

TABLE OF CONTENTS

| | |
|--|--------|
| LIST OF FIGURES | xix |
| LIST OF TABLES | xxvii |
| ACRONYMS AND ABBREVIATIONS | xxxiii |
| EXECUTIVE SUMMARY | xxxv |
| 1.0 PURPOSE OF ACTION AND NEED FOR POWER | 1 |
| 1.1 PURPOSE OF ACTION | 1 |
| 1.2 NEED FOR POWER | 4 |
| 1.3 INTERVENTIONS | 5 |
| 1.4 SCOPING PROCESS | 6 |
| 1.5 CONSULTATION | 7 |
| 1.6 COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT | 8 |
| 2.0 PROPOSED ACTION AND ALTERNATIVES | 9 |
| 2.1 NO-ACTION ALTERNATIVE | 9 |
| 2.1.1 Existing Project Facilities | 9 |
| 2.1.1.1 Brownlee Development | 9 |
| 2.1.1.2 Oxbow Development | 12 |
| 2.1.1.3 Hells Canyon Development | 12 |
| 2.1.1.4 Transmission Facilities | 12 |
| 2.1.1.5 Fish Hatcheries and Related Facilities | 12 |
| 2.1.1.6 Recreation Facilities | 16 |
| 2.1.1.7 Project Safety | 16 |
| 2.1.2 Current Project Operations | 16 |
| 2.1.2.1 Brownlee Development | 16 |
| 2.1.2.2 Oxbow Development | 18 |
| 2.1.2.3 Hells Canyon Development | 19 |
| 2.1.3 Current Environmental Measures | 19 |
| 2.1.4 Current Project Boundary | 20 |
| 2.2 IDAHO POWER'S PROPOSAL | 20 |
| 2.2.1 Proposed Project Facilities | 20 |
| 2.2.2 Proposed Project Operations | 20 |
| 2.2.3 Proposed Environmental Measures | 21 |
| 2.2.4 Proposed Project Boundary | 29 |
| 2.3 MODIFICATIONS TO IDAHO POWER'S PROPOSAL | 29 |
| 2.3.1 Mandatory Conditions | 29 |
| 2.3.1.1 Water Quality Certification | 29 |
| 2.3.1.2 Section 18 Fishway Prescriptions | 29 |
| 2.3.1.3 Section 4(e) Federal Land Management Conditions and Alternative Conditions | 31 |
| 2.3.2 Other Recommendations by Agencies and Interested Parties | 34 |
| 2.3.2.1 Section 10(j) Recommendations | 34 |
| 2.3.2.2 Section 10(a) Recommendations | 34 |
| 2.3.3 Staff Alternative | 35 |
| 2.3.4 Staff Alternative with Mandatory Conditions | 44 |

| | | |
|----------|--|-----|
| 2.4 | OTHER ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY | 44 |
| 2.4.1 | Federal Government Takeover of the Project..... | 44 |
| 2.4.2 | Issuance of Nonpower License..... | 44 |
| 2.4.3 | Project Retirement | 45 |
| 3.0 | ENVIRONMENTAL ANALYSIS | 47 |
| 3.1 | GENERAL DESCRIPTION OF THE AREA | 47 |
| 3.2 | CUMULATIVELY AFFECTED RESOURCES..... | 49 |
| 3.2.1 | Geographic Scope..... | 49 |
| 3.2.1.1 | Sediment Transport..... | 49 |
| 3.2.1.2 | Water Quality..... | 50 |
| 3.2.1.3 | Anadromous Fish..... | 50 |
| 3.2.1.4 | Resident Fish..... | 51 |
| 3.2.1.5 | Federally Listed Aquatic Mollusks | 52 |
| 3.2.1.6 | Riparian/Wetland Habitat | 52 |
| 3.2.1.7 | Native Grasslands and Shrublands..... | 52 |
| 3.2.1.8 | Noxious Weeds and Invasive Exotic Plants..... | 53 |
| 3.2.1.9 | MacFarlane's Four-o'clock..... | 53 |
| 3.2.1.10 | Bald Eagles and Peregrine Falcons | 53 |
| 3.2.1.11 | Recreational Resources | 54 |
| 3.2.2 | Temporal Scope..... | 54 |
| 3.3 | WATER QUANTITY | 55 |
| 3.3.1 | Affected Environment | 55 |
| 3.3.1.1 | Surface Water..... | 56 |
| 3.3.1.2 | Flood Storage | 62 |
| 3.3.1.3 | Navigation..... | 65 |
| 3.3.1.4 | Water Rights | 66 |
| 3.3.2 | Environmental Effects | 68 |
| 3.3.2.1 | Proposed Operations | 69 |
| 3.3.2.2 | Operational Recommendations and Alternative Evaluation Scenarios | 69 |
| 3.3.2.3 | Flood Storage | 79 |
| 3.3.2.4 | Brownlee Reservoir Levels..... | 79 |
| 3.3.2.5 | Oxbow and Hells Canyon Reservoir Levels | 83 |
| 3.3.2.6 | Project Outflows | 83 |
| 3.3.2.7 | Downstream Flows Important to Navigation..... | 86 |
| 3.3.2.8 | Flow Fluctuations Downstream of Hells Canyon Dam | 88 |
| 3.3.2.9 | Operations Compliance Measurement Location..... | 89 |
| 3.3.2.10 | Water Uses and Water Rights | 90 |
| 3.3.3 | Unavoidable Adverse Effects | 90 |
| 3.4 | SEDIMENT SUPPLY AND TRANSPORT | 91 |
| 3.4.1 | Affected Environment | 91 |
| 3.4.1.1 | Sediment Budget..... | 91 |
| 3.4.1.2 | Beaches and Terraces..... | 96 |
| 3.4.1.3 | Spawning Gravel..... | 98 |
| 3.4.2 | Environmental Effects | 99 |
| 3.4.2.1 | Effects of Project Operations on Sediment Transport..... | 99 |
| 3.4.2.2 | Sediment Augmentation and Monitoring..... | 106 |
| 3.4.3 | Cumulative Effects | 109 |
| 3.4.4 | Unavoidable Adverse Effects | 109 |

| | | |
|----------|--|-----|
| 3.5 | WATER QUALITY | 111 |
| 3.5.1 | Affected Environment | 111 |
| 3.5.1.1 | Water Quality Standards | 111 |
| 3.5.1.2 | Temperature | 117 |
| 3.5.1.3 | Biological Productivity | 128 |
| 3.5.1.4 | Total Dissolved Gas | 132 |
| 3.5.1.5 | Turbidity | 135 |
| 3.5.1.6 | Hazardous Materials | 137 |
| 3.5.1.7 | Coliform Bacteria..... | 138 |
| 3.5.2 | Environmental Effects | 138 |
| 3.5.2.1 | Effects of Project Operations on Water Quality | 138 |
| 3.5.2.2 | Dissolved Oxygen | 152 |
| 3.5.2.3 | Total Dissolved Gas..... | 163 |
| 3.5.2.4 | Water Temperature | 168 |
| 3.5.2.5 | Oxbow Bypassed Reach Flows..... | 177 |
| 3.5.2.6 | Effects of Other Measures on Water Quality | 179 |
| 3.5.3 | Cumulative Effects | 181 |
| 3.5.4 | Unavoidable Adverse Effects | 182 |
| 3.6 | AQUATIC RESOURCES | 183 |
| 3.6.1 | Affected Environment | 183 |
| 3.6.1.1 | Aquatic Habitat Conditions..... | 183 |
| 3.6.1.2 | Primary Production and Aquatic Macroinvertebrates..... | 188 |
| 3.6.1.3 | Anadromous Fish Species..... | 190 |
| 3.6.1.4 | Native Resident Salmonids | 195 |
| 3.6.1.5 | White Sturgeon | 214 |
| 3.6.1.6 | Reservoir Fisheries..... | 216 |
| 3.6.1.7 | Hells Canyon Riverine Fishery | 217 |
| 3.6.1.8 | Hatchery Operations | 221 |
| 3.6.2 | Environmental Effects | 228 |
| 3.6.2.1 | Effects of Project Operations on Aquatic Resources | 228 |
| 3.6.2.2 | Dissolved Oxygen..... | 310 |
| 3.6.2.3 | Total Dissolved Gas..... | 313 |
| 3.6.2.4 | Water Temperature | 320 |
| 3.6.2.5 | Oxbow Bypassed Reach Flows..... | 324 |
| 3.6.2.6 | Anadromous Fish Restoration..... | 325 |
| 3.6.2.7 | Fish Passage Facilities | 337 |
| 3.6.2.8 | Resident Salmonid Passage..... | 340 |
| 3.6.2.9 | Fish Pathogen Assessment | 344 |
| 3.6.2.10 | Tributary Habitat Improvements..... | 345 |
| 3.6.2.11 | Marine-Derived Nutrients | 350 |
| 3.6.2.12 | Hatchery Production | 352 |
| 3.6.2.13 | Sturgeon Conservation Measures..... | 363 |
| 3.6.2.14 | Sediment Augmentation..... | 372 |
| 3.6.2.15 | Benthic Community Monitoring..... | 374 |
| 3.6.2.16 | Effects of Other Measures on Aquatic Resources..... | 375 |
| 3.6.3 | Cumulative Effects | 375 |
| 3.6.3.1 | Pacific Lamprey | 376 |
| 3.6.3.2 | Redband Trout and White Sturgeon..... | 376 |
| 3.6.4 | Unavoidable Adverse Effects | 377 |
| 3.7 | TERRESTRIAL RESOURCES..... | 379 |
| 3.7.1 | Affected Environment | 379 |

