing of its intent to withdraw by a date certain. If renegotiation is not successful, at the time the withdrawal is effective, all funding commitments and/or other covenants made by the withdrawing Party cease, and the withdrawing Party shall have no further rights or obligations pursuant to the Agreement. A withdrawing Party reserves any existing legal rights under applicable statutes, including all arguments and defenses, and this Agreement cannot be used as an admission or evidence in support of or against any such argument or defense.

E.4. The provisions of this Agreement authorizing renegotiation, dispute resolution and withdrawal provide the sole remedies available to the Parties for remedying changed circumstances or disputes arising out of or relating to implementation of this Agreement.

E.5. Any Party may request renegotiation or withdraw for reasons other than those enumerated above subject, however, to the provisions in Section IV.E.3.

E.6. If one Party withdraws from the Agreement, any other Party has the option to withdraw as well, with prior notice.

E.7. Savings. Notwithstanding Section IV.E.3, in the event of withdrawal, BPA will continue providing funding for projects necessary for support of BiOp commitments (as determined by the Action Agencies), and may provide funding for other on-going projects or programs that the Parties mutually agree are important to continue.

F. Dispute Resolution

F.1. Negotiation

1.a. The Parties shall attempt in good faith to resolve any dispute arising out of or relating to implementation of this Agreement in accordance with this section and without resort to administrative, judicial or other formal dispute resolution procedures. The purpose of this Section IV.F.1 is to provide the Parties an opportunity to fully and candidly discuss and resolve disputes without the expense, risk and delay of a formal dispute resolution.

1.b. If the Parties are unable to resolve the dispute through informal dispute resolution, then the dispute shall be elevated to negotiating between executives and/or officials who have authority to settle the controversy and who are at a higher level of management than the person with direct responsibility for administration of this Agreement. All reasonable requests for information made by one Party to the other will be honored, with the Action Agencies treating "reasonable" within the context of what would be released under the Freedom of Information Act.

1.c. In the event a dispute over material non-compliance with the Agreement has not been resolved by negotiation, the affected Party may seek to withdraw, without further renegotiation, in accordance with Section IV.E.3.

F.2. Mediation

In the event the dispute has not been resolved by negotiation as provided herein, the disputing Parties may agree to participate in mediation, using a mutually agreed upon mediator. To the extent that the disputing Parties seeking mediation do not already include all Parties to this Agreement, the disputing Parties shall notify the other Parties to this Agreement of the mediation. The mediator will not render a decision, but will assist the disputing Parties in reaching a mutually satisfactory agreement. The disputing Parties agree to share equally the costs of the mediation.

G. Modification

The Parties by mutual agreement may modify the terms of this Agreement. Any such modification shall be in writing signed by all Parties.

V. MISCELLANEOUS PROVISIONS

A. Term of Agreement

The term of this Agreement will extend from its effective date through the end of fiscal year 2018 which is midnight on September 30, 2018.

B. Applicable Law

All activities undertaken pursuant to this Agreement must be in compliance with all applicable laws and regulations. No provision of this Agreement will be interpreted or constitute a commitment or requirement that the Action Agencies take action in contravention of law, including the APA, ESA, CWA, National Environmental Policy Act, Federal Advisory Committee Act, Information Quality Act, or any other procedural or substantive law or regulation. Federal law shall govern the implementation of this Agreement and any action, whether mediated or not.

C. Authority

Each Party to this Agreement represents and acknowledges that it has full legal authority to execute this Agreement.

D. Effective Date & Counterparts

The effective date of this Agreement shall be the date of execution by the last Party to provide an authorized signature to this Agreement. This Agreement may be executed in counterparts, each of which is deemed to be an executed original even if all signatures do not appear on the same counterpart. Facsimile and photo copies of this Agreement will have the same force and effect as an original.

E. Binding Effect

This Agreement shall be binding on the Parties and their assigns and successors. Each Party may seek dispute resolution in accordance with Section IV.F, or to withdraw in accordance with Section IV.E.3 if the dispute is not resolved.

F. No third party beneficiaries are intended by this Agreement.

G. All previous communications between the Parties, either verbal or written, with reference to the subject matter of this Agreement are superseded, and this Agreement duly accepted and approved constitutes the entire Agreement between the Parties.

H. Waiver, *Force Majeure*, Availability of Funds

H.1. The failure of any Party to require strict performance of any provision of this Agreement or a Party's waiver of performance shall not be a waiver of any future performance of or a Party's right to require strict performance in the future**.**

H.2. No Party shall be required to perform due to any cause beyond its control. This may include, but is not limited to fire, flood, terrorism, strike or other labor disruption, act of God or riot. The Party whose performance is affected by a *force majeure* will notify the other Parties as soon as practicable of its inability to perform, and will make all reasonable efforts to promptly resume performance once the *force majeure* is eliminated. If the force majeure cannot be eliminated or addressed, the Party may consider withdrawal pursuant to Section IV.E.3.

H.3 The actions of the Corps and Reclamation set forth in this Agreement are subject to the availability of appropriated funds. Nothing in this Agreement shall be construed to require the obligation or disbursement of funds in violation of the Anti-Deficiency Act.

I. Notice

I.1**.** Any notice permitted or required by the Good Faith provisions of this Agreement, Section IV.D, may be transmitted by e-mail or telephone to a Party's initial contact points, as that person is defined pursuant to the Good Faith provisions.

I.2. All other notices permitted or required by this Agreement shall be in writing, delivered personally to the persons listed below, or shall be deemed given five (5) days after deposit in the United States mail, addressed as follows, or at such other address as any Party may from time to time specify to the other Parties in writing. Notices may be delivered by facsimile or other electronic means, provided that they are also delivered personally or by mail. The addresses listed below can be modified at any time through written notification to the other Parties.

Notices to BPA should be sent to:

Vice President, Environment Fish & Wildlife
Mail Stop KE-4
Bonneville Power Administration
P.O. Box 3621
Portland, OR 97208-3621

Notices to the U.S. Army Corps of Engineers should be sent to:

U.S. Army Corps of Engineers, Northwestern Division
Chief, Planning, Environmental Resources and Fish Policy Support Division
1125 NW Couch Street
Suite 500
P.O. Box 2870
Portland, OR 97208-2870

Notices to the U.S. Bureau of Reclamation should be sent to:

Deputy Regional Director
Bureau of Reclamation
Pacific Northwest Region
1150 N. Curtis Rd., Suite 100
Boise, ID 83706

Notices to the State of Idaho should be sent to:

Administrator
Office of Species Conservation
300 North 6th Street, Suite 101
Boise, ID 83702

J. List of Attachments

Attachment A—BPA Funding for Idaho projects for FCRPS BiOp MOA (spreadsheet)
Attachment B—Narrative description and benefits of projects

SIGNATURES

/s/ Stephen J. Wright *May 2, 2008*

Stephen J. Wright Date
Administrator and Chief Executive Officer
Bonneville Power Administration

/s/ Steven R. Miles, P.E. *May 2, 2008*

Steven R. Miles, P.E. Date
Colonel, U.S. Army Corps of Engineers
Division Commander

/s/ Tim Personius *May 2, 2008*

(for) J. William MacDonald Date
Regional Director
U.S. Bureau of Reclamation
Pacific Northwest Region

/s/ C.L. "Butch" Otter *May 1, 2008*

C.L. "Butch" Otter Date
Governor
State of Idaho

ATTACHMENT A

BPA FUNDING FOR IDAHO PROJECTS FOR FCRPS BIOP MEMORANDUM OF AGREEMENT

#	PROJECT NAME	STATUS	BPA PROJECT No.	EXPENSE ($)										
				2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	TOTAL
	SALMON & STEELHEAD ESA PROJECTS: EXPENSE													
1	Upper Lemhi River Acquisition and Habitat Restoration: Acquisition	New			$ 4,000,000	$ 5,000,000	$ 3,000,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 12,000,000
2	Upper Lemhi River Acquisition and Habitat Restoration: Restoration activities	New		$ -	$ -	$ -	$ -	$ 1,000,000	$ 1,000,000	$ 300,000	$ 300,000	$ 300,000	$ 300,000	$ 3,200,000
3	Sockeye Conservation Hatchery Development: Planning *1	Expanded	200740200	$ 500,000	$ 500,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,000,000
4	Sockeye Conservation Hatchery Development: O&M	Expanded	200740200	$ -	$ 100,000	$ 700,000	$ 717,500	$ 735,437	$ 753,823	$ 772,669	$ 791,985	$ 811,785	$ 832,080	$ 6,215,279
5	Pahsimeroi River Habitat Project	New		$ 700,000	$ -	$ 700,000	$ 700,000	$ 700,000	$ 700,000	$ 1,050,000	$ 1,050,000	$ 950,000	$ 950,000	$ 7,500,000
6	Water Transactions Fund	Expanded	200201301	$ 700,000	$ -	$ 700,000	$ 700,000	$ 700,000	$ 700,000	$ 1,050,000	$ 1,050,000	$ 1,000,000	$ 1,000,000	$ 7,600,000
7	Lower Clearwater River/Potlatch River Watershed Management Plan Implementation	New		$ 500,000		$ 500,000	$ 500,000	$ 500,000	$ 500,000	$ 750,000	$ 750,000	$ 500,000	$ 500,000	$ 5,000,000
8	Lower Lemhi River Habitat Restoration Project: Easements	New		$ -	$ -	$ -	$ -	$ 2,500,000	$ 2,500,000	$ -	$ -	$ -	$ -	$ 5,000,000
9	Lower Lemhi River Habitat Restoration Project: Habitat restoration	New		$ -	$ -	$ 125,000	$ 125,000	$ 125,000	$ 125,000	$ 125,000	$ 125,000	$ 125,000	$ 125,000	$ 1,000,000
10	Nutrient Enhancement Project	New		$ -	$ -			$ 333,333	$ 333,333	$ 333,333	$ 333,333	$ 333,333	$ 333,333	$ 1,999,998
11	Steelhead Viability Assessments for ESA Recovery Metrics *2	Expanded	199005500	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 1,500,000
			YEARLY Totals:	$ 2,550,000	$ 4,750,000	$ 7,875,000	$ 5,892,500	$ 6,743,770	$ 6,762,156	$ 4,531,002	$ 4,550,318	$ 4,170,118	$ 4,190,413	$ 52,015,277

*1 Additional funds to BPA's 07-09 decision to support the PA

*2 Additional funds to BPA's 07-09 decision to support the PA

#	PROJECT NAME²	STATUS	BPA PROJECT No.	Capital ($)										
				2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	TOTAL
	SALMON & STEELHEAD ESA PROJECTS: CAPITAL													
12	Sockeye Conservation Hatchery Development: Purchase	Expanded	200740200	$ 2,375,000	$ 2,375,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,750,000
13	Sockeye Conservation Hatchery Development: Construction	Expanded	200740200	$ -	$ 3,000,000	$ 5,500,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,500,000
			YEARLY Totals:	$ 2,375,000	$ 5,375,000	$ 5,500,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 13,250,000

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ATTACHMENT B
IDAHO-BPA Project List
FOR IDAHO-ACTION AGENCY MOA
Upper Salmon and Clearwater Drainages

Priority	Project Title and Project Nos. as listed in Attachment A)	Project Description
1	Upper Lemhi River Acquisition and Habitat Restoration, Project Nos. 1 and 2	This project would permanently protect and restore chinook and steelhead habitat in the upper Lemhi River Watershed through the acquisition and protection of appropriate habitats in the Upper Lemhi Watershed and through the implementation of on-the-ground habitat improvements. Idaho would seek to obtain property that includes the mainstem Lemhi River in the heart of Chinook salmon spawning and rearing habitat and/or several critical tributaries. The goal would be to obtain habitat that would provide : • Year round access to up to 84 miles of previously inaccessible good quality spawning and rearing tributary habitat. • Up to an additional 190 miles of tributary habitat seasonally reconnected. • Up to 14 miles of mainstem Lemhi River and Big Springs Creek habitat upgraded via increased flows and riparian restoration. The draft FCRPS BiOp (Table 3-a and 3-b in Attachment B.2.2-2 Tributary Habitat Action Tables) has listed the following limiting factors for Lemhi River chinook salmon and steelhead: 1. Low stream flows 2. Water quality (high stream temperatures) 3. Fish passage (barriers and entrainment into irrigation ditches) 4. Substrate (sediment). Table 5 in the draft FCRPS BiOp Habitat RPA's identifies a 7% increase in freshwater survival for chinook salmon and 3% for steelhead for the 2007 – 2009 actions. However, the only BPA funded project identified in the draft BiOp currently implementing on-the-ground habitat projects in the Lemhi is the Fish Screening and Passage Improvements (The Screen Shop Program, BPA project 199401500). Specific actions designed to address the identified limiting factors and survival gaps include modifying, consolidating, and/or removing existing diversions to eliminate passage barriers and increase stream flow, installing fish screens on diversions, reconnecting tributaries, riparian habitat enhancement and fencing, culvert removal and/or replacement, instream habitat enhancement, channel reconfiguration, et al.
2	Conservation Hatchery Development,	This project would result in the acquisition and development of a new conservation hatchery facility designed to produce up to one million Snake River sockeye salmon smolts annually for reintroduction back to the habitat.

	Project Nos. 3, 4, 12 and 13	The flexibility to accommodate additional conservation hatchery programs as well as localized broodstock development programs would be incorporated into the design of the facility. The draft FCRPS (RPA Hatchery Strategy 2, Action 42) includes language specifically directing the Action Agencies to fund expansion of the safety-net program to increase sockeye salmon smolt releases to between 500,000 and 1 million fish annually. Anadromous adults that return to the program from increased reintroduction efforts will be used in controlled hatchery spawning events as well as released to the habitat to spawn naturally.
3	Pahsimeroi River Habitat Project, Project No. 5	This project would permanently protect and restore chinook and steelhead habitat in the lower Pahsimeroi River Watershed (downstream of Big Creek). The draft FCRPS BiOp (Table 3-a and 3-b in Attachment B.2.2-2 Tributary Habitat Action Tables) has listed the following limiting factors for Pahsimeroi River chinook salmon and steelhead: 1. Low stream flows 2. Water quality (high stream temperatures and excessive nutrients) 3. Fish passage (barriers and entrainment into irrigation ditches) 4. Substrate (sediment) 5. Poor riparian conditions (riparian area and LWD recruitment). Table 5 in the draft FCRPS BiOp Habitat RPA's identifies a 41% increase in freshwater survival for chinook salmon and 9% for steelhead resulting from the 2007 – 2009 actions. Specific actions designed to meet the identified limiting factors and survival improvements include conservation easements, acquisitions, modifying, consolidating, and/or removing existing diversions to eliminate passage barriers and increase stream flow, installing fish screens on diversions, reconnecting tributaries, riparian habitat enhancement and fencing, culvert removal and/or replacement, instream habitat enhancement, channel reconfiguration, spring, tributary, and mainstem channel restoration, et al.
4	Water Transactions Fund, Project No. 6	This program will use the Idaho Water Resource Board (IWRB) expertise to develop projects to address the primary limiting factor in the Lemhi and Pahsimeroi Basins, the lack of flow. Projects would be selected to address the freshwater survival improvements stated in the Biological Opinion (7% for chinook and 3% for steelhead in the Lemhi Drainage and 41% for chinook and 9% for steelhead in the Pahsimeroi Drainage). The projects would also be coordinated with existing planning documents (Subbasin Plan, Lemhi Conservation Plan, Nez Perce Settlement, etc.) and USBWP tech team input. The program would provide water to reconnect tributaries in the Lemhi and Pahsimeroi as well as increase flow in mainstem Lemhi and Pahsimeroi

		reaches to improve fish passage conditions and increase the quantity and quality of habitat. The IWRB has developed experience acquiring water in the Upper Salmon Basin through participation in the Water Entity/Columbia Basin Water Transactions Program (BPA Project Number 200201301) with funding from BPA and the Pacific Coast Salmon Recovery Fund. Water acquisition tools include short and long-term leases, permanent purchases, partial season leases, and diversion reduction agreements. The Board is also developing a sub-account in their Revolving Development Account to hold CBWTP-BPA funds for annual payments to irrigators. This mechanism provides financial accountability and IWRB coordination of policy and regulatory requirements necessary for effective water transactions. The program costs include: • Direct and indirect transaction costs for water acquisitions (leases, agreements, associated fees and charges) • Program management and negotiations for developing transactions • Monitoring programs to document effectiveness of transactions.
5	Lower Clearwater/Potlatch River Watershed Management Plan Implementation, Project No. 7	This project would accelerate the on-the-ground implementation of the recently completed Watershed Management Plan. Actions would focus on the primary limiting factors identified by NOAAF when it designated this watershed as the key watershed in the Clearwater for steelhead recovery and the limiting factors identified in the draft BiOp (Attachments B.2.2-2-Tributary Habitat Action Tables, Table 3-a. Snake river Steelhead 2007-2009 BPA Tributary Habitat Actions). These include: Riparian Areas and LWD Recruitment – impaired riparian condition and function; Stream substrate – elevated stream bed instability and elevated sediment; Floodplain connectivity and function – reduced floodplain connectivity, altered floodplain; and Channel structure. Specific actions designed to address these limiting factors include riparian and floodplain restoration and enhancement, riparian and floodplain conservation easements, acquisitions, reconnecting tributaries, removing migration barriers, instream habitat enhancement, summer streamflow improvement, et al.
6	Lower Lemhi River Habitat Restoration Project, Project Nos. 8 and 9	This project would permanently protect and restore chinook and steelhead habitat in the lower Lemhi River Watershed. The project would result in year round access to 66 miles of previously inaccessible good quality chinook and steelhead spawning and rearing habitat. The draft FCRPS BiOp (Table 3-a and 3-b in Attachment B.2.2-2 Tributary Habitat Action Tables) has listed the following limiting factors for Lemhi River chinook salmon and steelhead: Low stream flows Water quality (high stream temperatures) Fish passage (barriers and entrainment into irrigation ditches)

		Substrate (sediment). Table 5 in the draft FCRPS BiOp Habitat RPA's identifies a 7% increase in freshwater survival for chinook salmon and 3% for steelhead for the 2007 – 2009 actions. However, the only BPA funded project identified in the draft BiOp currently implementing on-the-ground habitat projects in the Lemhi is the Fish Screening and Passage Improvements (The Screen Shop Program, BPA project 199401500). Specific actions designed to meet the identified limiting factors and survival gaps include conservation easements, acquisitions, modifying, consolidating, and/or removing existing diversions to eliminate passage barriers and increase stream flow, installing fish screens on diversions, reconnecting tributaries, riparian habitat enhancement and fencing, culvert removal and/or replacement, instream habitat enhancement, channel reconfiguration, spring, tributary, and mainstem channel restoration, et al.
7	Nutrient Enhancement Project, Project No. 10	This project is a pilot study intended to pave the way for a larger-scale effort being spearheaded by NOAA scientists in collaboration with IDFG. The purpose of the larger study is to quantify the population-level benefits of nutrient addition and to determine the extent to which this technique can aid recovery. The objective of this project are: 1. Develop the expertise and experience with commercially available nitrogen nutrient sources to conduct nutrient enhancement projects in Idaho and secondarily and 2. Determine if the addition of such nutrients can measurably increase chinook and steelhead productivity in central Idaho streams (to be determined). Response variables include juvenile growth, density, and survival (to Lower Granite Dam and potentially to adult return). The approach will focus on release logistics and nutrient performance rather than fish monitoring. However, examination of a reduced set of fish parameters will enable a cursory evaluation of project success and lead the way for the more substantive assessments of larger proposed efforts. Ideally, this study would follow at least one year class of fish from emergence to emigration. This project will use a paired treatment/control approach on four streams in the Salmon or Clearwater river basins. Two streams will receive nutrients and two will serve as controls. Stream selection will involve preliminary measurement of stream chemistry to identify stream pairs with similar nutrient limitations. For this pilot study, we will target a 5-mile reach in streams with average summer flow of approximately 35 cfs.
8	Steelhead Viability Assessments for ESA Recovery Metrics, Project	This project focuses on status and trend monitoring of B-run steelhead populations in the Salmon and Clearwater drainages. The draft FCRPS BiOp has identified the need for additional monitoring for population productivity and abundance. RPA #50, bullet #5 states "Provide additional

	No. 11	status monitoring to ensure a majority of Snake River B-run steelhead populations are being monitored for population productivity and abundance." An existing project (199005500) will be modified to incorporate the objective of providing steelhead population status information, coordinated through the ongoing collaboration process to develop a regional strategy for RME. This project will collect life history, genetic, and abundance data for, and assess the status of, wild steelhead populations in Idaho to adequately address recovery objectives associated with the ESA (Viable Salmonid Population criteria: abundance, spatial structure, productivity, diversity).

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Appendix C

Proposed Sockeye Salmon Recovery Language Prepared by the Idaho Department of Fish and Wildlife

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APPENDIX C

IDAHO DEPARTMENT OF FISH AND GAME
DRAFT SNAKE RIVER SOCKEYE SALMON RECOVERY STRATEGY
APRIL 13, 2009

The following is a draft overview of the Idaho Department of Fish and Game's (Department) management strategy for Snake River sockeye salmon. This strategy incorporates the use state-of-the-art hatchery facilities, captive broodstock technology, cutting-edge genetic support and a comprehensive monitoring and evaluation plan to maintain the resource and to continue rebuilding numbers of fish in the wild. This document is not intended to serve as the Department's final management plan for Snake River sockeye salmon; but to assist NOAA Fisheries in their effort to develop recovery plan language for the ESU. Included in this document is a list of anticipated infrastructure improvements considered essential to maximize program success.

Precipitous declines of Snake River sockeye salmon led to their Federal listing as endangered in 1991 (56 FR 58619). In that same year, the Department initiated a captive broodstock program. The program's near-term goal is to slow the loss of critical population genetic diversity and heterozygosity and to prevent species extinction. The ultimate program goal is to reestablish Snake River sockeye in the wild, de-list the population, and provide for sport and treaty harvest opportunities.

A critical limiting factor for the Snake River sockeye captive broodstock program is the maintenance of population genetic diversity and heterozygosity. The Department is addressing this need through a coordinated effort involving staff at the Eagle Fish Hatchery and the Eagle Genetics Lab. Annually, individual-based genotype information is generated to guide the development of spawning plans. Spawning plans are designed to minimize the crossing of closely related individuals and to slow the loss of critical genetic information. Additionally, every effort is made to spawn all sockeye salmon that mature in the captive broodstock program and to avoid over- and under-representing specific individuals in the process. Broodstock retained to perpetuate the program are carefully selected to equalize family representation. Annually, the Department produces new broodstock cohorts to be reared at the Eagle Fish Hatchery in Idaho and at the NOAA facilities in Washington State. It is the Department's recommendation that the NOAA recovery plan stress the importance of the captive broodstock component and understand that it continues to serve a critical role in the overall recovery effort.

It is well documented that supportive breeding programs can lead to: 1) a reduction of the genetically effective population size, 2) elevated rates of inbreeding, and 3) loss of genetic diversity and heterozygosity in captive populations of species at some level of genetic, environmental and/or demographic risk (Ryman and Laikre 1991; Fleming 1994; Ryman 1994; Nomura 1999; Ryman et al. 1999; Wang and Ryman 2001; Ford 2002). Additionally, the loss of genetic diversity coupled with an increasing risk of inbreeding has been correlated with a reduction in reproductive fitness (Bryant and Reed 1999; Reed and Frankham 2003; Reed 2005).

By implementing breeding strategies that manage allelic diversity and the contribution of parents to successive generations, the rate of loss of critical population genetic diversity can be reduced (Fernández et al. 2004). The Snake River sockeye salmon captive broodstock program has made every effort to implement state-of-the art fish husbandry practices as well as advanced breeding plans that adhere to the principles described by Fernández et al. (2004). Despite these efforts, it is inevitable that some loss of genetic information will occur annually – just due to genetic drift alone. Additionally, because captive populations are maintained under fairly uniform environmental conditions, they experience relaxed natural as well as sexual selection pressure (Lynch and O'Hely 2001; Berejikian et al. 2004). Adaptation to the captive environment can alter a variety of behavioral traits and fitness correlates such as reproductive success, fecundity, growth rate, and survival (Mousseau and Roff 1987; Sheffer et al. 1997; Bryant and Reed 1999). Some of these traits, such as fecundity, breeding time, and general reproductive success have been shown to be heritable (Smoker et al. 1998; Quinn et al. 2000; Kruuk et al. 2000; Quinn et al. 2002; Seamons et al. 2004; Dickerson et al. 2005).

A second limiting factor for the Snake River sockeye salmon recovery program is the number of anadromous adults that return to collection sites in the Sawtooth Valley. Limited numbers of adult returns impacts the program's ability to take advantage of local adaptation and to improve the fitness of the composite population. To increase the number of adults that return to the program, the Department has developed a phased plan that includes: 1) increased smolt production, 2) increased use of anadromous adults in captive spawning designs as well as in natural spawning events in the habitat, and ultimately, 3) the integration of natural- and hatchery-origin adults in the hatchery as well as in the habitat. More detail on each phase is provided below:

PHASE I: INCREASED SMOLT PRODUCTION

Currently, insufficient incubation and juvenile rearing space is available to meet the project's long-term goal. Juvenile sockeye salmon are reared at the IDFG Sawtooth Fish Hatchery (a Lower Snake River Compensation Plan facility) and at the Oregon Department of Fish and Wildlife's Oxbow Fish Hatchery (a Mitchell Act facility). As both facilities are focused on higher priority mitigation mandates, limited rearing space is available for sockeye salmon. As such, the Department is currently pursuing the acquisition of suitable hatchery space to meet this objective. Consistent with the FCRPS Biological Opinion and the Idaho Fish Accord, the new Idaho facility would have the capacity to produce between 500,000 and 1 million full-term smolts annually for release to locations in the Sawtooth Valley. Focusing on a smolt release strategy maximizes the potential to return anadromous adults.

The interim abundance guidelines established by NOAA suggest that 1,000 naturally-produced adults are needed to return to Redfish Lake and 500 adults to Pettit and Alturas lakes over a two-generation period to initiate any policy discussions related to ESA-listing status. Little information is available to guide the development of minimum effective population size targets for this ESU. However, it is probably safe to assume, that the "50/500" rule described by Franklin (1980), Soulé (1980), and Nelson and Soulé (1987) should be considered, at a minimum, rough guidance for the development of adult return criteria. Under their rule, an effective population size of 50 or less is not considered genetically viable in the long-term and is vulnerable to the effects of inbreeding depression while an effective population size of 500 or greater would allow the population to retain adaptive genetic variation over time (evolutionary potential).

The Department anticipates that releasing up to 1 million smolts could consistently return approximately 5,000 anadromous adults annually. Increased eggs for the expanded smolt program will be produced at the Department's newly expanded Eagle Fish Hatchery broodstock station and possibly from increased production from NOAA facilities in Washington State.

PHASE II: INCREASED USE OF ANADROMOUS ADULTS IN CAPTIVE AND NATURAL SPAWNING EVENTS

The program's mid-term hatchery goal is to function as a conventional supplementation program, relying on genetically diverse, rack returns of anadromous adults to meet in-hatchery captive broodstock as well as prespawn adult out-planting needs. The Department's proposal to expand the production of this program to return and utilize more anadromous adults in breeding plans and for volitional spawning in the wild is consistent with the guiding principles discussed above.

Anadromous, adult sockeye salmon have been exposed to considerable natural selection pressure. If incorporated in hatchery spawning designs, benefits associated with the heritability of fitness correlates such as fecundity and breeding success should be passed on to the population. In fact, adaptation to the captive environment and associated fitness loss can be ameliorated through immigration from wild (or natural in our case) contributors through equalization of genetic contributions among families or founding lineages (Bryant and Reed 1999). If released to spawn volitionally, adult sockeye salmon (both full-term hatchery and anadromous) experience the relatively intense selection processes associated with pairing and breeding. Appropriately, positive fitness benefits may be passed on to the resulting natural population.

The current program restricts the use of pre-spawn anadromous adults to Redfish Lake only; the expansion of pre-spawn adult releases to either Pettit or Alturas lakes in the near-term presents an unacceptable level of risk to juvenile sockeye at the Sawtooth Fish Hatchery. Current rearing strategies include the culture of up to 100,000 full-term sockeye salmon smolts at the Department's Sawtooth facility. The final 9 months (September through May) of smolt culture at Sawtooth involves the rearing of fish on surface water from the Salmon River. The Sawtooth intake structure for the Salmon River is located downstream of both Pettit and Alturas lakes; the horizontal (fish-to-fish) transmission of bacterial and viral pathogens from anadromous sockeye spawning in Pettit/Alturas poses an extreme risk to juvenile sockeye that are cultured downstream of these key Basin lakes. While the Department ultimately favors the release of pre-spawn anadromous adults to both Pettit and Alturas lakes (and/or natural escapement of adults above the Sawtooth adult weir on the main Salmon River), we believe that the timing of this release strategy must coincide with the full transfer of the smolt program from the Sawtooth facility to the Department's new smolt rearing facility (Springfield Fish Hatchery).

PHASE III: DEVELOP AN INTEGRATED APPROACH TO MANAGING THE COMPOSITE POPULATION

The final phase of the draft program expansion plan takes advantage of local adaptation to increase program success. As anadromous adult returns increase to the point where consistent numbers are available to meet prespawn adult release objectives to the habitat (Phase II), it follows that increasing numbers of natural-origin adults (produced from in-lake spawning events) will return to collection sites in the Sawtooth Valley. As discussed above, benefits associated with natural selection as well as local adaptation are expected to increase the productivity of this component of the population (e.g., adult-to-adult survival). As sufficient numbers of natural-origin adults return, a sliding management scale will be developed to guide how natural- and hatchery-origin adults are used in the hatchery as well as in the wild. In other words, an integrated approach to manage both components of the composite population will be developed. The management plan will include a minimum escapement target for natural-origin adults (e.g., that proportion allowed to spawn volitionally in the habitat), the proportion of 1st generation integrated adults allowed to spawn with natural-origin adults in the habitat, and the proportion of natural-origin adults brought into the hatchery to spawn with 1st generation integrated adults. Spawn crosses consisting of hatchery-origin x hatchery-origin adults will be minimized when possible.