| | | |
|----------|--|-----|
| 3.7.1.1 | Terrestrial Habitat Conditions..... | 379 |
| 3.7.1.2 | Special Status Plants and Plant Communities..... | 381 |
| 3.7.1.3 | Plants of Cultural Importance | 383 |
| 3.7.1.4 | Noxious Weeds and Invasive Exotic Plants..... | 383 |
| 3.7.1.5 | Key Wildlife Species | 383 |
| 3.7.1.6 | Special Status Wildlife Species..... | 387 |
| 3.7.1.7 | Game Species of Cultural Importance | 390 |
| 3.7.1.8 | Land Management Practices | 390 |
| 3.7.2 | Environmental Effects | 392 |
| 3.7.2.1 | Effects of Project Operations on Terrestrial Resources | 392 |
| 3.7.2.2 | Special Status Plant Protection | 406 |
| 3.7.2.3 | Noxious Weed and Exotic Invasive Plant Management | 409 |
| 3.7.2.4 | Road, Transmission Line, and Right-of-Way Management | 410 |
| 3.7.2.5 | Upland and Riparian Habitat Acquisition | 412 |
| 3.7.2.6 | Cooperative Wildlife Management Projects | 423 |
| 3.7.2.7 | Wildlife Management on Idaho Power Lands | 426 |
| 3.7.2.8 | Special Status Wildlife..... | 429 |
| 3.7.2.9 | Effects of Other Measures on Terrestrial Resources..... | 433 |
| 3.7.3 | Cumulative Effects | 434 |
| 3.7.3.1 | Riparian and Wetland Habitats | 434 |
| 3.7.3.2 | Native Grasslands and Shrublands..... | 434 |
| 3.7.3.3 | Noxious Weeds and Invasive Exotic Plants..... | 435 |
| 3.7.3.4 | Peregrine Falcons..... | 435 |
| 3.7.4 | Unavoidable Adverse Effects | 435 |
| 3.8 | THREATENED AND ENDANGERED SPECIES..... | 437 |
| 3.8.1 | Affected Environment | 437 |
| 3.8.1.1 | Fall Chinook Salmon | 437 |
| 3.8.1.2 | Spring/Summer Chinook Salmon..... | 439 |
| 3.8.1.3 | Sockeye Salmon..... | 440 |
| 3.8.1.4 | Steelhead..... | 441 |
| 3.8.1.5 | Bull Trout..... | 442 |
| 3.8.1.6 | Bliss Rapids Snail | 443 |
| 3.8.1.7 | Idaho Springsnail | 444 |
| 3.8.1.8 | MacFarlane's Four-o'clock..... | 444 |
| 3.8.1.9 | Howell's Spectacular Thelypody | 445 |
| 3.8.1.10 | Spalding's Catchfly..... | 445 |
| 3.8.1.11 | Gray Wolf | 445 |
| 3.8.1.12 | Canada Lynx | 446 |
| 3.8.1.13 | Northern Idaho Ground Squirrel..... | 447 |
| 3.8.1.14 | Bald Eagle..... | 447 |
| 3.8.2 | Environmental Effects on Threatened and Endangered Species | 450 |
| 3.8.2.1 | Snake River Fall Chinook Salmon | 450 |
| 3.8.2.2 | Snake River Spring/Summer Chinook Salmon..... | 453 |
| 3.8.2.3 | Snake River Sockeye Salmon | 455 |
| 3.8.2.4 | Snake River Steelhead | 456 |
| 3.8.2.5 | Other Columbia River Basin Salmon and Steelhead ESUs | 458 |
| 3.8.2.6 | Bull Trout..... | 463 |
| 3.8.2.7 | Idaho Springsnail | 466 |
| 3.8.2.8 | MacFarlane's Four-o'clock and Spalding's Catchfly | 466 |
| 3.8.2.9 | Gray Wolf | 467 |
| 3.8.2.10 | Canada Lynx | 467 |

| | | | |
|--------|-----------------------------------|---|-----|
| | 3.8.2.11 | Northern Idaho Ground Squirrel | 468 |
| | 3.8.2.12 | Bald Eagle..... | 468 |
| 3.8.3 | Cumulative Effects | 475 | |
| | 3.8.3.1 | Snake River Fall Chinook Salmon..... | 476 |
| | 3.8.3.2 | Snake River Steelhead and Spring/Summer Chinook Salmon.... | 477 |
| | 3.8.3.3 | Snake River Sockeye Salmon | 478 |
| | 3.8.3.4 | Other Columbia River Basin Salmon and Steelhead ESUs | 478 |
| | 3.8.3.5 | Bull Trout..... | 479 |
| | 3.8.3.6 | MacFarlane's Four-o'clock..... | 480 |
| | 3.8.3.7 | Bald Eagle..... | 480 |
| 3.8.4 | Unavoidable Adverse Effects | 481 | |
| 3.9 | CULTURAL RESOURCES | 483 | |
| 3.9.1 | Affected Environment | 483 | |
| | 3.9.1.1 | Area of Potential Effect..... | 483 |
| | 3.9.1.2 | Cultural History Overview | 484 |
| | 3.9.1.3 | Previous Cultural Resource Investigations | 486 |
| | 3.9.1.4 | Prehistoric and Historic Archeological Resources..... | 486 |
| | 3.9.1.5 | Historic Buildings and Structures | 489 |
| | 3.9.1.6 | Traditional Cultural Properties, Sacred Sites, and Rock Art | 490 |
| 3.9.2 | Environmental Effects | 491 | |
| | 3.9.2.1 | Effects of Project Operations on Cultural Resources..... | 491 |
| | 3.9.2.2 | Site Treatment | 494 |
| | 3.9.2.3 | Cultural Resources Interpretation | 497 |
| | 3.9.2.4 | Support for Native American Programs..... | 498 |
| | 3.9.2.5 | Management of Cultural Resources | 500 |
| | 3.9.2.6 | Effects of Other Measures on Cultural Resources | 503 |
| 3.9.3 | Unavoidable Adverse Effects | 504 | |
| 3.10 | RECREATION RESOURCES | 505 | |
| 3.10.1 | Affected Environment | 505 | |
| | 3.10.1.1 | Regional Recreational Setting..... | 505 |
| | 3.10.1.2 | Recreational Facilities within the Project Boundary | 506 |
| | 3.10.1.3 | Recreational Use within the Project Boundary | 510 |
| | 3.10.1.4 | Recreational Activities..... | 514 |
| | 3.10.1.5 | Recreational Visitor Concerns | 515 |
| | 3.10.1.6 | Boating Use Downstream of the Project..... | 517 |
| 3.10.2 | Environmental Effects | 520 | |
| | 3.10.2.1 | Effects of Project Operations on Recreation Resources | 520 |
| | 3.10.2.2 | Recreation Plan | 525 |
| | 3.10.2.3 | Recreation Site Improvements | 527 |
| | 3.10.2.4 | Litter and Sanitation Plan..... | 540 |
| | 3.10.2.5 | Information and Education..... | 543 |
| | 3.10.2.6 | Trails | 544 |
| | 3.10.2.7 | Operation and Maintenance at Forest Service and BLM Sites ... | 546 |
| | 3.10.2.8 | Flow Information and Coordination Downstream of Hells Canyon Dam..... | 547 |
| | 3.10.2.9 | Adaptive Management | 548 |
| | 3.10.2.10 | Hells Canyon Visitors Center Staffing..... | 551 |
| | 3.10.2.11 | Warmwater Fisheries Management Plan | 551 |
| | 3.10.2.12 | Effects of Other Measures on Recreation | 552 |
| 3.10.3 | Cumulative Effects | 553 | |
| 3.10.4 | Unavoidable Adverse Effects | 553 | |

| | | |
|----------|---|-----|
| 3.11 | AESTHETICS | 555 |
| 3.11.1 | Affected Environment | 555 |
| 3.11.1.1 | Brownlee Development..... | 556 |
| 3.11.1.2 | Oxbow Development | 556 |
| 3.11.1.3 | Hells Canyon Development | 557 |
| 3.11.1.4 | Snake River Downstream of Hells Canyon Dam..... | 558 |
| 3.11.2 | Environmental Effects | 558 |
| 3.11.2.1 | Effects of Project Operations on Aesthetics..... | 558 |
| 3.11.2.2 | Aesthetic Improvements and Resource Management | 561 |
| 3.11.2.3 | Effects of Other Measures on Aesthetics | 563 |
| 3.11.3 | Unavoidable Adverse Effects | 564 |
| 3.12 | LAND MANAGEMENT AND USE | 565 |
| 3.12.1 | Affected Environment | 565 |
| 3.12.1.1 | Project Boundary | 565 |
| 3.12.1.2 | Land Ownership and Management Jurisdictions | 565 |
| 3.12.1.3 | Land and Water Uses | 568 |
| 3.12.1.4 | Road Management | 570 |
| 3.12.2 | Environmental Effects | 571 |
| 3.12.2.1 | Land Use Management | 571 |
| 3.12.2.2 | Coordination with State and Federal Land Management Agencies..... | 573 |
| 3.12.2.3 | Law Enforcement..... | 575 |
| 3.12.2.4 | Fire Protection..... | 576 |
| 3.12.2.5 | Boundary Modifications | 577 |
| 3.12.2.6 | Road Management Plan | 578 |
| 3.12.2.7 | Effects of Other Measures on Land Management..... | 580 |
| 3.12.3 | Unavoidable Adverse Effects | 581 |
| 3.13 | SOCIOECONOMIC RESOURCES | 583 |
| 3.13.1 | Affected Environment | 583 |
| 3.13.1.1 | Idaho Power Electricity Generation and Rates | 583 |
| 3.13.1.2 | Relationship of the Hells Canyon Project to Local Governments | 584 |
| 3.13.1.3 | Commercial Enterprises in the Project Area..... | 585 |
| 3.13.1.4 | Minority and Low-income Communities..... | 586 |
| 3.13.1.5 | Native American Tribes | 588 |
| 3.13.2 | Effects of Project Operations on Socioeconomic Resources..... | 589 |
| 3.13.2.1 | Effects on Power Costs | 589 |
| 3.13.2.2 | Net Cost to Local Government | 590 |
| 3.13.2.3 | Effects on Commercial Enterprises..... | 590 |
| 3.13.2.4 | Effects on Minority and Low-income Communities | 592 |
| 3.13.2.5 | Effects on Native Americans | 592 |
| 3.13.2.6 | Effects of Other Measures on Socioeconomics | 593 |
| 3.13.3 | Unavoidable Adverse Effects | 593 |
| 3.14 | EFFECTS OF NO-ACTION ALTERNATIVE | 593 |
| 3.15 | IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES..... | 594 |
| 3.16 | RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY | 594 |
| 4.0 | DEVELOPMENTAL ANALYSIS | 595 |
| 4.1 | BASIS FOR POWER, COSTS AND ECONOMIC BENEFITS OF THE PROJECT .. | 595 |
| 4.2 | COST OF ENVIRONMENTAL MEASURES | 597 |

| | | |
|----------|--|-----|
| 4.2.1 | Reduced Benefits Associated with Operational Changes | 597 |
| 4.2.2 | Cost of Environmental Measures under the Applicants' Proposal, Staff Alternative, and Staff Alternative with Mandatory Conditions..... | 600 |
| 4.3 | COMPARISON OF ALTERNATIVES | 600 |
| 5.0 | STAFF'S CONCLUSIONS | 606 |
| 5.1 | SUMMARY COMPARISON OF IDAHO POWER'S PROPOSAL AND STAFF ALTERNATIVE..... | 606 |
| 5.1.1 | Description of Alternatives..... | 606 |
| 5.1.1.1 | Idaho Power's Proposal | 606 |
| 5.1.1.2 | Staff Alternative..... | 606 |
| 5.1.1.3 | Staff Alternative with Mandatory Conditions..... | 622 |
| 5.1.2 | Summary of Effects | 622 |
| 5.2 | DISCUSSION OF KEY ISSUES | 635 |
| 5.2.1 | Sediment Augmentation and Monitoring | 635 |
| 5.2.2 | Water Supply—Operational Measures | 637 |
| 5.2.2.1 | Flood Storage | 637 |
| 5.2.2.2 | Navigation Target Flow Levels..... | 638 |
| 5.2.2.3 | Flow Augmentation for Anadromous Fish Juvenile Migration .. | 641 |
| 5.2.2.4 | Water Rights | 645 |
| 5.2.3 | Water Quality | 645 |
| 5.2.3.1 | Dissolved Oxygen Measures..... | 645 |
| 5.2.3.2 | Water Temperature Measures | 649 |
| 5.2.3.3 | Total Dissolved Gas Abatement | 651 |
| 5.2.3.4 | Water Quality Monitoring..... | 653 |
| 5.2.4 | Aquatic Resources | 654 |
| 5.2.4.1 | Fall Chinook Spawning and Incubation Flows | 654 |
| 5.2.4.2 | Flow Fluctuations Outside of the Fall Chinook Spawning and Incubation Period | 656 |
| 5.2.4.3 | Anadromous Fish Restoration..... | 659 |
| 5.2.4.4 | Resident Salmonid Passage..... | 665 |
| 5.2.4.5 | Tributary Habitat Improvements..... | 668 |
| 5.2.4.6 | Fish Pathogen Assessment | 670 |
| 5.2.4.7 | Oxbow Bypassed Reach Flows..... | 671 |
| 5.2.4.8 | Hatchery Production | 672 |
| 5.2.4.9 | Warmwater Fisheries | 675 |
| 5.2.4.10 | Sturgeon Conservation Measures..... | 677 |
| 5.2.4.11 | Invertebrate Monitoring | 680 |
| 5.2.5 | Terrestrial Resources | 681 |
| 5.2.5.1 | Special Status Plant and Wildlife Protection | 681 |
| 5.2.5.2 | Noxious Weed and Exotic Invasive Plant Management | 687 |
| 5.2.5.3 | Road, Transmission Line, and Right-of-Way Management | 688 |
| 5.2.5.4 | Upland and Riparian Habitat Acquisition | 689 |
| 5.2.5.5 | Cooperative Wildlife Management Projects | 694 |
| 5.2.5.6 | Wildlife Management on Project Lands | 695 |
| 5.2.6 | Cultural Resources..... | 697 |
| 5.2.6.1 | Finalization of the Historic Properties Management Plan | 697 |
| 5.2.6.2 | Cultural Resources Monitoring..... | 697 |
| 5.2.6.3 | Cultural Resource Site Stabilization | 698 |
| 5.2.6.4 | Ethnographic and Oral History Studies | 699 |
| 5.2.6.5 | Tribal Participation, Education, and Training..... | 699 |

| | | |
|---------|--|-----|
| 5.2.6.6 | Cultural Resources Interpretation | 700 |
| 5.2.6.7 | Other Cultural Resource Management Issues | 701 |
| 5.2.7 | Recreation Resources | 703 |
| 5.2.7.1 | Recreation Plan | 703 |
| 5.2.7.2 | Recreation Site Improvements | 704 |
| 5.2.7.3 | Sanitation and Litter Management | 706 |
| 5.2.7.4 | Information and Education..... | 707 |
| 5.2.7.5 | Trails | 707 |
| 5.2.7.6 | Operation and Maintenance at Forest Service and BLM Sites .. | 708 |
| 5.2.7.7 | Adaptive Management | 709 |
| 5.2.8 | Land Management and Aesthetics..... | 709 |
| 5.2.8.1 | Land Use Management | 709 |
| 5.2.8.2 | Law Enforcement and Fire Protection | 711 |
| 5.2.8.3 | Boundary Modifications | 712 |
| 5.2.8.4 | Road Management Plan | 713 |
| 5.2.8.5 | Aesthetic Resource Management..... | 714 |
| 5.3 | SUMMARY OF 10(J) RECOMMENDATIONS AND 4(E) CONDITIONS | 714 |
| 5.3.1 | Fish and Wildlife Agency Recommendations | 714 |
| 5.3.2 | Interior and Forest Service 4(e) Conditions..... | 715 |
| 5.4 | CONSISTENCY WITH COMPREHENSIVE PLANS | 742 |
| 5.4.1 | Section 10(a)(2) Comprehensive Plans | 742 |
| 5.4.1.1 | Plans Applicable to Both Idaho and Oregon..... | 742 |
| 5.4.1.2 | Plans Applicable to Idaho | 743 |
| 5.4.1.3 | Plans Applicable to Oregon | 743 |
| 5.4.2 | Other Plans | 745 |
| 5.5 | RELATIONSHIP OF LICENSE PROCESS TO LAWS AND POLICIES | 746 |
| 5.5.1 | Section 401 of the Clean Water Act—Water Quality Certification | 746 |
| 5.5.2 | Coastal Zone Management Act—Consistency Certification..... | 746 |
| 5.5.3 | Section 18 of the Federal Power Act—Authority to Prescribe Fishways..... | 746 |
| 5.5.4 | Endangered Species Act | 746 |
| 5.5.5 | Essential Fish Habitat | 750 |
| 5.5.6 | National Historic Preservation Act..... | 750 |
| 5.5.7 | Pacific Northwest Electric Power Planning and Conservation Act, Columbia River Basin Fish and Wildlife Program, and Mainstem and Subbasin Plan Amendments to the Columbia River Basin Fish and Wildlife Program..... | 751 |
| 5.5.8 | Wild and Scenic Rivers Act..... | 752 |
| 6.0 | LITERATURE CITED | 758 |
| 7.0 | LIST OF PREPARERS..... | 790 |
| 8.0 | LIST OF RECIPIENTS | 792 |