Integrated broodstock and escapement management plans must be driven by the natural population. In order for the benefits associated with local adaptation and increased fitness of natural-origin adults to influence the composite population, gene flow must be dominated by the natural-origin component (e.g., more natural-origin adults incorporated in the hatchery broodstock than hatchery-origin adults released to the habitat to spawn). If implemented, theory suggests that survival of the composite population will increase over time as adults become better adapted to the habitat as opposed to the hatchery. If the release of 500,000 to 1 million hatchery-origin smolts is expected to return approximately 5,000 hatchery-origin anadromous adults, adult returns from a fully integrated program are expected to be even greater (over time as local adaptation increases).

INFRASTRUCTURE NEEDS

As program expansion unfolds, some existing facilities will need to be modified and new facilities developed to accommodate increased juvenile production as well as adult returns. For example:

1. There is an immediate need to modify adult trapping and holding facilities on Redfish Lake Creek and on the Salmon River at the Sawtooth Fish Hatchery.

    a. Redfish Lake Creek. The present structure was constructed in the 1950's and functions as a juvenile out-migrant trap as well as an adult trap. Since the inception of the current recovery program in 1991, major repairs have been required to keep the facility operational. Facility needs include:

        i. A structural inspection of the existing facility with some level of new construction anticipated to meet the needs of the growing program. At a minimum, new structural work, new weir panels, and new adult trapping components are needed.

ii. Adult holding (other than the trap box associated with the weir) space is needed to accommodate expected numbers of returning adults. This could include temporary, on-site tanks or in-lake net pens.

iii. Electrical service to the site is needed to improve options associated with trapping and holding sockeye salmon. Improved PIT tag detection equipment (e.g., plate PIT tag detector) would improve the collection of emigration and immigration information and facilitate better life history, survival, and productivity data development for the ESU.

iv. Temporary living quarters are needed to increase program security and to isolate the work environment from the sleeping environment.

b. Sawtooth Fish Hatchery. The present fish hatchery was built in the mid 1980s as a mitigation hatchery for Chinook salmon and summer steelhead. The hatchery includes a weir on the Salmon River, a fish ladder, and adult holding ponds.

i. The design of the current fish ladder (and attraction water flow) as well as the presence of large numbers of Chinook salmon deters sockeye salmon from entering the fish ladder and adult trap. An engineering analysis of existing facilities is needed. Weir and ladder modifications are likely needed to address limiting factors.

ii. Adult holding, independent from that used to hold Chinook salmon, needs to be developed. This could include on-site temporary or permanent ponds or containers supplied with pathogen-free well water (not currently available), or chilled river water for short-term holding (not currently available).

iii. Adult "work-up" area needs to be expanded to accommodate sockeye.

2. New marking and tagging plans will need to be developed that will require increased fin clipping and likely increased coded wire tagging and PIT tagging. Funds will need to be identified to modify existing infrastructure or to develop new capabilities to meet this need.

3. New fish transportation capability will need to be developed to move up to 1 million smolts to release locations in the Sawtooth Valley. Up to two weeks of time could be needed to move smolts to release locations (at four trips per day). Funds will need to be identified to modify existing infrastructure or to develop new capabilities to meet this need.

GENERAL RECOMMENDATIONS

1. The Department urges NOAA to work with the Northwest Power and Conservation Council and the Bonneville Power Administration to maintain the hatchery conservation research program managed by NOAA from their Manchester, WA facility (BPA project # 199305600). A portion of the project should focus on answering sockeye broodstock questions such as – synchronizing maturation timing with and without the use of gonadotropin-releasing hormones, determining ideal adult size, improving fertilization success and egg survival to the eyed-stage of development, and - - important - - determining how to best incorporate anadromous adults into the captive broodstock spawning program as the program transitions to Phase II.

2. The Department urges NOAA to consider providing collaborative genetics support for the Snake River sockeye salmon captive broodstock program through the Conservation Biology division of the Science Center. Support could include analytical assistance, interpretation of results, and management recommendations.

3. The Department urges NOAA to work with cooperators to address logistical issues that may prevent implementing an adult sockeye salmon trap and transport plan from Lower Granite Dam to holding facilities at Eagle Fish Hatchery or to release locations in the Sawtooth Valley.

4. The Department generally supports the recommendations of the Columbia River Hatchery Scientific Review Group to:

    a. Focus on a smolt reintroduction strategy (500,000 to 1 million released annually)

    b. Transport, if necessary, adults from Lower Granite to Stanley

    c. Be prepared to discuss the logistics, pros, and cons of a downstream production element (eliminates the majority of migration mortality for both juveniles and adults)

5. The Department supports continuing a spread-the-risk approach to reintroduction. This includes maintain the existing egg box program in Pettit Lake, maintaining presmolt programs in up to three lakes, and a emphasizing the expanded smolt program described above. The existing adult release program (hatchery-origin adults released to the habitat to spawn volitionally) should be maintained. As the program transitions to relying more on anadromous adults to meet broodstock as well as adult release needs, the captive component (maintained more as a safety net in the future than as the primary spawning source for broodstock renewal and production releases) will be released to lakes to spawn as opposed to spawned in the hatchery.

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Appendix D

BioCriteria and Conceptual Design Information

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TECHNICAL MEMORANDUM 001R

MCMILLEN, LLC

To:	Dan Warren DJ Warren Associates	Project:	Springfield Sockeye Hatchery
From:	Mark Reiser	Cc:	File
Date:	November 12, 2010	Job No:	Purchase Order No: Vendor No:
Subject:	Biocriteria for Snake River Sockeye Program		

1.0 INTRODUCTION

The Idaho Department of Fish and Game (IDFG), in cooperation with Bonneville Power Administration (BPA), proposes to construct new hatchery facilities to incubate and raise up to one million sockeye salmon smolts at the site of the existing defunct Crystal Spring Trout Hatchery . McMillen has developed a preliminary, detailed operations schedule for the facility in order to establish water budgets by month, and to determine space requirements for incubation, early rearing and juvenile rearing improvements. The preliminary operations schedule (See Table 1), covers a two year period in order to shown the overlapping water demand required to support two brood years of fish on station at once. The purpose of this memorandum is to document the bio-programming assumptions and criteria used to formulate the operations schedule.

2.0 FISH DEVELOPMENT CYCLE

The colored bars across the top section of Table 1 shows the timing of incubation, early (indoor) rearing, and juvenile (outdoor) rearing. The adult holding process is an existing function that begins in August of each year at off station facilities and runs continuously through the end of October. Incubation will begin in October and run through Mid-February based on the timing of the present Snake River sockeye smolt program being run at Oxbow Hatchery. Early rearing in indoor troughs will begin in late January to mid February and run through May. Outdoor juvenile rearing begins in June and runs through the following April.

The beginning fish size shown of 0.11 grams in mid February is based on the 2008 brood year records for the Oxbow sockeye program. The preliminary schedule shows that the Springfield facility will be managed so that there is approximately a one month period in May when the outdoor raceways can be dewatered and disinfected after brood year A smolts are transferred out and before brood year B fry are transferred in.

3.0 BIOLOGICAL VARIABLES

The primary biological variables used in the preparation of the preliminary operations schedule include water temperature, species specific condition factor, and density and flow indices. The basis of the variable values used in the development of Table 1 are explained below.

3.1 Water Temperature

Water temperature is a primary determining factor in the development and growth rate of fish. The groundwater supply to be used for all stages of incubation and fish rearing will provide relatively constant year round water temperatures. Thermal data loggers deployed by IDFG in February through June of 2007 indicate the water temperatures vary between 9.5 and 10.28 degrees Celsius, and are mostly within a narrow range of 9.6 to 9.8 C. More recent temperature measurements conducted during aquifer test pumping in November 2010 indicate a range of 9.9 to 10.9 degrees C, with an average of 10.4 C. The monthly groundwater temperatures are shown along the top of Table 1 in degrees Centigrade. These temperatures are warmer in the winter and colder in the summer than the natural surface water temperatures that sockeye would experience.

A temperature of 9.5 degrees was used for the winter incubation period and 10 degrees C was used for the early rearing and juvenile rearing periods.

3.2 Expected Growth Rates

The projected monthly growth rate shown in Table 1 is based on a daily growth rate of 0.035 millimeters per Centigrade temperature units (ctu) per day. The growth rate row in Table 1 shows the projected millimeters of fish length increase per month. This growth rate is a management goal that was established to produce fish at no larger than 9 per pound (50 grams each), by the end of April each year. This goal may be difficult to achieve due to the constant temperature groundwater being used for the fish culture at this site. The use of mechanically chilled water early in the rearing cycle will be studied as a potential method of slowing fish growth in a cost effective manner. IDFG has requested the capacity to chill up to 25% of incubation water for control of fish development. The slightly warmer temperatures recorded in 2010 would tend to accelerate fish growth and may require additional chilling of incubation water to achieve target fish size at the release date.

3.3 Fish Weight and Length

The next row down on Table 1 shows cumulative fish length in inches which is determined by adding the growth per month to the fish length at the end of the preceding month. The weight of individual fish in grams is shown in the row below the length. The fish weight is taken from a graph presented in *"Research and Recovery of Snake river Sockeye Salmon – Annual Report 1995-1996"* (Kline and Lamansky 1997).

3.4 Density Index

Density index (DI), is a function of pounds of fish per cubic foot of rearing volume, per inch of fish length: lb. fish/cf volume/length (in.). The density index used for sockeye salmon is typically in the 0.2 to 0.3 range. The following is a summary of DI used at other sockeye facilities:

WDFW General Criteria:	DI=0.3
Okanagan Sockeye Program:	DI=0.56
IDFG Captive Broodstock:	0.5 lb/cf

IDFG staff have agreed to a density index of 0.3 for this project. The density index is then used to calculate the volume of rearing space required in terms of cubic feet. Table 1 shows the rearing volume required at the end of each month as fish size increase from left to right. The total volume is then divided by the cubic foot volume of individual rearing units in order to show the total number of rearing units required.

3.5 Flow Index

Flow index (FI), is a function of pounds of fish/fish length in inches times flow in gallons per minute (gpm). Flow index is an indication of how much oxygen is available for fish metabolism and is adjusted based on the elevation of the project site and water temperature, both of which affect the amount of oxygen in the water supply at saturation. According to Table 8 in Fish Hatchery Management (Piper 1982), the flow index for the Springfield site, at an elevation of 4385 feet and average water temperature of 10 degrees C (50 Degrees F), is recommended to be 1.54. A slightly more conservative flow value of 1.50 is used in Table 1.

Dissolved oxygen levels of 6.0 to 6.7 were measured during the aquifer testing conducted in November 2010. Total dissolved gas pressure was measured at 107%. This indicates that degassing/aeration will be needed to provide water at higher oxygen saturation levels.

4.0 EGG TAKE AND FISH SURVIVAL

In order achieve the 1,000,000 smolt production goal, Table 1 shows an egg take target of 1,157,625. This allows for 95% survival rates for eyed egg to hatch and 95% each for the subsequent early rearing and juvenile rearing phases. Rearing records from similar hatcheries indicates that these survival rates are often exceeded in good years, and are reasonable averages to use when sub-optimal years are factored in.

5.0 INCUBATION AND REARING FACILITIES

This section provides a brief summary of the incubation and rearing flows and volumes shown in Table 1.

5.1 Incubation

Incubator sizing is based on the use of standard Marisource (Heath) trays, configured in 4 tray high stacks. With an initial eyed egg delivery of 1,157,625, and an incubator loading rate of 4000 eggs per incubator tray, a total of 289 trays are required, in a total of 72 stacks. At 5 gpm of water supply to each stack, the total incubator water budget is approximately 360 gpm. The need for chilling incubation water will be studied further during the preliminary design phase.

5.2 Early Rearing

Early rearing is proposed to be accomplished in indoor rectangular troughs, located in the hatchery building, adjacent to the incubation area. Based on the flow and density indices discussed above, Table 1 is showing a total rearing trough volume requirement of 7,443 cubic feet. A total of 16 troughs at 4 feet wide, 42 feet long, and 2.75 feet average depth are proposed. Both incubation and early rearing will utilize either tempered or ambient groundwater water supplies. Table 1 shows the fish being transferred out at approximate size of 2.25 grams, at which point the fish are large enough to be marked during transfer to the outdoor rearing units. This results in a peak early rearing flow of 1,455 gpm in April of each year.

5.3 Juvenile Rearing

Depending on the amount of chilled water used during incubation, at some point between late March and early May, juvenile fish will be moved from the indoor rearing troughs into outdoor raceways where they will be held for approximately 12 months, to a target release size of 9 to10 fish per pound. Table 1 shows a total rearing volume 56,140 cubic feet based on a density index of 0.3. Twenty four 2,560 cubic foot raceways, with rearing area dimensions of 8 feet wide, 80 feet long and 4 feet average depth, are proposed. A minimum of 22 raceways would be required for holding an entire brood year of production. Two extra raceways are recommended to provide space for marking fish and to provide space for holding the initial batches of fish from the successive brood year, which may need to be transferred outdoors before the preceding brood year smolts are transferred out.

5.4 Peak Water Demand

Table 1 shows a peak flow of 26.2 cfs (11,783 gpm), to outdoor rearing for a given brood year, and a concurrent demand of 2.4 cfs (1077 gpm), for early rearing supply to the successive brood year in April of each year, for a total peak demand of 28.6 cfs. This flow rate will be used for sizing the process water production and delivery components, including pumps, aeration/degassing headboxes, and piping systems.

Table 1 - PRELIMINARY BIOPROGRAM AND APPROXIMATE HATCHERY OPERATION SCHEDULE - 1.0M SMOLT OPTION

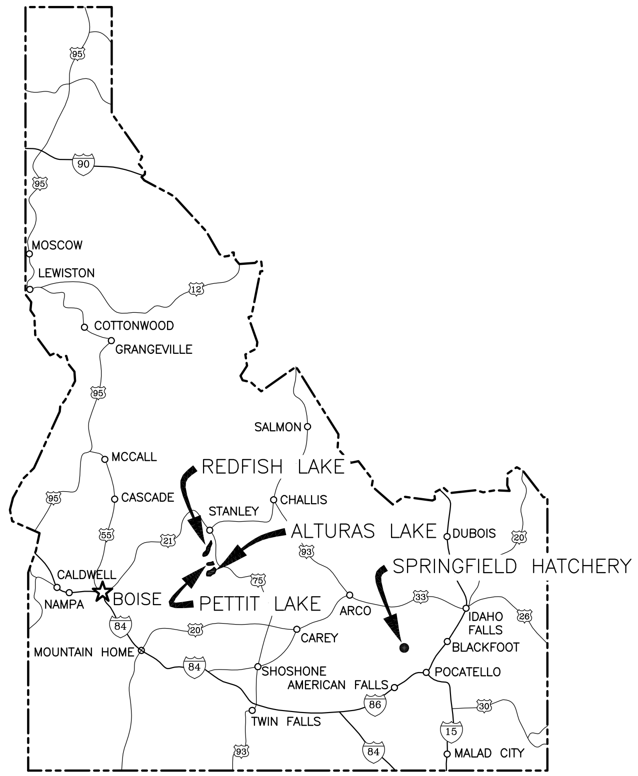
Springfield Hatchery - Snake River Sockeye Program

12-Nov-10

Item	Value	Unit	Note	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
SOCKEYE SMOLT PRODUCTION																													
Egg Take - Green to Eyed Egg Period						xfr in eyed eggs Nov 15												xfr in eyed eggs Nov 15											
On Station Incubation - Eyed Eggs xfr in Nov 15 at 400 CTU																													
Brood Year A Early Rearing in Troughs													Mark and Xfr by May 31																
Brood Year A Juvenile Rearing in R/W's																								Xfr out May 1					
Brood Year B Early Rearing in Troughs																									Mark and Xfr by May 31				
Brood year B Juvenile Rearing in R/W's																													
Groundwater (Incubation/Early Rearing Water Temps- Degrees C)				10	10	10	9.5	9.5	9.5	10	10	10	10	10	10	10	10	10	9.5	9.5	9.5	10	10	10	10	10	10	10	10
Groundwater (Outdoor Rearing Average Temps- Degrees C)				10	10	10	9.5	9.5	9.5	10	10	10	10	10	10	10	10	10	9.5	9.5	9.5	10	10	10	10	10	10	10	10
Expected Growth Rate (mm/month)	**0.035**	mm/ctu/day							4.99	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	9.975	9.975	9.975	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Fish Length (Inches) - Start Mid Feb at .11 gr.									1.10	1.51	1.92	2.34	2.75	3.16	3.58	3.99	4.40	4.82	5.21	5.60	5.99	6.41	6.82						
Fish Weight- per Piper (grams)	**At End of Month**								0.18	0.47	1.34	2.2	3.5	6.16	8	11	15.5	19	23	30	36	40	52						
Fish Size at Transfer-200/lb, Mark during xfr to reduce handling												2.25																	
Brood Year A Cubic Feet Raceways Req'd at DI=0.3													9344.9	14298	16422	20241	25844	28961.1	32415.4	39317.02	44089.7	45828.5	55966.78						
Brood Year A Raceways Req'd at 2560 cf each													3.7	5.6	6.4	7.9	10.1	11.3	12.7	15.4	17.2	17.9	21.9						
Brood Year B Cubic Feet Raceways Req'd at DI=0.3																									9344.9	14298	16422.3	20241.2	25844.14
Brood Year B Raceways Req'd at 2560 cf each																									3.7	5.6	6.4	7.9	10.1
Total Rearing Raceways Req'd													3.7	5.6	6.4	7.9	10.1	11.3	12.7	15.4	17.2	17.9	21.9		3.7	5.6	6.4	7.9	10.1
SMOLT PRODUCTION	**1,000,000**	at 9 fpp max.																											
Incubation - In heath trays																													
# of eyed eggs delivered	**1157625**																												
# at hatch	**1102500**																												
Eggs per tray	**4000**																												
# of trays	**289**																												
# of stacks at	**4**	*trays/stack*				72	72	72										72	72	72									
Total Flow (gpm)	**5**	*gpm/stack*				362	362	362										362	362	362									
Early Rearing - In (18)	**18**	*4'x40'x2.6' d (416 cf) troughs*																											
Size at transfer in	**0.18**	*gr*	*Per Oxbox data*																										
Size at transfer out	**2.25**	*gr.*	*Per IDFG*																										
# at transfer out	**1050000**	*95%*	*survival*																										
Total Weight at transfer to R/W's	**5204**	*lb.*																											
Rearing Trough Volume lb/(DxL)	**7424**	*cf*	*Per Piper*																										
Check Density at transfer-lbs./cf/in.	**0.30**	*lb/cf/inch*	*Per IDFG*																										
Peak Flow end of Month	**1452**	*gpm*							253	480	1074	1452									253	480	1074	1452					
Check Flow Index lb/in. x gpm	**1.53**	*Actual*	*Per Piper*																										
Brood Year A Juvenile Rearing - In 8' x 80' x 4'd Raceways																													
Size at release	**52.0**	*gr*	*Per IDFG*																										
# at release	**1000000**	*95%*	*survival*																										
Total Weight at transfer Out	**114537**	*lb.*																											
Raceway Volume per Piper: lb/(DxL)	**55967**	*cf*	*Per Piper*																										
Check Density at transfer-lbs./cf/in.	**0.30**	*lb/cf/inch*	*Verify Target*																										
Peak Flow (gpm) per Piper FI=1.50	**11753**	*gpm (End of Month)*											1962	3003	3449	4251	5427	6082	6807	8257	9259	9624	11753						
Brood Year B Juvenile Rearing - In 8' x 80' x 4'd Raceways																													
Peak Flow (gpm) per Piper FI=1.50		*End of Month*																							1962	3003	3449	4251	5427
TOTAL FLOW - Groundwater Water-Indoors						362	362	362	253	480	1074	1452						362	362	362	253	480	1074	1452					
TOTAL FLOW - Groundwater Water -Indoors(cfs)						0.81	0.81	0.81	0.56	1.07	2.39	3.23						0.81	0.81	0.81	0.56	1.07	2.39	3.23					
TOTAL FLOW - Groundwater (gpm)						362	362	362	253	480	1074	1452	1962	3003	3449	4251	5427	6444	7169	8618	9512	10104	12827	1452	1962	3003	3449	4251	5427
TOTAL FLOW - Groundwater (cfs)						0.81	0.81	0.81	0.56	1.07	2.39	3.23	4.4	6.7	7.7	9.5	12.1	14.4	16.0	19.2	21.2	22.5	28.6	3.23	4.4	6.7	7.7	9.5	12.1

IDAHO DEPARTMENT OF FISH AND GAME

SPRINGFIELD HATCHERY MASTER PLAN



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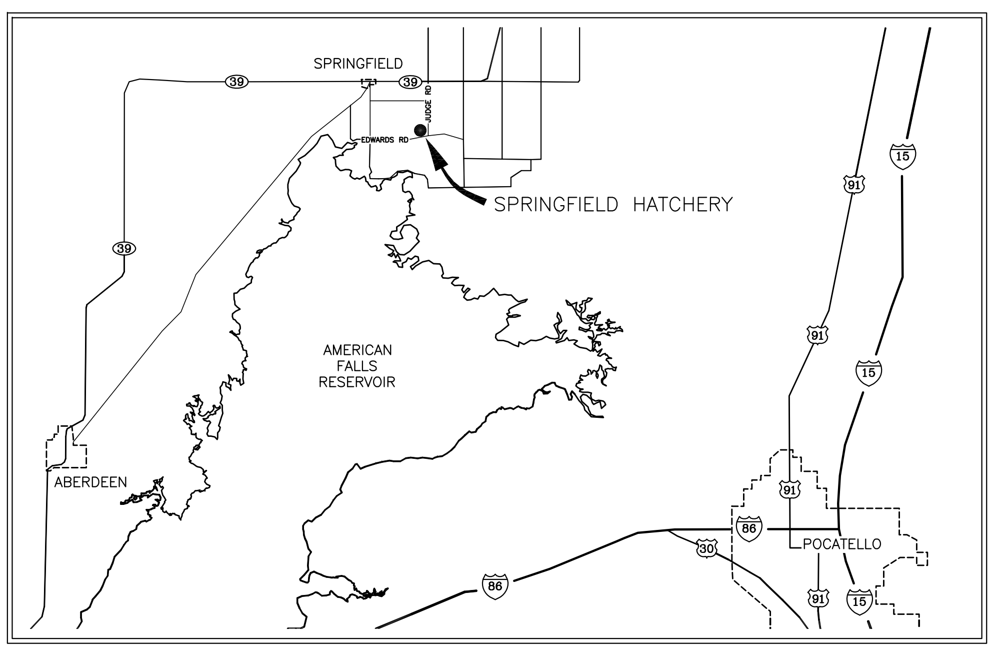
LOCATION MAP
NTS



N

VICINITY MAP
NTS

INDEX OF DRAWINGS

DRAWING NUMBER	DRAWING TITLE
	COVER SHEET
MP–1	LOCATION MAP, VICINITY MAP AND INDEX OF DRAWINGS
MP–1.1	OVERALL EXISTING SITE PLAN
MP–2	CONCEPTUAL HYDRAULIC PROFILE
MP–3	NORTH SITE DEMOLITION PLAN
MP–4	STANDARD SYMBOLS AND DESIGN CRITERIA
MP–5	NORTH SITE PROPOSED SITE PLAN
MP–6	ENLARGED SITE PLAN
MP–7	OUTDOOR RACEWAYS PLAN AND SECTION
	ELECTRICAL
MP–8	NORTH SITE ELECTRICAL PLAN
MP–9	SINGLE LINE