| | |
|------------|---|
| APPENDIX A | Agency Identifiers for Measures Addressed in the EIS |
| APPENDIX B | Comments on the Draft Environmental Impact Statement for the Hells Canyon Project, Project No. 1171-079 |
| APPENDIX C | Mandatory Conditions |
| APPENDIX D | Modeled Constraints for Idaho Power Company's Proposed Operation and Operational Alternatives |

| | |
|------------|--|
| APPENDIX E | Flow Fluctuations Downstream of Hells Canyon Dam—Figures |
| APPENDIX F | Information about the Status Bull Trout from the FWS 2005 Upper Snake River Biological Opinion |
| APPENDIX G | Information about the Status of Columbia River Salmon and Steelhead ESUs from the NMFS 2005 Upper Snake River Biological Opinion |
| APPENDIX H | Developmental Analysis of New Environmental Measures Proposed by Idaho Power |
| APPENDIX I | Developmental Analysis of Other Measures Included in the Staff Alternative |
| APPENDIX J | Developmental Analysis of Mandatory Measures That Are Not Included in the Staff Alternative |

This page intentionally left blank.

LIST OF FIGURES

| | | |
|------------|--|-----|
| Figure 1. | Location of the Hells Canyon Project | 3 |
| Figure 2. | Hydroelectric developments of the Hells Canyon Project..... | 10 |
| Figure 3. | Brownlee Development..... | 11 |
| Figure 4. | Oxbow Development..... | 13 |
| Figure 5. | Hells Canyon Development..... | 14 |
| Figure 6. | Transmission line associated with the Hells Canyon Project | 15 |
| Figure 7. | Simulated Brownlee reservoir levels for proposed operations under medium water conditions | 17 |
| Figure 8. | Selected USGS gage locations downstream from Hells Canyon dam | 57 |
| Figure 9. | Comparison of Brownlee reservoir inflows under extremely high (1997), medium (1995), extremely low (1992), medium-high (1999) and medium-low (1994) ^a water conditions..... | 58 |
| Figure 10. | Comparison of Brownlee reservoir average daily elevations under extremely high (1997), medium (1995), extremely low (1992), medium-high (1999) and medium-low (1994) ^a water conditions | 61 |
| Figure 11. | Comparison of Hells Canyon outflows (USGS Gage No. 13290450, Snake River at Hells Canyon dam, Idaho-Oregon state line) under extremely high (1997), medium (1995), extremely low (1992), medium-high (1999) and medium-low (1994) ^a water conditions..... | 63 |
| Figure 12. | Simulated Brownlee reservoir levels for extremely low water conditions..... | 80 |
| Figure 13. | Simulated Brownlee reservoir levels for medium-low water conditions | 80 |
| Figure 14. | Simulated Brownlee reservoir levels for medium water conditions..... | 81 |
| Figure 15. | Simulated Brownlee reservoir levels for medium-high water conditions | 81 |
| Figure 16. | Simulated Brownlee reservoir levels for extremely high water conditions..... | 82 |
| Figure 17. | Simulated project outflows for extremely low water conditions..... | 84 |
| Figure 18. | Simulated project outflows for medium-low water conditions | 84 |
| Figure 19. | Simulated project outflows for medium water conditions..... | 85 |
| Figure 20. | Simulated project outflows for medium-high water conditions | 85 |
| Figure 21. | Simulated project outflows for extremely high water conditions..... | 86 |
| Figure 22. | Summary of estimated sediment yield from tributaries using various techniques, sediment gaging at Weiser, and the four regional reservoirs..... | 95 |
| Figure 23. | Estimated cumulative annual area of sandbars that would be subject to sand mobilization under Proposed Operations and five alternative scenarios for an extremely low water year | 102 |
| Figure 24. | Estimated cumulative annual area of sandbars that would be subject to sand mobilization under Proposed Operations and five alternative scenarios for a medium water year..... | 102 |
| Figure 25. | Estimated cumulative annual area of sandbars that would be subject to sand mobilization under Proposed Operations and five alternative scenarios for an extremely high water year | 103 |
| Figure 26. | Recent (1990s) RM 345 ^a and Brownlee reservoir outflow and pre-project (1957) Brownlee dam site mean monthly water temperatures for the Brownlee reservoir | 122 |
| Figure 27. | Reaches, zones, and strata of Brownlee, Oxbow, and Hells Canyon reservoirs | 123 |
| Figure 28. | Vertical profiles of water temperature (open symbols) and DO concentrations (solid shaded symbols) in Brownlee reservoir (top), Oxbow reservoir (middle), and Hells Canyon reservoir (bottom), July and September 1995 | 124 |
| Figure 29. | Average daily 7-day average maximum temperatures of Snake River inflow to Brownlee reservoir (1996–2004) and outflow from Hells Canyon dam (1991–2004)..... | 127 |
| Figure 30. | Adjusted measured 7-day average maximum temperatures of outflow from Hells Canyon dam for a portion of the fall Chinook spawning period | 128 |
| Figure 31. | DO concentrations at the Brownlee reservoir inflow and downstream of Hells Canyon dam for 1992, 1995, and 1997 (low-, average-, and high-flow years) | 130 |

| | |
|---|-----|
| Figure 32. DO concentration time series for the Snake River downstream of Hells Canyon dam, late August through December 2000..... | 132 |
| Figure 33. Relationship between spill rate at Hells Canyon dam and TDG approximately 1.5 miles downstream of the dam, 1997–1999 | 134 |
| Figure 34. Dissipation of elevated TDG downstream of Hells Canyon dam relative to the 110 percent of saturation criterion, 1997–1999 | 135 |
| Figure 35. Map of the Swan Falls to Brownlee reach of the Snake River | 185 |
| Figure 36. Map of the Brownlee to Hells Canyon reach of the Snake River..... | 187 |
| Figure 37. Map of the Hells Canyon to Lower Granite reach of the Snake River..... | 189 |
| Figure 38. Passage timing of wild subyearling fall Chinook salmon smolts (PIT-tagged in the upper and lower Hells Canyon reaches) at Lower Granite dam..... | 194 |
| Figure 39. Time series of bull trout habitat suitability indices for temperature, dissolved oxygen and a composite score for temperature and dissolved oxygen at Brownlee reservoir during an extreme low flow hydrologic year (1992) and two operational scenarios (proposed and run-of-river full pool) | 199 |
| Figure 40. Time series of bull trout habitat suitability indices for temperature, dissolved oxygen and a composite score for temperature and dissolved oxygen at Oxbow reservoir during an extreme low flow hydrologic year (1992) and two operational scenarios (proposed and run-of-river full pool)..... | 200 |
| Figure 41. Time series of bull trout habitat suitability indices for temperature, dissolved oxygen and a composite score for temperature and dissolved oxygen at Hells Canyon reservoir during an extreme low flow hydrologic year (1992) and two operational scenarios (proposed and run-of-river full pool)..... | 201 |
| Figure 42. Time series of bull trout habitat suitability indices for temperature, dissolved oxygen and a composite score for temperature and dissolved oxygen at Brownlee reservoir during a medium flow hydrologic year (1995) and two operational scenarios (proposed and run-of-river full pool) | 202 |
| Figure 43. Time series of bull trout habitat suitability indices for temperature, dissolved oxygen and a composite score for temperature and dissolved oxygen at Oxbow reservoir during a medium flow hydrologic year (1995) and two operational scenarios (proposed and run-of-river full pool) | 203 |
| Figure 44. Time series of bull trout habitat suitability indices for temperature, dissolved oxygen and a composite score for temperature and dissolved oxygen at Hells Canyon reservoir during a medium flow hydrologic year (1995) and two operational scenarios (proposed and run-of-river full pool) | 204 |
| Figure 45. Time series of bull trout habitat suitability indices for temperature, dissolved oxygen and a composite score for temperature and dissolved oxygen at Brownlee reservoir during an extreme high flow hydrologic year (1997) and two operational scenarios (proposed and run-of-river full pool) | 205 |
| Figure 46. Time series of bull trout habitat suitability indices for temperature, dissolved oxygen and a composite score for temperature and dissolved oxygen at Oxbow reservoir during an extreme high flow hydrologic year (1997) and two operational scenarios (proposed and run-of-river full pool)..... | 206 |
| Figure 47. Time series of bull trout habitat suitability indices for temperature, dissolved oxygen and a composite score for temperature and dissolved oxygen at Hells Canyon reservoir during an extreme high flow hydrologic year (1997) and two operational scenarios (proposed and run-of-river full pool)..... | 207 |