REV	DATE	BY	DESCRIPTION

WARNING

0 1/2 1

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

McMILLEN, LLC

1401 SHORELINE DRIVE
SUITE 100
BOISE, ID 83702

OFFICE: 208.342.4214
FAX: 208.342.4216

IDAHO DEPARTMENT OF FISH AND GAME

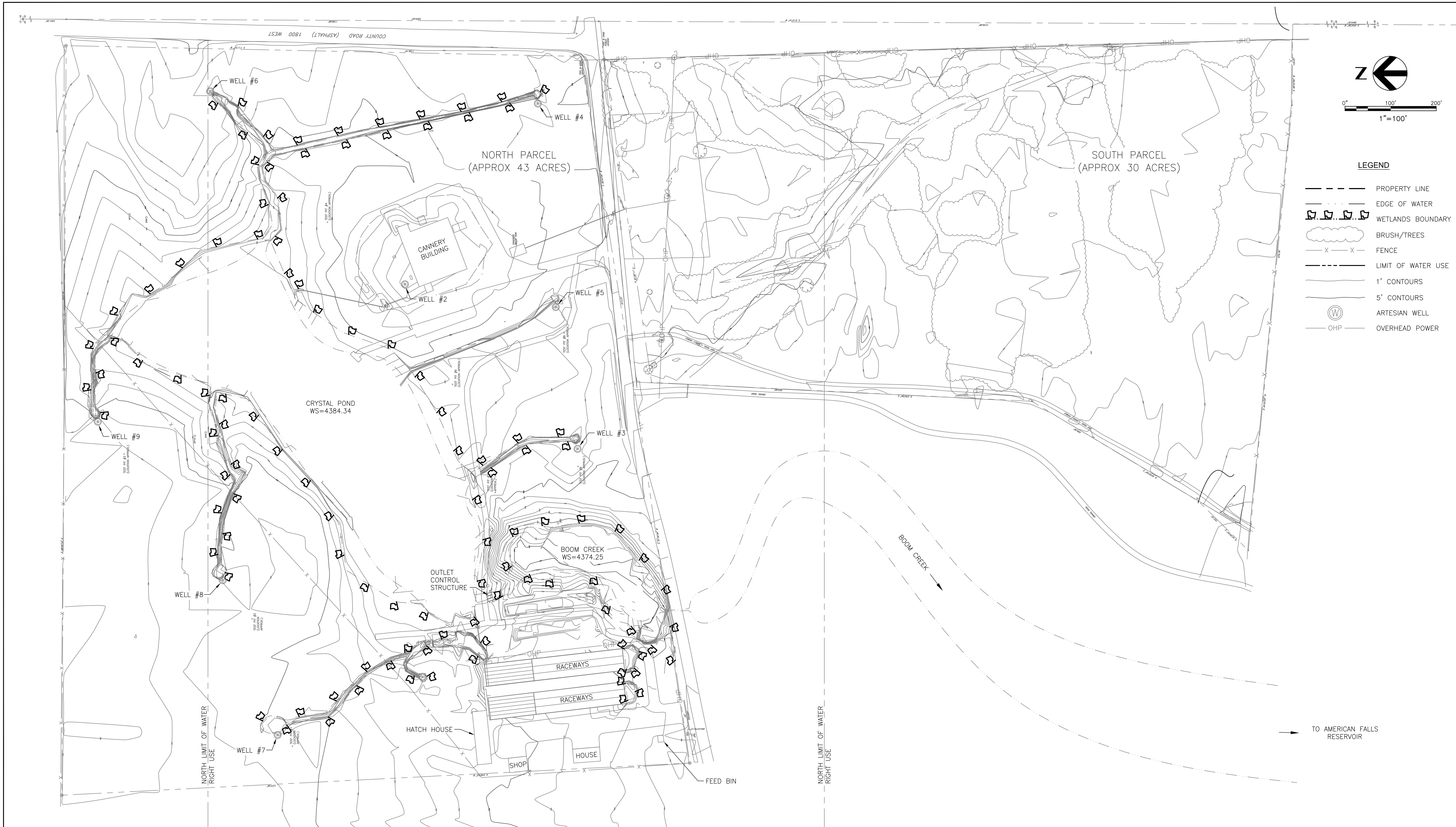
SPRINGFIELD HATCHERY MASTER PLAN

LOCATION MAP, VICINITY MAP AND INDEX OF DRAWINGS

DESIGNED MCR
DRAWN DL
CHECKED MCM
ISSUED DATE NOV 2010

DRAWING
MP-1
Sheet 01 of XX

SCALE: NONE



REV	DATE	BY	DESCRIPTION

WARNING

0 1/2 1

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McMILLEN, LLC

1401 SHORELINE DRIVE
SUITE 100
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IDAHO DEPARTMENT OF FISH AND GAME

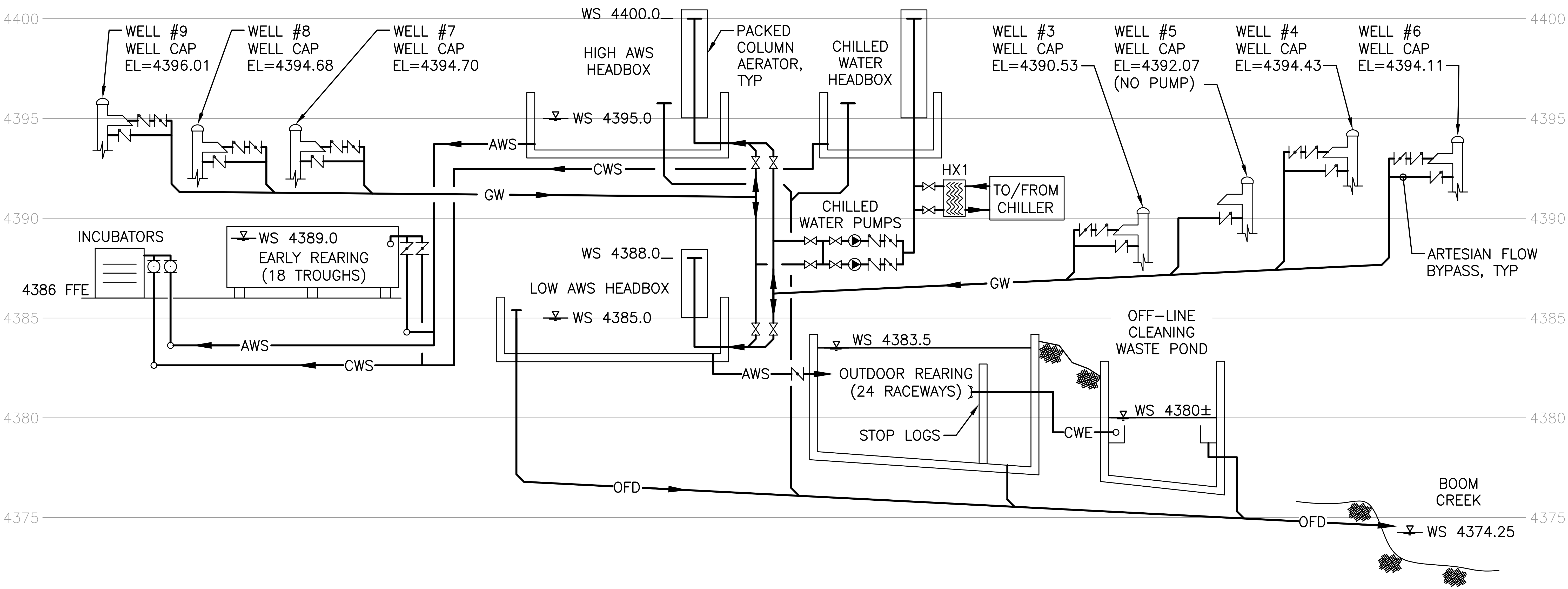
SPRINGFIELD HATCHERY MASTER PLAN

OVERALL EXISTING SITE PLAN

DESIGNED MCR
DRAWN DL
CHECKED MCM
ISSUED DATE NOV 2010

DRAWING
MP-1.1
Sheet 02 of XX

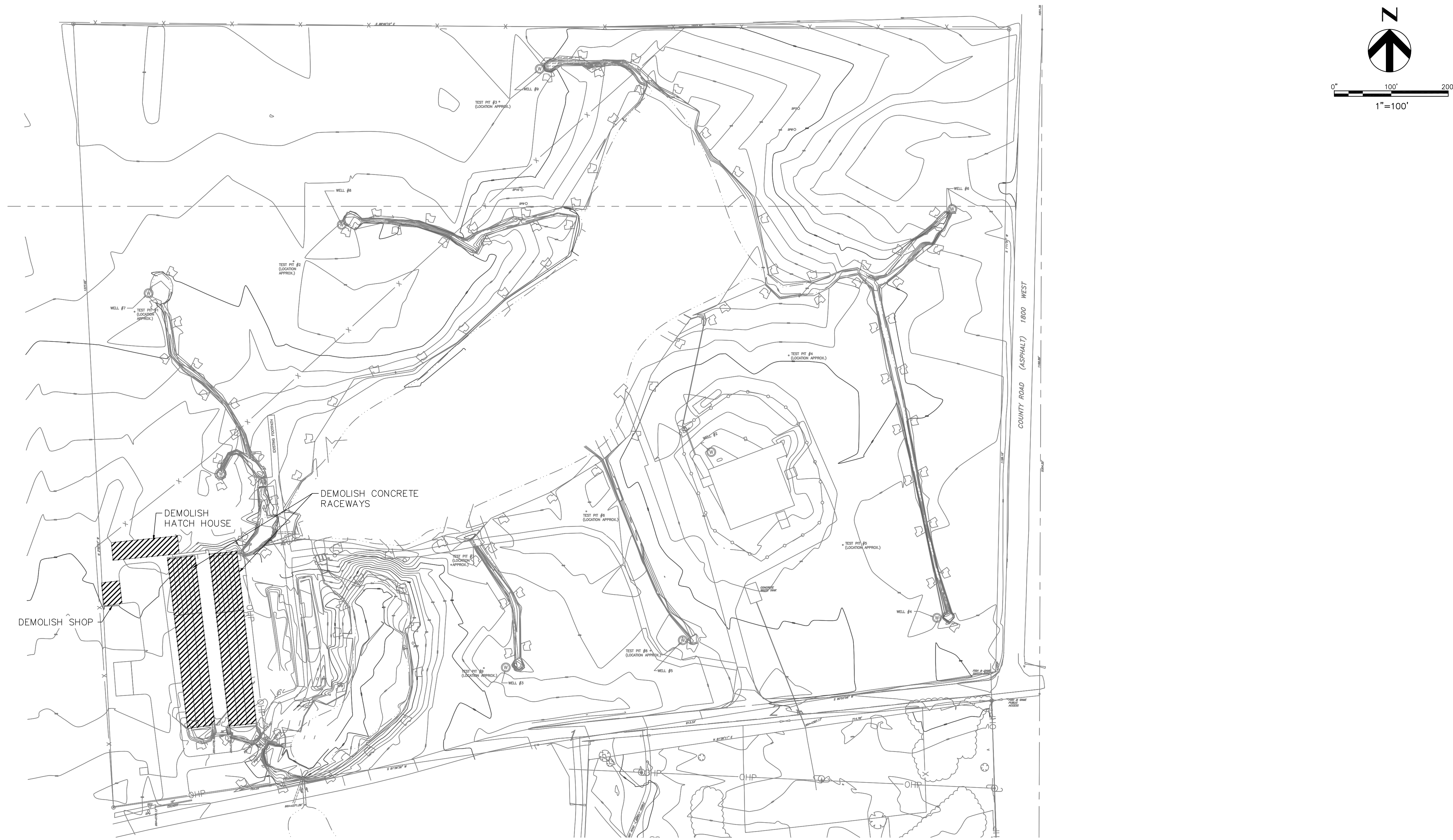
SCALE: 1"=100'



CONCEPTUAL HYDRAULIC PROFILE

SCALE: NTS

MCMILLEN, LLC THE SONNA BUILDING 910 MAIN ST. SUITE 258 OFFICE: 208.342.4214 BOISE, ID 83702 FAX: 208.342.4216	IDAHO DEPARTMENT OF FISH AND GAME SPRINGFIELD HATCHERY MASTER PLAN CONCEPTUAL HYDRAULIC PROFILE	MP-2 NOV 2010



REV	DATE	BY	DESCRIPTION

WARNING

0 1/2 1

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

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SUITE 100
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IDAHO DEPARTMENT OF FISH AND GAME

SPRINGFIELD HATCHERY MASTER PLAN

NORTH SITE DEMOLITION PLAN

DESIGNED MCR

DRAWN DL

CHECKED MCM

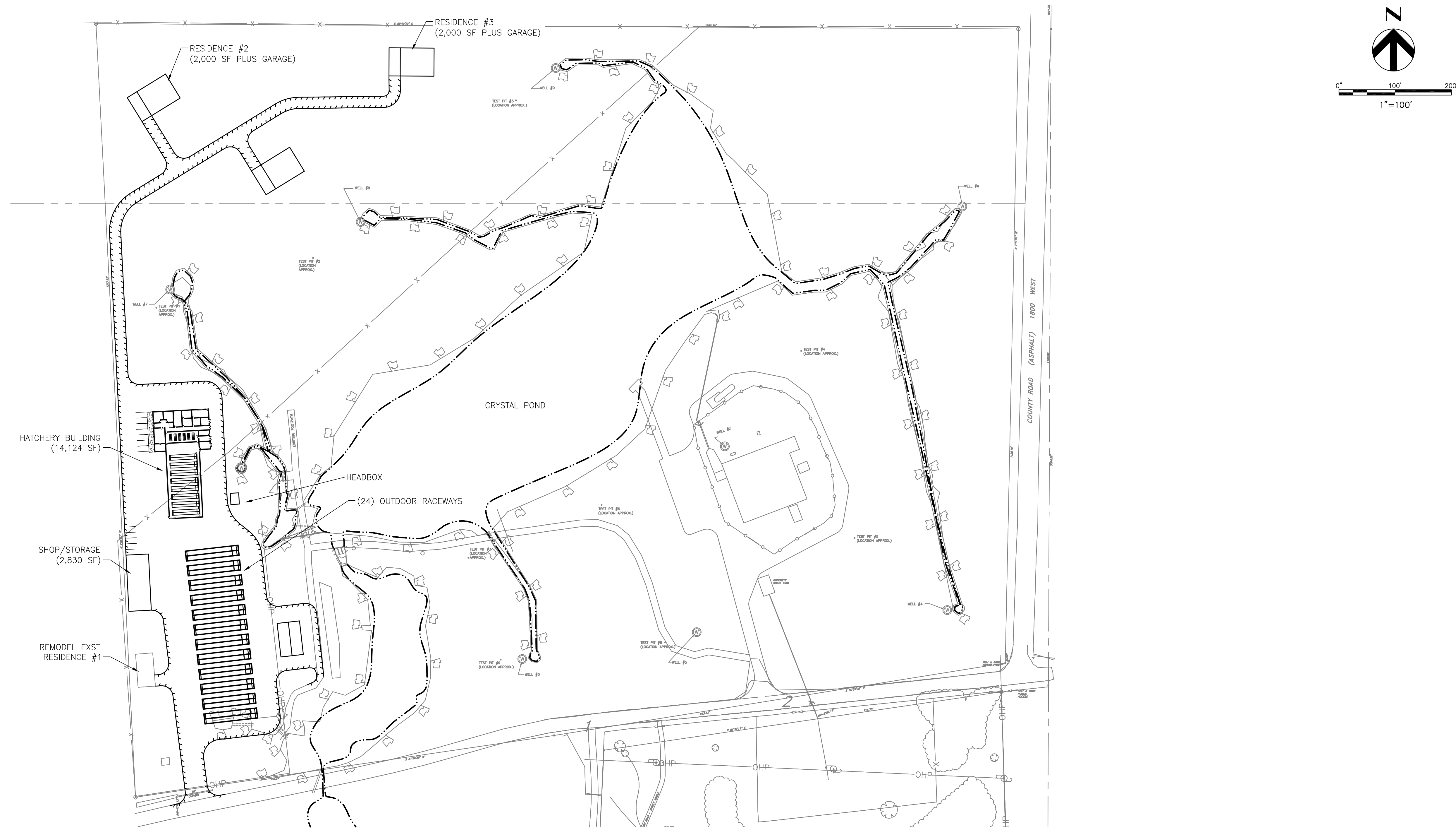
ISSUED DATE NOV 2010

DRAWING

MP-3

Sheet 04 of XX

SCALE: 1"=100'



REV	DATE	BY	DESCRIPTION

WARNING

0 1/2 1

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IDAHO DEPARTMENT OF FISH AND GAME

SPRINGFIELD HATCHERY MASTER PLAN

NORTH SITE PROPOSED SITE PLAN

DESIGNED MCR

DRAWN DL

CHECKED MCM

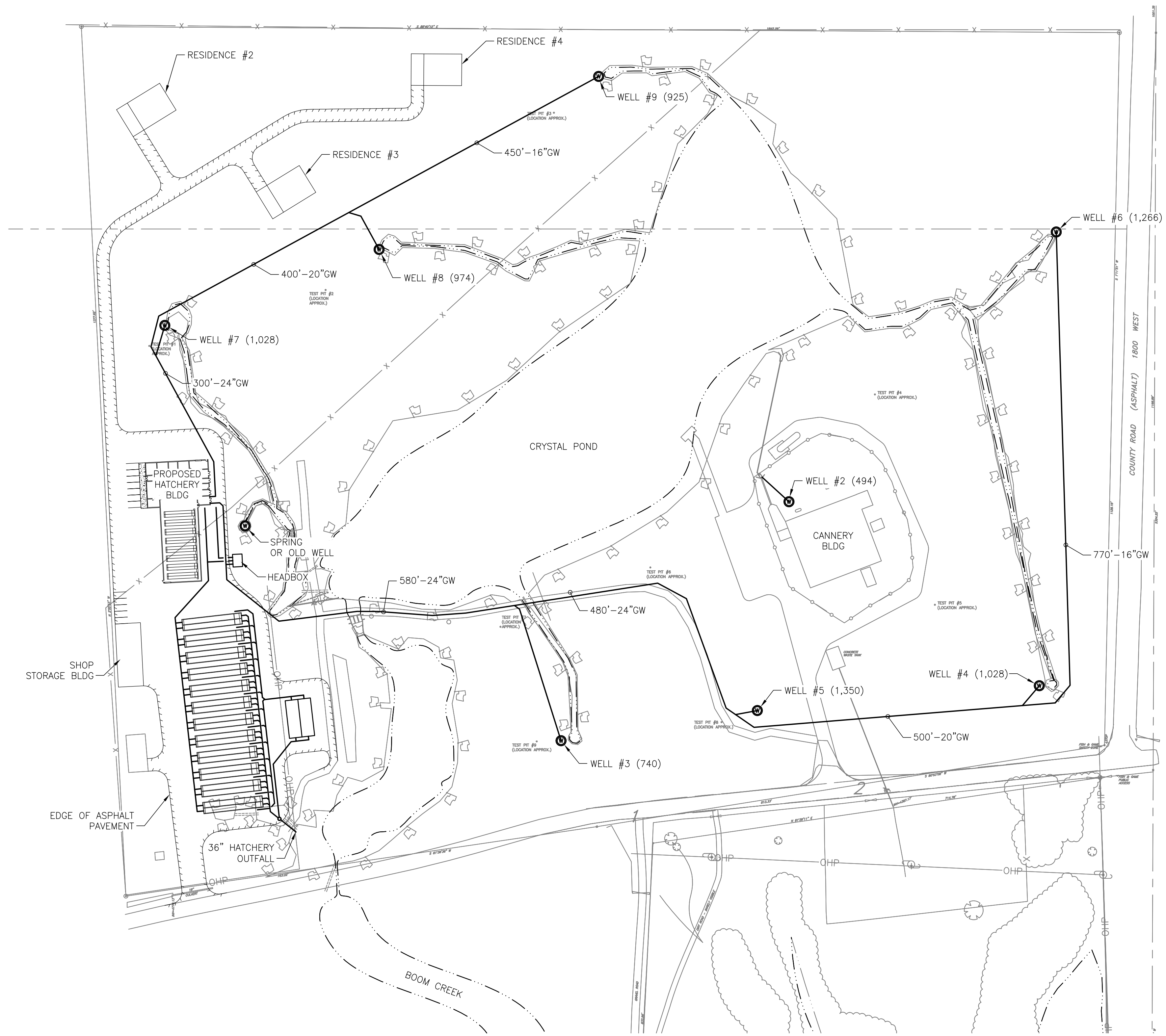
ISSUED DATE NOV 2010

DRAWING

MP-4

Sheet 05 of XX

SCALE: 1"=100'



N

0' 100' 200'
1"=100'

FLOW LEGEND

WELL #X (XXX)
ESTIMATED ARTESIAN FLOW

REV	DATE	BY	DESCRIPTION

WARNING
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

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1401 SHORELINE DRIVE
SUITE 100
BOISE, ID 83702
OFFICE: 208.342.4214
FAX: 208.342.4216

IDAHO FISH & GAME

IDAHO DEPARTMENT OF FISH AND GAME
SPRINGFIELD HATCHERY MASTER PLAN
NORTH SITE PIPING PLAN

DESIGNED MCR
DRAWN DL
CHECKED MCM
ISSUED DATE NOV 2010

DRAWING
MP-5
Sheet 06 of XX
SCALE: 1"=100'

REV	DATE	BY	DESCRIPTION

WARNING

0 1/2 1

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1401 SHORELINE DRIVE
SUITE 100
BOISE, ID 83702
OFFICE: 208.342.4214
FAX: 208.342.4216

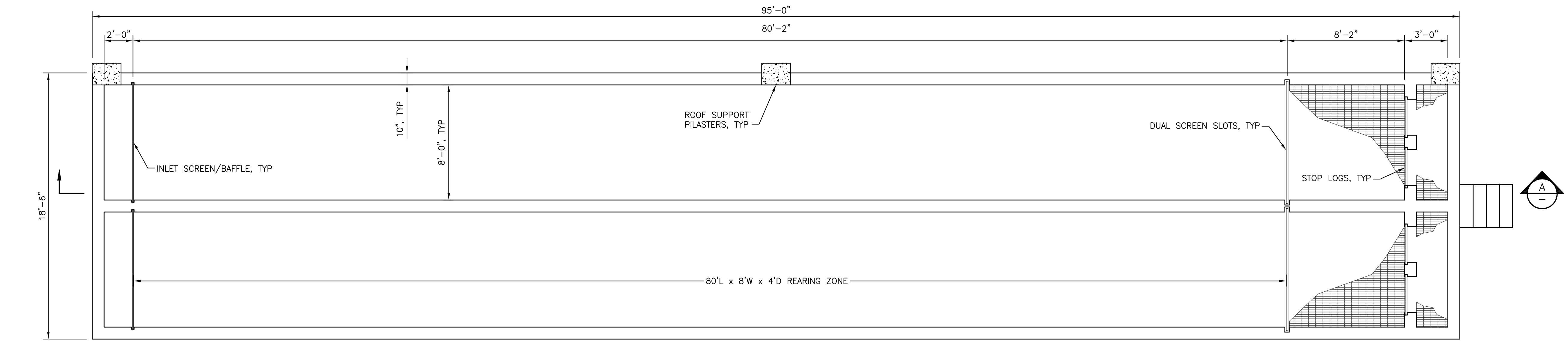
IDAHO DEPARTMENT OF FISH AND GAME

SPRINGFIELD HATCHERY MASTER PLAN

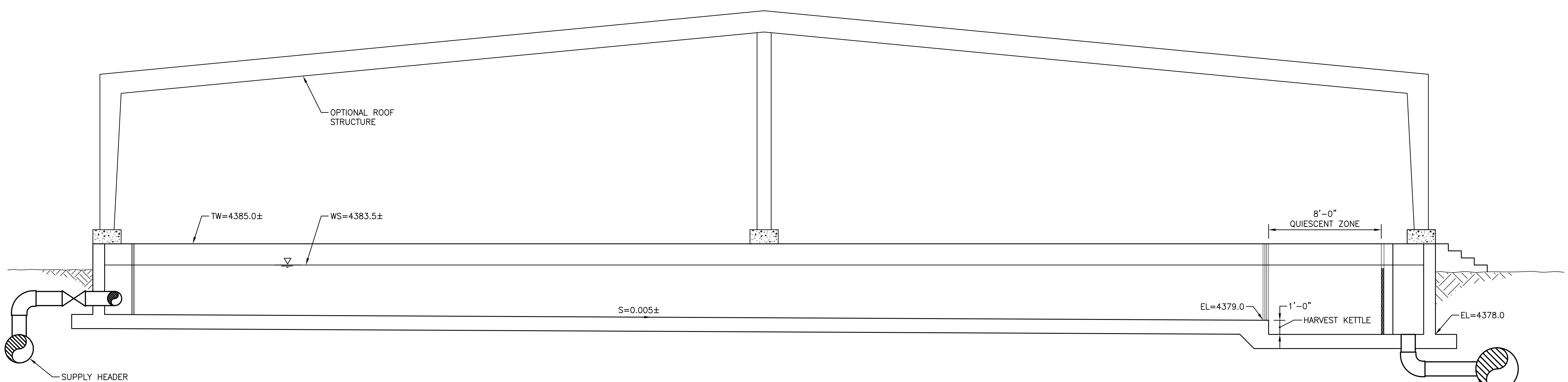
ENLARGED SITE PLAN

DESIGNED MCR
DRAWN DL
CHECKED MCM
ISSUED DATE NOV 2010

DRAWING
MP-6
Sheet 07 of XX
SCALE: 1"=50'



PLAN
SCALE: 1/4"=1'-0"



SECTION A
SCALE: 1/4"=1'-0"

N
0' 4' 8'
1/4"=1'-0"

REV	DATE	BY	DESCRIPTION

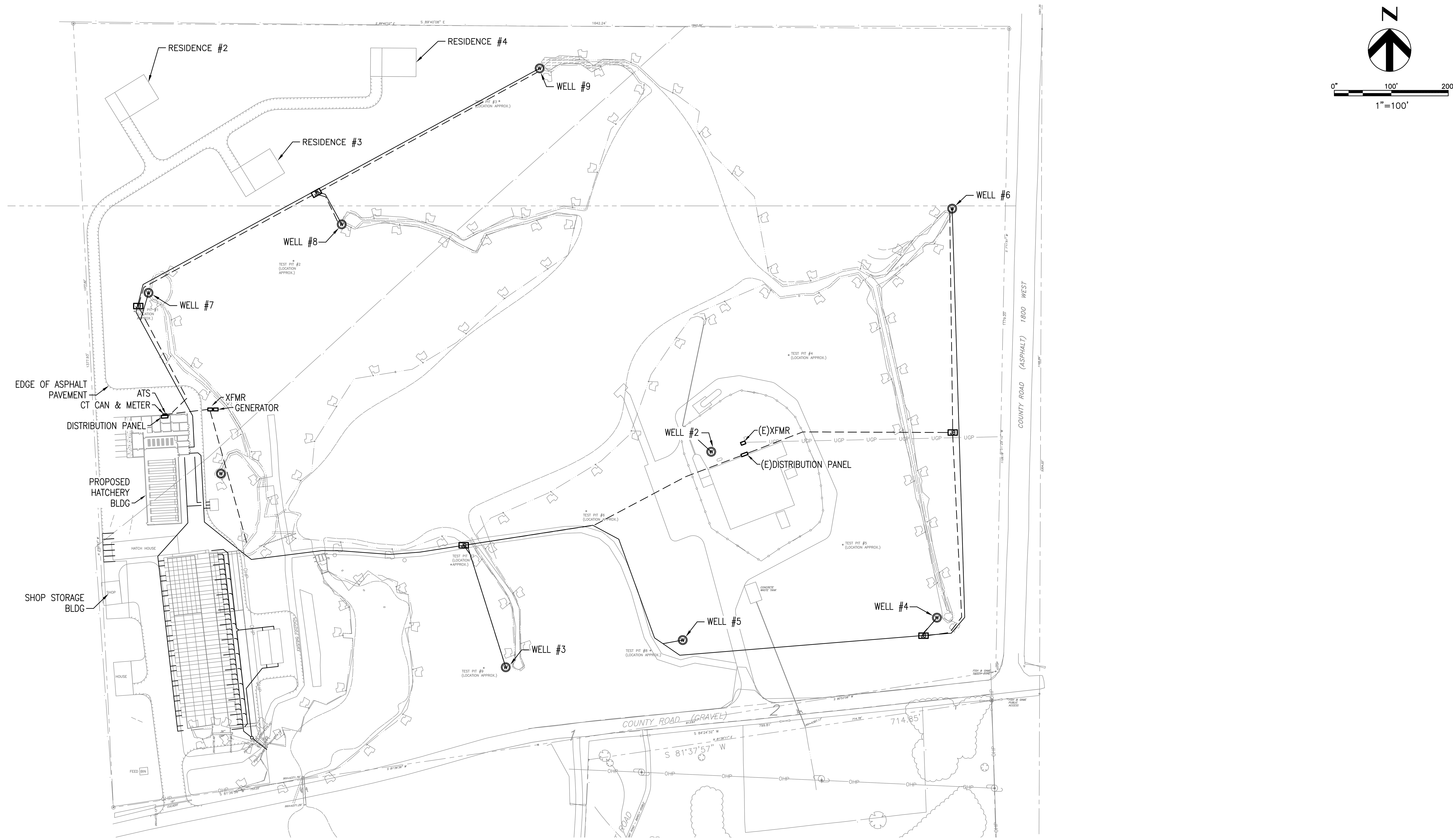
WARNING
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

McMILLEN, LLC
1401 SHORELINE DRIVE
SUITE 100
BOISE, ID 83702
OFFICE: 208.342.4214
FAX: 208.342.4216

IDAHO DEPARTMENT OF FISH AND GAME
SPRINGFIELD HATCHERY MASTER PLAN
OUTDOOR RACEWAYS PLAN AND SECTION

DESIGNED MCR
DRAWN DL
CHECKED MCM
ISSUED DATE NOV 2010

DRAWING
MP-7
Sheet 08 of XX
SCALE: 1/4"=1'-0"



REV	DATE	BY	DESCRIPTION

WARNING

0 1/2 1

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MCMILLEN, LLC

THE SONNA BUILDING
910 MAIN ST. SUITE 258
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DC ENGINEERING
440 East Corporate Dr., Ste. 103
Meridian ID 83642
ph 208-288-2181
fax 208-288-2182
project 10MCM11

IDAHO DEPARTMENT OF FISH AND GAME

SPRINGFIELD HATCHERY MASTER PLAN

NORTH SITE ELECTRICAL PLAN

DESIGNED__________

DRAWN__________

CHECKED__________

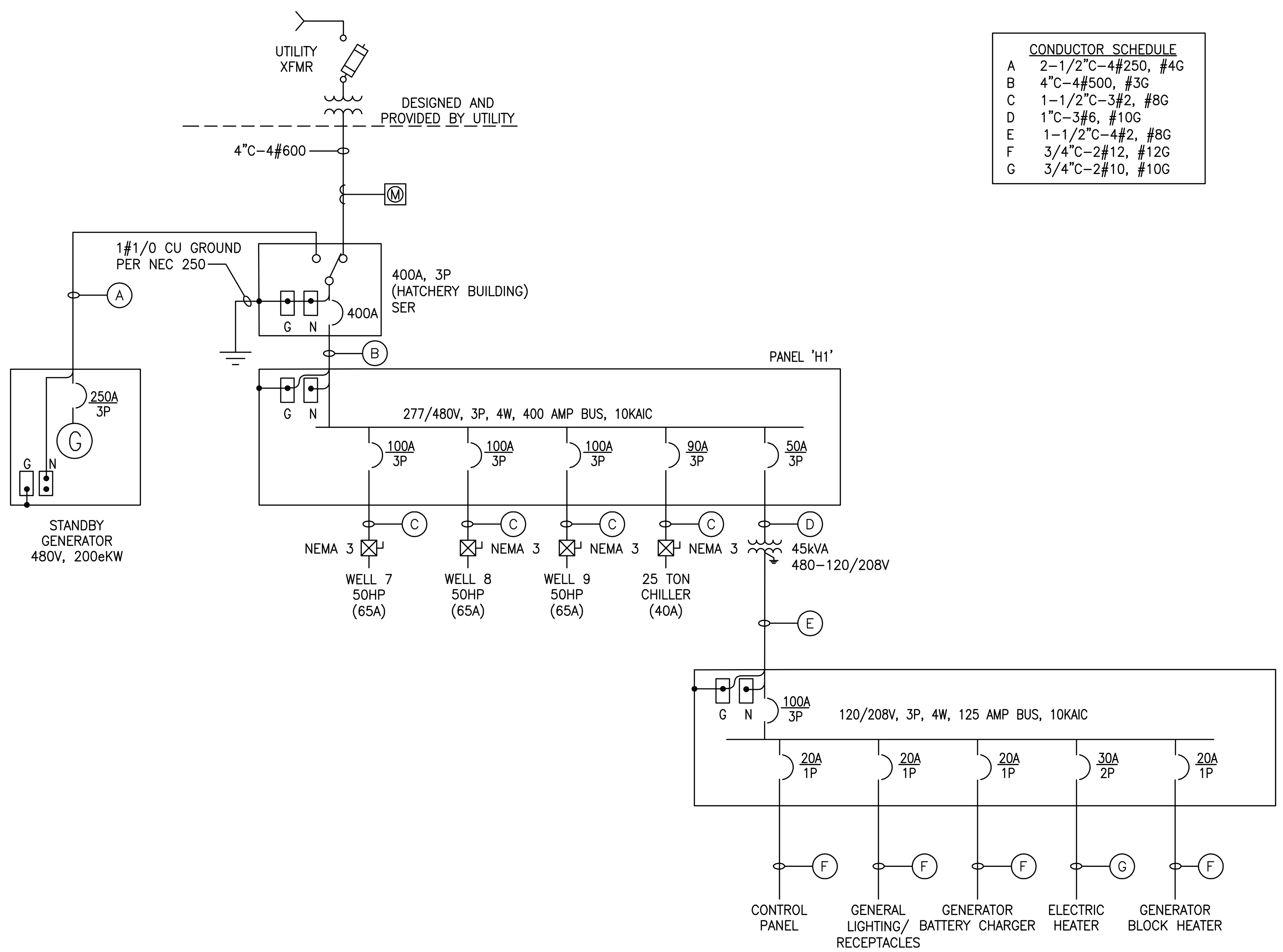
ISSUED DATE__________

DRAWING

MP-8

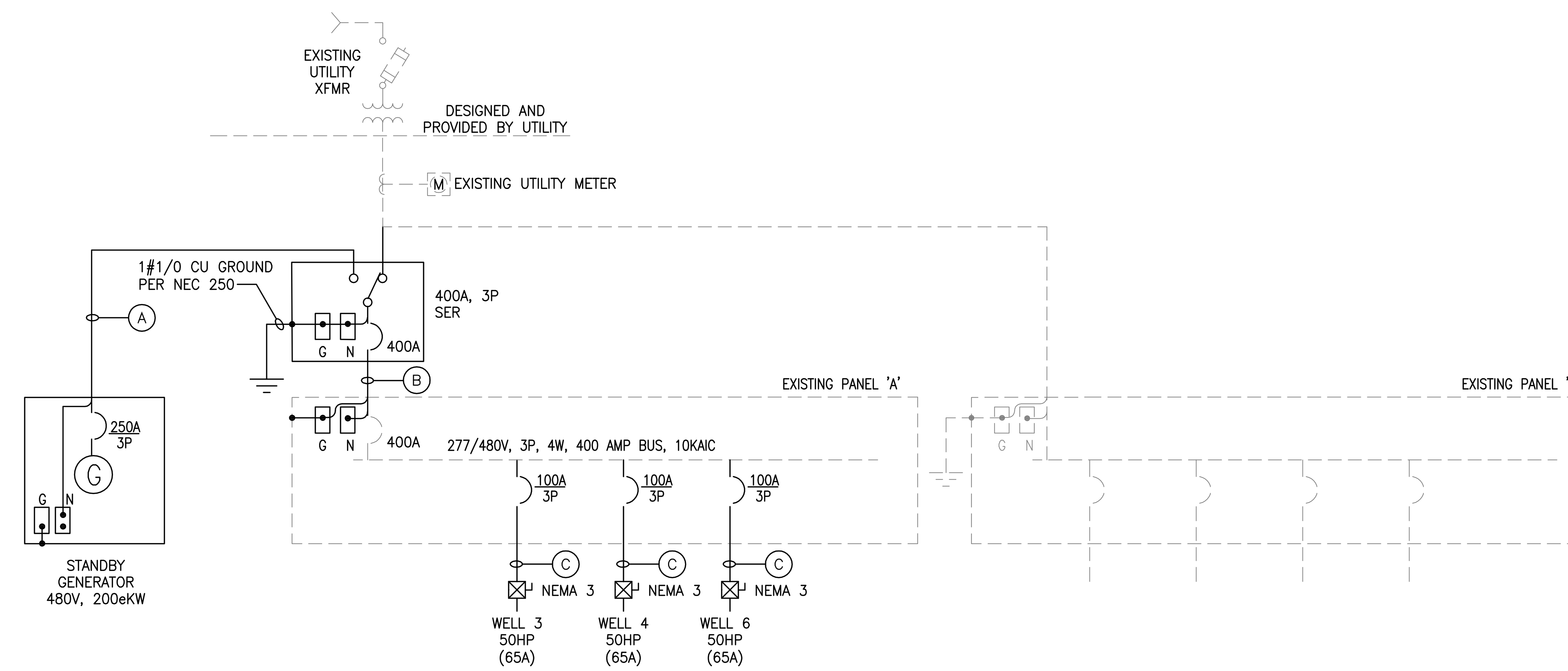
05

SCALE: 1"=100'



CONDUCTOR SCHEDULE	
A	2-1/2"C-4#250, #4G
B	4"C-4#500, #3G
C	1-1/2"C-3#2, #8G
D	1"C-3#6, #10G
E	1-1/2"C-4#2, #8G
F	3/4"C-2#12, #12G
G	3/4"C-2#10, #10G

HATCHERY BUILDING SINGLELINE
SCALE: N.T.S.
1 MP-9



SOUTHERLY WELL PUMPS SINGLELINE
SCALE: N.T.S.
2 MP-9

REV | DATE | BY | DESCRIPTION

WARNING
0 1/2 1
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MCMILLEN, LLC
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fax 208-288-2182
project 10MCM11

IDAHO DEPARTMENT OF FISH AND GAME
SPRINGFIELD HATCHERY MASTER PLAN
SINGLE LINE

DESIGNED
DRAWN
CHECKED
ISSUED DATE

DRAWING
MP-9
05
SCALE: 1"=100'

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Appendix E

Detailed Cost Estimates for the Springfield Hatchery

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Appendix E: Estimated Construction Costs (Detailed) by Division

Item	Quantity	Unit	Unit Cost	Subtotal	Contingency	Total Estimated Cost
Division 01 – General Requirements						
Mobilization/Demobilization, Bond, Insurance, etc.	1	%	0.1	$1,128,135	25%	$1,410,169
Division 02 – Existing Conditions						
Demolition of Existing Structures	1	LS	$30,000	$30,000	25%	$37,500
Dewatering	1	LS	$50,000	$50,000	25%	$62,500
Division 03 – Concrete						
Concrete in Place – Hatchery Floor Slab – 5" thick	212	CY	$500	$106,000	10%	$116,600
Concrete in Place – Wall Footings	50	CY	$500	$25,000	10%	$27,500
Concrete in Place – Raceway Walls	1,298	CY	$850	$1,103,300	10%	$1,213,630
Concrete in Place – Raceway Slabs	1,800	CY	$500	$900,000	10%	$990,000
Concrete in Place – Utility Building Floor Slab	50	CY	$850	$42,500	10%	$46,750
Concrete in Place – Well House Floor Slabs (6)	48	CY	$500	$24,000	10%	$26,400
Concrete in Place – Floor Trench	40	CY	$850	$34,000	10%	$37,400
Concrete in Place – OLSB Walls	35	CY	$850	$29,750	10%	$32,725
Concrete in Place – OLSB Slabs	85	CY	$500	$42,500	10%	$46,750
Headbox Slab	15	CY	$500	$7,500	10%	$8,250
Headbox Walls	25	CY	$650	$16,250	10%	$17,875
Division 04 – Masonry						
(NOT USED)						
Division 05 – Metals						
Metal Building – Hatchery	13,620	SF	$100	$1,362,000	25%	$1,702,500
Metal Building – Shop/Storage	2,830	SF	$75	$212,250	25%	$265,313
Metal Roof at Outdoor Raceways	28,500	SF	$40	$1,140,000	25%	$1,425,000
Predator Fence and Gates at Raceways	1	LS	$50,000	$50,000	25%	$62,500
Grating For Floor Trenches (Galv)	550	SF	$35	$19,250	25%	$24,063
Rearing Trough Screens (Alum)	650	SF	$25	$16,250	25%	$20,313
Hand Railing (Galv)	450	LF	$45	$20,250	25%	$25,313
Raceway Screens (Alum)	2,000	SF	$20	$40,000	25%	$50,000
High Level Headbox (Alum)	1	LS	$25,000	$25,000	25%	$31,250
48-inch Vacuum Degassers	5	EA	$8,000	$40,000	25%	$50,000
Raceway Screen and Stop Log Guide Embeds	1,500	LF	$15	$22,500	25%	$28,125
Gratings at end of Raceways	720	SF	$35	$25,200	25%	$31,500

Item	Quantity	Unit	Unit Cost	Subtotal	Contingency	Total Estimated Cost
Division 06 – Wood and Plastic						
Stop Logs	1	LS	$5,000	$5,000	10%	$5,500
Division 07 – Thermal and Moisture Protection						
Insulation – Hatchery	13,620	SF	$16	$217,920	25%	$272,400
Insulation – Shop/Storage	2,850	SF	$16	$45,600	25%	$57,000
Separation Panels at Incubation/Early Rearing	2,500	SF	$3	$7,500	25%	$9,375
Division 08 – Openings						
Doors	30	EA	$500	$15,000	25%	$18,750
Overhead Doors	5	EA	$3,000	$15,000	25%	$18,750
Windows	1	LS	$30,000	$30,000	25%	$37,500
Vents and Louvers	1	LS	$15,000	$15,000	25%	$18,750
Division 09 – Finishes						
Floor Sealant	10,000	SF	$0.20	$2,000	25%	$2,500
Interior Walls – Hatchery	7,500	SF	$20	$150,000	25%	$187,500
Interior Walls – Shop/Storage	1,400	SF	$20	$28,000	25%	$35,000
Misc. Painting	1	LS	$25,000	$25,000	25%	$31,250
Division 10 – Specials						
Remodel Residence #1	1	EA	$30,000	$30,000	25%	$37,500
New Residences	3	EA	$200,000	$600,000	25%	$750,000
Well Houses	6	EA	$25,000	$150,000	25%	$187,500
Division 11 – Equipment						
Well Pumps – 50 to 60 hp	6	EA	$30,000	$180,000	25%	$225,000
FRP Early Rearing Troughs	18	EA	$8,000	$144,000	10%	$158,400
Marisource Incubators 4 Tray Modules	72	EA	$700	$50,400	10%	$55,440
Walk-in Freezer	1	LS	$15,000	$15,000	10%	$16,500
Chiller – 25 tons	1	LS	$75,000	$75,000	25%	$93,750
Flow Meters	8	EA	$4,000	$32,000	25%	$40,000
Chem. Feed System	1	LS	$15,000	$15,000	10%	$16,500
Chem. Storage Secondary Containment	1	LS	$2,000	$2,000	10%	$2,200
Division 22 – Plumbing						
Domestic Water Plumbing and Fixtures – Hatchery	1	LS	$30,000	$30,000	25%	$37,500
Domestic Water Plumbing and Fixtures – Shop	1	LS	$7,000	$7,000	25%	$8,750
Sanitary Plumbing and Fixtures – Hatchery	1	LS	$50,000	$50,000	25%	$62,500
Floor Drains – Shop Storage	1	LS	$5,000	$5,000	25%	$6,250

Item	Quantity	Unit	Unit Cost	Subtotal	Contingency	Total Estimated Cost
Division 23 – Heating, Ventilating and AC						
Heat and Ventilate Hatchery Building	13,620	SF	$8	$108,960	25%	$136,200
Office Air Conditioning	1,000	SF	$4	$4,000	25%	$5,000
Heat and Ventilate Shop/Storage Building	2,830	SF	$8	$22,640	25%	$28,300
Heat and Ventilate Well Houses	6	EA	$3,000	$18,000	25%	$22,500
Division 26 – Electrical						
Building Power and Lighting	16,450	SF	$8	$131,600	25%	$164,500
Power to Well Pumps	6	EA	$25,000	$150,000	25%	$187,500
Yard Lighting	1	LS	$20,000	$20,000	25%	$25,000
Emergency Generator	1	LS	$100,000	$100,000	25%	$125,000
Division 31 – Earthwork						
Site Clearing	1	Acre	$10,000	$10,000	20%	$12,000
Earthwork Cut and Fill	1,500	CY	$20	$30,000	20%	$36,000
Structural Backfill & Compaction	950	CY	$25	$23,750	20%	$28,500
Erosion Control Facility	1	LS	$30,000	$30,000	20%	$36,000
Erosion Control Drain Line	1	LS	$15,000	$15,000	20%	$18,000
Roadway Base (1-1/2" Gravel)	2,000	CY	$16	$32,000	20%	$38,400
Roadway Top Fill (3/4" Gravel)	500	CY	$25	$12,500	20%	$15,000
Division 32 – Exterior Improvements						
Bollards	16	EA	$500	$8,000	20%	$9,600
3" Hot Mix Asphalt	7,700	SY	$25	$192,500	20%	$231,000
Concrete Paving	20	SY	$35	$700	20%	$840
Division 33 – Utilities						
Power Service	1	LS	$50,000	$50,000	20%	$60,000
Communications Upgrade	1	LS	$15,000	$15,000	20%	$18,000
Water Pump, Pressure Tank and Distribution	1	LS	$33,000	$33,000	20%	$39,600
Sanitary Drainfields	4	EA	$10,000	$40,000	20%	$48,000
Division 40 – Instrumentation and Controls						
Facility Monitoring and Controls	1	LS	$200,000	$200,000	25%	$250,000
Division 41 – Matl. Processing & Handling						
(NOT USED)						
Division 42 – Process Water Systems						
1" PVC, SCH 40 to Incubators	350	LF	$10	$3,500	20%	$4,200
3" PVC, SCH 40 to Early Rearing Troughs	400	LF	$15	$6,000	20%	$7,200

Item	Quantity	Unit	Unit Cost	Subtotal	Contingency	Total Estimated Cost
6” PVC, SCH 40 to Raceways	240	LF	$30	$7,200	20%	$8,640
6” PVC, SCH 40 CWE to OLSB	800	LF	$30	$24,000	20%	$28,800
8” PVC, SCH 40, Raceway Drains	240	LF	$30	$7,200	20%	$8,640
12” Incubation Header	100	LF	$80	$8,000	20%	$9,600
12” Hatchery Drain	120	LF	$60	$7,200	20%	$8,640
12” ASTM A53 SCH 40 Well Head Pipe	120	LF	$120	$14,400	20%	$17,280
16” HDPE	1,220	LF	$90	$109,800	20%	$131,760
20” HDPE	900	LF	$120	$108,000	20%	$129,600
24” HDPE	880	LF	$144	$126,720	20%	$152,064
24” Degasser Header	1	LS	$10,000	$10,000	20%	$12,000
36” Supply Header	420	LF	$210	$88,200	20%	$105,840
36” Drain Manifold	350	LF	$180	$63,000	20%	$75,600
Pipe Fittings	1	LS	$120,000	$120,000	20%	$144,000
1” Ball Valves	72	EA	$20	$1,440	20%	$1,728
3” Btfy Valves	18	EA	$250	$4,500	20%	$5,400
6” Btfy Valves	24	EA	$500	$12,000	20%	$14,400
12” Btfy Valves	18	EA	$1,500	$27,000	20%	$32,400
Pump Control Valves	6	EA	$3,000	$18,000	20%	$21,600
12” Check Valves	6	EA	$1,500	$9,000	20%	$10,800
Air Vac Valves	6	EA	$1,000	$6,000	20%	$7,200
Truck Fill Assembly	1	LS	$2,000	$2,000	20%	$2,400
Drain Manholes	3	EA	$3,000	$9,000	20%	$10,800
Pipe Supports	1	LS	$20,000	$20,000	20%	$24,000
					Project Subtotal (without Division 01)	$11,281,352
					Project Subtotal	$12,691,521

Notes & Assumptions;

- Costs shown in 2010 dollars

Appendix F

Water Supply Report

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WATER SUPPLY ASSESSMENT FOR THE IDAHO DEPARTMENT OF FISH AND GAME'S SPRINGFIELD HATCHERY

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November 2010

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Table of Contents

1. INTRODUCTION

This report documents the review of existing information along with the collection of new data to assess the water supply for The Idaho Department of Fish and Game Springfield Hatchery. An analysis of this data is provided to assess (1) the capability of existing wells to provide the required hatchery water supply, (2) water supply available by artesian flow to meet hatchery demands during low demand months, (3) pumping lifts necessary during peak demand months, and (4) potential future pumping lifts in the event of regional aquifer water level decline. Recommendations are provided for equipping and operating the wells.

The subject property is currently owned by the Idaho Department of Fish & Game (IDF&G) and is located in Section 24, T4S, R32E, approximately one mile south and one mile east of the town site of Springfield in Bingham County. There are at least nine artesian wells and a spring associated with the property. The site features also include a former trout farm (with raceways, hatchery building, and processing facility) and a small lake of approximately 4 acres known as Crystal Springs pond. The water used on the property is discharged into Boom Creek (also known as Boone Creek) and flows south. Figure 1 shows the hatchery property and associated wells.

2. SUMMARY OF EXISTING SPRINGFIELD HATCHERY WELLS

There are nine (9) wells onsite that flow under natural conditions by artesian pressure (no pumping). Well locations are shown on Figure 1. A summary of pertinent existing well information is provided in Table 1. A brief description of each well, including a well driller's report for each well, is provided in Appendix A.

Table 1 – Summary Well Information

Well	Well Completion Date	Altitude of Land Surface (ft asl)	Altitude of Discharge Invert (ft asl)	Total Depth (ft bgs)	Open Interval[1] (ft bgs)	Casing Diameter (inches)	Reported Specific Capacity (gpm/ft)
1	5/29/89	4388.0	Unknown	319	185-313	10	NR
2	6/25/89	4394.0	Unknown	250	233-243	10	165[a]
3	10/31/97	4387.7	4388.3	220	185-216	12	142[a], 98[b]
4	3/7/98	4390.6	4391.4	240	180-235	16	251[a],
5	6/18/98	4388.4	4390.0	265	230-262	16	300[a]
6	1/28/99	4391.7	4391.5	267	205-255	16	372 [a],
7	5/10/99	4390.5	4391.6	270	220-260	16	149[a],
8	7/27/99	4390.7	4392.0	270	230-262	16	209[b]
9	10/6/99	4391.7	4393.1	265	225-255	16	246[c]

Notes: [1] Perforated using Mills knife; [a] Source: ESC, 2007; [b] Source: Clearwater Geosciences, 2008;[c] Source: SPF, 2010

Wells 1 and 2 were constructed in 1989, and supply the existing hatchery building and processing building, respectively. Wells 3 through 9 were constructed from 1997 through 1999, and currently discharge through pipe or open channels to Crystal Springs Pond.

The nine wells range in depth from 220 to 319 feet, and were constructed to produce water from a sand and gravel aquifer. The upper extent of this sand and gravel layer is, on average, approximately 180 to 200 feet below ground surface (bgs) on site, lying below interbedded sand and clay layers that extend from approximately 50 feet bgs to 180 feet bgs. Fractured basalt ranging in thickness from 10 to 35 feet lies above the interbedded sand and clay layers.

The wells were drilled using the cable-tool method, and were completed with driven mild-steel casings ranging in diameter from 10 inches to 16 inches. All well casings are 0.250-inch wall thickness. The well heads are equipped with knife gate valves or butterfly valves to control flow. Artesian flow is discharged through side discharge pipes, generally to open channels, but also through pipe in the case of Wells 1, 2, and 5.

Water enters the wells through slots cut by Mills Knife. While an effective well completion technique, the slot sizes are too large to prevent sand from entering. As a result, all wells will produce sand. Any future wells should be constructed using well screens and filter packs to minimize water entrance velocities and to control sand production. Completion with well screens will generally result in higher well efficiency, providing more flow for a given amount of drawdown. Existing wells will need to be operated in a manner that minimizes sand production.

Well Discharge

Reported artesian flow from individual wells ranges from approximately 0.5 cfs in Well 2 to nearly 4 cfs in Well 6 and Well 7 (see Figure 2). Total combined flow from Wells 2 through 9 has ranged from 9 cfs to nearly 21 cfs, averaging 17.5 cfs over the last three years (Idaho Fish and Game data). There is additional flow from springs within and around Crystal Springs pond and from Well 1, so that the total flow from the site is likely somewhat greater than the flows shown in Figure 2.

Flow within the hatchery site (combined well and spring flow) was measured by Engineering Science and Construction on February 7, 2007 at 23.75 cfs.

Of significance in Figure 2 is the seasonal fluctuation in flow. Although not apparent in 2009, a summer-time low flow is apparent in data from 2007, 2008, and 2010. This seasonal low is likely associated with irrigation pumping. Irrigation pumping generally occurs from May through September, with peak pumping in June and July. Irrigation water demand, and associated low aquifer water levels, occurs after smolts have been transported off-site in April. As a result, water demand for hatchery purposes during the irrigation season is low. Therefore, seasonal declines should not significantly impact the ability to supply water to the hatchery facility.

3. Surface Water Flow and Groundwater Level trends

3.1. Surface Water Flow

From April 1985 through June 1988, the USGS measured flow in a stream they call “Crystal Waste Nr Springfield ID” (USGS 13069532). The monitoring location is in the NW¼NE¼NW¼ of Section 26, T04S, R32E (Lat 43 03’06”, Long 112 41’11” [NAD83]), on the right bank 250 feet below two culverts under the county road, 2.5 miles south of Springfield and approximately 2.5 miles downstream (southwest) of the hatchery. “Crystal Springs Waste” appears to be analogous to Boom Creek, which heads at Crystal Springs Pond. The flow measured by the USGS in “Crystal Waste” probably includes additional flow from other springs and artesian wells in the watershed.

The average daily flow in this drainage was 41 cfs (Figure 3). The maximum flow recorded was 93 cfs on April 18, 1987. The minimum flow recorded was 19 cfs on June 27, 29, July 1-5, 1985. The USGS reported the flow was impacted by irrigation return flow.

3.2. Groundwater Level Trends

There is a long-term, downward trend and a seasonal pattern in groundwater levels in the Springfield area as shown in Figure 4. This pattern is similar to other wells completed in the Eastern Snake River Plain Aquifer (ESRPA).

Groundwater declines have resulted from complex combinations of decreased recharge incidental to irrigation conveyance and application, increased use of ground water for irrigation and domestic use, and conversion of land from irrigated agriculture to urban and suburban uses. Prior to about 1885, recharge to the ESRPA occurred from stream seepage, subsurface inflow from tributary basins, and direct precipitation. Pre-development discharge appeared to be relatively constant. As the area was colonized in the late 19th century and early 20th century, recharge to and consequently discharge from the aquifer steadily increased, primarily as a result of recharge incidental to irrigation. During this time, irrigation water was withdrawn from streams, delivered in earthen canals, and applied directly to crops via flooding, furrows, or sub-irrigation. In the middle of the 20th century, irrigation technology advanced, allowing farmers to increase efficiency by using sprinkler application. Although most conveyance still occurs in the earthen canals, conversion to sprinkler irrigation has led to a reduction in incidental recharge, as has been observed in other areas in the West. Increased irrigation efficiency, coupled with the advancement of pumping technology and subsequent use of ground water for irrigation, led to changes in the nature and extent of recharge to the ESRPA, resulting in a long-term decline in groundwater levels beginning after about 1960. The decline is influenced by climatic conditions, with apparent stabilization during periods of above average precipitation (and associated increased recharge) and declines during periods of below average precipitation (and decreased recharge). This stair-step pattern of decline has continued to present day.

Future water-level changes in the ESRPA are difficult to predict due to changes in aquifer and surface water management within the Eastern Snake River Plain. New appropriations from the aquifer for consumptive purposes have not been allowed since the early 1990s, yet declines are still apparent over the past decade. These declines may be related to multi-year drought conditions, likely coupled with increased irrigation efficiency. There are arguments to suggest that long-term aquifer water-levels should stabilize in the ESRPA due to conjunctive management of surface and groundwater, along with managed aquifer recharge efforts. However, it is just as likely that water-levels will continue to decline into the future in response to ever higher irrigation efficiencies and decreased total recharge. There is little likelihood that aquifer water levels will significantly increase in the future.

Seasonally, irrigation in the area drives the annual pattern evident in groundwater levels. This is typical of wells completed in the ESRPA.

There is no obvious effect of the American Falls reservoir stage on groundwater trends in the area. The elevation of the reservoir is 4354 ft msl (USGS, 1984). Hydraulic head in the aquifer supplying water to the site is about 50 feet higher than the elevation of the reservoir.

In the vicinity of the site, groundwater flows toward the American Falls Reservoir, a hydraulic low point in the area (USGS, 1984). Regional groundwater flows toward the west-southwest.

4. SPRINGFIELD HATCHERY WELL TESTING

4.1. 2008 Test Pumping

Clearwater Geosciences test pumped Wells 3, 7, and 8 in 2008 (Clearwater Geosciences, 2008). Testing was conducted using a portable end-suction centrifugal pump and flow rates were determined using weirs installed on discharge streams. Water levels were measured using transducers.

Tested well performance is summarized in Table 2.

Table 2 – 2008 Pump Testing Data

Well No.	Flow Rate (gpm)	Maximum Drawdown During Test (feet)	Specific Capacity at Maximum Drawdown During Test (gpm/ft)
3	2,400	24.5	98.0
7	3,950	16.4	240.9
8	3,870	18.5	209.2

Clearwater Geosciences performed three pumping tests on three wells, which provides useful data related to well capacity, interference between wells, and sand production. Aquifer hydraulic properties were calculated based on data from the three tests. Average aquifer transmissivity was calculated at 3.2 x 10^6 ft^2/day (24,000,000 gpd/ft). Average storativity was calculated at 0.016 (1.6 x 10^{-2}). However, these values are not valid because they were calculated by measuring drawdown using transducers in wells that were open to the atmosphere (still flowing and not shut in). This leads to much lower drawdown than expected for a given stress to the aquifer. The aquifer properties reported from the 2008 testing should not be used for planning purposes.

4.2. 2010 Test Pumping

SPF and Riverside, Inc. (test pumping contractor) tested three wells the week of November 1, 2010. Testing consisted of step-rate aquifer tests at Well 4, Well 6, and Well 9 to assess well productivity, well efficiency, and sand content.

A temporary, end suction centrifugal test pump was installed in each well tested. The pump model was DV200C (see cut sheet in Appendix B). The pump was capable of producing approximately 3,000 gpm at 25 feet of suction head.

Drawdown was measured using an electric-line well probe. Pumping rate was measured using a 16-inch x 10-inch circular orifice weir and manometer. Sand content was measured using an Imhoff cone.

Details of each test are provided below.

Well 4 (November 4, 2010)

Testing at Well 4 consisted of a 2-hour, step-rate discharge test. SPF measured water levels in the pumping well (Well 4) and shut-in pressure in nearby Well 6.

The discharge rate at Well 4 was sequentially increased over four different rates, each lasting approximately 30 minutes: 1,500 gpm; 2,000 gpm; 2,500 gpm; and 3,000 gpm. These rates represent average rates based on manometer readings taken throughout each 30-minute step. The well was flowing at an unknown rate prior to starting the pump. As a result, static water level in Well 4 prior to test pumping is unknown. For calculation purposes, a static water level of 6.0 feet above ground surface (ags) is assumed. Drawdown at the 3,000 gpm rate was 17.78 feet and pumping water level was 11.78 feet below ground surface. The pumping rate and water level drawdown are illustrated in Figure 5. Specific drawdown versus discharge is provided in Figure 6. Well efficiency and predicted drawdown at various flow rates is provided in Figure 7. Tested specific capacities ranged from 222 gpm/ft at 1,500 gpm to 169 gpm/ft at 3,000 gpm.

Water discharged contained 0.03% sand during the first 15 minutes of Steps 1 and 2, slowly decreasing over the last 15 minutes of each step down to 0.01%. The sand content increased to 0.18% during Steps 3 and 4, again slowly decreasing over the last 15 minutes of each step down to 0.05%. The water was visually cloudy after the initial tan/brown color (from sand) was produced, and the water appeared visually clear at the end of the last step. The concentration of sand produced during short-term testing was high, but likely reflects development of the well because the well was producing at rates exceeding historical flow rates. Nonetheless, methods for sand mitigation will need to be designed into future pumping facilities. Sand mitigation can be operational (that is, flushing to waste prior to diverting to hatchery use) and mechanical (sand traps or sand filters). It is likely that sand production will decrease significantly during continuous pumping, but will never be completely eliminated.

The shut-in pressure in Well 6 before step testing at Well 4 was 0.8 psi (1.8 feet), and was measured at the top of the well-head flange (approximately 4 feet above ground surface). The shut-in valve was leaking on the well, so the actual shut-in pressure in the well is some value slightly higher than 0.8 psi. The elevation of the gage, plus the 0.8 psi gage pressure, results in an approximate shut-in pressure of 6 feet above ground surface. After step 2 at Well 4, the pressure in Well 6 was below 0.2 psi (unable to obtain an accurate pressure reading at this low pressure). Well 6 never stopped flowing (the valve on the well was always leaking) during step-rate testing at Well 4. The invert of the discharge pipe from the well is 3.0 feet below the pressure gage, so that the total drawdown at Well 4 was less than 5 feet. Based on these observations, drawdown at Well 4 during the Well 6 test is estimated to be in the range of 2 to 4 feet during step-rate pumping at 3,000 gpm.

Well 6 (November 3, 2010)

Testing at Well 6 consisted of a 2-hour, step-rate discharge test. The discharge rate at Well 6 was sequentially increased over four different rates, each lasting approximately 30 minutes: 1,500 gpm; 2,000 gpm; 2,480 gpm; and 3,040 gpm. These rates represent average rates based on manometer readings taken throughout each 30-minute step. The well was flowing at an unknown rate prior to starting the pump. As a result, static water level in Well 6 prior to test pumping is unknown. For calculation purposes, a static water level of 6.0 feet ags is assumed. Drawdown at the 3,040 gpm rate was 12.2 feet and pumping water level was 6.2 feet below ground surface. The pumping rate and water level drawdown are illustrated in Figure 8. Specific drawdown versus discharge is provided in Figure 9. Well efficiency and predicted drawdown at various flow rates is provided in Figure 10. Tested specific capacity ranged from 357 gpm/ft at 1,500 gpm to 249 gpm/ft at 3,040 gpm.

Water discharged contained 0.01% sand during the first 15 minutes of Steps 1 and 2, slowly decreasing over the last 15 minutes of each step down to trace levels. The sand content increased to 0.08% during Steps 3 and 4, again slowly decreasing over the last 15 minutes of each step down to 0.01%. The water was visually cloudy after the initial tan/brown color (from sand) was produced, and the water appeared visually clear at the end of the last two steps. As with Well No. 4, the observed sand content is an indication that the well was being developed during test pumping. Long-term sand content should be significantly less, but sand mitigation methods should be employed to minimize adverse impacts to hatchery facilities.

Well 9 (November 5, 2010)

Aquifer testing at Well 9 consisted of a 2-hour, step-rate discharge test. The discharge rate at Well 6 was sequentially increased over four different rates, each lasting approximately 30 minutes: 1,500 gpm; 2,000 gpm; 2,500 gpm; and 3,000 gpm. These rates represent average rates based on manometer readings taken throughout each 30-minute step during the step-rate test. The well was flowing at an unknown rate prior to starting the pump. As a result, static water level in Well 9 prior to test pumping is unknown. For calculation purposes, a static water level of 6.0 feet ags is assumed. The pumping rate and water level drawdown are illustrated in the Figure 11. Specific drawdown versus discharge is provided in Figure 12. Well Efficiency and predicted drawdown at various flow rates is provided in Figure 13. Tested specific capacity ranged from 246 gpm/ft at 1,500 gpm to 205 gpm/ft at 3,000 gpm.

Water discharged contained 0.02% sand during the first 15 minutes of Steps 1 and 2, slowly decreasing over the last 15 minutes of each step down to trace levels. The sand content increased to 0.03% during Step 3, and 0.2% at the beginning of Step 4. The sand content slowly decreased over the course of the last step, producing water with 0.03% sand and just slightly cloudy water. As with the other wells, sand mitigation methods should be employed for future well operation.

Aquifer Properties

Because the reported aquifer properties from the 2008 aquifer tests are not valid for planning purposes (see section 4.1), SPF used other methods to assess aquifer transmissivity and storativity.

Estimation from Shoshone-Bannock Hatchery Aquifer Test. The same week that the Springfield 2010 test pumping work occurred, SPF collected data that can be used to estimate aquifer properties from the wells at the nearby Shoshone-Bannock hatchery site. This site is located approximately one mile south of the Springfield Hatchery.

SPF installed a transducer in Shoshone-Bannock Hatchery Well 3, which was shut in (not flowing). Figure 14 is a plot of pressure versus time in Shoshone-Bannock Hatchery Well 3, showing the aquifer response to a variety of stresses. The largest response to stress at Well 3 occurred during a flow test where three Shoshone-Bannock wells were opened, allowing them to flow under artesian pressure. The total flow from the wells was 3,150 gpm. The wells flowed at this rate for approximately three hours before being shut in. Figure 15 is a semi-log plot of drawdown in Well 3 versus time over the 3 hours of the flow test. Figure 16 is a graph of residual drawdown versus t/t', where t = time since pumping started and t'= time since pumping stopped, for Well 3 during the recovery period after the 3-hour flow test. Although the procedure utilized in the test of these wells was not designed for rigorous aquifer analysis, it provides adequate data for estimation of aquifer properties.

Transmissivity (T) can be calculated using the Cooper-Jacob method (Cooper and Jacob, 1946) for pumping drawdown data:

$$T = \frac{264Q}{\Delta s} \qquad (4\text{-}1)$$

Where:

T = Transmissivity (gallons/day/ft [gpd/ft])

Q = Pumping Rate (gallons per minute [gpm])

Δs = Water level drawdown (feet) per log cycle of time, t (min) since pumping started (from Figure 15).

The best-fit straight line shown on Figure 15 for the drawdown data from Well 3 results in a transmissivity of 2,247,570 gpd/ft (300,477 ft^2/day), calculated using a pumping rate of 3,150 gpm and a drawdown of 0.37 feet/log cycle.

Transmissivity can also be calculated using the Theis recovery method (Theis, 1935) for residual drawdown data during recovery:

$$T = \frac{264Q}{\Delta s'} \qquad (4\text{-}2)$$

Where:

T = Transmissivity (gallons/day/ft [gpd/ft])

Q = Pumping rate (gallons per minute [gpm])

$\Delta s'$ = Residual drawdown per log cycle of t/t' from Figure 16 (dimensionless)

Where:

t = time since pumping started

t'= time since pumping stopped

The best fit straight line shown on Figure 16 for the drawdown data results in a transmissivity of 2,598,750 gpd/ft (347,426 ft^2/day), calculated using an average pumping rate of 3,150 gpm and a residual drawdown of 0.32 ft/log cycle.