| | |
|--|-----|
| Figure 48. Dissolved oxygen suitability for all salmonids during the extreme low flow year of 1992 modeled under proposed operations and run-of-river full pool operations. Suitability time series are shown for RM 242 (near Hells Canyon dam), RM 239 (below Granite Rapids), RM 222, (near Salt Creek), RM 191 (above Salmon River), and RM 152 (near Asotin) of the Hells Canyon reach | 208 |
| Figure 49. Dissolved oxygen suitability for all salmonids during the medium flow year of 1995 modeled under proposed operations and run-of-river full pool operations. Suitability time series are shown for RM 242 (near Hells Canyon dam), RM 239 (below Granite Rapids), RM 222, (near Salt Creek), RM 191 (above Salmon River), and RM 152 (near Asotin) of the Hells Canyon reach..... | 209 |
| Figure 50. Dissolved oxygen suitability for all salmonids during the extreme high flow year of 1997 modeled under proposed operations and run-of-river full pool operations. Suitability time series are shown for RM 242 (near Hells Canyon dam), RM 239 (below Granite Rapids), RM 222, (near Salt Creek), RM 191 (above Salmon River), and RM 152 (near Asotin) of the Hells Canyon reach | 210 |
| Figure 51. Time series of temperature suitability for bull trout during the extreme low flow year of 1992 modeled under proposed operations and run-of-river full pool operations. Suitability times series are shown for RM 242 (near Hells Canyon dam) RM 191 (above Salmon River), and RM 152 (near Asotin) of the Hells Canyon reach | 211 |
| Figure 52. Time series of temperature suitability for bull trout during the medium flow year of 1995 modeled under proposed operations and run-of-river full pool operations. Suitability times series are shown for RM 242 (near Hells Canyon dam) RM 191 (above Salmon River), and RM 152 (near Asotin) of the Hells Canyon reach | 212 |
| Figure 53. Dissolved oxygen suitability for all salmonids during the extreme high flow year of 1997 modeled under proposed operations and Run-of River Full Pool operations. Suitability time series are shown for RM 242 (near Hells Canyon dam), RM 239 (below Granite Rapids), RM 222, (near Salt Creek), RM 191 (above Salmon River), and RM 152 (near Asotin) of the Hells Canyon reach | 213 |
| Figure 54. Mean catch per unit effort for all years combined and selected species | 219 |
| Figure 55. Location of Idaho Power hatchery facilities..... | 222 |
| Figure 56. Hourly total wetted stream area predicted for the upper Hells Canyon reach (Hells Canyon dam to the Salmon River confluence) modeled under the Proposed Operations during the extremely low flow year of 1992 (top), the medium flow year (middle) and the extremely high flow year of 1997 (bottom) | 232 |
| Figure 57. Hourly total wetted stream area predicted for the upper Hells Canyon reach (Hells Canyon dam to the Salmon River confluence) modeled under Scenario 1b, Year-round 2-Inches-Per-Hour Ramping Rate, during the extremely low flow year of 1992 (top), the medium flow year (middle) and the extremely high flow year of 1997 (bottom)..... | 233 |
| Figure 58. Hourly total wetted stream area predicted for the upper Hells Canyon reach (Hells Canyon dam to the Salmon River confluence) modeled under Scenario 1c, Year-round 6-Inches-Per-Hour Ramping Rate, during the extremely low flow year of 1992 (top), the medium flow year (middle) and the extremely high flow year of 1997 (bottom) | 234 |
| Figure 59. Hourly total wetted stream area predicted for the upper Hells Canyon reach (Hells Canyon dam to the Salmon River confluence) modeled under the Flow Augmentation Scenario during the extremely low flow year of 1992 (top), the medium flow year (middle) and the extremely high flow year of 1997 (bottom) | 235 |
| Figure 60. Hourly total wetted stream area predicted for the upper Hells Canyon reach (Hells Canyon dam to the Salmon River confluence) modeled under the Navigation Scenario during the extremely low flow year of 1992 (top), the medium flow year (middle) and the extremely high flow year of 1997 (bottom) | 236 |

| | |
|--|-----|
| Figure 61. Hourly total wetted stream area predicted for the lower Hells Canyon reach (Salmon River confluence to Lower Granite reservoir) modeled under Proposed Operations during the extremely low flow year of 1992 (top), the medium flow year (middle) and the extremely high flow year of 1997 (bottom) | 237 |
| Figure 62. Hourly total wetted stream area predicted for the lower Hells Canyon reach (Salmon River confluence to Lower Granite reservoir) modeled under Scenario 1b, Year-round 2-Inches-Per-Hour Ramping Rate, during the extremely low flow year of 1992 (top), the medium flow year (middle) and the extremely high flow year of 1997 (bottom)..... | 238 |
| Figure 63. Hourly total wetted stream area predicted for the lower Hells Canyon reach (Salmon River confluence to Lower Granite reservoir) modeled under Scenario 1c, Year-round 6-Inches-Per-Hour Ramping Rate, during the extremely low flow year of 1992 (top), the medium flow year (middle) and the extremely high flow year of 1997 (bottom) | 239 |
| Figure 64. Hourly total wetted stream area predicted for the lower Hells Canyon reach (Salmon River confluence to Lower Granite reservoir) modeled under the Flow Augmentation Scenario during the extremely low flow year of 1992 (top), the medium flow year (middle) and the extremely high flow year of 1997 (bottom) | 240 |
| Figure 65. Hourly total wetted stream area predicted for the lower Hells Canyon reach (Salmon River confluence to Lower Granite reservoir) modeled under the Navigation Scenario during the extremely low flow year of 1992 (top), the medium flow year (middle) and the extremely high flow year of 1997 (bottom) | 241 |
| Figure 66. Weighted useable area versus discharge for fall Chinook juvenile habitat above the Salmon River (Hells Canyon dam to the Salmon River confluence) and below the Salmon River (Salmon River confluence to Lower Granite reservoir) predicted using the 2D habitat model | 251 |
| Figure 67. Weighted useable area versus discharge for fall Chinook juvenile habitat upstream of the Salmon River (Hells Canyon dam to the Salmon River confluence) and downstream of the Salmon River (Salmon River confluence to Lower Granite reservoir) predicted using the 1D habitat model | 252 |
| Figure 68. Hourly weighted useable area for fall Chinook juveniles upstream of the Salmon River simulated for proposed operations using the 2D model for three water year types | 253 |
| Figure 69. Hourly weighted useable area for fall Chinook juveniles upstream of the Salmon River simulated for proposed operations using the 1D model for three water year types | 254 |
| Figure 70. Flow augmentation water provided from Brownlee reservoir and total flow augmentation water provided from the Snake River basin | 264 |
| Figure 71. Estimated survival probabilities (with standard errors) from the point of release in the Snake River (Billy Creek [RM 164.7] or Pittsburg Landing [RM 215]) to the tailrace of Lower Granite dam for PIT-tagged hatchery fall Chinook salmon, 1995–2000 | 266 |
| Figure 72. Relations between the estimated probability of survival to Lower Granite dam and indices of discharge, temperature, and transparency and release date for groups of PIT-tagged hatchery fall Chinook salmon released at Pittsburg Landing and Billy Creek on the free-flowing Snake River, 1995–2000. | 267 |
| Figure 73. Detection rate of PIT-tagged Snake River subyearling Chinook salmon at Lower Granite dam, 1992–1995 and its relation to mean summer flow (top) and maximum summer water temperature (bottom) in Lower Granite reservoir. Ninety-five percent simultaneous confidence intervals are shown on either side of the regression lines..... | 268 |
| Figure 74. Survival (with 95 percent confidence intervals) to the tailrace of Lower Granite dam for PIT-tagged wild subyearling fall Chinook salmon in 1998 (top), 1999 (center), and 2000 (bottom), predicted from mean flows and water temperatures with and without summer flow augmentation | 269 |