The transmissivity calculated using the Cooper-Jacob method and the Theis recovery method at the Shoshone-Bannock hatchery site are similar, with transmissivity on the order of 2,000,000 gpd/ft.

Estimation from 2008 Springfield Pumping Tests. The testing in 2008 showed that a 3,000 gpm discharge increase at Well 8 caused a nearly immediate decrease in flow of 400 gpm from Well 7. Given the specific capacity of Well 7 (approximately 200 gpm/ft), this flow decrease corresponds to a head decrease of 2 feet at Well 8. Using a Theis analysis, a rapid head change of this magnitude would correspond to a transmissivity in the range of about 2,000,000 gpd/ft and a storativity of approximately 0.0001.

Estimation from Springfield Well Specific Capacities. As noted on page 6 of the 2008 aquifer test report, a common empirical equation for estimation of aquifer transmissivity (in gpd/ft) is to multiply specific capacity (gpm/ft) by a factor of 2000. The 2008 report noted an average well specific capacity of 230 gpm/ft, corresponding to an estimated transmissivity of 460,000 gpd/ft. In reality, this value likely underestimates transmissivity, because the specific capacity includes well loss and neglects the impacts of partial penetration (that is, each well is not perforated throughout the entire aquifer thickness). Therefore, measured specific capacity values indicate that the aquifer transmissivity likely exceeds 500,000 gpd/ft.

Storativity for confined aquifers typically range from 0.001 to 0.0001, and a value of 0.0001 can be used for estimation purposes.

5. CONSIDERATIONS FOR GROUNDWATER SUPPLY PLANNING

The hatchery's maximum groundwater demand is 28.6 cfs and occurs in April. Minimum groundwater demand is 3.2 cfs and occurs in May. To meet maximum demand, the hatchery will need to install pumps in wells to provide reliable flow beyond that provided under natural (non-pumping) artesian conditions.

In order to assess the impacts of pumping a total combined flow rate of 28.6 cfs on aquifer water levels, SPF developed a simple analytical model of the Springfield Hatchery well field to allow us to predict well water levels under various combinations of pumping wells and pumping rates. This model is based on non-equilibrium formula methods and provides a tool to approximate operational conditions at the hatchery related to groundwater production. The predictions we make using this tool are approximations that can be used to help drive design decisions (expected pump lifts, for example). The actual conditions encountered will be different than our predictions, and the difference is tied to variations in subsurface conditions that exist below the hatchery and regional groundwater trends (the tool does not take either into consideration). Because of this, we used the most conservative aquifer transmissivity and storativity values within reason in order to provide "worst case" results (the most drawdown expected within reasonable aquifer property value ranges).

Under current water-level conditions, we assumed pumping will occur in four wells (Well 4, 5, 7, and 8). Utilizing average transmissivity and storativity values of 500,000 gpd/ft and 0.0001 (see Section 4 for details), respectively, we calculated drawdown in each hatchery well associated with producing a total of 28.6 cfs from these four wells (see table below). Pumping these wells will cause the other wells to stop flowing, and the water levels in the non-pumping wells will drop below ground surface to an average depth of 35 ft bgs after 180 days of continuous pumping (see Table 3 below).

Table 3 – Predicted Water Levels Under Continuous Pumping at 28.6 cfs

		Predicted Water Levels (ft bgs)				
	Desired Flow Rate (gpm)	**30 Days**	**60 Days**	**120 Days**	**180 Days**	**365 days**
Well 1	0	33.2	35.2	37.3	38.4	40.5
Well 2	0	31.5	33.6	35.6	36.8	38.9
Well 3	0	28.9	30.9	32.9	34.1	36.2
Well 4	3209	37.8	39.9	41.9	43.1	45.2
Well 5	3209	38.3	40.3	42.4	43.6	45.6
Well 6	0	28.2	30.2	32.3	33.5	35.5
Well 7	3209	35.5	37.6	39.6	40.8	42.9
Well 8	3209	43.0	45.0	47.0	48.2	50.3
Well 9	0	32.7	34.8	36.8	38.0	40.1
Total	12,836 (28.6 cfs)					

We also used the analytical model to predict aquifer water level decline associated with the anticipated hatchery operations schedule (shown below) rather than just the anticipated maximum groundwater production.

Table 4 – Hatchery Water Demands

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(cfs)	19.2	21.2	22.6	28.6	3.2	4.4	6.7	7.7	9.5	12.1	14.4	16.0
(gpm)	8,628	9,533	10,126	12,855	1,455	1,967	3,009	3,456	4,260	5,439	6,463	7,181

Because the demand in May through December is less than the current natural flow of the wells (approximately 17 cfs), we ran the model starting in January and increased groundwater production over the year by pumping wells 4, 5, 7, and 8 to reach a peak flow of 28.6 cfs in April (see table below for pumping rates from each well throughout the year). This analysis assumes all flow from the wells (currently approximately 17 cfs) can be used without pumping (under gravity flow) during May through December.

Table 5 - Well Production from Pumps (gpm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Well 1	0	0	0	0	F	F	F	F	F	F	F	F
Well 2	0	0	0	0	F	F	F	F	F	F	F	F
Well 3	0	0	0	0	F	F	F	F	F	F	F	F
Well 4	2157	2383	2532	3214	F	F	F	F	F	F	F	F
Well 5	2157	2383	2532	3214	F	F	F	F	F	F	F	F
Well 6	0	0	0	0	F	F	F	F	F	F	F	F
Well 7	2157	2383	2532	3214	F	F	F	F	F	F	F	F
Well 8	2157	2383	2532	3214	F	F	F	F	F	F	F	F
Well 9	0	0	0	0	F	F	F	F	F	F	F	F
Total	8,628	9,533	10,126	12,855	F	F	F	F	F	F	F	F

Note: F = well is flowing naturally under artesian pressure

Beyond April, we assume the pumping wells would shut down, and natural discharge (artesian flow) will provide enough water to meet hatchery demand. The analytical model allows us to calculate the water level in each well throughout the year (see Table 6), based on the pumping schedule shown in Table 4.

Table 6 - Predicted Water Levels (ft bgs)
(assumes pumping at rates shown in Table 4 and 2010 aquifer water levels)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Well 1	22.3	24.6	26.2	33.2	F	F	F	F	F	F	F	F
Well 2	20.2	22.7	24.2	31.6	F	F	F	F	F	F	F	F
Well 3	17.7	20.1	21.7	28.9	F	F	F	F	F	F	F	F
Well 4	24.1	27.0	29.0	37.9	F	F	F	F	F	F	F	F
Well 5	24.3	27.3	29.2	38.3	F	F	F	F	F	F	F	F
Well 6	17.8	20.1	21.5	28.2	F	F	F	F	F	F	F	F
Well 7	21.6	24.6	26.6	35.6	F	F	F	F	F	F	F	F
Well 8	28.9	31.9	33.9	43.0	F	F	F	F	F	F	F	F
Well 9	22.0	24.3	25.8	32.8	F	F	F	F	F	F	F	F

Note: F = well is flowing naturally under artesian pressure

A conservative assumption for the potential drop in aquifer water levels over time (long-term trend discussed previously) should be made and added to the numbers in the table above for planning purposes. Based on the evaluation of regional water level trends, we recommend conservatively assuming aquifer water levels will drop an average of 15 feet over the next 20 years. Under a 15-foot loss in aquifer water level, pumping will likely begin in mid-summer to meet projected operational demands. Maximum pumping levels in April (four wells operating at 28.6 cfs total) will increase to between 53 and 58 feet below ground surface. Pumping will need to begin in mid summer.

The analyses above assume all available artesian flow from each well can be used without pumping. This assumption may not be valid, as the hatchery will likely need to have the water flow to an elevation above ground surface (to a de-gasification/aeration facility, for example). Because of this, we evaluated total shut-in pressure if all wells were to be shut in for 30 days. Assuming current water-level conditions (17 cfs of natural flow under artesian conditions), the aquifer water level would rise to an average height of approximately 17 feet above ground surface (assumes the flow from all 9 wells is the same and totals 17 cfs).

The minimum hatchery demand is 3.2 cfs in April. If all wells were shut in except for Well 4, Well 4 would flow 3.2 cfs (1,432 gpm) at a height of 9 feet above ground surface after 30 days of flow. In June, hatchery demand is 4.4 cfs (1,967 gpm), and Well 4 would flow at this rate at a height of 6 feet above ground surface. The hatchery demand increases to 6.7 cfs (3,009) cfs in July. Well 4 would flow this rate at ground surface (elevation 4390) after 30 days of flow. Spreading the 6.7 cfs discharge between wells will result in higher overall water levels, so that that flow under natural artesian pressure to a aeration facility should be possible through the summer and into early fall, depending on the elevation at which this water is needed. In all other months, pumping (either from the wells or from a central lift station) is likely required to supply enough head for aeration and degasification.

6. WATER QUALITY

SPF collected water quality parameters from accessible wells on site (see summary table below).

Table 8 – Springfield Hatchery Wells Field Water Quality Parameter Data

Date/Time	Well No.	Temp (ºC)	pH	EC	SC	DO	TGP	BP
11/3/10; 14:00	3	10.9	6.92	405.5	565.4	6.7	648	657
11/3/10; 14:15	4	10.1	6.93	425.7	595.4	6.2	651	652
11/3/10; 14:08	5	10.1	6.93	412.9	576.4	6.5	652	657
11/4/2010; 11:10	6	9.9	6.89	419.2	589.6	6.0	653	654
11/3/10; 15:10	7	10.5	6.92	408.6	564.9	6.2	650	657
11/3/10; 15:30	8	10.2	6.92	408.0	564.9	6.3	650	655
11/3/10; 15:35	9	10.0	6.93	405.7	568.7	6.2	650	657

EC = electrical conductivity (μS/cm); SC = specific conductance (μS/cm); DO = dissolved oxygen (mg/L); TGP = total gas pressure (mm Hg); BP = barometric pressure (mm Hg)

Table 9 – Springfield Hatchery Wells Laboratory Data

Analyte	Well 4	Well 9
Aluminum	<0.10	<0.10
Arsenic	<0.003	<0.003
Cadmium	<0.0005	<0.0005
Chromium	NA	NA
Copper	<0.01	<0.01
Iron	<0.05	<0.05
Lead	<0.005	<0.005
Magnesium	NA	NA
Manganese	<0.05	<0.05
Mercury	<0.0002	<0.0002
Nickel	<0.02	<0.02
Potassium	NA	NA
Silver	<0.001	<0.001
Sodium	NA	NA
Sulfur	NA	NA
Zinc	<0.01	<0.01
Nitrate (as N)	1.9	1.9
Ammonia (as N)	<0.04	<0.04
Nitrate + Nitrite (as N)	1.92	1.86
Nitrite (as N)	<0.01	<0.01
Total Kjeldahl Nitrogen (TKN)	<0.10	<0.10
Total Nitrogen	1.92	1.86
Alkalinity ($CaCO_3$)	193	190
Fluoride	0.55	0.52
Sulfide	<0.05	<0.05
Total Dissolved Solids (TDS)	368	332
Total Suspended Solids (TSS)	<3	<3

Note: All values in mg/L; NA= not available at time of report preparation

Field and laboratory results suggest water quality does not vary significantly across the Springfield Hatchery well field. Water quality is good, with total nitrogen of less than 2 mg/L and no detectable metals. Specific conductance, pH, temperature, and dissolved oxygen average 575 μS/cm, 6.9 s.u., 10.2 °C, and 6.3 mg/L, respectively.

6. Discussion and Conclusions

1. The existing artesian wells can produce the required peak month hatchery supply of 28.6 cfs when equipped with pumps.

2. At a minimum, pumping from wells will be necessary to produce the required supply during the months of January through April. Operation of four pumping wells, with two standby wells, is recommended. Artesian flow (without pumping) may be adequate to supply hatchery requirements in other months.

3. Maximum pumping water levels under existing aquifer conditions are estimated to range from 38 to 43 feet (four wells, 28.6 cfs total). Maximum pumping water levels under future aquifer conditions will likely be greater. For planning purposes, an assumption of a maximum aquifer water level decline of 15 feet (and corresponding increase in pumping lifts) after 20 years is appropriate.

4. Depending on degasification and aeration facility elevations, and head losses from wells to facilities, pumping (directly from wells or indirectly from a pump station at the degasification and aeration facilities) may be required from late summer through December.

5. Sand production must be mitigated at all wells. Operational mitigation should include flushing to waste upon pump start up for up to one hour. Sand traps should be provided to contain sand prior to entry into hatchery facilities. Future wells should be constructed with well screens and filter packs to eliminate or significantly reduce sand production.

6. Water quality appears to be consistent across the hatchery site. Average temperature at seven measured wells in November 2010 was 10.2 °C (50.4 °F). Specific Conductance averaged 575 μS/cm. There were no detectable metals, and total nitrogen was less than 2 mg/L.

7. REFERENCES

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Jacob, C.E. 1947. *Drawdown Test to Determine the Effective Radius of Artesian Well.* Trans. Amer. Soc. Of Civil Engrs., Vol. 112, Paper 2321, pp. 1047-1064.

Rorabaugh, M.J. 1953. Graphical and Theoretical Analysis of Step-Drawdown Test of Artesian Well. Proc. Amer. Soc. Civil Engrs., Vol. 79, separate no. 362, 23 pp.

Theis, C.V. 1935. *The Relation Between the Lowering of the Piezometric Surface and the Rate and Duration of Discharge of a Well Using Groundwater Storage*. Trans. Amer. Geophys. Union, Vol. 16, pp. 519-524.

Figures

SPF WATER ENGINEERING

Figure 1. Springfield Hatchery Wells

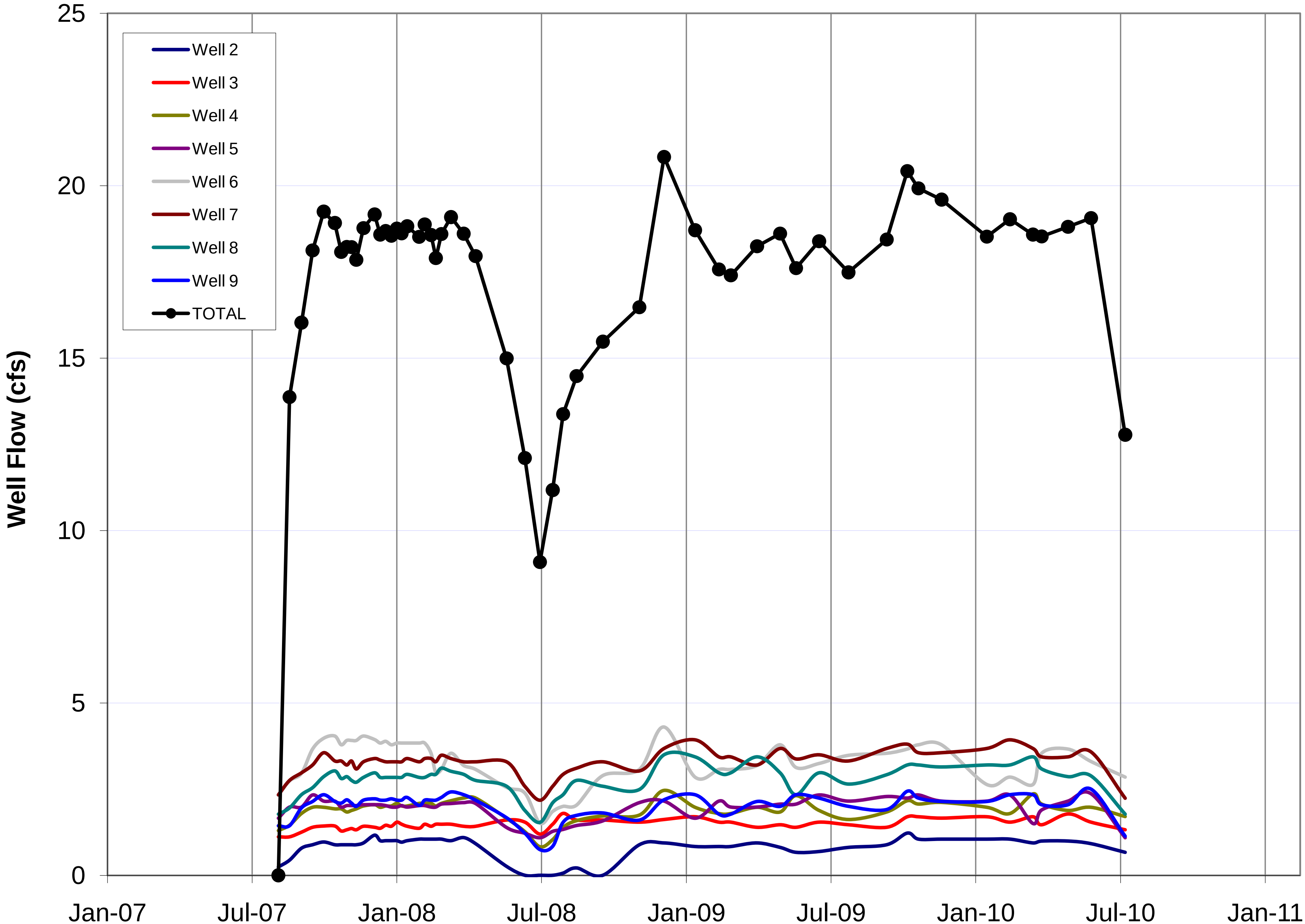

Figure 2 - Historic Springfield Hatchery Well Discharge

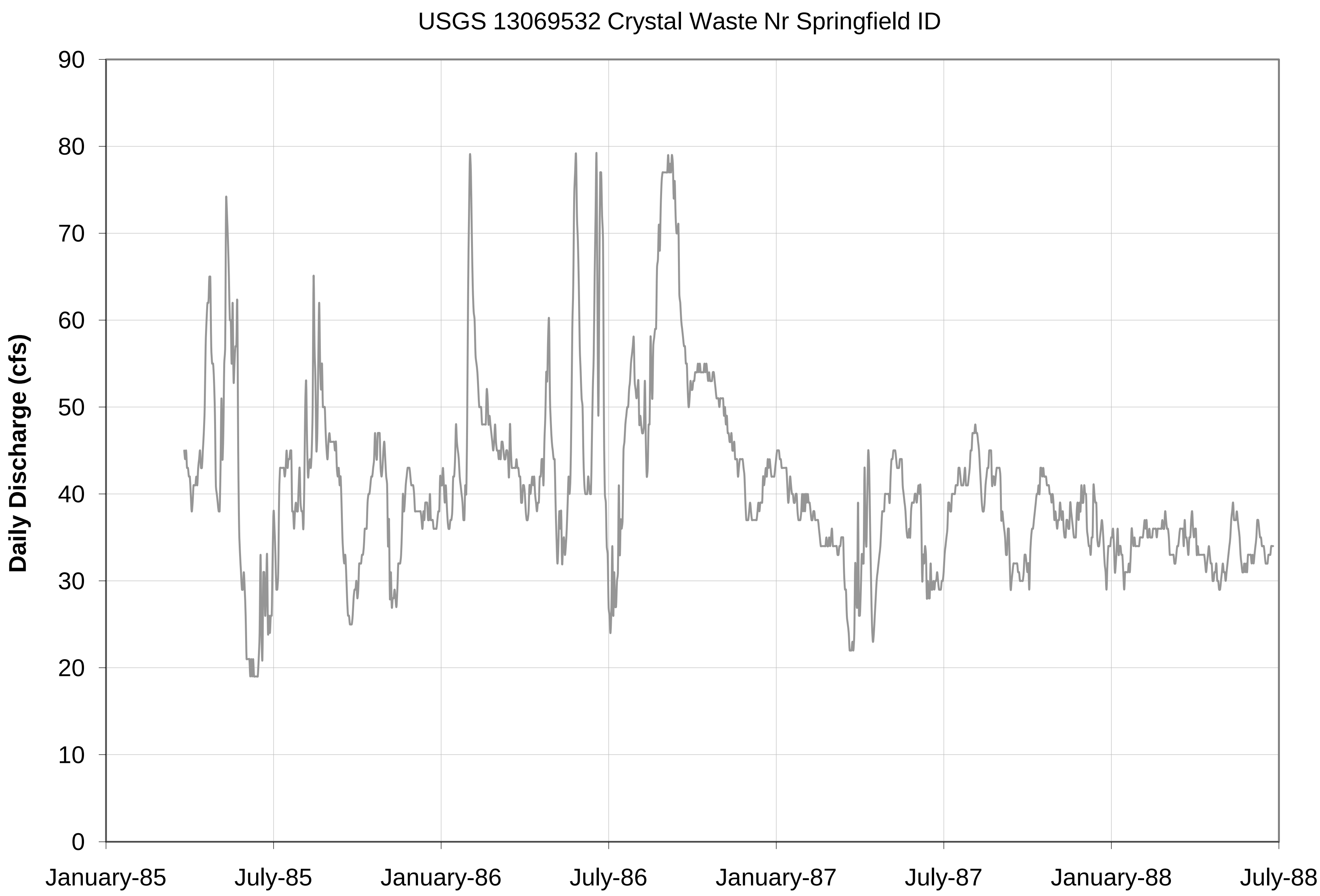

Figure 3 – Surface Water Flow 2.5 Miles Downstream From Hatchery Site

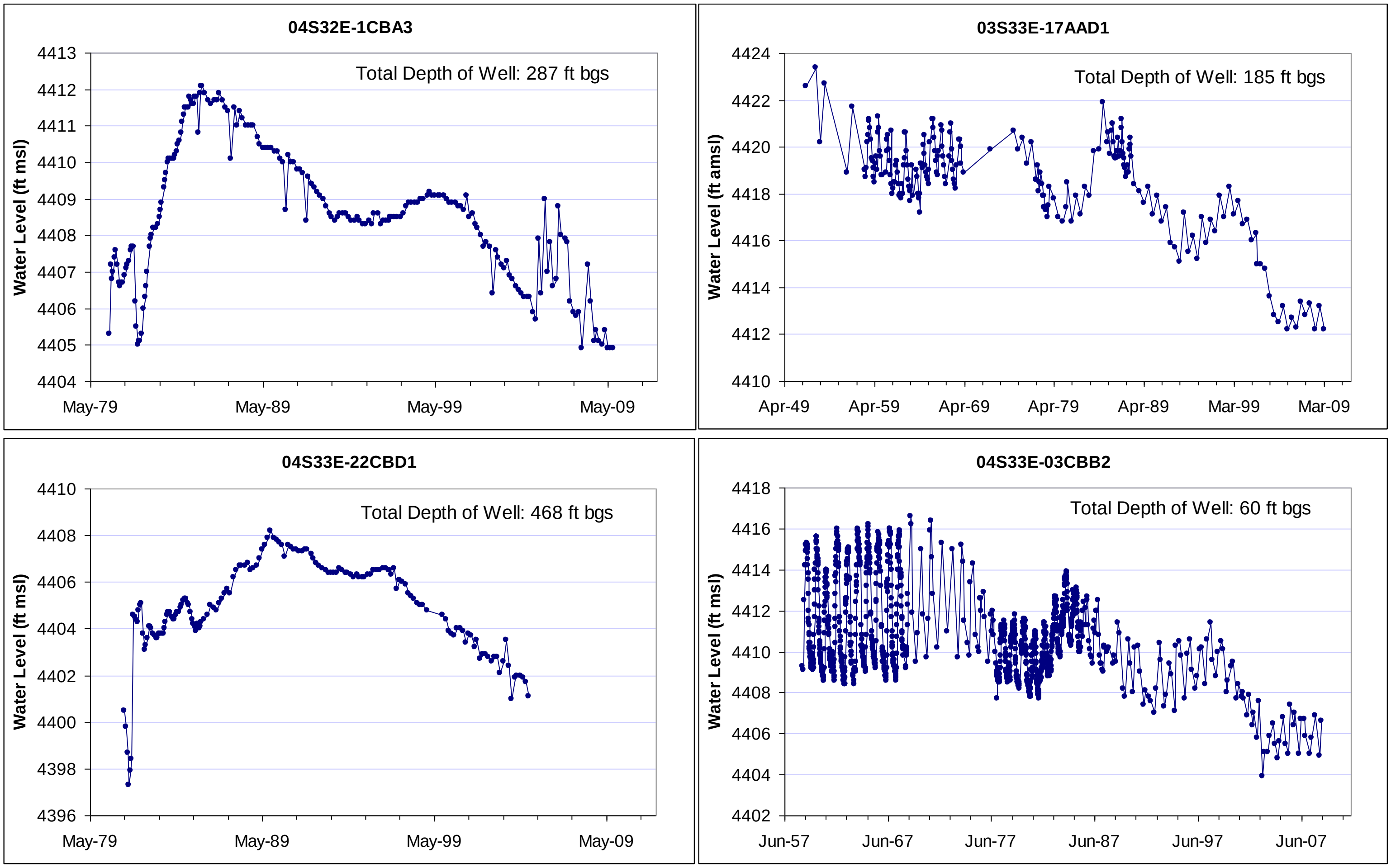

Figure 4 – Hydrographs of Wells within a 6-Mile Radius of Springfield Hatchery

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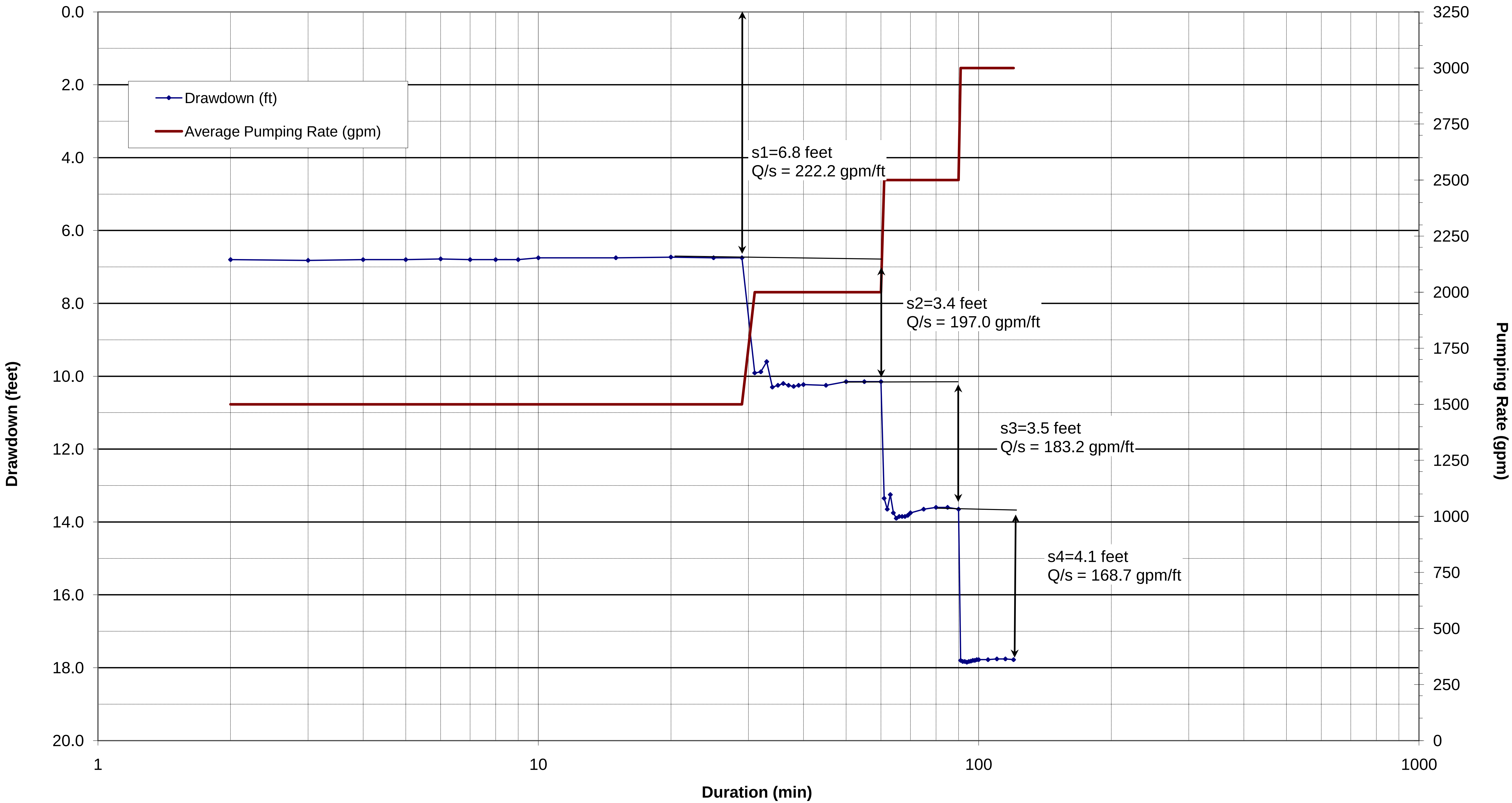

Figure 5 - Springfield Well 4 Hydrograph, Step-Rate Discharge Test

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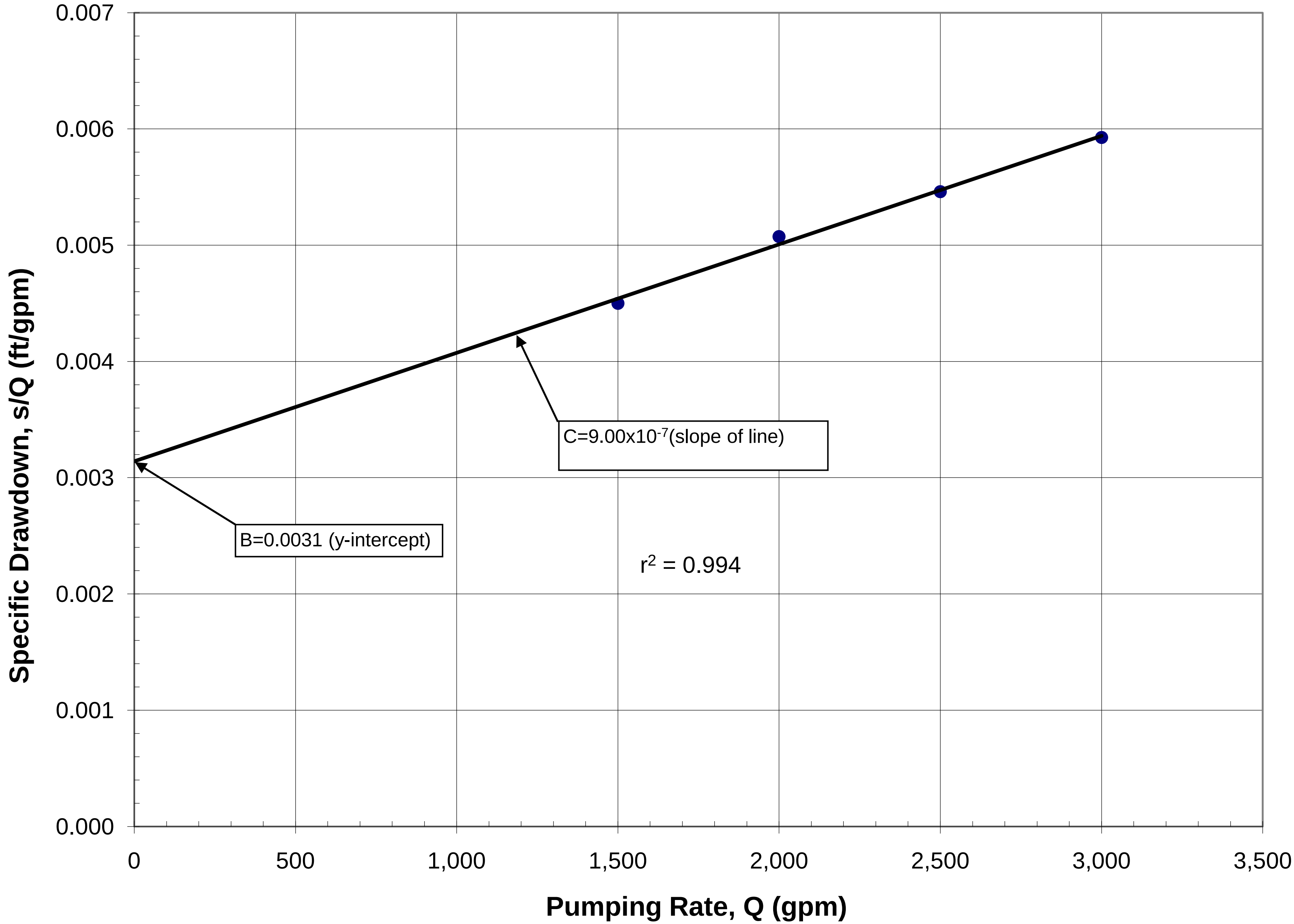

Figure 6 - Springfield Well 4 Specific Drawdown vs. Pumping Rate, Step-Rate Discharge Test

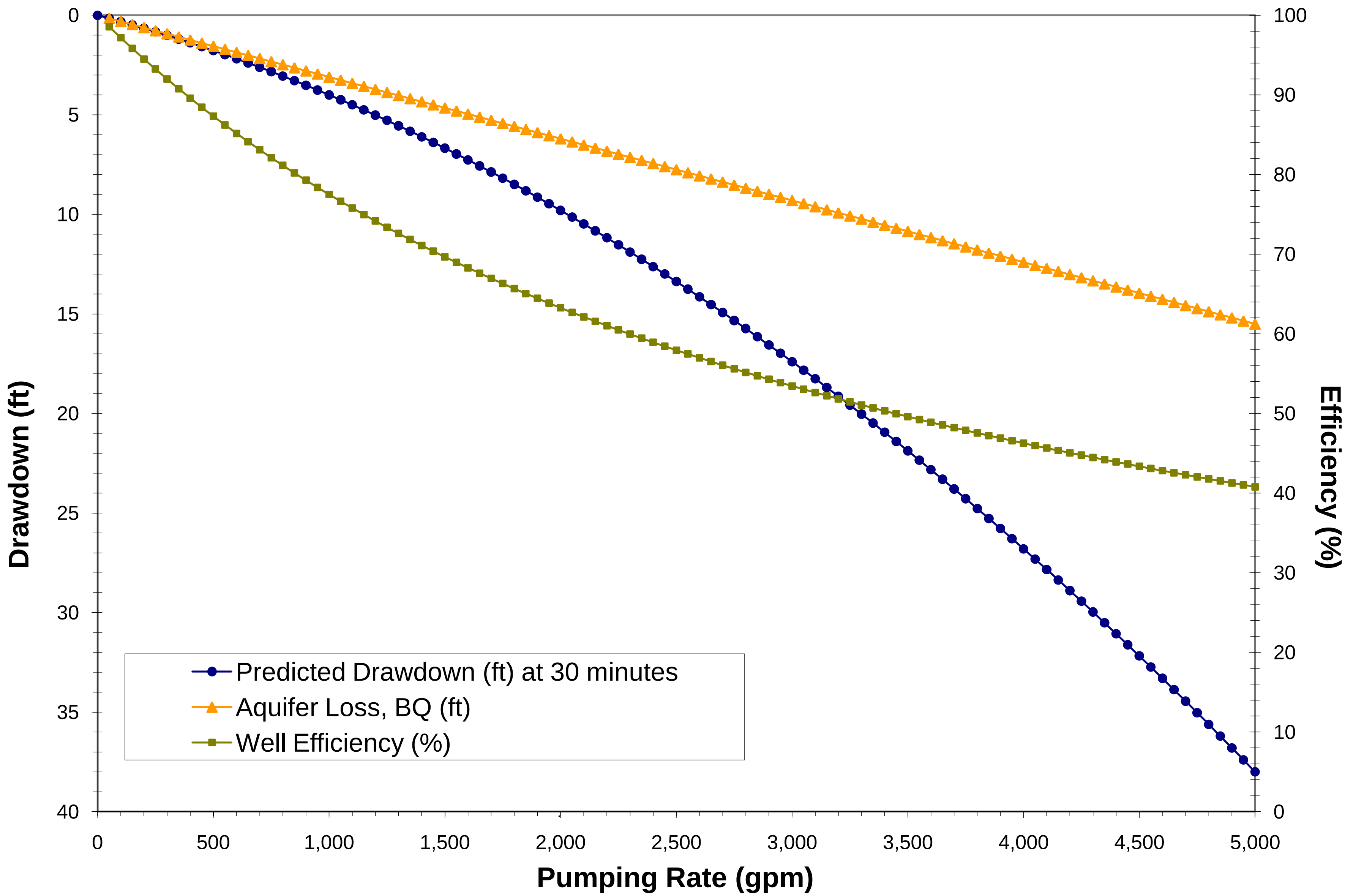

Figure 7 - Springfield Well 4
Specific Capacity and Efficiency Diagram,
Step-Rate Discharge Test

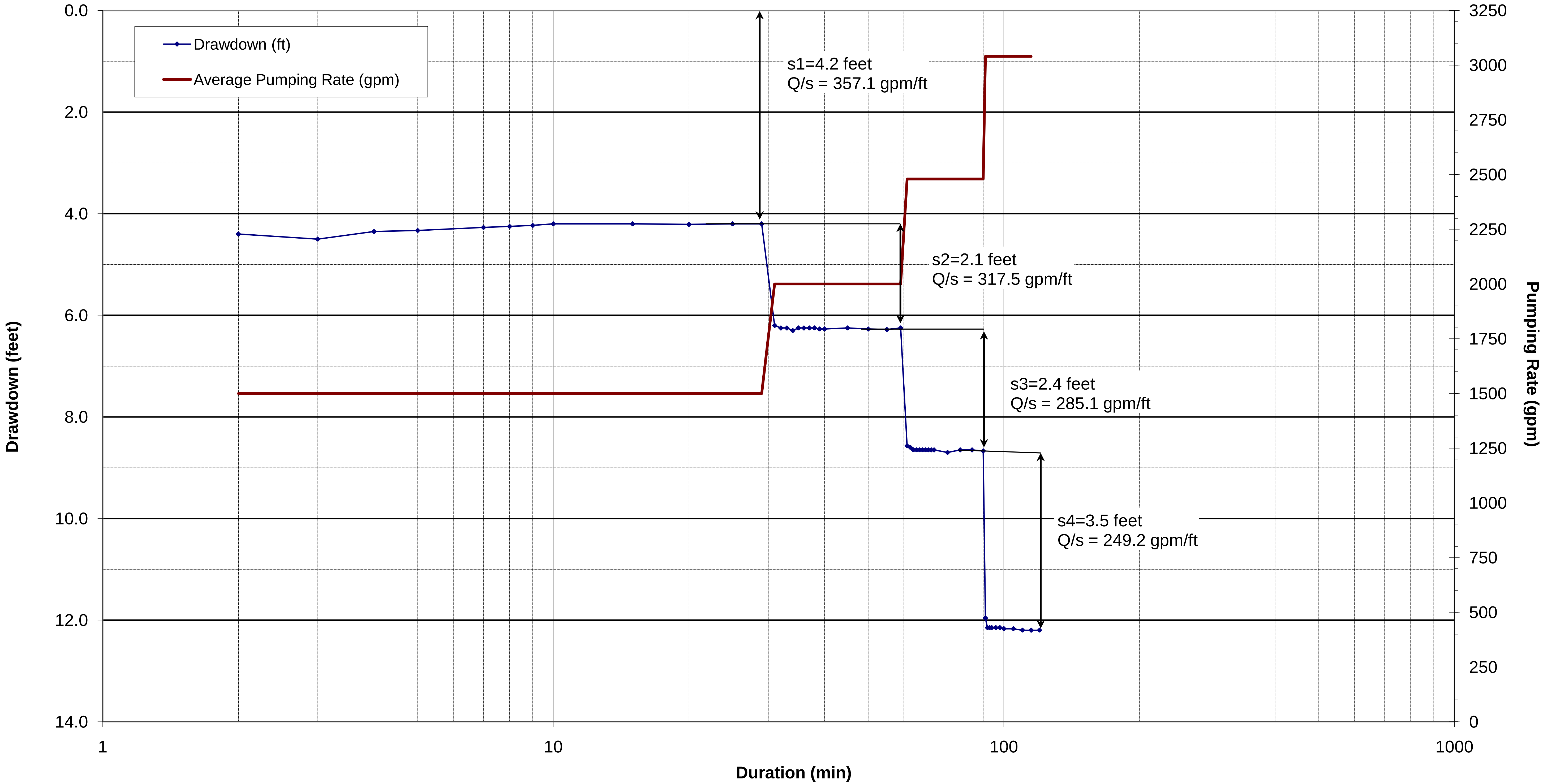

Figure 8 - Springfield Well 6 Hydrograph, Step-Rate Discharge Test

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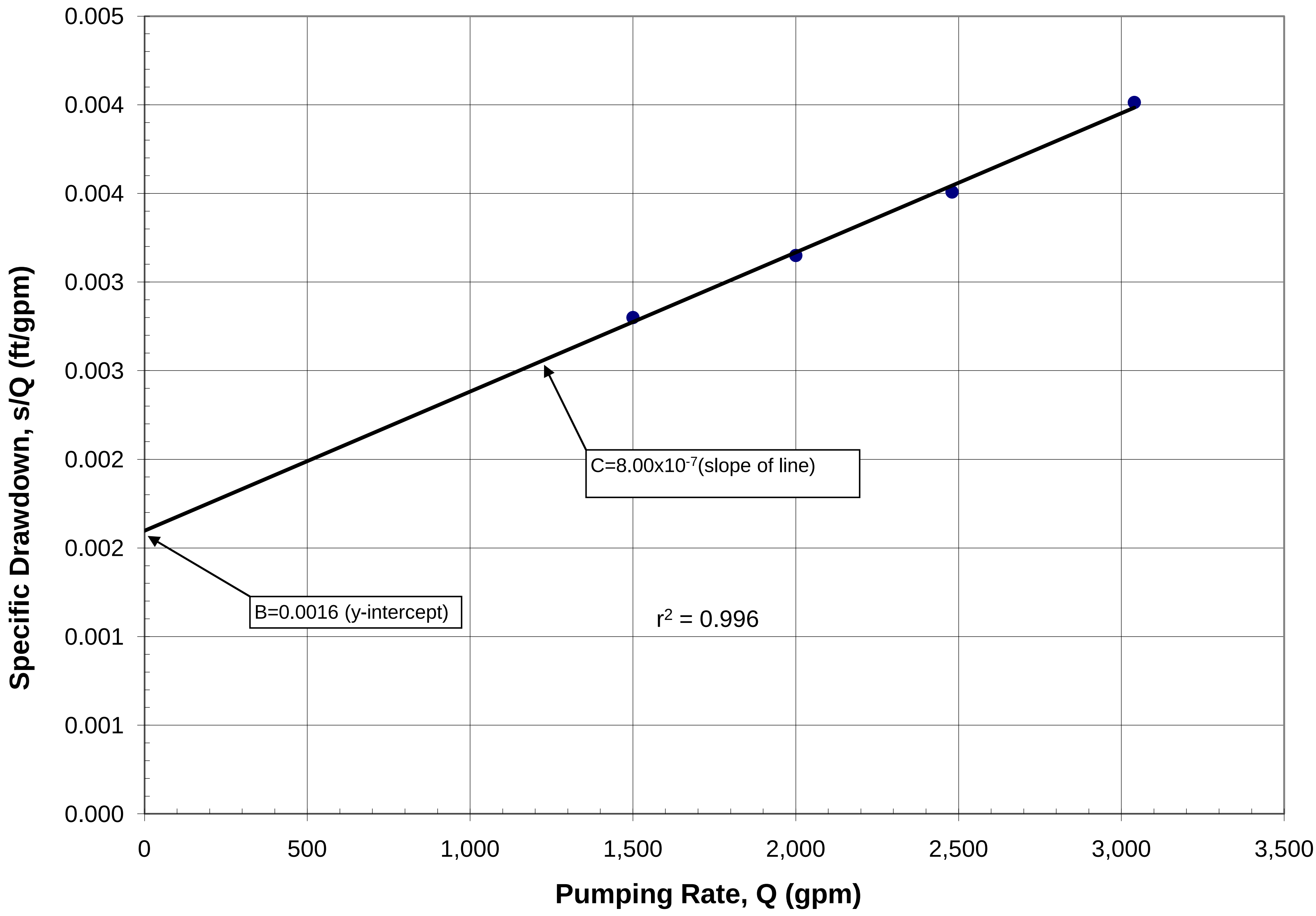

Figure 9 - Springfield Well 6 Specific Drawdown vs. Pumping Rate, Step-Rate Discharge Test

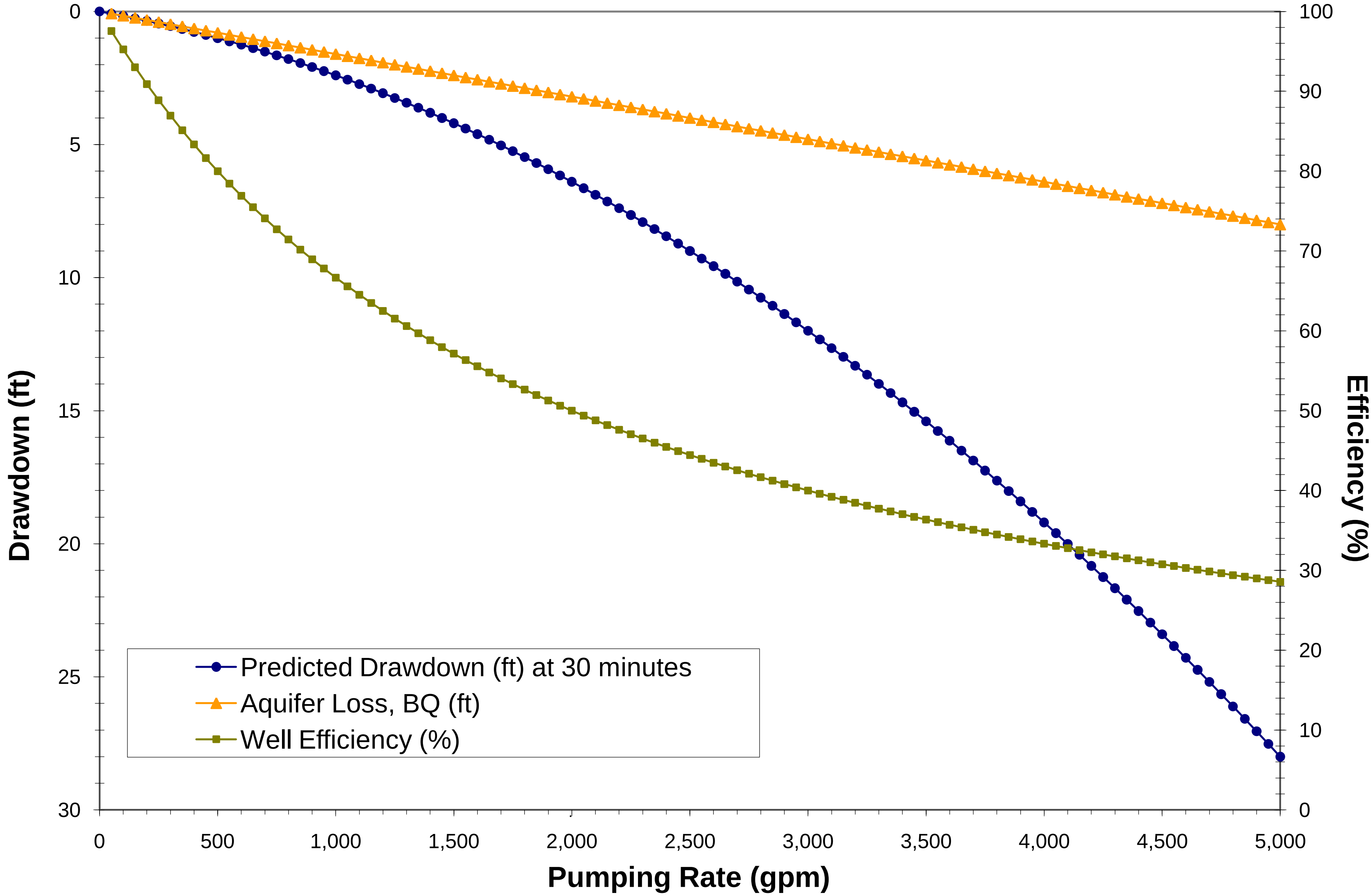

Figure 10 - Springfield Well 6
Specific Capacity and Efficiency Diagram,
Step-Rate Discharge Test

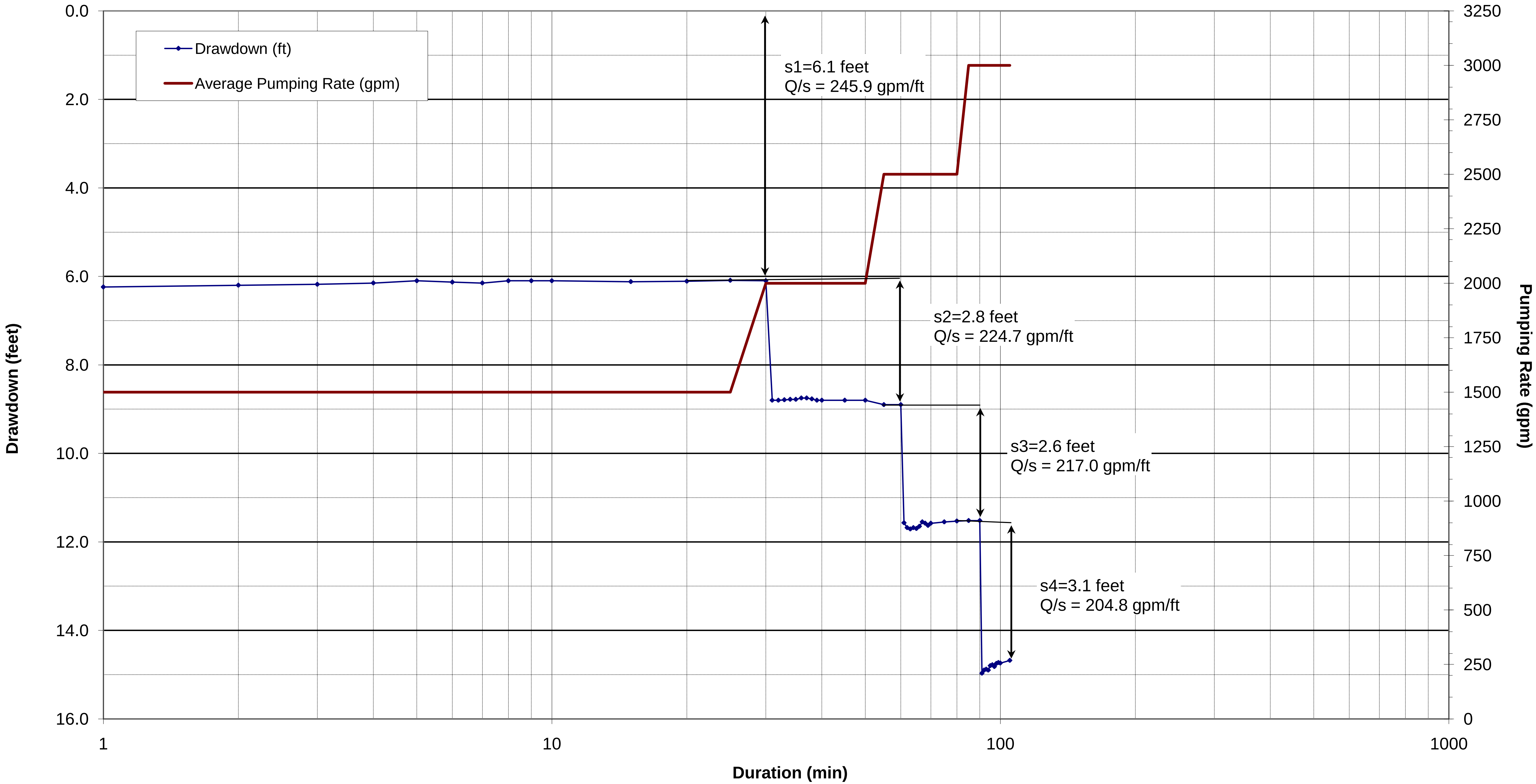

Figure 11 - Springfield Well 9 Hydrograph, Step-Rate Discharge Test

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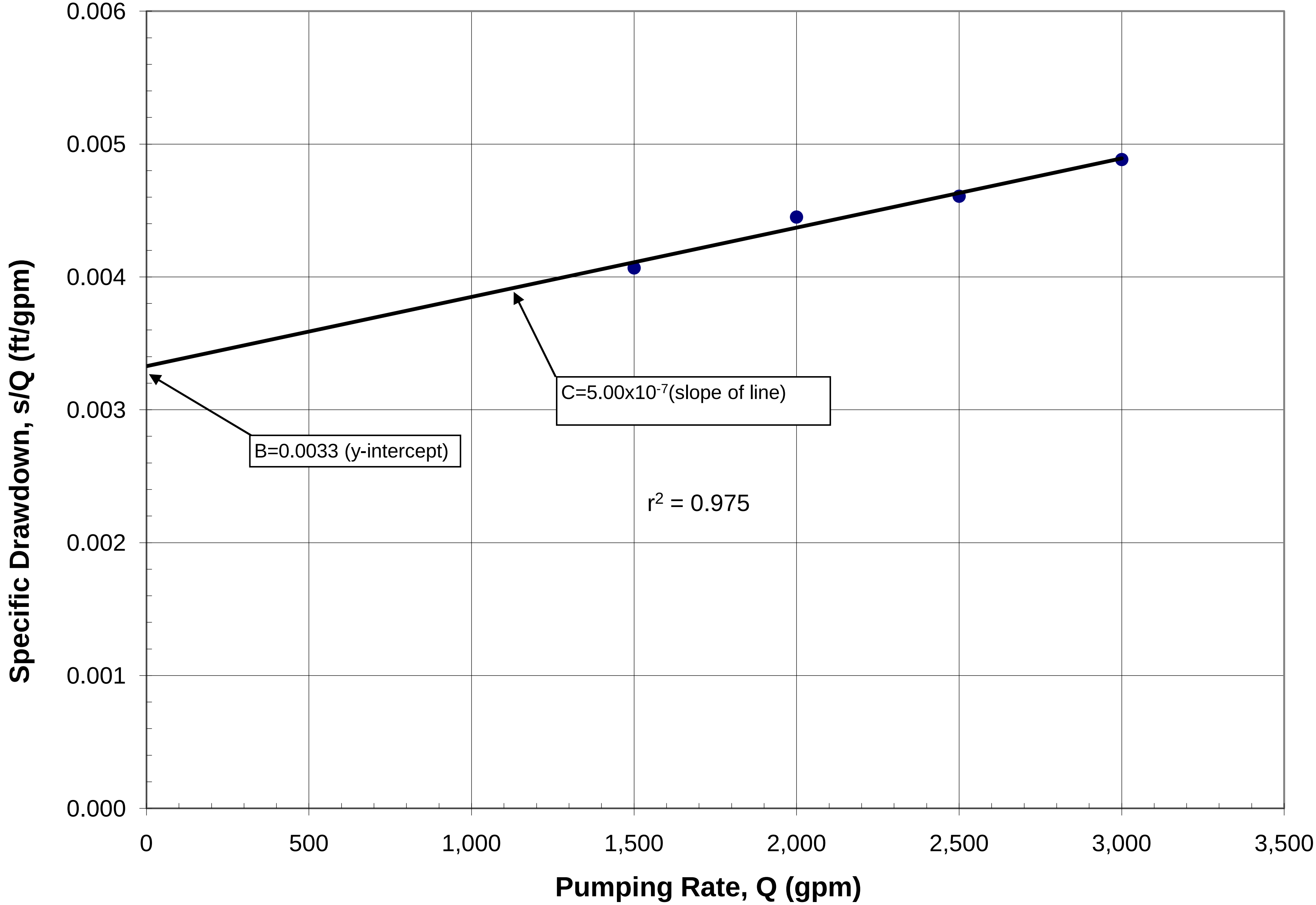

Figure 12 - Springfield Well 9 Specific Drawdown vs. Pumping Rate, Step-Rate Discharge Test

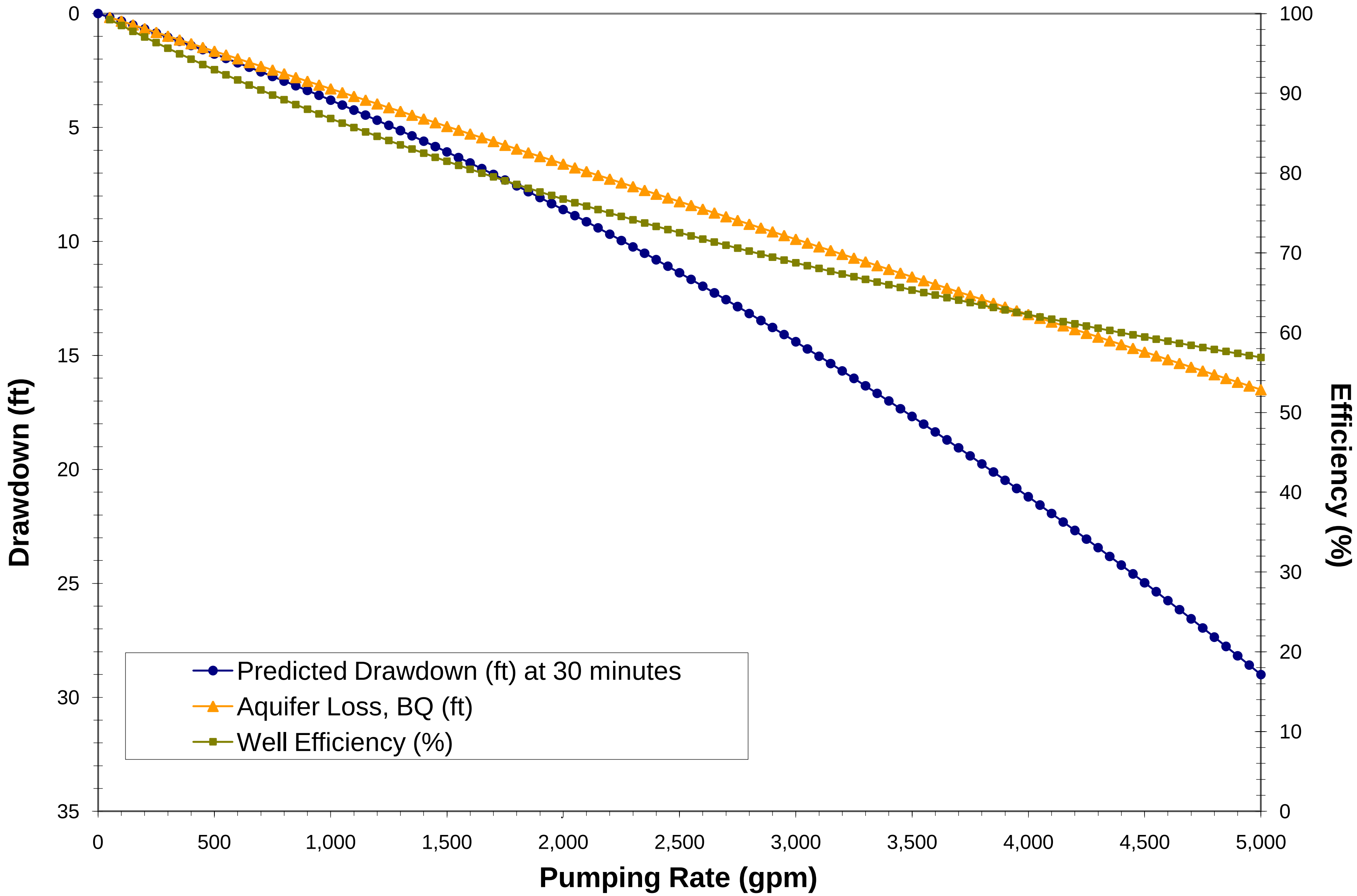

Figure 13 - Springfield Well 4
Specific Capacity and Efficiency Diagram,
Step-Rate Discharge Test