| | |
|---|-----|
| Figure 75. Estimated survival between McNary dam tailrace and John Day dam tailrace plotted against various river condition indices for run-of-river subyearling Chinook salmon released in tailrace of McNary dam, 1999, 2001, and 2002. Flow index panel illustrates simple linear regression line without year effects. Temperature index panel illustrates constant mean survival above and below 20°C..... | 270 |
| Figure 76. 1992 simulated hourly Hells Canyon outflow temperatures for the Flow Augmentation Scenario and Proposed Operations | 272 |
| Figure 77. Total adult fall Chinook salmon passing Lower Granite dam and total flow augmentation volume provided from the Snake River basin during the primary year of outmigration (4 years prior to adult return data)..... | 273 |
| Figure 78. Total adult fall Chinook salmon passing Lower Granite dam and total flow augmentation volume provided from Brownlee reservoir during the primary year of outmigration (4 years prior to adult return data)..... | 274 |
| Figure 79. Weighted useable area versus discharge relationships for bull trout (upper plot) and redband trout (lower plot) in the upper and lower Hells Canyon reaches..... | 279 |
| Figure 80. Hourly weighted useable area for bull trout adults in the upper Hells Canyon reach (Hells Canyon dam to the Salmon River confluence) simulated for Proposed Operations for three water year types..... | 281 |
| Figure 81. Hourly weighted useable area for bull trout adults in the upper Hells Canyon reach (Hells Canyon dam to the Salmon River confluence) simulated for the Flow Augmentation Scenario for three water year types | 282 |
| Figure 82. Hourly weighted useable area for redband trout adults in the upper Hells Canyon reach (Hells Canyon dam to the Salmon River confluence) simulated for Proposed Operations for three water year types..... | 283 |
| Figure 83. Hourly weighted useable area for redband trout adults in the upper Hells Canyon reach (Hells Canyon dam to the Salmon River confluence) simulated for the Flow Augmentation Scenario for three water year types | 284 |
| Figure 84. Hourly weighted useable area for white sturgeon spawning in the upper Hells Canyon reach (Hells Canyon dam to the Salmon River confluence) simulated for Proposed Operations for three water year types | 287 |
| Figure 85. Hourly weighted useable area for white sturgeon spawning in the upper Hells Canyon reach (Hells Canyon dam to the Salmon River confluence) simulated for the Flow Augmentation Scenario for three water year types | 289 |
| Figure 86. Hourly weighted useable area for white sturgeon incubation in the upper Hells Canyon reach (Hells Canyon dam to the Salmon River confluence) simulated for Proposed Operations for three water year types | 290 |
| Figure 87. Hourly weighted useable area for white sturgeon incubation in the upper Hells Canyon reach (Hells Canyon dam to the Salmon River confluence) simulated for the Flow Augmentation Scenario for three water year types | 291 |
| Figure 88. Hourly weighted useable area for white sturgeon larvae in the upper Hells Canyon reach (Hells Canyon dam to the Salmon River confluence) simulated for Proposed Operations for three water year types..... | 292 |
| Figure 89. Hourly weighted useable area for white sturgeon larvae in the upper Hells Canyon reach (Hells Canyon dam to the Salmon River confluence) simulated for the Flow Augmentation Scenario for three water year types | 293 |
| Figure 90. Hourly weighted useable area for white sturgeon young-of-year in the upper Hells Canyon reach (Hells Canyon dam to the Salmon River confluence) simulated for Proposed Operations for three water year types..... | 294 |
| Figure 91. Hourly weighted useable area for white sturgeon young-of-year in the upper Hells Canyon reach (Hells Canyon dam to the Salmon River confluence) simulated for the Flow Augmentation Scenario for three water year types | 295 |

| | |
|--|-----|
| Figure 92. Hourly weighted useable area for white sturgeon juveniles in the upper Hells Canyon reach (Hells Canyon dam to the Salmon River confluence) simulated for Proposed Operations for three water year types | 296 |
| Figure 93. Hourly weighted useable area for white sturgeon juveniles in the upper Hells Canyon reach (Hells Canyon dam to the Salmon River confluence) simulated for the Flow Augmentation Scenario for three water year types | 297 |
| Figure 94. Hourly weighted useable area for white sturgeon adults in the upper Hells Canyon reach (Hells Canyon dam to the Salmon River confluence) simulated for Proposed Operations for three water year types | 298 |
| Figure 95. Hourly weighted useable area for white sturgeon adults in the upper Hells Canyon reach (Hells Canyon dam to the Salmon River confluence) simulated for the Flow Augmentation Scenario for three water year types | 299 |
| Figure 96. Length-frequency distributions (adjusted for gear selectivity) of white sturgeon sampled with setlines in the Snake River reaches from Swan Falls to Lower Granite dams | 303 |
| Figure 97. Smallmouth bass spawning period and Brownlee reservoir elevations predicted for three water year types for Proposed Operations and for Scenario 2, Flow Augmentation | 305 |
| Figure 98. Crappie spawning period and Brownlee reservoir elevations predicted for three water year types for Proposed Operations and for Scenario 2, Flow Augmentation | 306 |
| Figure 99. Channel catfish spawning period and Brownlee reservoir elevations predicted for three water year types for Proposed Operations and for Scenario 2, Flow Augmentation | 307 |
| Figure 100. Elevation change during an estimated active nest duration of 16 days for channel catfish nests constructed between June 15 and July 31..... | 309 |
| Figure 101. Percent occurrence of fish with severe gas bubble trauma (GBT) and percent saturation of TDG taken during weekly sampling in the Brownlee tailwater in the spring of 2006 | 316 |
| Figure 102. Percent occurrence of fish with severe gas bubble trauma (GBT) and percent saturation of TDG taken during weekly sampling in the Oxbow forebay/pool in the spring of 2006 | 317 |
| Figure 103. Percent occurrence of fish with severe gas bubble trauma (GBT) and percent saturation of TDG taken during weekly sampling in the Oxbow bypassed reach in the spring of 2006 ... | 318 |
| Figure 104. Percent occurrence of fish with severe gas bubble trauma (GBT) and percent saturation of TDG taken during weekly sampling in Hells Canyon reservoir near the Oxbow powerhouse discharge in the spring of 2006 | 319 |
| Figure 105. Final fall Chinook salmon fry mortality relative to the highest water temperature (°C) that embryos were exposed to during natural/variable temperature experiments (data from Olson and Foster [1955] shown in square symbols, Olson et al. [1970] shown in diamonds, and Geist et al. [2006] shown in triangles)..... | 322 |
| Figure 106. Plan view of Hells Canyon trap modification Alternative 3 revised..... | 339 |
| Figure 107. Catch rates and hours of effort expended sampling for white sturgeon with setlines in the Snake River between Shoshone Falls and the confluence with the Salmon River..... | 369 |
| Figure 108. Estimated total and wild escapement of fall-run Chinook salmon at Lower Granite dam, 1975–2003 | 439 |
| Figure 109. Estimated total and wild escapement of spring/summer Chinook salmon at Lower Granite dam, 1975–2003 | 440 |
| Figure 110. Sockeye salmon passage counts at Lower Granite dam for years 1975–2004 | 441 |
| Figure 111. Estimated total and wild escapement of steelhead at Lower Granite dam for the 1984–1985 through 2003–2004 run years | 442 |
| Figure 112. Simulated flows below Hells Canyon dam and at Anatone, WA for a representative extreme low flow year (1992) for proposed operations (scenario 1d used as surrogate) and with Brownlee reservoir held at minimum operating pool (scenario 5). Scenario 1d was used to remove diurnal fluctuations caused by load following operations to facilitate the visual comparison of daily average flows..... | 460 |

| | |
|---|-----|
| Figure 113. Simulated flows below Hells Canyon dam and at Anatone, WA for a representative medium flow year (1995) for proposed operations (scenario 1d used as surrogate) and with Brownlee reservoir held at minimum operating pool (scenario 5). Scenario 1d was used to remove diurnal fluctuations caused by load following operations to facilitate the visual comparison of daily average flows | 461 |
| Figure 114. Simulated flows below Hells Canyon dam and at Anatone, WA for a representative extreme high flow year (1997) for proposed operations (scenario 1d used as surrogate) and with Brownlee reservoir held at minimum operating pool (scenario 5). Scenario 1d was used to remove diurnal fluctuations caused by load following operations to facilitate the visual comparison of daily average flows..... | 462 |
| Figure 115. Hells Canyon Project recreational sites..... | 507 |
| Figure 116. Hours of recreational use by year and zone..... | 512 |
| Figure 117. Average percentage of total warm-season hours of recreational use by activity. | 514 |
| Figure 118. Total hours of warm-season recreational use by primary activity..... | 515 |
| Figure 119. Annual number of boaters by status (commercial or private) and type (float or power) registered as entering the HCNRA through Hells Canyon Creek portal | 517 |

This page intentionally left blank.