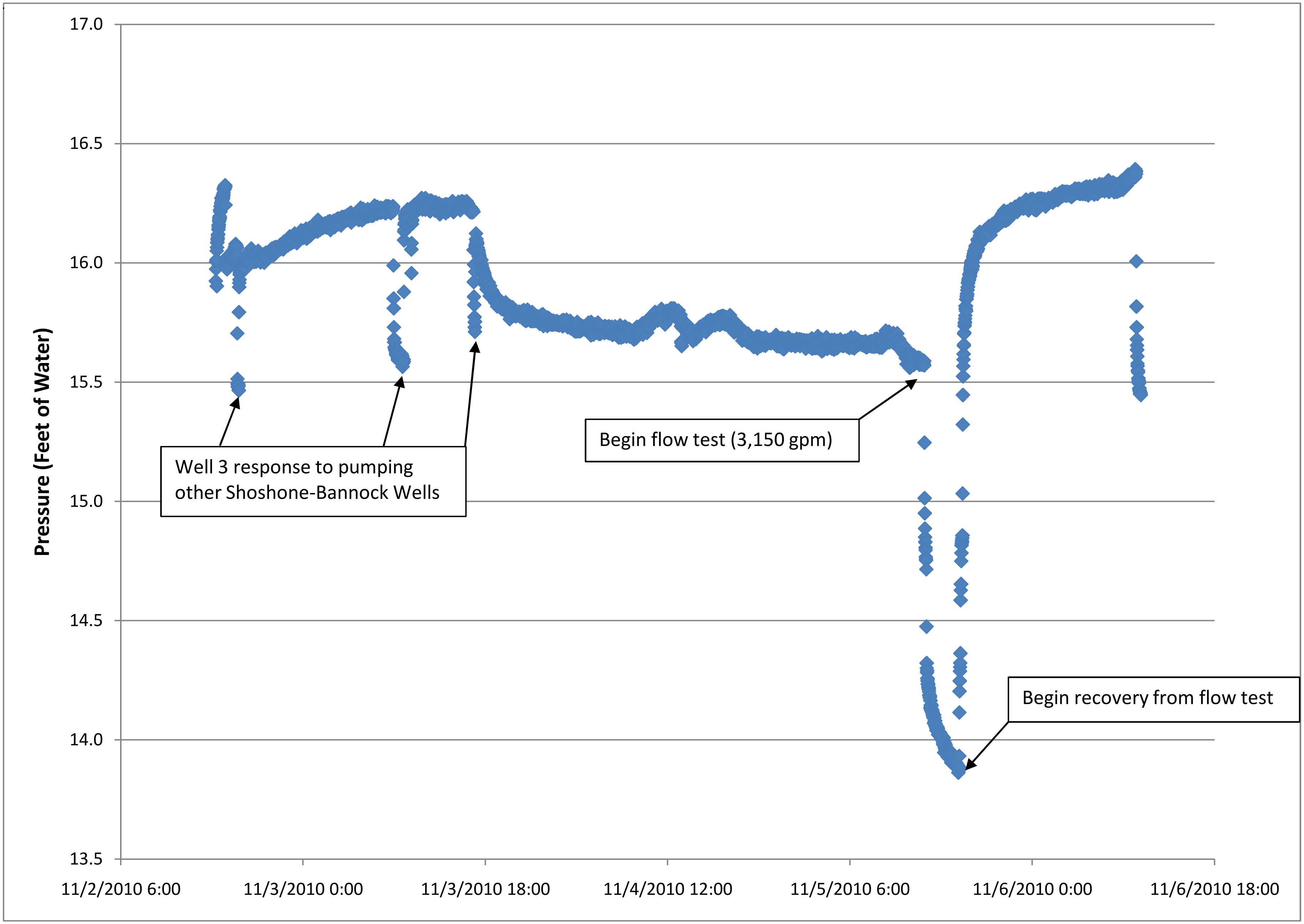

Figure 14 - Pressure in Shoshone-Bannock Hatchery Well 3 During Test Pumping and Flow Testing

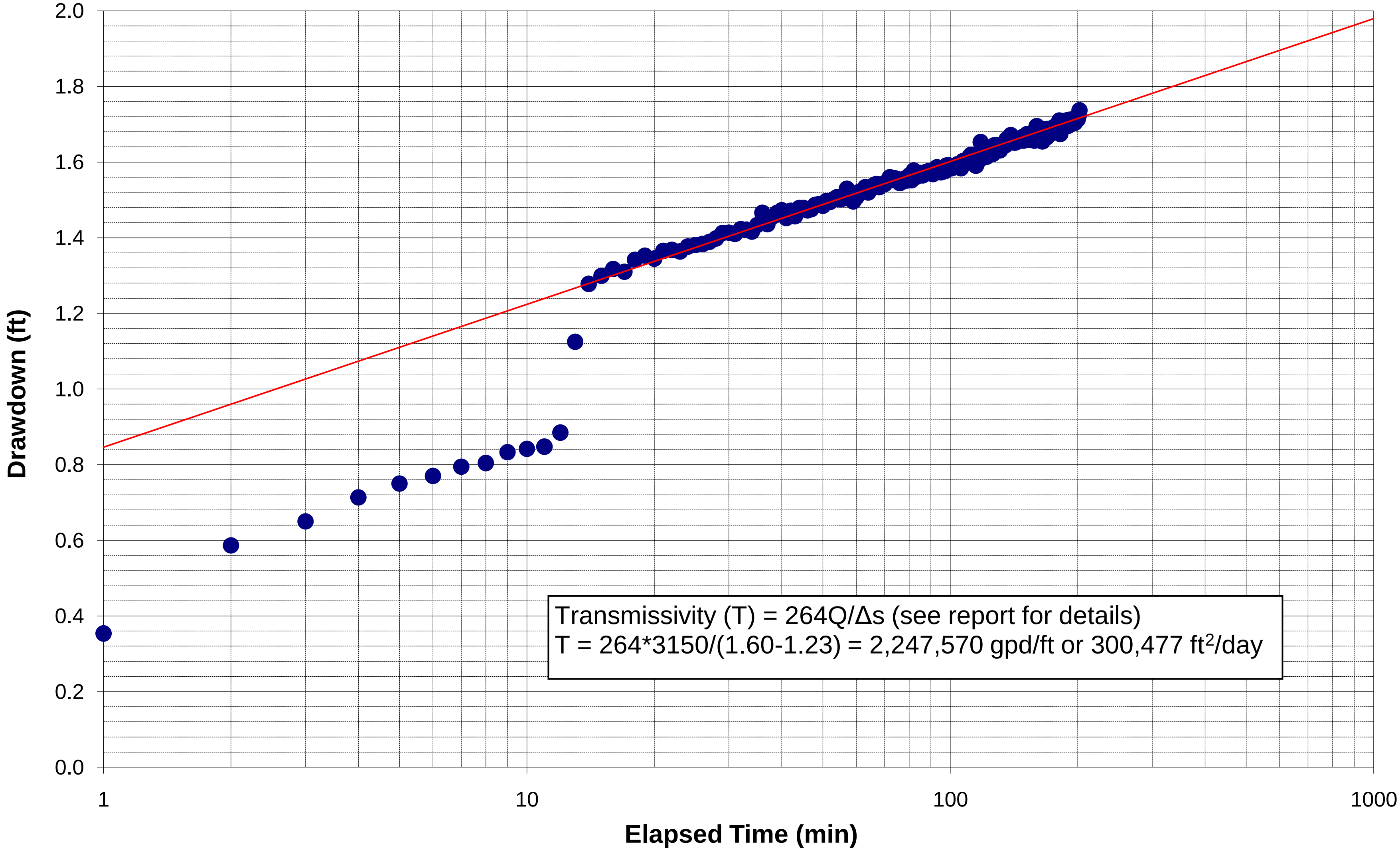

Figure 15 - Shoshone-Bannock Hatchery Well 3 Cooper-Jacob Evaluation

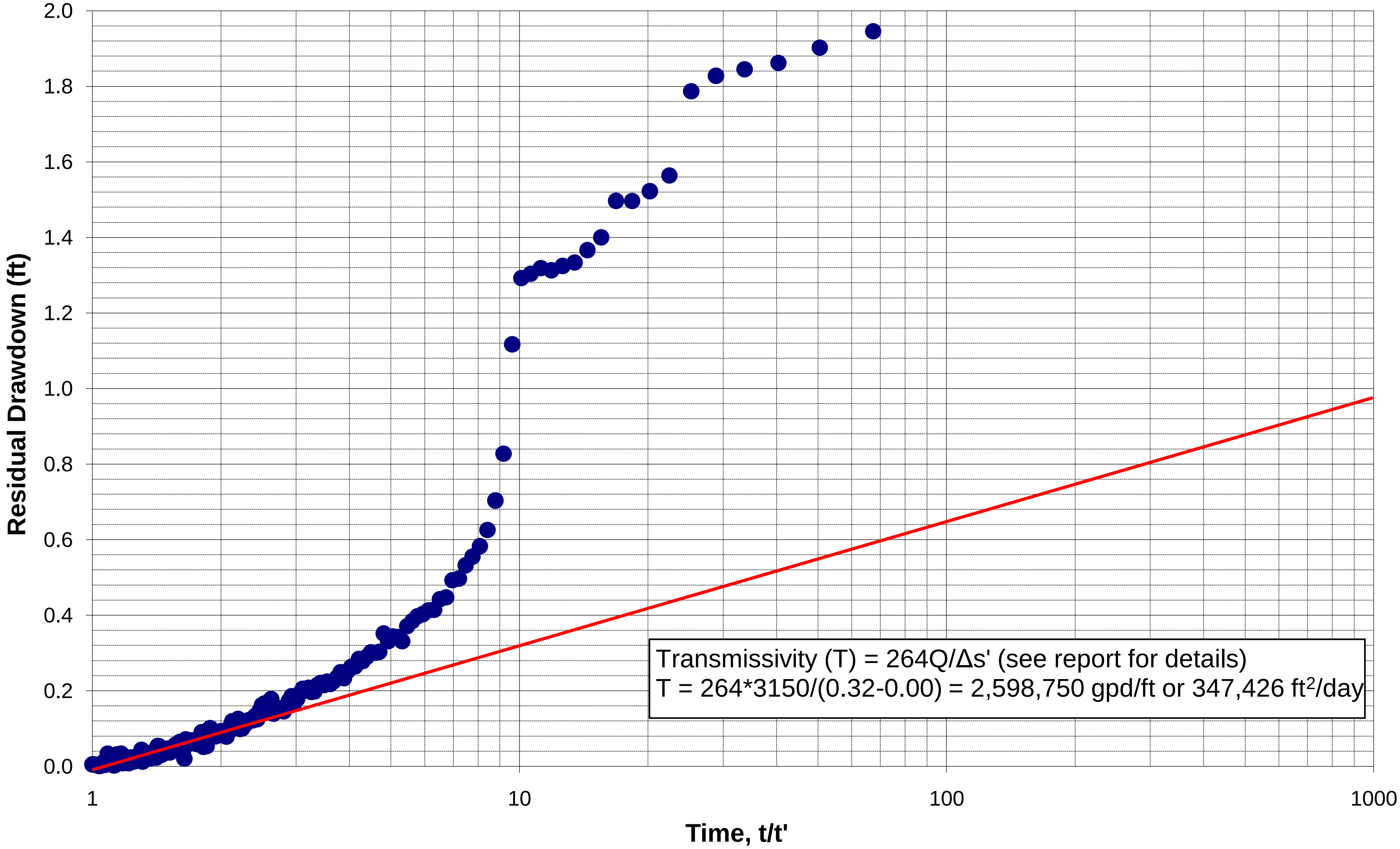

Figure 16 - Shoshone-Bannock Well 3 Theis Recovery Evaluation

Appendix A
Summary of Existing Wells at the Springfield Hatchery

Well 1 (No Well Tag)

- Completed in 1989
- 10", 0.25" wall mild steel casing to 319 feet bgs
- Perforated (0.25" by 3" mills knife) from 185 to 313 feet bgs
- 10" flange and butterfly valve
- At time of well completion:
  - 18 psi reported shut-in pressure
  - 56 deg F water
  - 1,600 gpm flow (3 hrs)
  -

1. WELL OWNER

Name CRYSTAL SPRINGS TROUT RANCH

Address HAGERMAN ID 83425

Owner's Permit No. 35-88-E065

2. NATURE OF WORK

☑ New well ☐ Deepened ☐ Replacement

☐ Abandoned (describe method of abandoning) ______

3. PROPOSED USE

☐ Domestic ☐ Irrigation ☐ Test ☐ Municipal

☐ Industrial ☐ Stock ☐ Waste Disposal or Injection

☑ Other FISH (specify type)

4. METHOD DRILLED

☐ Rotary ☐ Air ☐ Hydraulic ☐ Reverse rotary

☑ Cable ☐ Dug ☐ Other ______

5. WELL CONSTRUCTION

Casing schedule: ☑ Steel ☐ Concrete ☐ Other ______

Thickness	Diameter	From	To
.250 inches	14" inches	+ 0 feet	30' feet
.250 inches	10" inches	+1 feet	319 feet
inches	inches	feet	feet
inches	inches	feet	feet

Was casing drive shoe used? ☑ Yes ☐ No

Was a packer or seal used? ☐ Yes ☑ No

Perforated? ☑ Yes ☐ No

How perforated? ☐ Factory ☑ Knife ☐ Torch

Size of perforation 1/4 inches by 3 inches

Number	From	To
200 perforations	185 feet	313 feet
[illegible] perforations	feet	feet
perforations	feet	feet

Well screen installed? ☐ Yes ☑ No

Manufacturer's name N/A

Type ______ Model No. ______

Diameter ___ Slot size ___ Set from ___ feet to ___ feet

Diameter ___ Slot size ___ Set from ___ feet to ___ feet

Gravel packed? ☐ Yes ☑ No ☐ Size of gravel ______

Placed from ______ feet to ______ feet

Surface seal depth 108 Material used in seal: ☑ Cement grout ☐ Puddling clay ☐ Well cuttings

Sealing procedure used: ☐ Slurry pit ☐ Temp. surface casing ☑ Overbore to seal depth

Method of joining casing: ☐ Threaded ☑ Welded ☐ Solvent Weld

☐ Cemented between strata

Describe access port TOP OF WELL

6. LOCATION OF WELL

Sketch map location must agree with written location. N

7. WATER LEVEL

Static water level 12 feet below land surface.

Flowing? ☑ Yes ☐ No G.P.M. flow 1600

Artesian closed-in pressure 18 p.s.i.

Controlled by: ☑ Valve ☐ Cap ☐ Plug

Temperature 56 °F. Quality GOOD

8. WELL TEST DATA

☐ Pump ☐ Bailer ☐ Air ☐ Other ______

Discharge G.P.M.	Pumping Level	Hours Pumped
1600	0	3 Flowed

9. LITHOLOGIC LOG 78573

Hole Diam.	Depth From	Depth To	Material	Water Yes	Water No
16"	0	12	TOP SOIL		✓
16"	12	30	LAVA	✓	
14"	30	74'	LAVA GRAY, BROKEN	✓	
14"	74	110	CLAY & SAND	✓	
10"	110	120	SAND	✓	
10"	120	138	CLAY		✓
10"	138	156	SAND		
10"	156	183	CLAY		✓
10	183	290	SAND + GRAVEL + CLAY	✓	
10	290	311	GRAVEL + SAND	✓	
10	311	313	GRAVEL	✓	
10	313	319	CLAY		✓

CEMENTED 14" CASING FROM 30' UP TO TOP OF WELL

CEMENTED 10" FROM 108' TO TOP OF WELL & COVERED 14" CASING

10" FLANGE & BUTTERFLY VALVE TO SHUT OFF FLOW

RECEIVED JUL 28 1989 Department of Water Resources Eastern District Office

10. Work started 5/15/89 finished 5-29-89

11. DRILLERS CERTIFICATION

I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Well 2 (No Well Tag)

- Completed in 1989
- 10”, 0.25” wall mild steel casing to 250 feet bgs
- Perforated (0.25” by 3” mills knife) from 233 to 243 feet bgs
- 10” flange and butterfly valve
- At time of well completion:
  - 18 psi reported shut-in pressure
  - Temperature not reported
  - 1,600 gpm flow (8 hrs)

1. WELL OWNER

Name Crystal Springs Trout Ranch

Address Hagerman Id. 83425

Owner's Permit No. 35-88-E065

2. NATURE OF WORK

[x] New well ☐ Deepened ☐ Replacement

☐ Abandoned (describe method of abandoning)

3. PROPOSED USE

☐ Domestic ☐ Irrigation ☐ Test ☐ Municipal

☐ Industrial ☐ Stock ☐ Waste Disposal or Injection

[x] Other Fish Hatchery (specify type)

4. METHOD DRILLED

☐ Rotary ☐ Air ☐ Hydraulic ☐ Reverse rotary

[x] Cable ☐ Dug ☐ Other

5. WELL CONSTRUCTION

Casing schedule: [x] Steel ☐ Concrete ☐ Other

Thickness	Diameter	From	To
.250 inches	14" inches	+ 0 feet	30' feet
.250 inches	10" inches	+1 feet	250' feet
inches	inches	feet	feet
inches	inches	feet	feet

Was casing drive shoe used? [x] Yes ☐ No

Was a packer or seal used? ☐ Yes [x] No

Perforated? [x] Yes ☐ No

How perforated? ☐ Factory [x] Knife ☐ Torch

Size of perforation 1/4 inches by 3 inches

Number		From	To
200	perforations	233 feet	243 feet
	perforations	feet	feet
	perforations	feet	feet

Well screen installed? ☐ Yes [x] No

Manufacturer's name N/A

Type ______ Model No. ______

Diameter ___ Slot size N/A Set from ___ feet to ___ feet

Diameter ___ Slot size ___ Set from ___ feet to ___ feet

Gravel packed? ☐ Yes [x] No ☐ Size of gravel

Placed from ______ feet to ______ feet

Surface seal depth 110' Material used in seal: [x] Cement grout ☐ Puddling clay ☐ Well cuttings

Sealing procedure used: ☐ Slurry pit ☐ Temp. surface casing [x] Overbore to seal depth

Method of joining casing: ☐ Threaded [x] Welded ☐ Solvent Weld

☐ Cemented between strata

Describe access port Top of well

6. LOCATION OF WELL

Sketch map location must agree with written location.

N W E

Subdivision Name

Lot No. ______ Block ______

NOV 20 1991

7. WATER LEVEL

Static water level 10 feet below land surface.

Flowing? [x] Yes ☐ No G.P.M. flow 1600

Artesian closed-in pressure 18 p.s.i.

Controlled by: [x] Valve ☐ Cap ☐ Plug

Temperature ____ °F. Quality ______

8. WELL TEST DATA

☐ Pump ☐ Bailer ☐ Air [x] Other Flowing

Discharge G.P.M.	Pumping Level	Hours Pumped
1600	0	8

9. LITHOLOGIC LOG 73088

Hole Diam.	Depth From	Depth To	Material	Water Yes	Water No
16"	0	7'	Top Soil		✓
	7	10	Clay		
	10	30	Lava	✓	
14"	30	35	Lava Cinders	✓	
	35	37	Lava	✓	
	37	43	Sand Gravel Clay	✓	
	43	56	Lava	✓	
	56	66	Sand Gravel Clay	✓	
	66	78	Gravel	✓	
14"	78	110	Sand Gravel Clay	✓	
10"	110	144	Sand	✓	
	144	228	Sand Gravel small	✓	
	228	245	Sand & Gravel large	✓	
	245	250	Clay		

Cemented 14" casing 30' up

Cemented 10" casing from 110' up to top of well & covered 14" casing.

10" flange & butterfly valve to shut off flow

RECEIVED

JUL 2 ~ 1989

Department of Water Resources
Eastern District Office

10.

Work started June 10, 1989 finished June 25, 1989

11. DRILLERS CERTIFICATION

I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Firm Name Vollmer Drilling Firm No. 383

Box Z Aberdeen, Id.

Address 83210 Date 06/28/89

Signed by (Firm Official)

Well 3 (D0004202)

- Completed in 1997
- 12", 0.25" wall mild steel casing to 220 feet bgs
- Perforated (0.375" by 2" mills knife) from 185 to 216 feet bgs
- Butterfly valve on discharge
- Discharges to pond then partially submerged 18" pipe
- Has a weir (overgrown)
- At time of well completion:
  - 4 psi reported shut-in pressure
  - 50 deg F water
  - No reported flow measurement
- Shut-in pressure in 2007 (ESC , 2007): 5.2 ft water
- Specific capacity (Clearwater Geosciences, 2008): 142 gpm/ft

Form 238-7 8/95

IDAHO DEPARTMENT OF WATER RESOURCES

WELL DRILLER'S REPORT

Use Typewriter or Ballpoint Pen

061792

Office Use Only
Inspected by ____
Twp____ Rge____ Sec ____
____1/4 ____1/4 ____1/4
Lat: : : Long: : :

1. DRILLING PERMIT NO. 35-97-E-0101-
Other IDWR No. T 5030 35-04271

2. OWNER:
Name North Fork Energy
Address P.O. Box 5405
City Boise State ID. Zip 83705

3. LOCATION OF WELL by legal description:
Sketch map location must agree with written location.

Twp. 4 North ☐ or South ☒
Rge. 32 East ☒ or West ☐
Sec. 24 ____ 1/4 SE 1/4 NE 1/4
Gov't Lot ____ County Bingham
Lat: : : Long: : :
Address of Well Site 1830 W. 950 S.
(Give at least name of road + Distance to Road or Landmark) City Springfield
Lt.____ Blk.____ Sub. Name____

4. USE:
☐ Domestic ☐ Municipal ☐ Monitor ☐ Irrigation
☐ Thermal ☐ Injection ☐ Other Fish Propagation

5. TYPE OF WORK check all that apply (Replacement etc.)
☒ New Well ☐ Modify ☐ Abandonment ☐ Other____

6. DRILL METHOD
☐ Air Rotary ☒ Cable ☐ Mud Rotary ☐ Other____

7. SEALING PROCEDURES

SEAL/FILTER PACK Material	From	To	AMOUNT Sacks or Pounds	METHOD
Cement	0	40'	6.5 yds	Grout Pump
Bentonite chip	14	63	30 sacks	Pour
Cement	0	14	5 sacks	Pour

Was drive shoe used? ☒Y ☐N Shoe Depth(s) 63' 220'
Was drive shoe seal tested? ☐Y ☒N How?____

8. CASING/LINER:

Diameter	From	To	Gauge	Material	Casing	Liner	Welded	Threaded
16"	+1	63'	.250	steel	☒	☐	☒	☐
12"	+2	220	.250	steel	☒	☐	☒	☐
					☐	☐	☐	☐

Length of Headpipe____ Length of Tailpipe____

9. PERFORATIONS/SCREENS
☒ Perforations Method Mills Knife
☐ Screens Screen Type____

MICROFILMED APR 0 7 1998

From	To	Slot Size	Number	Diameter	Material	Casing	Liner
185	216	3/8x2	135	12"	steel	☒	☐
						☐	☐
						☐	☐

10. STATIC WATER LEVEL OR ARTESIAN PRESSURE:
____ft. below ground Artesian pressure 4 lb.
Depth flow encountered 180 ft. Describe access port or control devices: 12" Valve

11. WELL TESTS:
☐ Pump ☐ Bailer ☐ Air ☒ Flowing Artesian

Yield gal./min.	Drawdown	Pumping Level	Time

Water Temp. 50 Bottom hole temp. 50
Water Quality test or comments: clean
Depth first Water Encountered 17'

12. LITHOLOGIC LOG: (Describe repairs or abandonment)

Bore Dia.	From	To	Remarks: Lithology, Water Quality & Temperature	Water Y	Water N
25'	0	4	Topsoil		
	4	20	Brown clay	X	
	20	25	Light Brown clay		X
	25	36	Lava Rock	X	
	36	52'	Tan clay + sand		X
16"	52	63	Small Gravel + Brown clay	X	
	63	68	sand Gravel + Grey clay	X	
12"	68	90	Grey Sand	X	
	90	105	Tan clay sticky		X
	105	117	Grey Sand	X	
	117	130	Tan clay sticky		X
	130	135	Grey Sand	X	
	135	140	Black Sand	X	
	140	168	Grey Sand	X	
	168	180	Brown clay		X
	180	193	Gravel + Sand	X	
	193	220	Gravel Sand + Brown clay	X	

RECEIVED
NOV 2 5 1997
Department of Water Resources Eastern Region

RECEIVED
DEC 0 4 1997
Department of Water Resources

Completed Depth 220' (Measurable)
Date: Started 9-24-97 Completed 10-31-97

13. DRILLER'S CERTIFICATION
I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Firm Name Findlay Drilling Firm No. 062
Firm Official [signature] Date 11-14-97
and
Supervisor or Operator [signature] Date 11-14-97
(Sign once if Firm Official & Operator)

FORWARD WHITE COPY TO WATER RESOURCES

Well 4 (D0004491)

- Completed in 1998
- 16”, 0.25” wall mild steel casing to 238 feet bgs
- Perforated (0.625” by 3.5” mills knife) from 180 to 235 feet bgs
- 16” discharge; butterfly valve on casing
- Knife valve on discharge; yellow jackets in handle
- Downstream weir blown out on right bank (need to repair)
- At time of well completion:
  - 2 psi reported shut-in pressure
  - 51 deg F water
  - 4 cfs flow
- Shut-in pressure in 2007 (ESC , 2007): 4.1 ft water
- Specific capacity (Clearwater Geosciences, 2008): 251 gpm/ft

Form 238-7 3/95

IDAHO DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT
Use Typewriter or Ballpoint Pen

065382

Office Use Only
Inspected by ______
Twp ____ Rge ____ Sec ____
____1/4 ____1/4 ____1/4
Lat: : : Long: : :

1. DRILLING PERMIT NO. 35-97-E-135-
Other IDWR No. Tag D.000 4491

2. OWNER:
Name North Fork Energy
Address P.O. Box 5405
City Boise State ID Zip 83705

3. LOCATION OF WELL by legal description:
Sketch map location must agree with written location.

Twp. 4 North ☐ or South ☒
Rge. 32 East ☒ or West ☐
Sec. 24, ___1/4 SE 1/4 NE 1/4
Gov't Lot ____ County Bingham
Lat: : : Long: : :
Address of Well Site 1830 W. 950S. City Springfield
(Give at least name of road + Distance to Road or Landmark)
Lt. ____ Blk. ____ Sub. Name ____

4. USE:
☐ Domestic ☐ Municipal ☐ Monitor ☐ Irrigation
☐ Thermal ☐ Injection ☒ Other Fish Production

5. TYPE OF WORK check all that apply (Replacement etc.)
☒ New Well ☐ Modify ☐ Abandonment ☐ Other ____

6. DRILL METHOD
☐ Air Rotary ☒ Cable ☐ Mud Rotary ☐ Other ____

7. SEALING PROCEDURES

SEAL/FILTER PACK Material	From	To	AMOUNT Sacks or Pounds	METHOD
Neat Cement	0	10'	3.5 yds	Pour Outside of 24" casing
Neat Cement	0	53	7.6 yds	Pressure Grout between 24" openhole + 20" casing
Bentonite chip	15	60	35 sack	Pour chips Than cement plug on chips from 8-15'

Was drive shoe used? ☐ Y ☐ N Shoe Depth(s) ____
Was drive shoe seal tested? ☐ Y ☐ N How? ____

8. CASING/LINER:

Diameter	From	To	Gauge	Material	Casing	Liner	Welded	Threaded
24	0	10	.250	Steel	☒	☐	☐	☐
20	0	60	"	"	☒	☐	☒	☐
16	+1	238	"	"	☒	☐	☒	☐

Length of Headpipe ____ Length of Tailpipe ____

9. PERFORATIONS/SCREENS
☒ Perforations Method Mills Knife
☐ Screens Screen Type ____

From	To	Slot Size	Number	Diameter	Material	Casing	Liner
180	235	5/8 x 3.5	350			☒	☐
						☐	☐
						☐	☐

10. STATIC WATER LEVEL OR ARTESIAN PRESSURE:
____ ft. below ground Artesian pressure 2 lb.
Depth flow encountered 180 ft. Describe access port or control devices: Valve @ well head

11. WELL TESTS:
☐ Pump ☐ Bailer ☐ Air ☒ Flowing Artesian

Yield gal./min.	Drawdown	Pumping Level	Time
4CFS			

Water Temp. 51° Bottom hole temp. 51°
Water Quality test or comments: ____
Depth first Water Encountered 10'

12. LITHOLOGIC LOG: (Describe repairs or abandonment)

Bore Dia.	From	To	Remarks: Lithology, Water Quality & Temperature	Water Y	Water N
24	0	3	Topsoil		X
	3	10	Brown Tan Clay	X	
	10	46	Basalt	X	
	46	50	Dark Brown Clay		X
	50	53	Tan clay sticky		X
20	53	62	Tan clay sticky		X
	62	89	Sand Gravel + Clay	X	
	89	100	Brown sticky clay		X
16	100	135	Brown sticky clay		X
	135	170	Grey Sand		X
	170	178	Grey clay		X
	178	180	Brown clay		X
	180	210	Gravel + Sand	X	
	210	220	Gravel + Sand caving	X	
	220	235	Compacted Gravel + Sand	X	
	235	240	Caving Gravel + Sand	X	

From 60'-100' of 20" openhole caving clay + Gravel - Good clay pack on outside of 16" casing in That area.

MICROFILMED SEP 23 1998

RECEIVED JUL 27 1998 Department of Water Resources

Completed Depth 238 (Measurable)
Date: Started 12-29-97 Completed 3-27-98

13. DRILLER'S CERTIFICATION
I/We certify that all minimum well construction standards were complied with at the time the rig was removed.
Firm Name North Fork Energy Firm No. 595
Firm Official C.B. Beyme Date 4-1-98
and
Supervisor or Operator [signature] Date 3-31-98
(Sign once if Firm Official & Operator)

RECEIVED APR 10 1998 Department of Water Resources Eastern Region

FORWARD WHITE COPY TO WATER RESOURCES

Well 5 (D0004659)

- Completed in 1998
- 16”, 0.25” wall mild steel casing to 265 feet bgs
- Perforated (0.625” by 3.5” mills knife) from 230 to 262 feet bgs
- 16” discharge; no butterfly valve
- Knife valve on discharge;
- Piped to pond (12” pipe)
- At time of well completion:
  - shut-in pressure not reported
  - 51 deg F water
  - 2,000 gpm flow
- Shut-in pressure in 2007 (ESC , 2007): 4.5 ft water
- Specific capacity (Clearwater Geosciences, 2008): 300 gpm/ft

Form 238-7 11/97 DMD

IDAHO DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT 065381

Office Use Only
Inspected by ______
Twp ____ Rge ____ Sec ____
____ 1/4 ____ 1/4 ____ 1/4
Lat: : : Long: : :

1. WELL TAG NO. D 0004659
DRILLING PERMIT NO. 35-98-E-0037-000
Other IDWR No. 35-04271

2. OWNER:
Name North Fork Energy
Address P.O. Box 5405
City Boise State ID Zip 83705

3. LOCATION OF WELL by legal description:
Sketch map location must agree with written location.
Twp. 4 North ☐ or South ☒
Rge. 32 East ☒ or West ☐
Sec. 24 , ____ 1/4 NE 1/4 NE 1/4
Gov't Lot ____ County Bingham
Lat: : : Long: : :
Address of Well Site 1830 W. 950 S. City Springfield
(Give at least name of road + Distance to Road or Landmark)
Lt. ____ Blk. ____ Sub. Name ____

4. USE:
☐ Domestic ☐ Municipal ☐ Monitor ☐ Irrigation
☐ Thermal ☐ Injection ☐ Other Fish Propagation

5. TYPE OF WORK check all that apply (Replacement etc.)
☒ New Well ☐ Modify ☐ Abandonment ☐ Other ____

6. DRILL METHOD
☐ Air Rotary ☒ Cable ☐ Mud Rotary ☐ Other ____

7. SEALING PROCEDURES

SEAL/FILTER PACK Material	From	To	AMOUNT Sacks or Pounds	METHOD
Neat Cement	0	43	3.5 yds	Pressure Grout outside of 20" casing in 24" borehole
Neat Cement	0	15	.5 yds	Pour on top of chips
Bentonite chips	15	85	40 bags	Pour chips in Annulus between 16" casing and 20" casing

Was drive shoe used? ☒ Y ☐ N Shoe Depth(s) 265'
Was drive shoe seal tested? ☐ Y ☐ N How? ____

8. CASING/LINER:

Diameter	From	To	Gauge	Material	Casing	Liner	Welded	Threaded
20"	0	63'	.250	steel	☒	☐	☒	☐
16"	+1	265	"	"	☒	☐	☒	☐
					☐	☐	☐	☐

Length of Headpipe ____ Length of Tailpipe ____

9. PERFORATIONS/SCREENS
Perforations 256 Method Mills Knife
Screens Screen Type ____

From	To	Slot Size	Number	Diameter	Material	Casing	Liner
230	262	5/8 x 3.5				☐	☐
						☐	☐
						☐	☐

10. STATIC WATER LEVEL OR ARTESIAN PRESSURE:
____ ft. below ground Artesian pressure ____ lb.
Depth flow encountered 180 ft. Describe access port or control devices: valve @ wellhead

11. WELL TESTS:
☐ Pump ☐ Bailer ☐ Air ☒ Flowing Artesian

Yield gal./min.	Drawdown	Pumping Level	Time
2000			

Water Temp. 51° Bottom hole temp. 51°
Water Quality test or comments: clear
Depth first Water Encounter 35'

12. LITHOLOGIC LOG: (Describe repairs or abandonment)

Bore Dia.	From	To	Remarks: Lithology, Water Quality & Temperature	Water Y	Water N
24	0	3	Topsoil		X
	3	10	Brown clay		X
	10	14	Brown sand		X
	14	24	Grey clay sticky		X
	24	25	Black clay		X
	25	39	Basalt	X	
	39	43	Tan clay + Sand		X
20	43	45	" " "		X
	45	63	Brown sand	X	
	63	85	Small Gravel + Sand	X	
16	85	135	Tan sticky clay		X
	135	170	Grey sand	X	
	170	175	Grey clay		X
	175	180	Brown Clay		X
	180	265	Gravel + Sand	X	

RECEIVED JUL 1 6 1998 Department of Water Resources Eastern Region
RECEIVED JUL 3 0 1998 Department of Water Resources
MICROFILMED SEP 2 3 1998

Completed Depth 265' (Measurable)
Date: Started 4-23-98 Completed 6-18-98

13. DRILLER'S CERTIFICATION
I/We certify that all minimum well construction standards were complied with at the time the rig was removed.
Company Name North Fork Energy Firm No. 595
Firm Official C.D. [signature] Date 7-15-98
and
Driller or Operator [signature] Date 6-28-98
(Sign once if Firm Official & Operator)

FORWARD WHITE COPY TO WATER RESOURCES

Well 6 (D0006318)

- Completed in 1999
- 16", 0.25" wall mild steel casing to 260 feet bgs
- Perforated (0.625" by 3.5" mills knife) from 205 to 255 feet bgs
- 16" discharge; no butterfly valve
- Knife valve on discharge;
- 3' rectangular weir (some leakage around left bank)
- At time of well completion:
  - 2 psi reported shut-in pressure
  - 52 deg F water
  - 900 gpm flow
- Shut-in pressure in 2007 (ESC , 2007): 3.4 ft water
- Specific capacity (Clearwater Geosciences, 2008): 372 gpm/ft

Form 238-7 1/97 DMO

IDAHO DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT 95784

Office Use Only
Inspected by ______
Twp ____ Rge ____ Sec ____
____ 1/4 ____ 1/4 ____ 1/4
Lat: : : Long: : :

1. WELL TAG NO. D 0006318
DRILLING PERMIT NO. 35-98-E-0108-000
Other IDWR No. 35-04271

2. OWNER:
Name North Fork Energy Inc.
Address P.O. Box 5405
City Boise State ID Zip 83705

3. LOCATION OF WELL by legal description:
Sketch map location must agree with written location. well #6
Twp. 04 North ☐ or South ☒
Rge. 32 East ☒ or West ☐
Sec. 24 NE 1/4 NE 1/4 1/4
Gov't Lot ____ County Bingham
Lat: : : Long: : :
Address of Well Site 1800 W. 1050 S.
City Springfield
Lt. ____ Blk. ____ Sub. Name ____

4. USE:
☐ Domestic ☐ Municipal ☐ Monitor ☐ Irrigation
☐ Thermal ☐ Injection ☒ Other Fish Propagation

5. TYPE OF WORK check all that apply (Replacement etc.)
☒ New Well ☐ Modify ☐ Abandonment ☐ Other ____

6. DRILL METHOD
☐ Air Rotary ☒ Cable ☐ Mud Rotary ☐ Other ____

7. SEALING PROCEDURES

SEAL/FILTER PACK Material	From	To	AMOUNT Sacks or Pounds	METHOD
Cement	0	10	6yds	outside casing Annulus
Neat Cement	0	52'	7yds	Annular space between 20 and 24
Bentonite chip	10	75	42 bags	Annular space outside of 16 casing, cement cap on top of bentonite from 0-10'

Was drive shoe used? ☒ Y ☐ N Shoe Depth(s) 260'
Was drive shoe seal tested? ☐ Y ⓝ N How? ____

8. CASING/LINER:

Diameter	From	To	Gauge	Material	Casing	Liner	Welded	Threaded
24	0	10'	.250	Steel	☒	☐	☐	☐
20	0	60'	.250	Steel	☒	☐	☒	☐
16	+1	260	.250	Steel	☒	☐	☒	☐

Length of Headpipe ____ Length of Tailpipe ____

9. PERFORATIONS/SCREENS
Perforations 290 Method Mills Knife
Screens Screen Type ____

From	To	Slot Size	Number	Diameter	Material	Casing	Liner
205	255	5/8	290			☒	☐
		3.5				☐	☐
						☐	☐

10. STATIC WATER LEVEL OR ARTESIAN PRESSURE:
____ ft. below ground Artesian pressure 2 lb.
Depth flow encountered 187 ft. Describe access port or control devices: Shut off valve @ well head

11. WELL TESTS:
☐ Pump ☐ Bailer ☐ Air ☒ Flowing Artesian

Yield gal./min.	Drawdown	Pumping Level	Time
900			

Water Temp. 52° Bottom hole temp. 52°
Water Quality test or comments: clear Depth first Water Encounter 10'

12. LITHOLOGIC LOG: (Describe repairs or abandonment) Water

Bore Dia.	From	To	Remarks: Lithology, Water Quality & Temperature	Y	N
24	0	6	Sandy silt		X
	6	10	Brown clay	✓	
	10	35	Basalt	✓	
	35	43	Red Basalt + Cinders	✓	
	43	50	Black Basalt	✓	
	50	52	Broken Basalt	✓	
20	52	58	Dark Brown clay		X
	58	78	Gravel + Sand	✓	
16	78	92	Gravel + Sand	✓	
	92	142	Tan sticky clay		X
	142	170	Grey sand	✓	
	170	172	Grey clay		X
	172	187	Tan clay		X
	187	267	Large Gravel + Sand	✓	

RECEIVED
MAR 0 8 1999
Department of Water Resources

RECEIVED
MAR 0 4 1999
Department of Water Resources
Eastern Region

MICROFILMED
JUN 0 8 1999

Completed Depth 260' (Measurable)
Date: Started 10-13-98 Completed 1-28-99

13. DRILLER'S CERTIFICATION
I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Company Name North Fork Energy Firm No. 595
Firm Official C.B. Bayman Date 2-18-99
and
Driller or Operator Bud [illegible] Date 2-18-99
(Signature of Firm Official & Operator)

FORWARD WHITE COPY TO WATER RESOURCES

Well 7 (D0006624)

- Completed in 1999
- 16”, 0.25” wall mild steel casing to 265 feet bgs
- Perforated (0.625” by 3.5” mills knife) from 220 to 260 feet bgs
- 16” discharge; butterfly valve
- Knife valve on discharge
- 3’ rectangular weir
- At time of well completion:
  - 2 psi reported shut-in pressure
  - 52 deg F water
  - 2,250 gpm flow
- Shut-in pressure in 2007 (ESC , 2007): 6.9 ft water
- Specific capacity (Clearwater Geosciences, 2008): 149 gpm/ft

Form 238-7
11/97
DMD

IDAHO DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT

95400

Office Use Only
Inspected by ______
Twp ____ Rge ____ Sec ____
____ 1/4 ____ 1/4 ____ 1/4
Lat: : : Long: : :

1. WELL TAG NO. D 0006624
DRILLING PERMIT NO. 35-99-E-0006-000
Other IDWR No. 35-04271

2. OWNER:
Name North Fork Energy
Address P.O. Box 5405
City Boise State ID Zip 83705

3. LOCATION OF WELL by legal description:
Sketch map location must agree with written location. Well #7

Twp. 04 North ☐ or South ☒
Rge. 32 East ☒ or West ☐
Sec. 24, ____ 1/4 SE 1/4 NE 1/4 (10 acres, 40 acres, 160 acres)
Gov't Lot ____ County Bingham
Lat: : : Long: : :
Address of Well Site 1800 W. 1050 S. Judge Rd. City Springfield
(Give at least name of road + Distance to Road or Landmark)
Lt. ____ Blk. ____ Sub. Name ____

4. USE:
☐ Domestic ☐ Municipal ☐ Monitor ☐ Irrigation
☐ Thermal ☐ Injection ☒ Other Fish Propagation

5. TYPE OF WORK check all that apply (Replacement etc.)
☒ New Well ☐ Modify ☐ Abandonment ☐ Other ____

6. DRILL METHOD
☐ Air Rotary ☒ Cable ☐ Mud Rotary ☐ Other ____

7. SEALING PROCEDURES

SEAL/FILTER PACK Material	From	To	AMOUNT Sacks or Pounds	METHOD
Grey Clay	28	45	cave in around pipe into 24" Annulus	
Cement	0	28	3.5 yds	Grout pump in 24" Annulus
Bentonite Chips	42	85	45	Pour chips around 16" casing Cement 0-22'

Was drive shoe used? ☒ Y ☐ N Shoe Depth(s) 265
Was drive shoe seal tested? ☐ Y ☐ N How? ____

8. CASING/LINER:

Diameter	From	To	Gauge	Material	Casing	Liner	Welded	Threaded
20"	0	70	.250	steel	☒	☐	☒	☐
16"	+1	265	"	"	☒	☐	☒	☐
					☐	☐	☐	☐

Length of Headpipe 3' Length of Tailpipe ____

9. PERFORATIONS/SCREENS
Perforations 320 Method Mills Knife
Screens Screen Type ____

From	To	Slot Size	Number	Diameter	Material	Casing	Liner
220	260	5/8 x 3"	320		steel	☒	☐
						☐	☐
						☐	☐

10. STATIC WATER LEVEL OR ARTESIAN PRESSURE:
____ ft. below ground Artesian pressure 2 lb.
Depth flow encountered 185' ft. Describe access port or control devices: Valve @ well Head

11. WELL TESTS:
☐ Pump ☐ Bailer ☐ Air ☒ Flowing Artesian

Yield gal./min.	Drawdown	Pumping Level	Time
2250			

Water Temp. 52 Bottom hole temp. ____
Water Quality test or comments: clear
Depth first Water Encounter 12'

12. LITHOLOGIC LOG: (Describe repairs or abandonment)

Bore Dia.	From	To	Remarks: Lithology, Water Quality & Temperature	Water Y	Water N
24	0	2	Soil		
	2	12	Silty sand	X	
	12	20	Grey clay		
	20	40	Basalt	X	
	40	45	Brown clay		
20	45	48	Brown clay		
	48	64	Sand	X	
	64	85	Gravel	X	
16	85	90	Gravel	X	
	90	115	Brown clay		
	115	128	Silty Brown Sand		
	128	138	Brown clay		
	138	167	Brown sand		
	167	180	Brown clay		
	180	184	Brown sand		
	184	270	Gravel + Sand	X	

RECEIVED JUN 15 1999 Department of Water Resources
RECEIVED JUN 08 1999 Department of Water Resources Eastern Region
MICROFILMED AUG 25 1999

Completed Depth 265 (Measurable)
Date: Started 2-5-99 Completed 5/10/99

13. DRILLER'S CERTIFICATION
I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Company Name North Fork Energy Firm No. 595
Firm Official [signature] Date 5-17-99
and
Driller or Operator [signature] Date 5/17/99
(Sign once if Firm Official & Operator)

FORWARD WHITE COPY TO WATER RESOURCES

Well 8 (D0006758)

- Completed in 1999
- 16", 0.25" wall mild steel casing to 265 feet bgs
- Perforated (0.625" by 3.5" mills knife) from 230 to 262 feet bgs
- 16" discharge; butterfly valve
- Knife valve on discharge
- 3' rectangular weir
- At time of well completion:
  - 2 psi reported shut-in pressure
  - Water temperature not reported
  - 2,250 gpm flow
- Shut-in pressure in 2007 (ESC , 2007): NR
- Specific capacity (Clearwater Geosciences, 2008): NR

Form 238-7 11/97

IDAHO DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT

054450

Office Use Only
Inspected by ______
Twp ____ Rge ____ Sec ____
____ 1/4 ____ 1/4 ____ 1/4
Lat: : : Long: : :

1. WELL TAG NO. D 0006758
DRILLING PERMIT NO. 35 99 E 0024
Other IDWR No. ______

2. OWNER:
Name North Fork Energy Inc.
Address P.O Box 5405
City Boise ID. State ____ Zip 83705
WATER RIGHT # 36-04271

3. LOCATION OF WELL by legal description:
Sketch map location must agree with written location.

Twp. 04 North ☐ or South ☒
Rge. 32 East ☒ or West ☐
Sec: 24, ____ 1/4 SE 1/4 NE 1/4
Gov't Lot ____ County ______
Lat: : : Long: : :
Address of Well Site 1800 W. 1050 S. Judge Rd. City Springfield
(Give at least name of road + Distance to Road or Landmark)
Lt. ____ Blk. ____ Sub. Name ______

4. USE:
☐ Domestic ☐ Municipal ☐ Monitor ☐ Irrigation
☐ Thermal ☐ Injection ☐ Other Fish Propagation

5. TYPE OF WORK check all that apply (Replacement etc.)
☒ New Well ☐ Modify ☐ Abandonment ☐ Other ______

6. DRILL METHOD
☐ Air Rotary ☒ Cable ☐ Mud Rotary ☐ Other ______

7. SEALING PROCEDURES

SEAL/FILTER PACK Material	From	To	AMOUNT Sacks or Pounds	METHOD
Cement + Bentonite	0-	50	6yds	Grout pumped around 20" casing in 24" Annulus
Bentonite chip	24	110	50 sacks	Pour in 20" Annulus around 16" casing
Cement	0	24	1/2 yard	Pour same as above

Was drive shoe used? ☒ Y ☐ N Shoe Depth(s) 265'
Was drive shoe seal tested? ☐ Y ☒ N How? ______

8. CASING/LINER:

Diameter	From	To	Gauge	Material	Casing	Liner	Welded	Threaded
20	0	92	.250	steel	☒	☐	☒	☐
16	+1	265	"	"	☒	☐	☒	☐
					☐	☐	☐	☐

Length of Headpipe ______ Length of Tailpipe ______

9. PERFORATIONS/SCREENS
Perforations 280 Method Mills Knife
Screens Screen Type ______

From	To	Slot Size	Number	Diameter	Material	Casing	Liner
230	262	5/8-3"			steel	☒	☐
						☐	☐
						☐	☐

10. STATIC WATER LEVEL OR ARTESIAN PRESSURE:
____ ft. below ground Artesian pressure 2 lb.
Depth flow encountered 190 ft. Describe access port or control devices: Valve @ well head

11. WELL TESTS:
☐ Pump ☐ Bailer ☐ Air ☒ Flowing Artesian

Yield gal/min.	Drawdown	Pumping Level	Time
2250			

Water Temp. ______ Bottom hole temp. ______
Water Quality test or comments: ______
Depth first Water Encounter ______

12. LITHOLOGIC LOG: (Describe repairs or abandonment)

Bore Dia.	From	To	Remarks: Lithology, Water Quality & Temperature	Water Y	Water N
24	0	2	Sod		X
	2	8	Sand	X	
	8	15	Brown silty Clay		X
	15	26	Grey Clay		X
	26	44	Basalt Broken	X	
	44	50	Grey Clay		X
20	50	54	Grey Clay		X
	54	60	Brown Sand	X	
	60	89	Gravel + Sand	X	
	89	110	Brown sticky Clay		X
16	110	122	Brown Sand	X	
	122	140	Brown Clay		X
	140	165	Brown Sand	X	
	165	178	Brown Clay		X
	178	187	Brown Sand	X	
	187	270	Gravel + Sand	X	

RECEIVED SEP 10 1999 Department of Water Resources
RECEIVED AUG 26 1999 Department of Water Resources Eastern Region

Completed Depth ______ (Measurable)
Date: Started 4-15-99 Completed 7-27-99

13. DRILLER'S CERTIFICATION
I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Company Name North Fork Energy Firm No. 595
Firm Official [signature] Date 8-24-99
and
Driller or Operator [signature] Date 8-24-99
(Sign once if Firm Official & Operator)

Well 9 (D0011007)

- Completed in 1999
- 16", 0.25" wall mild steel casing to 260 feet bgs
- Perforated (0.625" by 3.5" mills knife) from 225 to 255 feet bgs
- 16" discharge; butterfly valve
- Knife valve on discharge
- 3' rectangular weir
- At time of well completion:
  - 2 psi reported shut-in pressure
  - 52 deg F water
  - 1,800 gpm flow
- Shut-in pressure in 2007 (ESC , 2007): NR
- Specific capacity (Clearwater Geosciences, 2008): NR; (SPF, 2010): 246 gpm/ft at 1500 gpm, 205 gpm/ft at 3000 gpm

Form 238-7 11/97 DMD

IDAHO DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT

Office Use Only
Inspected by ______
Twp ____ Rge ____ Sec ____
____ 1/4 ____ 1/4 ____ 1/4
Lat: : : Long: : :

054451

1. WELL TAG NO. D 0011007
DRILLING PERMIT NO. 35 99 - E-0058 - 000
Other IDWR No. 35-04271

2. OWNER:
Name North Fork Energy Inc.
Address P.O. Box 5404
City Boise State ID Zip 83705

3. LOCATION OF WELL by legal description:
Sketch map location must agree with written location. #9
Twp. 04 North ☐ or South ☒
Rge. 32 East ☒ or West ☐
Sec. 24, ____ 1/4 NE 1/4 NE 1/4
Gov't Lot ____ County Bingham
Lat: : : Long: : :
Address of Well Site 1800 W. 1050 S. Judge Rd. City Springfield
Lt. ____ Blk. ____ Sub. Name ____

4. USE:
☐ Domestic ☐ Municipal ☐ Monitor ☐ Irrigation
☐ Thermal ☐ Injection ☐ Other Fish Propagation

5. TYPE OF WORK check all that apply (Replacement etc.)
☒ New Well ☐ Modify ☐ Abandonment ☐ Other ____

6. DRILL METHOD
☐ Air Rotary ☒ Cable ☐ Mud Rotary ☐ Other ____

7. SEALING PROCEDURES

Seal/Filter Pack Material	From	To	Amount (Sacks or Pounds)	Method
Bentonite + Cement	0	53	6yds. 96 sacks	Grout Pump 24" Annulus
Bentonite Chips	15'	112'	46 sacks	Pour between 20" + 16" casing
Cement Grout	0	15'	1 1/4 yd.	Pour Grout between 20 + 16" casing

Was drive shoe used? ☒ Y ☐ N Shoe Depth(s) 260'
Was drive shoe seal tested? ☐ Y ☒ N How? ____

8. CASING/LINER:

Diameter	From	To	Gauge	Material	Casing	Liner	Welded	Threaded
20	0	94'	.250	steel	☒	☐	☒	☐
16	+1	260	.250	steel	☒	☐	☒	☐

Length of Headpipe ____ Length of Tailpipe ____

9. PERFORATIONS/SCREENS
Perforations 360 Method Mills Knife
Screens ____ Screen Type ____

From	To	Slot Size	Number	Diameter	Material	Casing	Liner
225	255	3"	360	5/8		☒	☐

10. STATIC WATER LEVEL OR ARTESIAN PRESSURE:
____ ft. below ground Artesian pressure 2 lb.
Depth flow encountered 188 ft. Describe access port or control devices: Valve @ well head

11. WELL TESTS:
☐ Pump ☐ Bailer ☐ Air ☒ Flowing Artesian

Yield gal./min.	Drawdown	Pumping Level	Time
1800 gpm			

Water Temp. 52° Bottom hole temp. 52°
Water Quality test or comments: Good
Depth first Water Encounter ____

12. LITHOLOGIC LOG: (Describe repairs or abandonment)

Bore Dia.	From	To	Remarks: Lithology, Water Quality & Temperature	Water Y	Water N
24	0	1	Topsoil		
	1	12	Sand	X	
	12	14	Brown clay		X
	14	19	Grey clay		X
	19	49	Basalt	X	
	49	53	Brown clay		X
20	53	58	Grey clay		X
	58	92	Sand + Gravel	X	
	92	112	Brown clay		X
16	112	125	Brown Sand	X	
	125	134	Brown clay		X
	134	170	Brown Sand	X	
	170	185	Brown clay		X
	185	265	Large Gravel + Sand	X	

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MICROFILMED NOV 30 1999

Completed Depth 260' (Measurable)
Date: Started 6-22-99 Completed 10-6-99

13. DRILLER'S CERTIFICATION
I/We certify that all minimum well construction standards were complied with at the time the rig was removed.
Company Name North Fork Energy Firm No. 595
Firm Official C.B. Beymer Date 10-12-99
and
Driller or Operator [signature] Date 10-12-99
(Signature if Firm Official & Operator)

FORWARD WHITE COPY TO WATER RESOURCES

Appendix B
2010 Test Pump Cut Sheet

Rain for Rent

Model DV-200c

Standard Features

- Hot Dip Galvanized Trailers and Skids
  - Radiator Enclosure
  - Battery Box
  - Wheels
- Zinc Plated Jacks
- Emissions Certified Engines
  - Perkins and John Deere
- DOT LED lights
- Electric Brakes with Safety breakaway
- Locking Battery Box

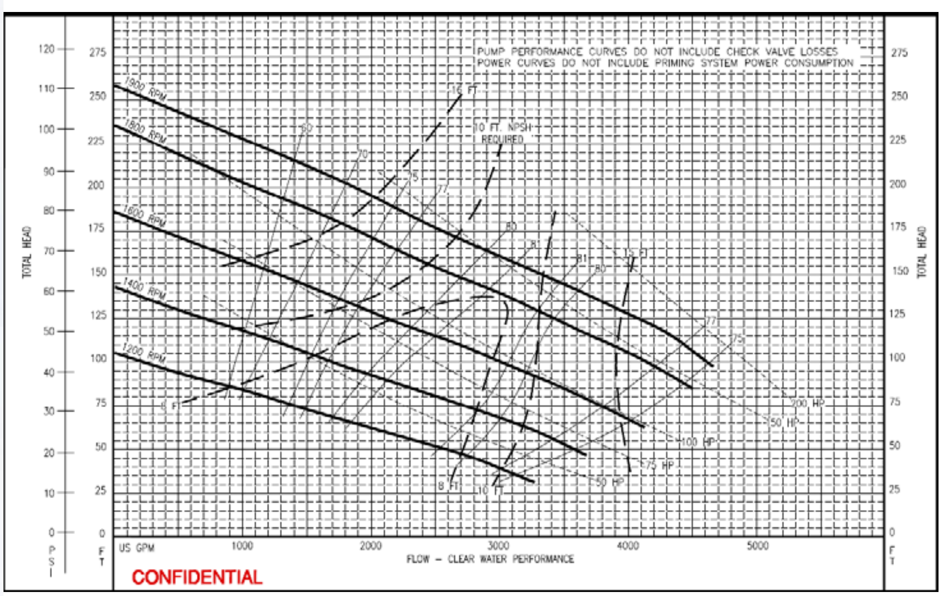
Pump Features

- Solids-handling capabilities to 3.375" diameter maximum
- Continuous self-priming
- Runs dry unattended
- Suction lift up to 28 ft.
- Skid- or trailer-mounted
- Auto-start-capable control panel

Technical

- SAE-mounted
- 12 volt, electric start with control panel
- Skid- or trailer-mounted with optional lifting bale
- 24-hour minimum capacity fuel tank
- Compressor/Venturi automatic priming system
- Electric drive option available
- Sound attenuated option available

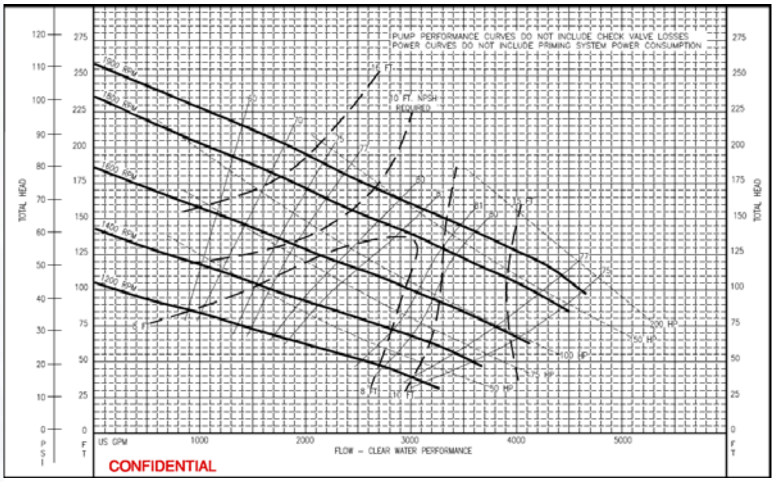
- **Material Specifications**
- Standard Build – ASTM A48 CLASS 30 Gray Iron volute Enclosed 2 vane non-clog impeller and replaceable wear rings
- Pump Shaft
  LaSalle 1144 stress proof steel
- Mechanical Seal
  Tungsten carbide vs. silicon carbide mating faces
  Oil-bath lubrication for dry running
- Suction / discharge flanges ANSI 150# FF



Rain for Rent
P.O. Box 2248
Bakersfield CA 93303
800-742-7246
661-393-1542
FAX 661-393-1542
www.rainforrent.com
info@rainforrent.com

DV-200c Technical Specifications

Production Curve



Performance Specs

2 VANE NON-CLOG IMPELLER	
Minimum Operating Speed:	1400 RPM
Maximum Operating Speed:	1900 RPM
Maximum Head:	260 FT
Maximum Flow:	4600 GPM
Fuel Consumption: Perkins 1106D-E60TA (4000 GPM @ 125' TDH)	8.5 GPH @ 1900 RPM

Design Details

Pump Designation:	DV-200C
Pump Description:	Centrifugal end suction pump, single stage, volute type, 2 vane non-clog impeller
Solid Handling Size:	Up to 3.375inches (45mm)
Operating Temperature	MIN: -4ºF (-20ºC) - MAX: +212ºF (+100ºC)

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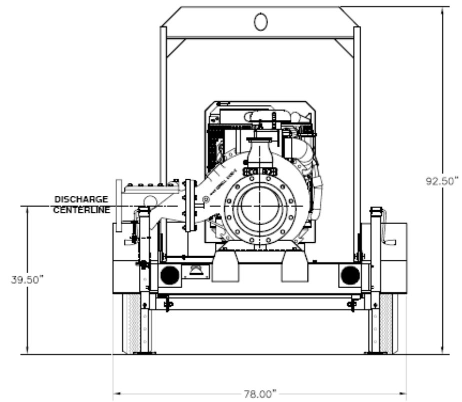
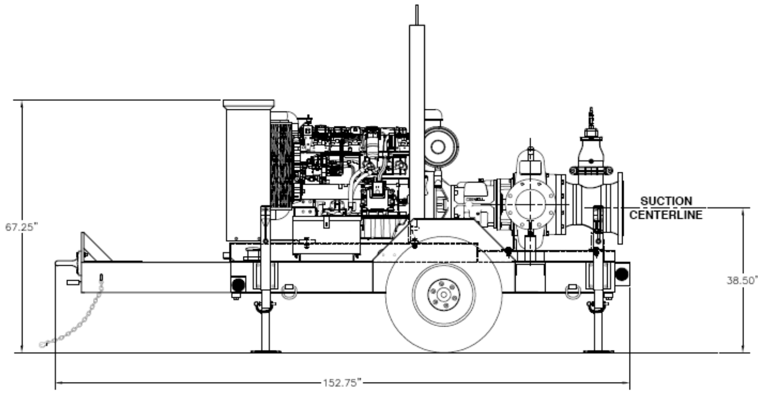
Dimensions





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Idaho Department of Fish and Game, November 2010

Springfield Sockeye Hatchery
Master Plan for the Snake River Sockeye Program