LIST OF TABLES

| | |
|---|-----|
| Table ES-1. Summary of effects of Idaho Power's Proposal and Staff Alternative..... | xli |
| Table 1. Summary of Idaho Power's preferred portfolio summary and timeline..... | 5 |
| Table 2. Summary of operating constraints for Idaho Power's Proposed Operations..... | 20 |
| Table 3. Mainstem hydroelectric projects on the Snake River from Shoshone Falls downstream and on the lower Columbia River | 51 |
| Table 4. Key features along the main stem of the Snake River..... | 55 |
| Table 5. Frequency of annual inflows to Brownlee reservoir for five representative years..... | 57 |
| Table 6. Physical characteristics of Brownlee, Oxbow, and Hells Canyon reservoirs..... | 59 |
| Table 7. Required flood control draft at Brownlee reservoir based on November 1998 rule curve..... | 64 |
| Table 8. Project-related water rights for the Hells Canyon Project..... | 66 |
| Table 9. Operational recommendations..... | 70 |
| Table 10. Sediment budget..... | 93 |
| Table 11. Estimated cumulative annual area of sandbars that would be subject to inundation under Proposed Operations and five alternative scenarios | 100 |
| Table 12. Estimated cumulative annual area of sandbars that would be subject to sand mobilization under Proposed Operations and five alternative scenarios | 101 |
| Table 13. Estimated percent change in cumulative annual area of sandbars that would be subject to sand mobilization under five alternative scenarios. Percentages are given relative to the area of sand mobilization for Proposed Operations..... | 103 |
| Table 14. Percent exceedance for selected flows based on flow-duration curves for Proposed Operations and five alternative scenarios..... | 105 |
| Table 15. Idaho designated beneficial uses and most recent EPA-approved 303(d) listings for the Snake River | 111 |
| Table 16. Oregon designated beneficial uses and most recent EPA-approved 303(d) listings for the Snake River | 112 |
| Table 17. TMDL water quality targets for the Snake River–Hells Canyon and applicable Idaho and Oregon water quality criteria..... | 113 |
| Table 18. Summary of Snake River tributary flows, water temperatures, and total phosphorus loadings, 1980–2003 | 118 |
| Table 19. Percent of days that Hells Canyon Project water temperatures exceeded applicable numeric criteria..... | 126 |
| Table 20. Summary of turbidity data for various reaches of the project, 1992–1997 | 136 |
| Table 21. Summary of total suspended solids data available for the Snake River and its tributaries near their terminus, 1970–1997 | 136 |
| Table 22. Summary comparison of Brownlee reservoir simulated temperatures for Proposed Operations and Scenario 2 (Flow Augmentation) | 140 |
| Table 23. Summary comparison of simulated Hells Canyon outflow hourly water temperatures for Proposed Operations and Scenario 2 to TMDL water temperature targets | 142 |
| Table 24. Summary comparison of Brownlee reservoir simulated DO concentrations for Proposed Operations and Scenario 2 (Flow Augmentation) | 144 |
| Table 25. Summary comparison of simulated Hells Canyon outflow hourly DO concentrations for Proposed Operations and Scenario 2 (Flow Augmentation) to applicable criteria and TMDL targets | 146 |
| Table 26. Summary of the occurrence of hourly modeled Brownlee outflows of greater than 38,000 cfs, ^a which likely would result in TDG exceeding the 110-percent of saturation criterion with current spillway structures and operations | 148 |
| Table 27. Summary of the occurrence of hourly modeled Hells Canyon dam gage (No. 13290450) flows of greater than 30,500 cfs, which likely would result in TDG exceeding the 110 percent of saturation criterion with current spillway structures and operations | 148 |

| | | |
|-----------|---|-----|
| Table 28. | Summary comparison of Brownlee reservoir simulated DO concentrations for Proposed Operations with and without proposed reservoir DO supplementation..... | 157 |
| Table 29. | Principal tributaries to the Snake River that historically supported anadromous fish, with the location of Brownlee, Oxbow and Hells Canyon dams shown for reference..... | 184 |
| Table 30. | Number of rainbow trout stocked by IDFG and ODFW at project reservoirs and at major tributaries from 1987 to 1997 | 197 |
| Table 31. | Abundance estimates for white sturgeon populations in Snake River reaches from Shoshone Falls to Lower Granite dam..... | 215 |
| Table 32. | Fish sampled in project reservoirs listed by species code, common and scientific names, and native or nonnative status | 218 |
| Table 33. | Estimated average annual angling effort, catch and harvest rates by species for 1994 through 1998, and 2000 | 220 |
| Table 34. | Distribution of steelhead smolts produced at Niagara Springs hatchery for brood years 1965 through 1999..... | 223 |
| Table 35. | Estimated adult contribution of steelhead produced at Niagara Springs hatchery from 1979 through 1998 | 225 |
| Table 36. | Distribution of spring Chinook smolts released for mitigation purposes from the Rapid River hatchery for brood years 1964 through 1998..... | 226 |
| Table 37. | Distribution of summer and spring Chinook smolts released for mitigation purposes from the Pahsimeroi hatchery for brood years 1981 through 2000..... | 227 |
| Table 38. | Estimated adult contribution of spring Chinook produced at the Rapid River hatchery from 1978 through 1998..... | 229 |
| Table 39. | Distribution of fall Chinook smolts produced at the Oxbow hatchery for brood years from 1961 through 2000..... | 229 |
| Table 40. | Estimated maximum seasonal percentage of streambed that would be subject to daily dewatering upstream and downstream of the Salmon River under Proposed Operations and four alternative scenarios..... | 242 |
| Table 41. | Fall Chinook spawning flow, incubation flow, and spawner survey recommendations..... | 244 |
| Table 42. | Estimated redd capacity for the Snake River at selected discharge levels from Hells Canyon dam..... | 246 |
| Table 43. | Ramping rate and minimum flow recommendations outside of the fall Chinook spawning season | 248 |
| Table 44. | Estimated minimum, maximum, and maximum percent daily fluctuation in WUA during the fall Chinook rearing period (March 15 to June 15), based on 2D modeling of fall Chinook rearing habitat in the Hells Canyon reach upstream and downstream of the Salmon River | 255 |
| Table 45. | Estimated minimum, maximum, and maximum percent daily fluctuation in WUA during the fall Chinook rearing period (March 15 to June 15) based on 1D modeling of fall Chinook rearing habitat in the Hells Canyon reach upstream and downstream of the Salmon River | 255 |
| Table 46. | Estimated maximum seasonal percentage of streambed that would be subject to daily dewatering during the fall Chinook rearing period (March 15 to June 15) upstream and downstream of the Salmon River under Proposed Operations and four alternative scenarios | 257 |
| Table 47. | Entrapment site locations, flows at which sites disconnect from the river (entrapment flow), number of entrapment events, and numbers of age-0 fall Chinook salmon estimated to be entrapped and killed between March 15 and June 15, 2005 in the upper Hells Canyon reach of the Snake River | 260 |
| Table 48. | Total number of fish other than wild age-0 fall Chinook salmon encountered during entrapment pool surveys conducted in the upper Hells Canyon reach of the Snake River in 2005 | 261 |

| | | |
|-----------|--|-----|
| Table 49. | Estimated age-0 fall Chinook salmon entrapment losses under the 2005 minimum flow (8,700 cfs) and three alternative modeled flows released from Hells Canyon dam | 261 |
| Table 50. | Estimated age-0 fall Chinook salmon entrapment losses under the 2005 ramping rate (12-inches-per-hour) and three alternative ramping rates applied to Hells Canyon dam operations at an inflow of 11,340 cfs (observed April 26, 2005) | 262 |
| Table 51. | Total number of yearling and subyearling fall Chinook salmon released from acclimation sites in the Hells Canyon reach (Pittsburg Landing and Captain John Rapids) and in the Clearwater River (Big Canyon), fall Chinook returns over Lower Granite dam, and redd counts in the Clearwater and Snake rivers. | 275 |
| Table 52. | Estimated minimum, maximum, and maximum percent daily fluctuation in WUA for bull trout and redband trout adults in the upper Hells Canyon reach (Hells Canyon dam to the Salmon River)..... | 280 |
| Table 53. | Estimated minimum, maximum, and maximum percent daily fluctuation in WUA for white sturgeon in the upper Hells Canyon reach (Hells Canyon dam to the Salmon River) | 300 |
| Table 54. | Spawning seasons, nesting duration and nest depths of smallmouth bass, crappie, and channel catfish in Brownlee reservoir | 304 |
| Table 55. | The ercentage of each species collected during the 2006 sampling season (January–June) by the rank of GBT. Ranks 1 through 4 represent percentages of skin area covered with bubbles of 0, 1 to 5, 6 to 25, 26 to 50, and >50 | 315 |
| Table 56. | Anadromous fish restoration recommendations..... | 327 |
| Table 57. | Water quality improvement recommendations related to anadromous fish restoration | 329 |
| Table 58. | Incremental smolt yields with fish passage provided at Idaho Power's mainstem Snake River dams under various passage scenarios..... | 333 |
| Table 59. | Phased anadromous fish passage plan..... | 334 |
| Table 60. | Estimated smolt production and adult returns from habitat made accessible under the phased restoration approach (assumes that no passage is provided at other dams in tributary streams)..... | 336 |
| Table 61. | Tributary habitat enhancement recommendations..... | 346 |
| Table 62. | Recommendations for providing marine-derived nutrients..... | 350 |
| Table 63. | Hatchery recommendations..... | 354 |
| Table 64. | Additional hatchery/surplus fish recommendations | 357 |
| Table 65. | Recommended measures related to white sturgeon conservation | 365 |
| Table 66. | Percentage of fall Chinook redds observed in the mainstem Snake River, by reach, 1991 to 2000..... | 373 |
| Table 67. | Special status species and species groups used to focus evaluations of project effects | 387 |
| Table 68. | Acres of existing upland and riparian cover types along the Snake River downstream of Hells Canyon dam, and the change in acreage that would result from implementation of various flow scenarios | 398 |
| Table 69. | Minimum acreage proposed or recommended for acquisition to address project effects on terrestrial resources..... | 414 |
| Table 70. | Acreage of current project effects, by habitat type..... | 416 |
| Table 71. | Acreage of anticipated project effects resulting from change in flow regime and shoreline erosion)..... | 417 |
| Table 72. | Releases of fall Chinook hatchery smolts into the Snake River basin | 438 |
| Table 73. | Bald eagle nests in the Hells Canyon Project area, as of 2005 | 448 |
| Table 74. | Annual productivity for bald eagle nests in the Hells Canyon Project vicinity | 449 |
| Table 75. | Bald eagle nest sites, potential noise disturbance, and potential buffers | 470 |
| Table 76. | Number of registered boaters entering the HCNRA through Hells Canyon Creek, Pittsburg Landing, Dug Bar, and Cache Creek portals combined, by year | 505 |
| Table 77. | Formal and semi-formal public recreational facilities within the Hells Canyon Project boundary | 508 |

| | | |
|------------|--|-----|
| Table 78. | Descriptive statistics of dispersed, undeveloped, and informal recreational sites within the project boundary | 510 |
| Table 79. | Total annual recreation days by development and season..... | 511 |
| Table 80. | Percent of warm-season recreation days by development..... | 511 |
| Table 81. | Physical capacity of project sites developed for RVs and tents | 513 |
| Table 82. | Percentage of comments by major category and reservoir..... | 515 |
| Table 83. | Snake River fluctuation-related problems experienced by boaters | 519 |
| Table 84. | Typical source of flow information for boaters who checked flows before their trip (% using various sources)..... | 519 |
| Table 85. | Elevation of the toe of boat ramps at Brownlee reservoir parks compared to full pool elevation | 521 |
| Table 86. | Proposed and recommended recreational facility improvement measures..... | 529 |
| Table 87. | Range of drawdown zone (feet) for Brownlee reservoir under Proposed Operations and the Flow Augmentation Scenario during July to October representing the following water conditions: extremely low flow (1992), medium flow (1995) and extremely high flow (1997) | 559 |
| Table 88. | Land ownership and management by development within the Hells Canyon Project proposed project boundary, in acres | 566 |
| Table 89. | Idaho Power's sales of electricity in 2004..... | 583 |
| Table 90. | Idaho Power's average electricity rates compared to Idaho, Oregon, and U.S. averages in cents/kWh, 2004..... | 584 |
| Table 91. | Annual property taxes paid by Idaho Power to counties bordering the Hells Canyon Project in 2000..... | 585 |
| Table 92. | Donations by Idaho Power to counties bordering the Hells Canyon Project for enhanced services in 2002 and 2003 | 585 |
| Table 93. | Total visitor spending by county | 586 |
| Table 94. | Total population and population percentage by race categories..... | 587 |
| Table 95. | Poverty statistics and housing affordability statistics..... | 587 |
| Table 96. | Descriptive statistics of reservations in the project vicinity | 588 |
| Table 97. | Cost and net annual generation of the proposed and Staff Alternative measures | 589 |
| Table 98. | Estimated change in Idaho Power rates by rate class for the proposed and Staff Alternative measures | 590 |
| Table 99. | Contingent valuation study results for recreational expenditures in Oregon, Washington and Idaho (n = 143) and estimated project-related expenditures for recreational activities .. | 591 |
| Table 100. | Summary of key parameters for economic analysis of the Hells Canyon Hydroelectric Project..... | 595 |
| Table 101. | Costs associated with the No-action Alternative for the Hells Canyon Project | 596 |
| Table 102. | Annualized lost benefits associated with supplemental operational measures included in the Staff Alternative or recommended by the Corps for navigation purposes | 598 |
| Table 103. | Summary by resource area of capital and one-time costs, annual operation and maintenance costs, and total annualized costs of additional environmental measures included in Idaho Power's Proposal and the Staff Alternative..... | 601 |
| Table 104. | Summary of the annual cost, power benefits, and net benefits for the No-action Alternative, Idaho Power's Proposal, the Staff Alternative, and the Staff Alternative with Mandatory Conditions | 603 |
| Table 105. | Summary of effects of Idaho Power's Proposal and Staff Alternative..... | 623 |
| Table 106. | Special status and rare endemic plants identified for inclusion in management and monitoring plans by agencies, tribes, or staff in relation to Staff Alternative | 684 |
| Table 107. | Special status wildlife identified for inclusion in monitoring and management plans, or for which agencies, tribes or staff recommended specific management measures, in relationship to Staff Alternative | 684 |

| | |
|---|-----|
| Table 108. Fish and wildlife agency recommendations for the Hells Canyon Project..... | 716 |
| Table 109. Interior and Forest Service modified 4(e) conditions for the Hells Canyon Project. | 739 |
| Table 110. Summary of effect determinations for fish, plants, and wildlife | 747 |
| Table 111. Measures included in the Staff Alternative relevant to objectives of Columbia River Fish and Wildlife Program subbasin plans..... | 753 |

This page intentionally left blank.

ACRONYMS AND ABBREVIATIONS

| | |
|------------------|---|
| ACEC | area of critical environmental concern |
| ADA | Americans with Disabilities Act |
| Advisory Council | Advisory Council of Historic Preservation |
| AIR | additional information request |
| aMW | average megawatt |
| APE | Area of Potential Effect |
| AR | American Rivers |
| BLM | Bureau of Land Management |
| BMP | best management practices |
| BOR | Bureau of Reclamation |
| °C | degrees Celsius |
| cfs | cubic feet per second |
| CFR | Code of Federal Regulations |
| Commerce | U.S. Department of Commerce |
| Commission | Federal Energy Regulatory Commission |
| Corps | U.S. Army Corps of Engineers |
| CRMP | Cultural Resources Management Plan |
| CWA | Clean Water Act |
| CWMA | Cooperative Weed Management Area |
| DO | dissolved oxygen |
| EA | environmental assessment |
| EIS | environmental impact statement |
| EPA | U.S. Environmental Protection Agency |
| EPAAct | Energy Policy Act of 2005 |
| ESA | Endangered Species Act |
| °F | degrees Fahrenheit |
| FERC | Federal Energy Regulatory Commission |
| FMR | fire modified rock |
| Forest Service | U.S. Forest Service |
| FPA | Federal Power Act |
| FWS | U.S. Fish and Wildlife Service |
| GBT | gas bubble trauma |
| HART | Hydropower Application Review Team |
| HCNRA | Hells Canyon National Recreation Area |
| HCRMP | Hells Canyon Resource Management Plan |
| HEP | Habitat Evaluation Procedure |
| HGMP | Habitat and Genetic Management Plan |
| HPMP | Historic Properties Management Plan |
| I&E | information and education |
| Idaho Power | Idaho Power Company |
| IDEQ | Idaho Department of Health and Welfare, Division of Environmental Quality |
| IDFG | Idaho Department of Fish and Game |
| IDPR | Idaho Department of Parks and Recreation |
| Interior | U.S. Department of the Interior |
| IRU | Idaho Rivers United |
| ISAB | Independent Scientific Advisory Board |
| IWHP | Integrated Wildlife Habitat Program |
| kaf | thousand acre-feet |
| kV | kilovolt |

| | |
|------------------------|---|
| kWh | kilowatt-hour |
| mg/L | milligram per liter |
| MHWM | mean high water mark |
| msl | msl |
| MW | megawatt |
| MWh | megawatt-hours |
| National Register | National Register of Historic Places |
| NEPA | National Environmental Policy Act |
| NGO | non-governmental organization |
| NHPA | National Historic Preservation Act |
| NMFS | National Marine Fisheries Service |
| NPDES | National Pollutant Discharge Elimination System |
| NPPVA | Northwest Professional Power Vessel Association |
| NTU | nephelometric turbidity unit |
| O&M | operation and maintenance |
| ODEQ | Oregon Department of Environmental Quality |
| ODFW | Oregon Department of Fish and Wildlife |
| ODSL | Oregon Department of State Lands |
| OPRD | Oregon Parks and Recreation Department |
| ORV | outstanding remarkable value |
| OSMB | Oregon State Marine Board |
| OWRD | Oregon Water Resources Department |
| PA | Programmatic Agreement |
| pH | potential hydrogen (a measure of acidity and alkalinity) |
| PME | protection, mitigation, and enhancement |
| RAMP | Recreation Adaptive Management Plan |
| RARWG | Recreation and Aesthetics Resource Work Group |
| RM | river mile |
| ROS | Recreation Opportunity Spectrum |
| RRWG | Recreation Resource Work Group |
| RV | recreational vehicle |
| SHPO | State Historic Preservation Officer |
| SMA | special management area |
| SRBA | Snake River Basin Adjudication |
| TCP | traditional cultural property |
| TDG | total dissolved gas |
| TESSMP | Threatened, Endangered, and Sensitive Species Management Plan |
| TMDL | total maximum daily load |
| TRWG | Terrestrial Resources Work Group |
| TSS | total suspended solids |
| TSS/L | total suspended solids per liter |
| $\mu\text{g}/\text{L}$ | microgram per liter |
| USGS | U.S. Geological Survey |
| VRMP | Visual Resource Management Plan |
| WMA | wildlife management area |
| WMMP | Wildlife Mitigation and Management Plan |
| WUA | weighted useable area |